

# Developing a web-based application to characterise potential impacts of MRECs on marine ecosystems and fisheries

Tethys LINC project Webinar, 28<sup>th</sup> April 2016



Centre for Environment  
Fisheries & Aquaculture  
Science



**Cefas**

# WP2: Parameterisation of ecological processes

- Compare and map potential locations of MECs to known spawning, nursery or feeding habitats or migration routes for various important fish and shellfish species and identify potential conflicts.
- Explore how best to model the effects of MECs on these fish communities and ecologies.

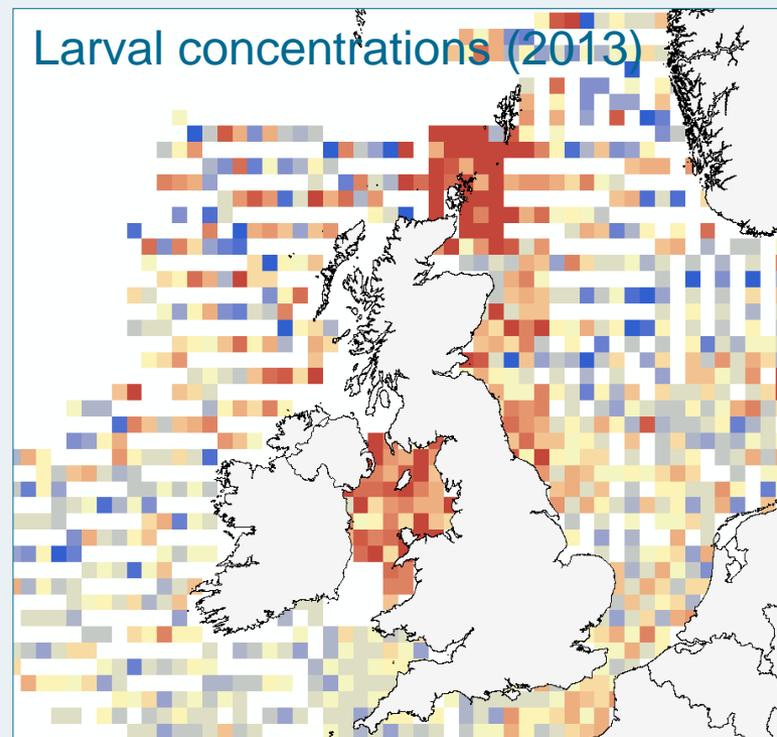
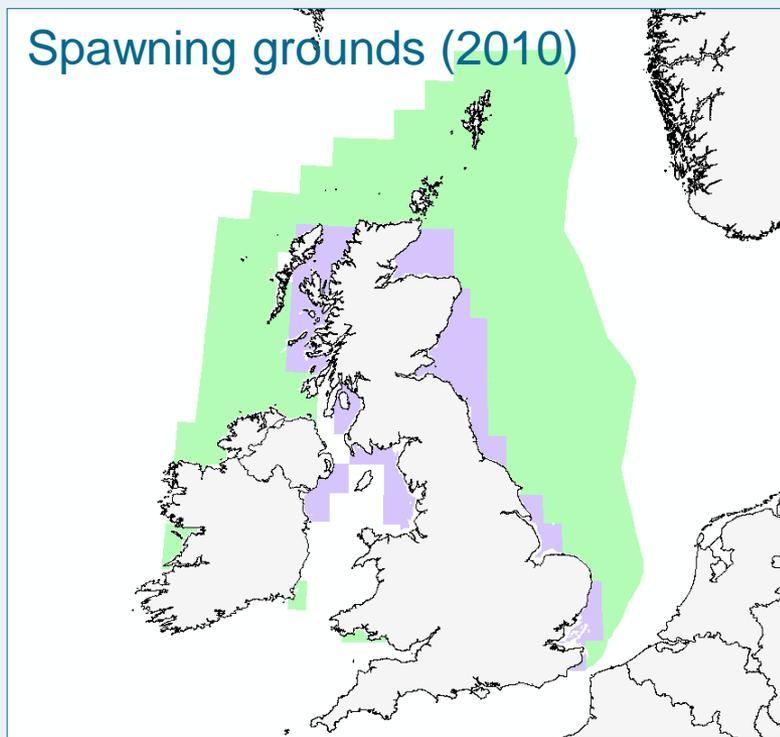


# LINC Higher Ecosystem Modelling Workshop

- Describe generic species distribution, biological information and habitat requirements.
- Describe life stage information.
- Identify potentially impacted life stages.
- Obtain area-specific data.
- Define site-specific data requirements.
- Identify data limits and apply methods to scale area data to study site.



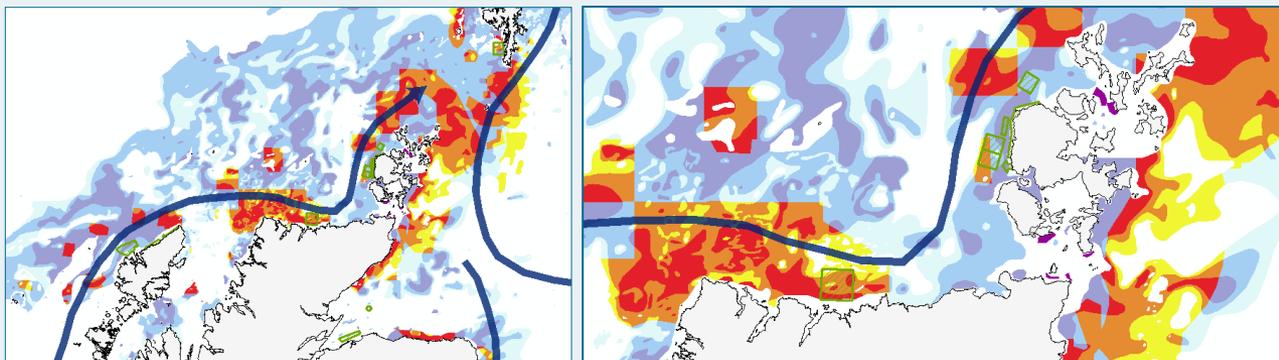
## Herring Life Stage – Eggs and Larvae



Herring lay eggs on the ground -> not in pelagic survey!  
Larvae enter survey downstream from release site?



# Conflict potential?



Life stage	Key features	Potential conflict – tidal	Potential conflict – wave
<i>Egg</i>	Deposited and attached to gravel; spawned in late August, released in September	Direct – unlikely Indirect – changes to currents, sand deposits, or salinity	Direct – geographical conflict; noise damage Indirect – changes to currents, sand deposits, or salinity
<i>Larvae</i>	Use currents and circulation for dispersal to nursery grounds in North Sea	Direct – unlikely Indirect – changes to currents or salinity	Direct – geographical conflict; noise damage Indirect – changes to currents or salinity
<i>Juvenile</i>	Nursery grounds in western North Sea	Unlikely	Unlikely
		Unlikely	Unlikely
		Direct – unlikely Indirect – unlikely	Direct – geographical conflict; noise avoidance behaviour; reduction of suitable spawning sites Indirect – changes to habitat and habitat availability (e.g. sand deposits)

**Species** Blue mussel (*Mytilus edulis*)

**Location** West & East coasts of Scotland, Orkney Islands, Shetland Isles

**Distribution**



Widespread around the UK coast. Large commercial beds in the Wash, Morecambe Bay, Conway Bay and the estuaries of south-west England, north Wales, and west Scotland.

Distribution in Scotland: widespread along the west coast; on the east coast found in the Firths of Dornoch, Tay & Forth. Large beds absent from Pentland Firth area.

**Fisheries Assessment areas**



**Wild harvesting:**  
Recent Scottish landings for wild blue mussel very hard to get!

**Aquaculture:**  
The Scottish cultivated mussel sector expanded considerably between 2000 and 2010. In 2000 marketable production was 2000 tonnes, increasing to 7,200 tonnes in 2010. This decreased slightly in 2011 (to 7,000 tons) and 2012 (to 6,300 tonnes) Annual value is approximately £8 million. Production is distributed around the west coast mainland, the Western Isles and Shetland. Shetland is the dominant producing area with some 70% of production in 2012. The decline in recent production is generally considered linked to variation in the availability of natural spatfall.

Key features of Species, life stage/behaviour					Potential Impacts				References
					Potential conflict- tidal		Potential conflict- wave		
					Direct	Indirect	Direct	Indirect	
Stock boundaries	N/A								
Depth	High intertidal to shallow sublittoral (ca. 5m).								
Substrate preference	Rocky surfaces and crevices, artificial hard substrates (wood, metal etc.), mixed coarse grounds and soft sediments (muddy sand).								

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do

Clipboard: Paste, Cut, Copy, Format Painter

Font: Calibri, 12, Bold, Italic, Underline, Text Color, Background Color

Alignment: Wrap Text, Merge & Center

Number: General, Percentage, Decimals

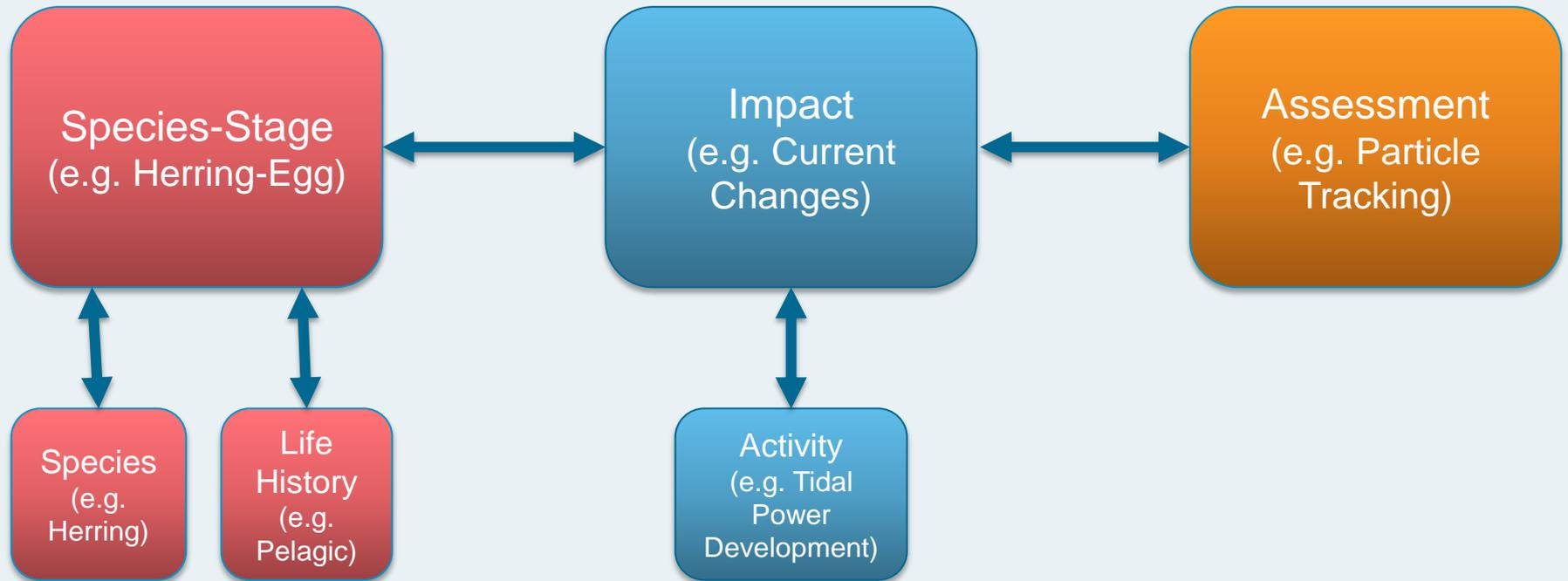
Conditional Formatting, Format as Table

Styles: Neutral, Explanatory...

	A	B	C	D	E
D5	Direct – unlikely; Indirect – changes to currents salinity, sand deposits, wave exposure/abrasion & physical disturbance				
	<b>Species</b>	<b>Life Stage</b>	<b>Key features</b>	<b>Potential conflicts- tidal development</b>	<b>Potential conflicts - wave development</b>
1	<a href="#">Blue Mussel</a>	<a href="#">Egg</a>	Broadcast spawning, external fertilisation. Protracted spawning period with peak in spring and late summer.	Direct - unlikely; Indirect - changes to currents, or salinity	Direct – geographical conflict; noise damage; Indirect – changes to currents, or salinity
2	<a href="#">Blue Mussel</a>	<a href="#">Larvae</a>	Fertilised egg develops into ciliated trocophore larva. Planktonic phase of 2-8 weeks. Use currents and circulation for dispersal to suitable settlement sites.	Direct – unlikely; Indirect – changes to currents or salinity	Direct – geographical conflict; noise damage; Indirect – changes to currents or salinity
3	<a href="#">Blue Mussel</a>	<a href="#">Juvenile –veliger</a>	2 settlement stages between which larvae (pediveliger) become planktonic again before resettling; primary attachment (at size 0.25-0.4mm) on filamentous materials using foot; secondary attachment (0.5-1.5mm) by byssus thread onto suitable (fixed) surface. Metamorphosis may be delayed for up to 6 months if no suitable surface encountered.	Direct – unlikely; Indirect – changes to currents or salinity	Direct – geographical conflict; noise damage; Indirect – changes to currents or salinity
4					

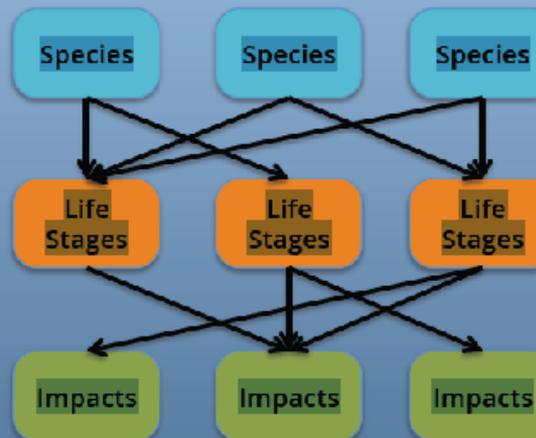


# LINC Impact Database Structure

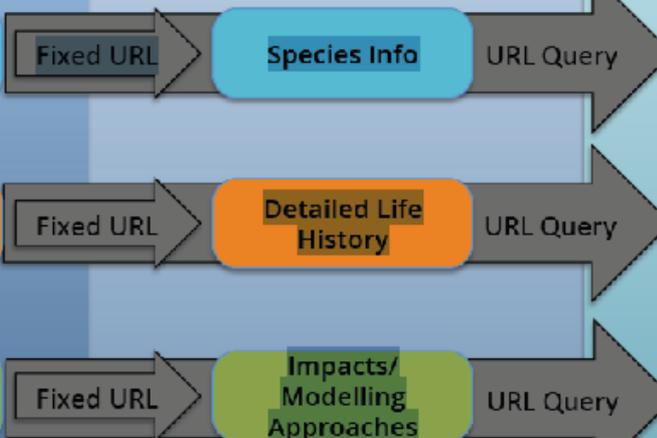


# LINC Project Impact Pathway Database Tool

## Impact Pathway Database



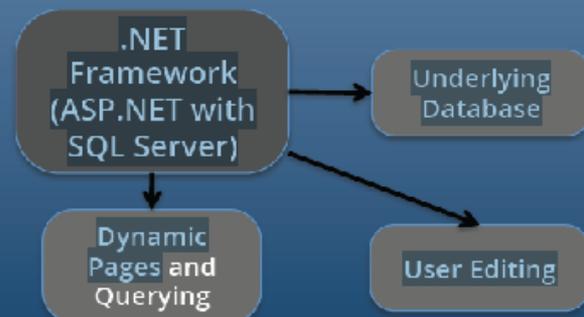
## Drill-down Content



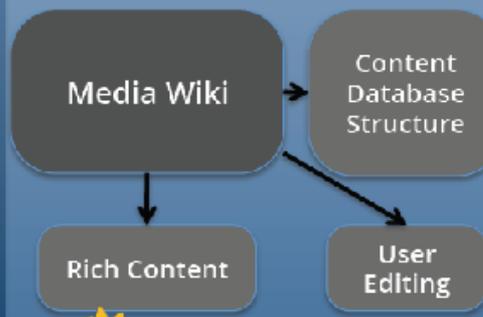
## Dynamic Content



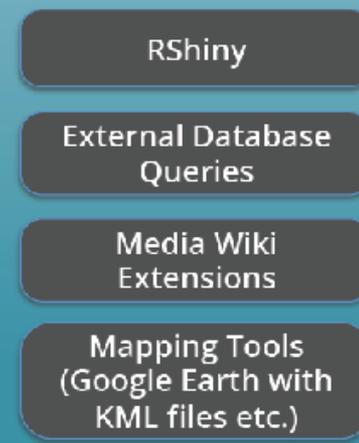
### Implemented through:



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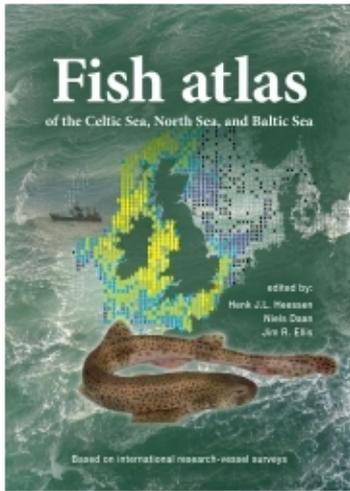
### Implemented through:



## Other possible “data” layers and outputs

- A “query” layer to identify what species information exists, their life history stages, specific habitat requirements.
- Value: economic (to whom), ecological, conservation.
- Species range and distribution, importance of specific area to species (at any point in its life cycle).
- Fishing activities layer
- Identify knowledge gaps data limits and methods to scale area data to study site.
- Define modelling requirements and methods to assess risk and predict impact.
- Identify monitoring requirements – key indicators





PREVIEW

BACK | COMING SOON

ISBN: 9789050115377

Pages: 572 p.

Size: 21 x 30 cm

hardcover, full colour

Discount members: 10 %

Based on international research vessel data



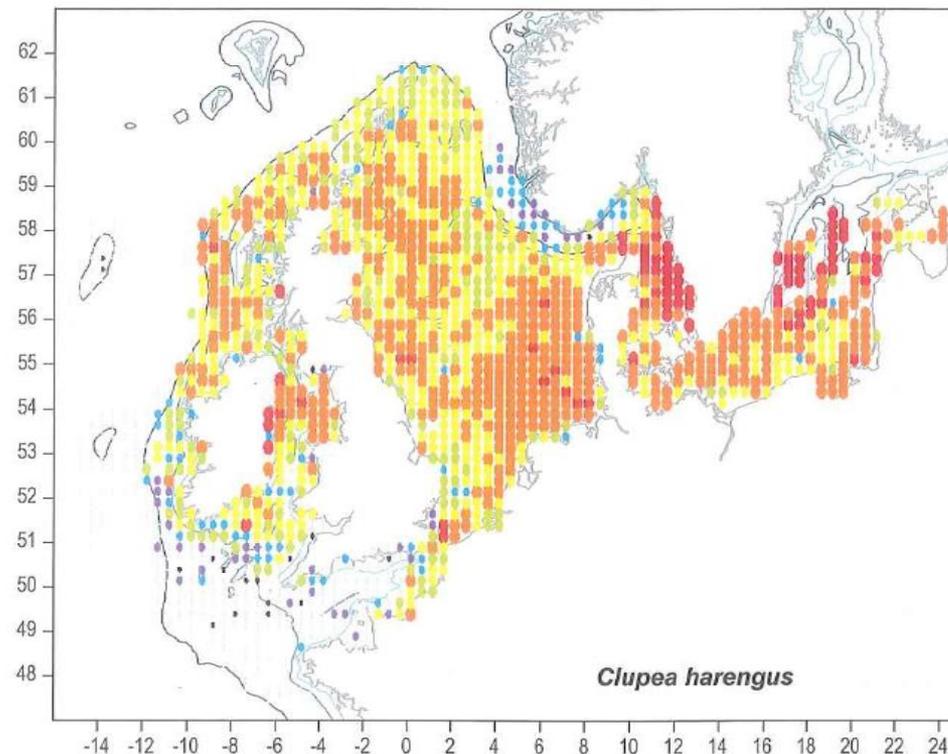
Author: edited by Henk J.L. Heessen,

Niels Daan, Jim R. Ellis

Price: € 79,50

## 20.2 *Clupea harengus*

## 20. Shads, herring, pilchard, sprat (Clupeidae)



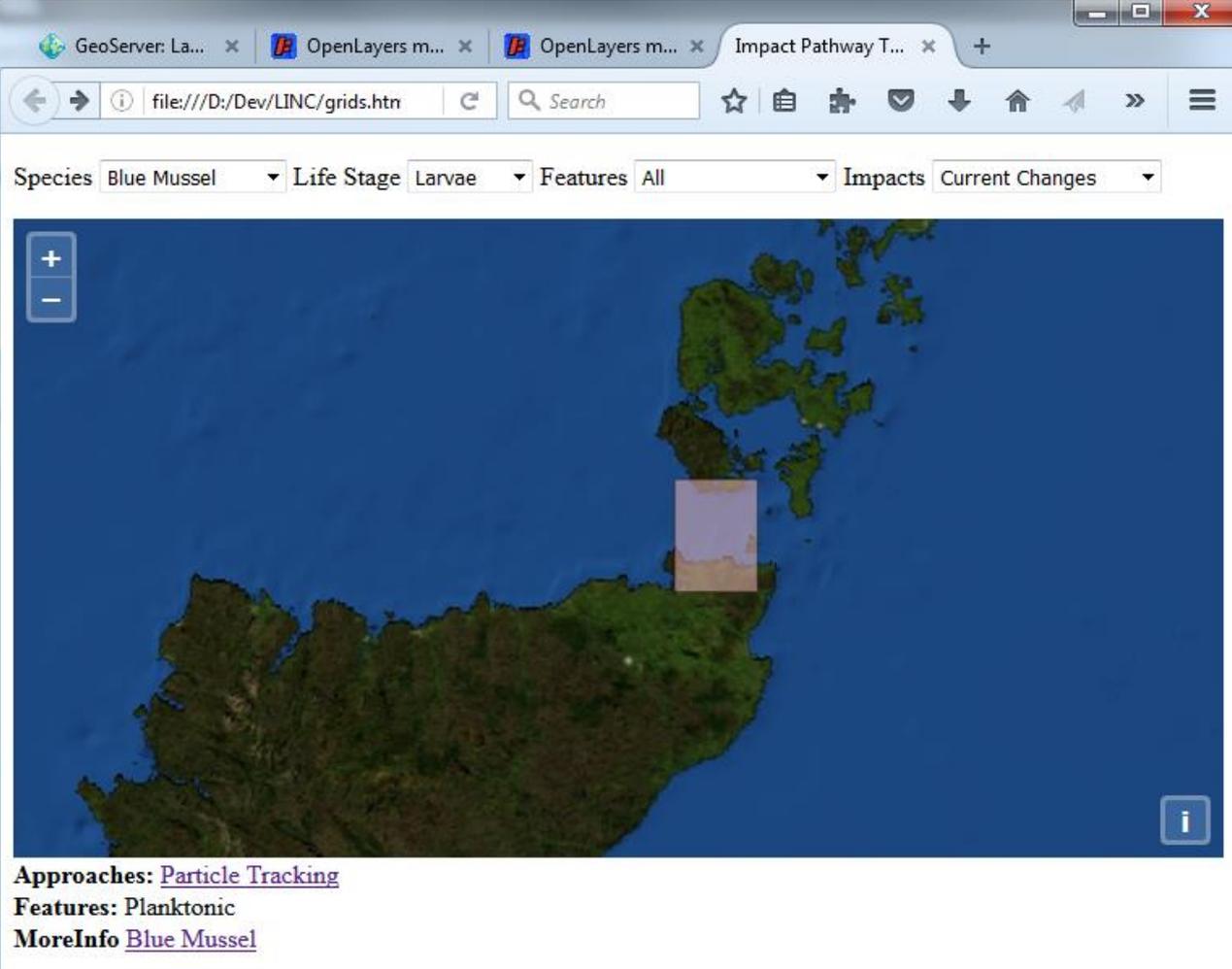
Catch rates of herring.

- full-colour pictures, clear distribution maps and graphs,
- 48 text boxes to describe additional details of general interest.





# Prototype example



GeoServer: La... x OpenLayers m... x OpenLayers m... x Impact Pathway T... x

file:///D:/Dev/LINC/grids.htm Search

Species Blue Mussel Life Stage Larvae Features All Impacts Current Changes

Approaches: [Particle Tracking](#)

Features: Planktonic

MoreInfo [Blue Mussel](#)



# Welcome

3 months ago

Overview TableOfContents



Welcome to the Impact Pathway Tool Knowledgebase, part of the LINC Project!

Search or click on the links on the right to begin exploring the still developing content for this tool.



## LINC Project Impact Pathway Knowledgebase

Marine Renewable Development Impacts and Risk Assessments



Contents Open Recent Tools More

Welcome

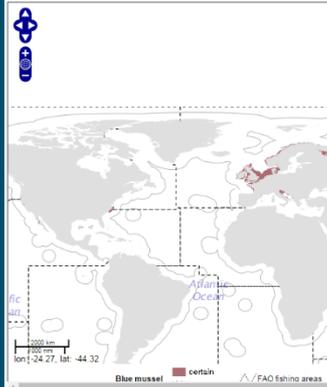
- Species Information
  - Life History
  - Species
    - Atlantic Salmon
      - Distribution
      - Importance
      - Summary
    - Blue Mussel
      - Distribution

### Blue Mussel Distribution

3 months ago

Blue Mussel

In the UK, blue mussels are widespread around the coast. Large commercial fisheries exist in Scotland and the Shetland Islands. The global distribution of the species is shown below from the [FAO Aquaculture Atlas](#).



#### Regional Distribution

Scotland

Distribution in Scotland: widespread along the west coast; on the east coast

### Blue Mussel Importance

3 months ago

Aquaculture Blue Mussel



### Commercial Exploitation

#### Aquaculture

In Scotland, the cultivated mussel sector expanded considerably between 2000 and 2010. In 2000 mussels were worth 1.5 million (£) (to 6,300 tonnes) and 2012 (to 6,300 tonnes).

The annual value of the fishery is approximately £8 million. Production is distributed around the west coast of Scotland. The decline in recent production is generally considered to be linked to variation in the availability of suitable substrata.

### Conservation

Blue mussel have not been assessed by the [IUCN](#), and are not considered under threat.

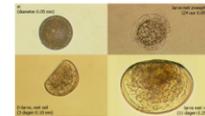
### Ecosystem

### Life History Summary - Blue Mussel

3 months ago

Blue Mussel

#### Eggs



After broadcasting, eggs are externally fertilised. After around 24 hours, they develop into their planktonic larval stage.

#### Larvae

The trochophore larval planktonic phase lasts 2-8 weeks. Blue mussel exhibits a two stage settlement, between which larvae become planktonic again before resettling.

The pediveliger settles on filamentous substrates at 0.25-0.4mm on filamentous materials using its foot and then moving on to suitable adult substrata by bysso-pelagic drifting. Pediveligers can delay settlement for up to 7 weeks.

#### Juvenile



The secondary attachment occurs at 0.5-1.5mm, by bysso thread onto suitable surface. Metamorphosis may be delayed for up to 6 months if no suitable surface encountered. This final settlement (after frequent moult at 2-5mm), often on or between individual mussels of existing mussel bed. Newly settled mussels are termed "spat".

Young mussels colonize spaces within the bed increasing the spatial complexity, and the bed provides numerous niches for other organisms. Overcrowding results in mortality as underlying mussels are starved or suffocated by the accumulation of silt, faeces and pseudofaeces, especially in rapidly growing populations ([Richardson & Seed, 1990](#)). Death of underlying individuals may detach the mussel bed from the substratum, leaving the bed vulnerable to tidal scour and wave action ([Seed & Suchanek, 1992](#)).

#### Adults

Adult blue mussel are gregarious, and at high densities forms dense beds of one or more (up to 5 or 6) layers, with individuals bound together by bysso threads.

#### Spawner

Spawning occurs in spring and later summer allowing two periods of recruitment ([Seed 1995](#)). *Mytilus edulis* has a high fecundity producing >1,000,000 eggs per spawning event.



# Would such a tool have a wider value?

1. Are we “re-inventing a wheel”, does this or something similar already exist?
2. Is there something similar we might learn from?
3. Is there interest in supporting and/or being involved in future development, maybe as part of a follow-on project (LINC2)?
4. What funding structures might support such a project?



# How a follow-on project might look

1. Web-tool development work-package
2. Impact expert group workshops
3. Modelling expert group workshops
4. Of value to: Developers  
Regulators  
Stakeholders  
Conservationists

