ICES CM 2019/A:70

DTU AQUA
National Institute for Aquatic Resources

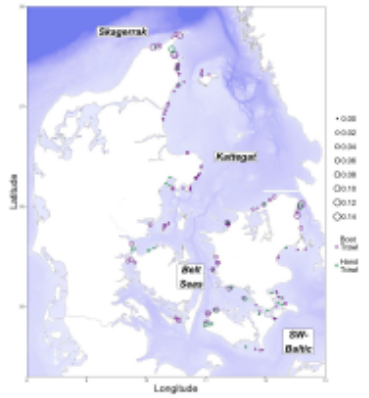
Habitat Suitability Modelling for Juvenile Fish

Example: European Plaice (*Pleuronectes platessa*) of the Inner Danish Waters

Applied Aim:
Provide maps of habitat use to inform spatial managers and future research on juvenile connectivity.

Fundamental Aim:
Compare and contrast the use of density and growth as proxies for habitat suitability.

Field Collections



Trawl sites and catches of plaice in July-August of 2016. Sites were stratified across four depths (0-4m) and four soft bottom types. Fish were sampled with a 2m beam trawl (6mm stretched mesh) and physical environmental conditions were measured on site. Bathymetry is limited to 120m to show variation throughout the main study area.

Empirical Models

Response Variables:
Habitat Association Models (HAM)
- Abundance

Habitat Growth Models (HGM)
- Daily Length Specific Growth Rate (DLSGR)
- 10 day growth from otolith microstructure

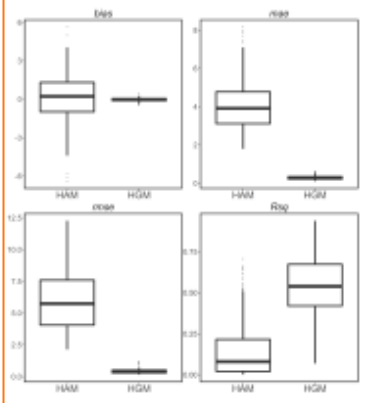
Explanatory Variables:
- Depth
- Bottom Type
- Temperature
- Salinity
- Oxygen Saturation
- Wind Exposure
- Latitude
- Age

Generalised Linear (Mixed) Models:

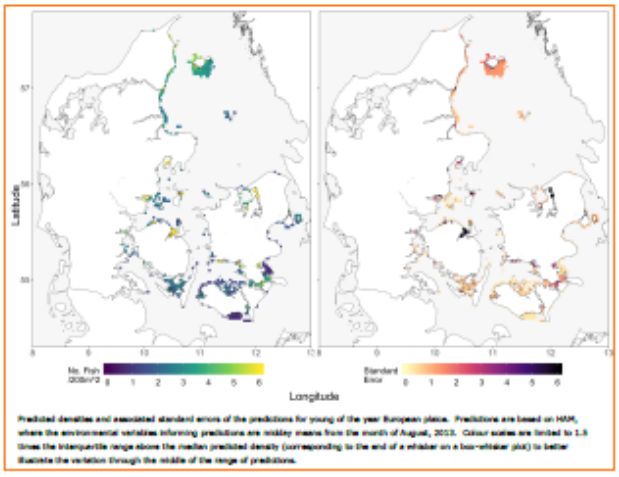
$$Abundance_{Plaice_{ys}} \overset{\sim}{\sim} \mu * (1 + \frac{\mu}{\varphi}) \quad Salinity + \ln(Exposure) + Latitude + offset(\ln(TrawledArea))$$

$$DLSGR_{Plaice_{ys}} \overset{\sim}{\sim} LogN(\mu, \sigma^2) \quad Salinity + Age + Latitude + RE(site)$$

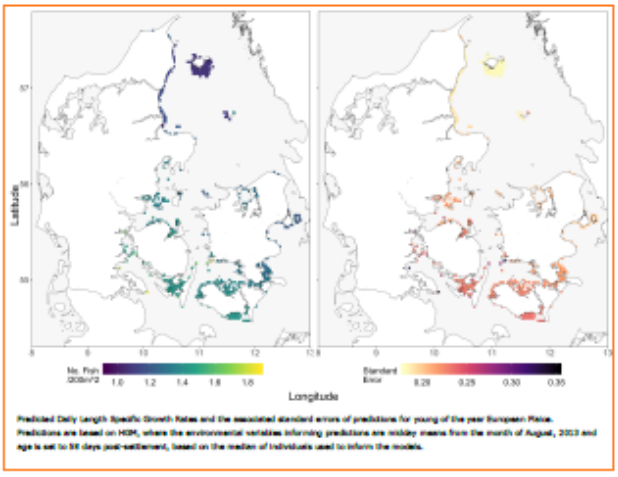
Model Validation



Validation metrics derived from 500 iterations of repeated random sub-sampling cross-validation for the selected models of yc-plaice abundance (HAM) and growth (HGM). Model parameters were re-fit to 90% of the data and used to predict the remaining 10%. These metrics are derived from the comparisons of predicted and observed values for each iteration.



Predicted densities and associated standard errors of the predictions for young of the year European plaice. Predictions are based on HAM, where the environmental variables informing predictions are midday means from the month of August, 2013. Colour scales are limited to 1.5 times the interquartile range above the median predicted density (corresponding to the end of a whisker on a box-whisker plot) to better illustrate the variation through the middle of the range of predictions.



Predicted Daily Length Specific Growth Rates and the associated standard errors of predictions for young of the year European Plaice. Predictions are based on HGM, where the environmental variables informing predictions are midday means from the month of August, 2013 and age is set to 90 days post-settlement, based on the median of individuals used to inform the models.

Applied Conclusion:
Validated models were used to produce maps of predicted habitat suitability paired with maps of prediction uncertainty.

Fundamental Conclusion:
The proxy chosen for habitat suitability impacts the relative suitability assigned to an area. Future work should aim to integrate multiple proxies of habitat suitability.

Elliot J. Brown Alexandros Kokkalis Josianne G. Støttrup

CM-code:

ICES CM 2019/A:70

Title of Abstract:

Habitat association models and habitat growth models for juvenile fish of the inner Danish waters.

Authors:

Elliot J. Brown, Alexandros Kokkalis, Josianne G. Støttrup

Abstract:

In order to quantify the indirect effects of human activities on important fisheries species, the natural drivers of habitat suitability must first be understood. The methods used to describe these drivers and create habitat suitability metrics are diverse and one of the fundamental decisions to be made in quantifying habitat suitability is the measure used to represent it. Here we present a survey of juvenile habitats from the inner Danish waters that uses two measures, density and growth, as proxies for habitat suitability. Habitat suitability is modelled as a function of the physical environment using generalised linear (mixed) models which are validated using repeated random sub-sampling before being employed to create predicted maps of habitat suitability and their inherent uncertainty. The resultant density and growth models are discussed and contrasted.

Keywords:

juvenile habitat, inner Danish waters, Baltic Sea, transitional waters, habitat suitability, growth modelling, habitat association modelling

Contact Author:

Elliot J. Brown

Section for Ecosystem Based Marine Management, National Institute of Aquatic Resources, The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

email: elbr@aqua.dtu.dk

Twitter Username:

@EJB_easyas_123