SEA CHANGE

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ALIEN FISH INVASIONS

A lesson plan developed for the EU project Sea Change by DTU Aqua and Copenhagen International School

LESSON PLAN: ALIEN FISH INVASIONS

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The lesson plan was produced as a part of the Horizon 2020 project Sea Change by DTU Aqua in collaboration with Copenhagen International School. The lesson plan was conceived and developed by Christian Riisager-Pedersen (ORCID: 0000-0003-3873-9727) and Ivo Grigorov (ORCID: 0000-0001-6264-802X), with valuable input from Jane Behrens from DTU Aqua, in collaboration with Werner Riedel and Lorraine Wykes from Copenhagen International School.

*For comments and questions contact Christian Riisager-Pedersen, DTU Aqua (**chrii@aqua.dtu.dk**) or (**aqua@aqua.dtu.dk**).*

The data presented in the lesson plan was kindly provided and disseminated by the following institutions and their employees:

- Danish Technical University, National Institute for Aquatic Resources (DTU Aqua)
- Jane Behrens (ORCID: 0000-0002-0136-9681)
- Marie Plambech Ryberg

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Introduction to the lesson plan (teacher)

"Alien fish invasion"

This document

This document provides the teacher with background information about how and why the lesson plan was developed, and suggest how it can be used.

General introduction to the series of ocean literacy lesson plans

The ocean literacy lesson plans have been developed to allow teachers bring the newest and most exciting research topics into the class rooms, while covering the mandatory curriculum. To do this detailed lesson plans are provided including, background texts, real research data, manuals for hands-on work. Additionally lesson plans have been drafted to allow cross-subject work enabling the students to discover the benefits of using multiple disciplines to understand real world challenges. The application of biological concepts to understand societal challenges, should therefore both support the students' general **utilization** capacity of biological knowledge, increase their understanding about the **nature of science** as well as their ability to take global perspective and thus foster **international-mindedness**. The students ability to combine theoretical knowledge with practical experiments and assessments is further supported in the lesson plan by manuals describing how to carry out data analyses, field work or laboratory work.

The ocean literacy lesson plans have been developed by the Institute for Aquatic Resources at the Technical University Denmark (DTU Aqua) in collaboration with Copenhagen International School. The lesson plan has been developed as part of the EU HORIZON 2020 project SeaChange, which aims to bring the newest research into the curriculum of students around the world and thus contribute to ocean literacy.

The lesson plan: "Alien fish invasion"

The lesson plan at hand has been designed to contribute to the topic in the IB curricula focusing on cell biology, molecular biology and gas exchange. However, a number of other biological topics from the IB curricula is also relevant, as demonstrated in the table below. As this lesson plan is particularly focused on presenting and interpreting data, it has been drafted to support the goal in Theory of Knowledge related to the students ability to "*be aware of themselves as thinkers, encouraging them to become more acquainted with the complexity of knowledge*." As not all classes will have covered all the specific concepts in the lesson plan, it is recommended that the teacher goes through all the materials and removes the parts, which their classes are not yet ready for. Subsequently it could be meaningful to return to those later in the year, to demonstrate how the student's new knowledge enable them to understand the topic to a greater extent.

Cell biology (1)	Membrane transport (1.4)
Molecular biology (2)	Cell respiration (2.8)
Human physiology (6)	Gas exchange (6.4)
Evolution (5)	Natural selection (5.2)
Ecology and Conservation (14)	Impact of humans on ecosystems (C.3)

Provided materials

The lesson is build up around several documents, containing the information needed to carry out the lesson with a minimum of preparation time for the teacher.

Materials for the teacher:

1) Introduction to the lesson plan	This document.
2) PowerPoint presentation	A presentation, which the teacher can use in the class to guide the students through the 90 minute exercise. It will allow the teacher to introduce the topic and supplements the written materials. It will hopefully enable the teacher to catch the interest of the students. It is highly recommended that the teacher studies it before the class. It does for example contain a suggested fish dissection, which can be skipped without problems if preferred. Should this be prioritized, fish and dissection kits must be bought and prepared.
3) Experimental data with examples	The Excel document contains raw data from the experiment carried out by the researchers. However in addition to the student's version, examples of ways to present figures is provided.
4) Scientific background paper	This document contains the original research paper, which this exercise is built on. It is NOT necessary for the understanding of the lesson plan, but might be of interest to some teachers. The first author of the study has helped design the content of this lesson plan.

Materials for students:

5) Background paper	This document is a background text introducing the topic and how biological theory can be used to design experiments. The text should ideally be read e.g. as homework before the lesson.
4) Manual	This document describes the exercise which will be carried out in the class room. It has been drafted so that it can be used as a written report if the teacher decides. It is important that the teacher edits this document, to make it fit their class.
5) Experimental raw data	This document is an excel sheet with the data collected by scientists during the experiments. It can be used directly to generate graphs and figures.

Additional materials

1) Crosscutting texts	To encourage cross-subject work with e.g. geography documents on the ecosystem service concept is provided. Teachers are encouraged collaborate with e.g. teachers from other disciplines to try to estimate the costs that fisheries experience if the invasion of round gobies reduce the catch of e.g. trout by 25%.

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OTHER OCEAN LITERACY LESSON PLANS FROM SEA CHANGE

- Marine Pollution & Human Health. http://dx.doi.org/10.5281/zenodo.1284141
- Seafood & Human Health. http://dx.doi.org/10.5281/zenodo.1284103
- The Ocean, a Treasure Trove for Human Medicine, Health and Wellbeing. http://dx.doi.org/10.5281/zenodo.1284137
- The Ocean is Planet Earth's Life Support System. http://dx.doi.org/10.5281/zenodo.1284133

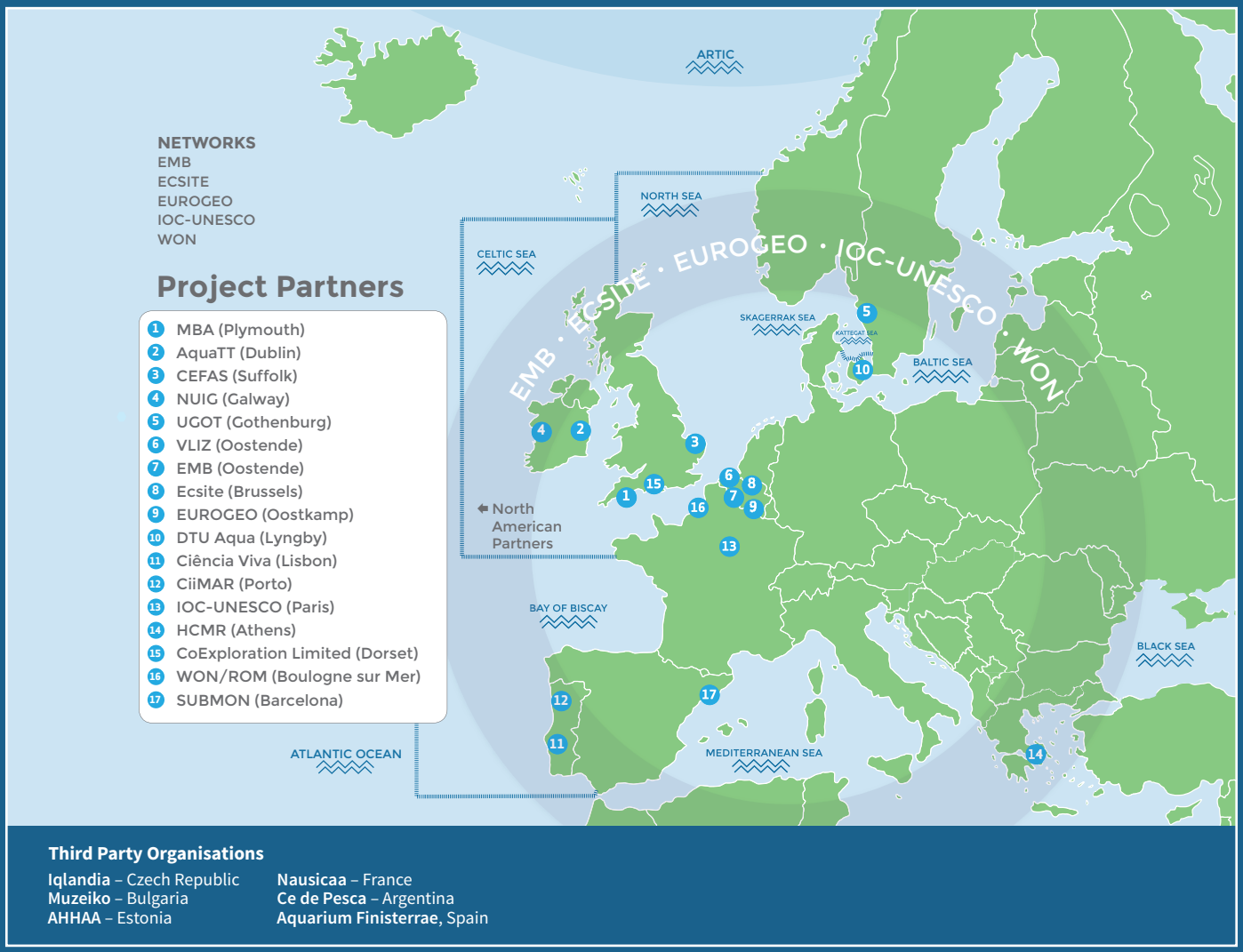
ADDITIONAL RESOURCES

More Sea Change Ocean Literacy and educational resources can be found at:
www.seachangeproject.eu/resources

A variety of other Ocean Literacy resources and activities can also be found in the Ocean Edge Directory:
www.seachangeproject.eu/seachange-about-4/campaign/sea-change-database

The Crab Watch citizen science app for Android or iPhone can be downloaded here:
www.seachangeproject.eu/ouroceanourhealth/crab-watch

SEA CHANGE CONSORTIUM



Third Party Organisations

Iqlandia – Czech Republic
Muzeiko – Bulgaria
AHHAA – Estonia
Nausicaa – France
Ce de Pesca – Argentina
Aquarium Finisterrae, Spain

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Contact details:

Project Coordinator:
Jon Parr
jpar@MBA.ac.uk

Communications:
Emer Cooney
emer@aquatt.ie

@SeaChange_EU
SeaChangeProjectEU

www.seachangeproject.eu

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