Assessing connectivity in young flatfish and its implementation in fisheries management



Sophie DELERUE-RICARD^{1,2}, Ilaria Coscia¹, Léo Barbut³, Geneviève Lacroix³, Andreas Vanden Bavière², Johan Robbens², Filip A.M. Volckaert¹ ¹ Laboratory of Biodiversity and Evolutionary Genomics, Katholieke Universiteit Leuven, Ch. Deberiotstraat 32, B-3000 Leuven, Belgium ² Institute for Agricultural and Fisheries Research (ILVO), Ankerstraat 1, B-8400 Oostende, Belgium ³ Royal Belgian Institute of Natural Sciences (RBINS), DO 'Nature', Gulledelle 100, B-1200 Brussels, Belgium E-mail: sophie.deleruericard@bio.kuleuven.be



INTRODUCTION & AIMS

• Overfishing and selective fishing lead to a loss of genetic diversity as well as changed life cycles. Given the commercial importance of the North Sea sole species, **conservation efforts** have to be made.



• Early life stages are of critical importance for recruitment and they provide a unique opportunity to reveal connectivity patterns.



Future ?

Interannual recruitment variability



Figure 1: Recruitment (R) variability in the North Sea

sole (ICES 2013).

OBJECTIVES

- Does larval dispersal vary in time and space? 1.
- What biotic and abiotic factors are driving larval connectivity? 2.
- Can we predict the impact on recruitment of changes in physical and biological drivers? 3.



METHODOLOGY

(1) ENVIRONMENTAL CHEMICAL HETEROGENEITY

Tool 1: Microchemistry: Otolith elemental composition

15 chemical elements (e.g., Na, Ba, Mn)



(2) LOCAL GENETIC SIGNATURE

Tool 2: SNPs for sole

Screen FishPopTrace's 426 SNPs* for 4 Atlantic populations

Illumina-Veracode Genotyping

200 outlier SNPs

Connectivity matrix

Origin assignment

Correlation analysis between matrices

Figure 2: Sampling points of sole larvae, postlarvae and juveniles along the Belgian-French coast. Sea sampling = beam trawl, benthic sledge and WP3 plankton net. Beach sampling = beam trawl on foot. Fish size limit <10cm. Courtesy of A. Vanden Bavière.



Figure 3: Sole postlarval otolith sampled for ICPMS. A: natal signature (core of the otolith). B: capture location signature (edge). Sample holes in white. *Courtesy of A. Gueffen.*

Temporal stability analysis between old and new samples Seascape (spatial) analysis Population structure, relatedness

and population origin

SCENARIO TESTING – IPCC PREDICTIONS OCC

- River runoff, SST, wind & atmospheric pressure, behaviour
- Larval retention (Fig. 4)

Tool 3: Modelling of larval dispersal



OUTCOMES

- Individual tracing with otolith microchemistry and genomics to understand:
 - \rightarrow dispersal and connectivity
 - \rightarrow recruitment

• Comparison of **bio-hydrodynamic model** with *in situ* data \rightarrow to assess the relative impacts of hydrodynamics, environment,

Figure 4: Larval abundance of North Sea sole at the end of larval transport obtained from a bio-hydrodynamic model (Lacroix et al. 2013). Relative contributions of 6 spawning grounds: EC (Eastern English Channel), BC (off the Belgian coast), Tx (off Texel), GB (inner German Bight), N (Norfolk banks), Th (Thames estuary).

behaviour and physiology \rightarrow to improve the predictability of **cohort strength**

• Fisheries management at the subpopulation level because of: \rightarrow potential collapse of less productive components \rightarrow the importance of biocomplexity for long term stability and sustainability of fish stocks

VOCABULARY	* Recruitment: the part of fish juveniles that have reached a sufficient length to enter the s SNPs: Single Nucleotide Polymorphisms are molecular markers Stock: the economically exploitable part of a population	toc
BIBLIOGRAPHY	Lacroix G., Gregory E. Maes, Loes J. Bolle and Filip A.M. Volckaert. (2013) Modelling dispersal dynamics of the early life stages of a marine flatfish <i>Solea solea</i> (L.). Journal of Sea Research 84 . pp. 13-25. ICES Advice 2013, Book 6 – <u>http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2013/2013/sol-nsea.pdf</u>	/ / C
ACKNOWLEDGEMENTS	FWO – Project nr G.0702.13N (2013-2016) "Understanding and predicting the impact of the interaction between oceanographic and biological factors on larval recruitment and population connectivity in flatfish – B-FishConnect".	EN

Old datasets: Beyst et al. 2001,2002; Cuveliers et al. 2010; Dewicke et al. 2003; Rogers et al. 1998; Van der Veer et al. 2011.