Abiotic modelling options of estuarine areas as building blocks for ecological predictions

Stijn Bruneel [1,2], Pieterjan Verhelst [1,2], Jan Reubens [3], Tom Moens [2], Peter Goethals [1]

[1] Laboratory of Environmental Toxicology and Aquatic Ecology, Faculty of Bioscience Engineering, UGent. E-mail: stijn.bruneel@ugent.be

[2] Marine Biology Research Group, Faculty of Sciences, Ghent University

[3] VLIZ (Vlaams Instituut voor de Zee)

An upcoming topic of ecological research is the implementation of movement in habitat suitability models (HSM). These models, also known as species distribution models (SDM), aim at identifying the relationship between environment and organisms. Fish, especially potamodromous and diadromous fish such as eel (*Anguilla anguilla* L.), are highly mobile and might interact with each other and the environment. Therefore, fish sampling techniques and modelling tools which do not account for movement or interaction, introduce considerable uncertainties. Only recently the incorporation of ecological knowledge regarding movement and the evolution of more individual based sampling techniques such as telemetry, have opened the door to more movement dependent models such as individual based models (IBM). However, this new approach to model species distributions should not only drive researchers to use new fish sampling techniques and biotic modelling tools but should also offer an opportunity to rethink existing environmental modelling tools used in SDMs.

- Point-based population fish sampling
- Unprocessed in-situ abiotic point-measurements

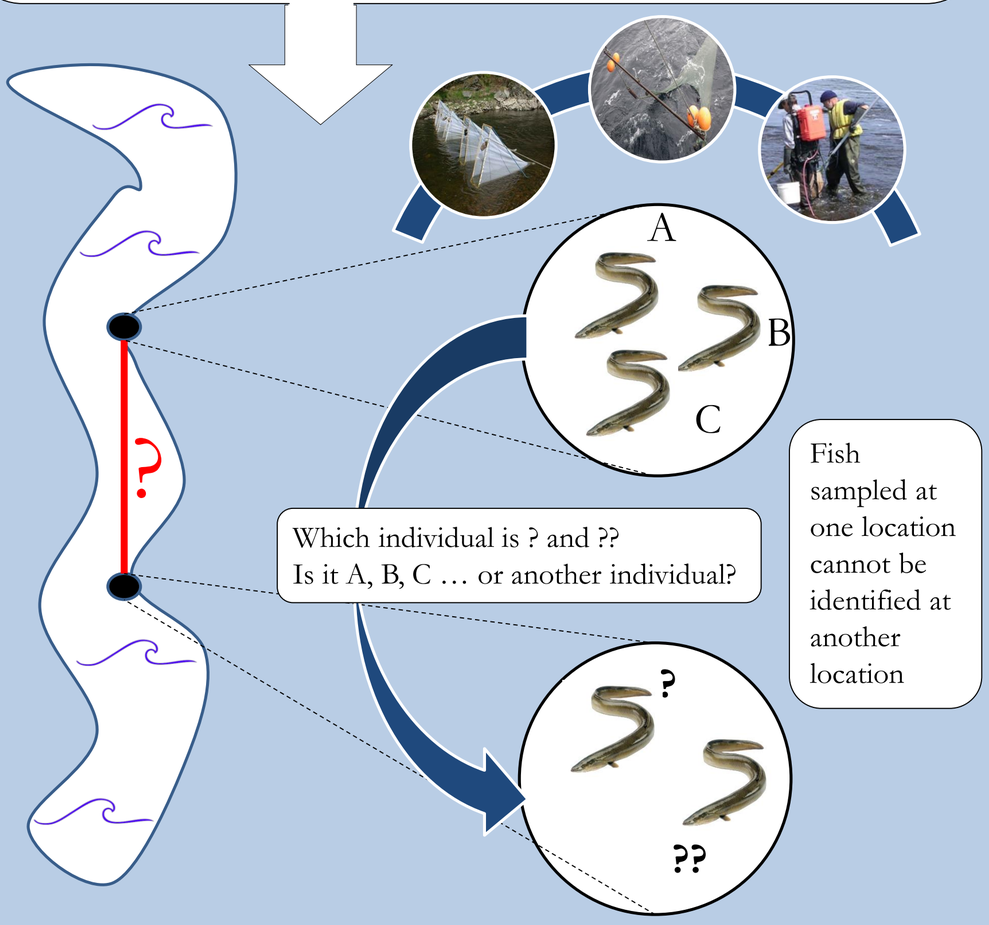
- Point-based individual fish sampling (allowing trajectory description)
- Processed in-situ abiotic point-measurements and remote sensing

Fish Sampling techniques

Traditional sampling techniques: Fykes, trawls and electrofishing

- Groups of fish (populations)
- At point locations

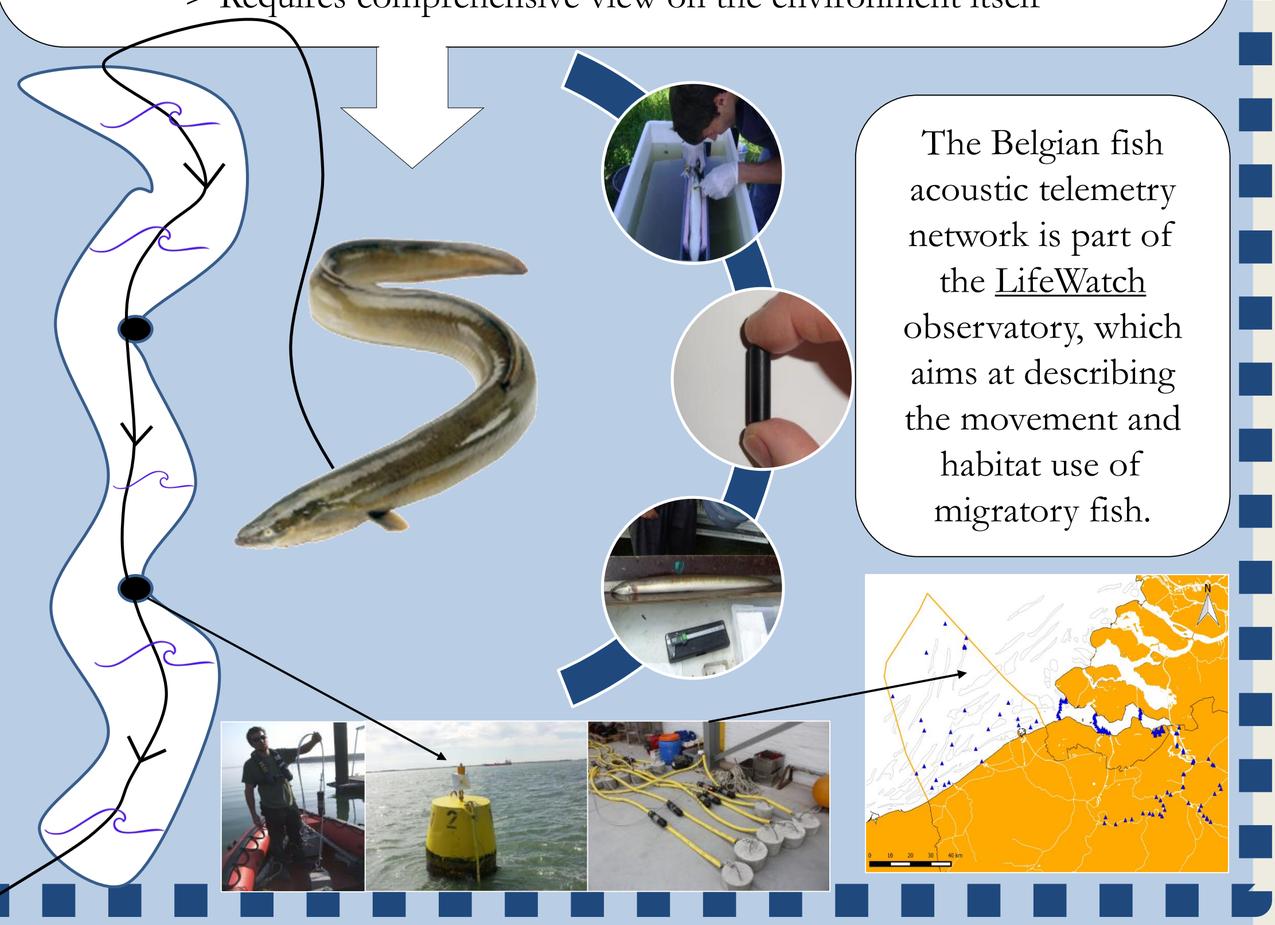
No idea of the behavior of individual fish and how it is related to environmental changes.



Innovative sampling technique: Acoustic telemetry

Fish are surgically tagged with a transmitter which can be detected by receivers (point-locations) scattered in the environment, allowing to reconstruct individual fish trajectories.

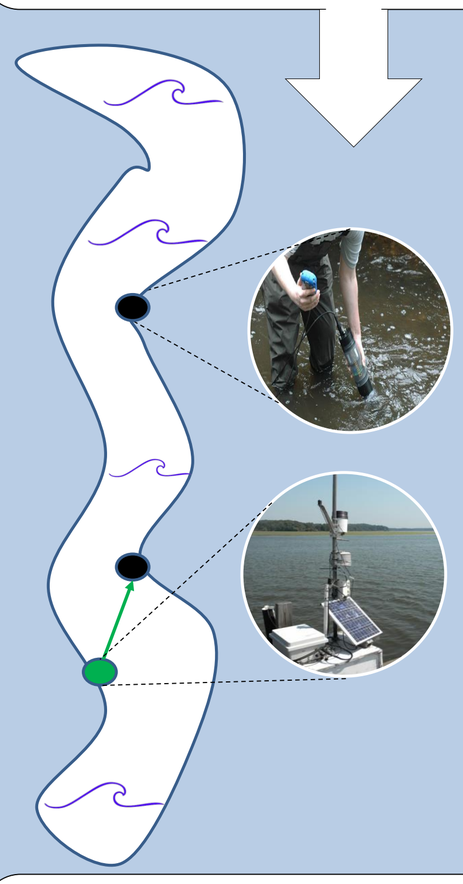
> Telemetry > Point-measurements of recognizable individuals > Trajectories > Comprehensive view on how individuals move in the environment > Requires comprehensive view on the environment itself



The Belgian fish acoustic telemetry network is part of the LifeWatch observatory, which aims at describing the movement and habitat use of migratory fish.

Biotic data > Point-based < Environmental data

- Water sampling during fish sampling
- Nearby fixed measurement stations



Environmental data

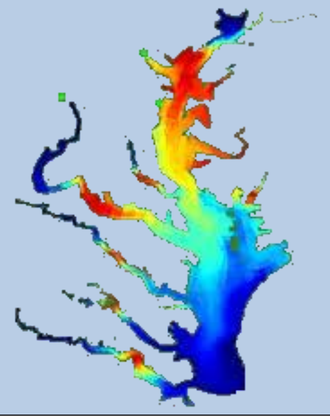
Environmental layers instead of point data

Point measurements > Interpolation methods (kriging)

Knowledge incorporation > Mechanistic models (process-based)

Satellite imagery > Remote sensing

Kriging (interpolation)
- Strong link with point data
- Accounts for spatial autocorrelation
- Measure of uncertainty (geostatistics)



Mechanistic model
- Based on universal laws
- High extrapolation reliability
- Requires little data input

Remote sensing
- Surface covering
- Evolving technology

Conclusion: The new generation of biotic data acquisition (e.g. telemetry) and processing (e.g. IBM) tools are individual based with a high spatial and temporal coverage potential, enabling the reproduction of fish trajectories. Therefore used environmental datasets should be expanded from point-based to area-covering in order to identify effects of environmental changes between sampling points on movement of fish. Different methods, using point measurements, physical-chemical knowledge, remotely sensed data or a combination are promising ways to integrate environmental data into ecological models.