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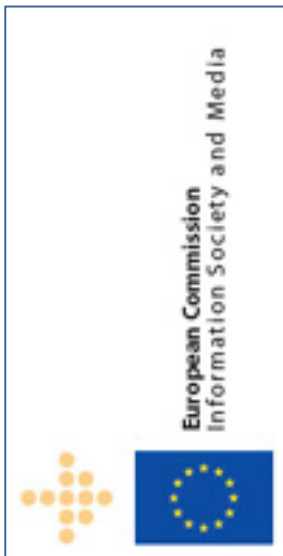
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The goal of BlueBRIDGE, *Building Research environments for fostering Innovation, Decision making, Governance and Education to support Blue growth*, is to support capacity building in interdisciplinary research communities actively involved in increasing the scientific knowledge of the marine environment, its living resources, and its economy with the aim of providing a better ground for informed advice to competent authorities and to enlarge the spectrum of growth opportunities as addressed by the Blue Growth societal challenge.

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# GLOSSARY

ABBREVIATION	DEFINITION
CNR	Consiglio Nazionale della Ricerche (National Research Council of Italy)
CoP	Community of Practice
EAB	External Advisory Board
EC	European Commission
ICES	International Council for the Exploration of the Sea
ICRE8	International Centre for Research on the Environment and the Economy
IRD	Institut de Recherche pour le Developpement
Virtual Laboratory	A VRE conceived to serve the needs arising in a specific research question and/or in a given region / area and /or in a given Community of Practice.
Virtual Research Environment	An innovative, web-based, community-oriented, comprehensive, flexible, and secure working environment conceived to serve the needs of a given community engaged in a (research) task
VLab	Virtual Laboratory
VRE	Virtual Research Environment
WP	Work Package

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# DELIVERABLE SUMMARY

The goal of Blue Skills is to develop and deploy Virtual Research Environments (VREs) essential for boosting education and knowledge bridging between research and innovation in the area of protection and management of marine resources.

In order to achieve this goal, plans have been laid for real courses, both with physical attendance and online courses, which have been, and continue to be implemented throughout the project span.

The course programme is expected to evolve during the project lifetime, e.g. new courses to be supported can be constantly identified. The initial list has been produced in October 2015 (MS4 Blue Skills VRE Plan) and whenever a course to be supported is identified it is recorded through dedicated tickets. The up to date list of target courses is always available by an automatic report available at <https://support.d4science.org/issues/684>.

Depending on the characteristics of each course either a new Virtual Laboratory can be created or one or more existing ones can be re-used to support the activity of course participants.

In the reporting period, **15 courses** took place with the support of **7 dedicated VLabs**. These courses were attended by more than **335 participants** in total.

## EXECUTIVE SUMMARY

The Blue Skills work package entails the training element of the project. There are four main contributors to the work package: International Council for the Exploration of the Seas (ICES), Istituto di Scienza e Tecnologie dell'Informazione "A. Faedo" of the National Research Council of Italy (CNR), the University of Athens (UoA), and, Institut de recherche pour le développement (IRD). These provide a broad range of training opportunities, ranging from training scientists, researchers and stock assessors, to students at both Masters and PhD level.

The training element of BlueBRIDGE aims to boost education by reducing trainers' effort in preparing platforms for practical experimentation in courses organised by universities, institutions, and companies that require multidisciplinary data access, curation, and analytics.

The main results to date have included the extensive utilisation of the BlueBRIDGE infrastructure by a series of Virtual Laboratories, in a range of topics and ways. In some instances the use of the infrastructure and its facilities has been purely for communication and material dissemination, while in others, the infrastructure has been used for analysis and modelling.

In the reporting period, **15 courses** took place with the support of **7 dedicated VLabs**. These courses were attended by more than **335 participants** in total.

Due to the organic nature of the project, many elements have been added to the virtual research environments throughout the year. The hope is that within the coming year of the project, more facilities will be added and consolidated as a standard part of the tool and more uptake opportunities for the developed tools will be explored.

## 1 BLUE SKILLS OBJECTIVES

The rationale behind the Work Package 8 is the aim to deliver BlueBRIDGE virtual research environments (VREs) and Virtual Laboratories (VLabs) to support educational activities run by ICES, IRD, other EU academic institutions and SMEs. The aim is to help scientists, at various stages of their careers, in acquiring necessary competences on topics related to stock assessment, oceanography and ecosystem approach to fisheries, and also to help course instructors to run their courses in a more efficient way (before, during and after each course).

The main responsibility of the work package is to administer the implementation of the virtual research environments in real world learning situations. This is to fulfil one of the main pillars of the project, the support of educators in efficiently preparing platforms for practical experimentation in scientific courses. BlueBRIDGE aims to support these training activities by building tools to ease the effort required in preparing platforms for practical experimentation in courses organised by universities, institutions, and companies that require multidisciplinary data access, curation, and analytics. It is clear that the scope of this activity is wider than the marine domain.

These VREs have, and will continue to support preparation of the environment for courses and workshops. They support courses addressing, among the others, vessels activity monitoring, fisheries managements, biodiversity conservation, oceanography and aquaculture production optimization. Services, tools, models, interfaces and datasets will be developed or integrated to address these topics. The VREs, in addition to providing an online platform, expand the tools available for stock assessment, running of models and ease communication and dissemination of material.

The remainder of the report is organised as follows. Section 2 summarises the activity performed up to December 2016 by listing the set of supported courses and discussing the key performance indicators characterising the Blue Skills activity. Section 3 describes each supported course by giving details on course objectives, date, venue, instructors, and supporting environment (aka VLab). Section 4 sketches the list of courses characterising the next period (the consolidated list will be produced by 'MS18 Blue Skills VRE Plan: Revised Version' at January 2017). Finally, Section 5 concludes the report by reporting some early feedback resulting from the exploitation of Virtual Laboratories in real courses.



## 2 EVOLUTION TO DATE

The Blue Skills activity (WP8) is organised in four tasks. The first one is dedicated to the development of common features across all the supported training courses while the remaining three deliver VREs covering specific training needs in ICES, IRD and other academic organizations and SMEs. These VREs (actually VLab) [2] have, and will continue to offer: (i) a completely innovative and powerful environment supporting practical uptake of scientific knowledge by leveraging on the e-Infrastructure capacity, (ii) access to a large variety of data sources and tools; (iii) virtual and ubiquitous working environments equipped with a large variety of always up-to-date models and facilities.

In the first period of the project, the main WP8 objective has been to make use of the BlueBRIDGE facilities to support real life courses. In pursuing such an objective WP8 beneficiaries were called to familiarize with BlueBRIDGE existing technologies and facilities thus to (a) figure out how to properly assemble them to serve the needs and expectations arising in real life courses, (b) suggest enhancements and modifications aiming at making the existing facilities more suitable for the training cases, (c) liaise with instructors to make course practices benefitting from the potentialities of the BlueBRIDGE infrastructure and its VREs \ VLabs. There has been extensive development of facilities across Blue Skills Virtual Labs, to ensure the provision of services, models, interfaces and datasets, which can serve the courses and workshops, which are arranged by project contributors, and available throughout the span of the project. The facilities are provided by the experts and scientists, tasked with teaching the courses, or participating in the workshops. This has included the provision of the R interface stock assessment tool, Python interface, Tuna Atlas, and communication tools. Shiny will also made available in the near future. The resources made available have been integrated within the D4Science e-Infrastructure.

In the following sections of this deliverable it is presented the application of BlueBRIDGE facilities in human capacity building activities, i.e. training courses organized by individual partner organizations. A summary of the Blue Skills events supported **up to December 2016** is listed below in Table 1.

**Table 1. BlueBRIDGE supported courses**

Date	Event	Participants <sup>1</sup>	Supporting Environment
Sep. '15	Ecopath with Ecosim (EwE) modeling approach, new features of EwE, how BlueBRIDGE can support EwE, Ecopath with Ecosim (EwE) (cf. Sec. 3.2.1)	18	Stock Assessment [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a>
Nov. '15	Using e-Infrastructures for Biodiversity Conservation (cf. Sec. 3.3.1)	30	Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a>
Feb. '16 – Mar. '16	Training course in the R environment (cf. Sec. 3.1.1)	36	ICES Training Course in the R Environment (ICES_TCRE) [2] <a href="https://i-marine.d4science.org/web/ices_tcre">https://i-marine.d4science.org/web/ices_tcre</a>

<sup>1</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

Date	Event	Participants <sup>1</sup>	Supporting Environment
Mar. '16	Ecopath with Ecosim (EwE) 10odelling approach, new features of EwE, how BlueBRIDGE can support EwE, Ecopath with Ecosim (EwE) (cf. Sec. 3.2.2)	28	Stock Assessment [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a>
Apr. '16	Demonstration and training on the features of the BlueBRIDGE e-infrastructure (cf. Sec. 3.3.2)	10	Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a>
May '16	Signal processing and mining of Big Data: biological data as case study (cf. Sec. 3.3.3)	26	Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a>
May - Jun. '16	Modelling aquatic ecosystems with Ecopath, Ecosim and Ecospace (cf. Sec. 3.2.3)	22	Stock Assessment [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a>
Jun. '16	Social science methods for natural scientists (cf. Sec. 3.1.2)	30	ICES Training Course on Social Science Methods for Natural Scientists (ICES_TCSSM) [2] <a href="https://i-marine.d4science.org/web/ices_tcsm">https://i-marine.d4science.org/web/ices_tcsm</a>
Sep. '16	Design and analysis of statistically sound catch sampling programmes (cf. Sec. 3.1.3)	18	ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes (ICES_DASC) [2] <a href="https://i-marine.d4science.org/web/ices_dasc">https://i-marine.d4science.org/web/ices_dasc</a>
Sep. '16	Data-limited stock assessment (cf. Sec. 3.1.4)	27	ICES Training Course on Data Limited Stock Assessment (ICES_DALSA) [2] <a href="https://i-marine.d4science.org/web/ices_dalsa">https://i-marine.d4science.org/web/ices_dalsa</a>
Nov.- Dec. '16	Stock assessment (advanced) (cf. Sec. 3.1.5)	27	ICES Training Course on Stock Assessment Advanced (ICES_SA) [2] <a href="https://i-marine.d4science.org/web/ices_sa">https://i-marine.d4science.org/web/ices_sa</a>
Nov. '16	BlueBRIDGE: Cloud Infrastructure serving Aquafarms (cf. Sec. 3.3.4)	18	Aquaculture Training Lab [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a>
Dec. '16	Principles and methods of broadband/wideband technologies: Application to fisheries acoustics (cf. Sec. 3.1.6)	29	ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics (ICES_FIACO) [2] <a href="https://i-marine.d4science.org/web/ices_fiaco">https://i-marine.d4science.org/web/ices_fiaco</a>
Dec. '16	BlueBRIDGE: Cloud Infrastructure serving Aquafarms and Supporting Models (cf. Sec. 3.3.5)	16	Aquaculture Training Lab [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a>

Date	Event	Participants <sup>1</sup>	Supporting Environment
Dec. '16	BlueBRIDGE: Cloud Infrastructure serving Aquafarms and Supporting Models (cf. Sec. 3.3.6)	5	Aquaculture Training Lab [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a>

In total, 15 courses have been supported by creating 7 dedicated Virtual Laboratories.

## 2.1 KEY PERFORMANCE INDICATORS

Measurable objectives require Key Performance Indicators (KPIs) to ensure project management effectively and efficiently monitor the project evolution and progress towards such objectives. BlueBRIDGE has identified a number of KPIs related to each objective to ensure the highest impact, as well as the quality and success of the expected outputs. The following KPIs have been set for the Blue Skills work package.

Table 2. Blue Skills KPIs

Subject	KPI target	KPI current
ICES: Courses for scientists and researchers	12	6
ICES: Scientists and researchers exploiting the VRE	300	167
IRD: Courses for scientists, students and researchers	10	3
IRD: Students and Researchers exploiting the VRE	190	n.a. <sup>2</sup>
Knowledge bridging VRE: courses for students	10	3
Knowledge bridging VRE: courses for scientists and researchers	6	3
Knowledge bridging VRE: students exploiting the VRE	615	61
Knowledge bridging VRE: scientists and researchers exploiting the VRE	135	44

The picture emerging from these figures might look problematic, the current values of some KPIs are low with respect to the target values. However, it is expected that new opportunities and new courses can be organised in the forthcoming period thanks to (a) the availability of new facilities developed in the reporting period and now made available (including outcomes from the other Blue pillars [1][2][6][8][9][10]), and (b) the experiences gained in releasing and operating V Labs for supporting real courses.

<sup>2</sup> The IRD courses are mainly focused on the exploitation of the EwE desktop application, no specific VRE or VLab has been created to support them.

### 3 BLUE SKILLS ORGANISED COURSES

A total of 15 courses have been organised and supported in the context of the Blue Skills activity: six are related to ICES training programme activity (cf. Sec. 3.1), three are focused on Ecopath with Ecosim (EwE) modeling approach (cf. Sec. 3.2), and six are dedicated to introduce students to BlueBRIDGE concepts and facilities (cf. Sec. 3.3).

#### 3.1 ICES KNOWLEDGE BRIDGING

The ICES training programme has existed since 2009, as a response to the need for formalised training to help build capacity in ICES and to support the scientists involved in the advisory process. The objective of ICES involvement in training is quality assurance in its advisory processes. Since its inception, the ICES training programme has developed, to include topics of strategic importance for the entire ICES community.

Training courses are selected on an annual basis, by a group appointment by the ICES Science Committee. Courses are selected based on strategic importance for ICES, the needs of the ICES community, and new and emerging techniques, deemed relevant for ICES working and expert groups.

Expert instructors are selected from the ICES community, and are always identified as being at the forefront of the field in question.

Training course participants range from policy makers to students, to researchers and members of expert and working groups.

For ICES, the Virtual Research Environments are replacing an existing online platform, and provide a far larger capacity for data management, code sharing and data analysis.

Up to December 2016 ICES has offered six courses which have made use of the BlueBRIDGE VRE and VLab facilities. Due to the range of topics on offer, the use of the facilities made available and exploited by the VLabs has been varied.

##### 3.1.1 TRAINING COURSE IN THE R ENVIRONMENT

<b>Dates</b>	29 February '16 – 4 March '16
<b>Venue</b>	ICES HQ, Copenhagen, Denmark
<b>Instructors</b>	Bjarki Þór Elvarsson, Marine Research Institute, Iceland Einar Hjörleifsson, Marine Research Institute, Iceland
<b>Participants<sup>3</sup></b>	36
<b>Objective &amp; Content</b>	The objective of the course was to provide participants with a solid foundation in efficient use of the R environment using various typical and familiar fisheries datasets (landings, catch, survey, and tagging data).  At the end of the course, participants had received instruction on how to import data from a multitude of sources (text files, excel, access, sql databases) and via the web, clean, manipulate, explore, summarize and graph data. How to apply the principle of reproducible analysis and report writing

<sup>3</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

	from A through Z, deliverable through the current common deliverable formats and produce functions and understand the principles of creating R packages as well participate in social coding.
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course in the R Environment (ICES_TCRE)” [2] <a href="https://i-marine.d4science.org/web/ices_tcre">https://i-marine.d4science.org/web/ices_tcre</a> has been created and operated to support the course. This VRE provides access to processing as well as to data preparation and sharing facilities, including: an online R development environment (RStudio), data mining algorithms, a tabular data management application, GIS maps of environmental and biological data, access to biodiversity occurrence records and taxonomic data from major data providers (e.g. OBIS, GBIF, WoRMS, Catalog of Life), state-of-the-art stock assessment models and sharing tools (Workspace, Social Networking).
<b>Note</b>	The material used for the course is available on the instructors own Git Hub page because of specific policies.

### 3.1.2 SOCIAL SCIENCE METHODS FOR NATURAL SCIENTISTS

<b>Dates</b>	26 – 28 June '16
<b>Venue</b>	Brest, France
<b>Instructors</b>	Marloes Kraan, IMARES, Wageningen University, Netherlands Maiken Bjorkan, Nordland research institute, Norway
<b>Participants<sup>4</sup></b>	30
<b>Objective &amp; Content</b>	Through gaining new skills, participants are prepared to be better able to work effectively with stakeholders in (cooperative) research projects, as well as having a better appreciation of the strengths and application of the social sciences in fisheries research.  By way of professional introduction to the topic, this course provided a 'hands on' guidance on the basics required to navigate this challenging landscape. Employing a participant-led 'learning by doing' approach the facilitators were able to guide the participants step by step through the basics of social science methods such as interviewing, participant observation, mapping etc., in a supportive and interactive process designed to develop confidence and capacities.
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course on Social Science Methods for Natural Scientists (ICES_TCSSM)” [2] <a href="https://i-marine.d4science.org/web/ices_tcsm">https://i-marine.d4science.org/web/ices_tcsm</a> has been created and operated to support the course. This VRE provides its users with the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members plus the tabular data management facility, the data analytics facility, the facility for accessing biodiversity data and geospatial data.
<b>Note</b>	Feedback: The VRE was used mainly as a communication tool, allowing sharing of presentations, material and photos.

### 3.1.3 DESIGN AND ANALYSIS OF STATISTICALLY SOUND CATCH SAMPLING PROGRAMMES

<b>Dates</b>	12–16 September '16
<b>Venue</b>	ICES HQ, Copenhagen, Denmark
<b>Instructors</b>	Jon Helge Vølstad, Institute of Marine Research, Norway

<sup>4</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

	Mary Christman, Courtesy Professor of the University of Florida, USA
<b>Participants<sup>5</sup></b>	18
<b>Objective &amp; Content</b>	<p>This course aims to introduce the principles of survey design and the basis of standard practices in the field to participants working with data collection.</p> <p>Design and Analysis of Statistically Sound Catch Sampling Programmes was an applied statistical methods course, concerned almost exclusively with the design of commercial fishery data collection based on statistical sampling schemes. The course examined problems of applying sampling methods, particularly the principles of sample selection and basic estimation, and made use of case studies to demonstrate practical application</p>
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes (ICES_DASC)” [2] <a href="https://i-marine.d4science.org/web/ices_dasc">https://i-marine.d4science.org/web/ices_dasc</a> has been created and operated to support the course. This VRE provides its users with the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members.
<b>Note</b>	The VRE was mainly used by the instructors, the participants and ICES Secretariat as a communication tool, allowing sharing of presentations, material and photos.

### 3.1.4 DATA-LIMITED STOCK ASSESSMENT

<b>Dates</b>	12 – 16 September ‘16
<b>Venue</b>	Reykjavik, Iceland
<b>Instructors</b>	<p>Jim Berkson, NMFS Liaison to the National Sea Grant College Program, USA</p> <p>Anne Cooper, ICES Secretariat, Denmark</p> <p>Jason Cope, NMFS Northwest Fisheries Science Center, USA</p> <p>Chantel Wetzel, NMFS Northwest Fishery Science Center</p>
<b>Participants<sup>6</sup></b>	27
<b>Objective &amp; Content</b>	This course was aimed to enable participants to identify data, information, content and how they interact in a variety of assessment settings – from data-limited to data-rich. Students were taught to recognize a diverse range of data-limited assessment methodologies and the data needs for each. In addition, they were instructed to understand each method's assumptions, benefits, limitations, and prior applications and performances.
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course on Data Limited Stock Assessment (ICES_DALSA)” [2] <a href="https://i-marine.d4science.org/web/ices_dalsa">https://i-marine.d4science.org/web/ices_dalsa</a> has been created and operated to support the course. This VRE provides its users with the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members.
<b>Note</b>	The training course on Data Limited Stock Assessment made use of the VLab to house course materials, communicate between participants and instructors, share course material, and for dissemination of the practicalities of the course.

<sup>5</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

<sup>6</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

	This course could benefit a lot of RStudio-as-a-Service facility [2]. In fact, the VLab was initially provided with it yet not fully exploited for several reasons: (a) the tool was new at the time and course instructors had not had an opportunity to explore the functionality beforehand, (b) The course was dependent on an “R-Shiny” interface that was not expected to work with the R Studio facility. Since then, the DLS R-Shiny code has been used on an e-Infrastructure R Studio environment where it functions well. Building on these experiences, when developing the Advanced Stock Assessment methods course (cf. Sec. 3.1.5) it was decided to make extensive use of the RStudio-as-a-Service facility, provided that it is possible to create identical RStudio sessions for course participants.
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### 3.1.5 STOCK ASSESSMENT (ADVANCED)

<b>Dates</b>	28 November '16 - 2 December '16
<b>Venue</b>	ICES HQ, Copenhagen, Denmark
<b>Instructors</b>	Jan Jaap Poos, Wageningen IMARES, The Netherlands Richard Hillary, CSIRO Marine and Atmospheric Research, Australia
<b>Participants</b> <sup>7</sup>	27
<b>Objective &amp; Content</b>	This five-day course was designed to train stock assessment scientists and advisors in population dynamics and advanced stock assessment. Theory is put into practice as much as possible by working on examples from different angles. Various assumptions have to be examined, as well as the strengths and weaknesses of different methods. The course was organized into a series of sessions with alternating focus on theoretical concepts and hands-on work on examples. These example sessions require different software environments such as R and AD Model Builder to be completed.
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course on Stock Assessment Advanced (ICES_SA)” [2] <a href="https://i-marine.d4science.org/web/ices_sa">https://i-marine.d4science.org/web/ices_sa</a> has been created and operated to support the course. This VRE provides the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members, plus a <i>R Studio as-a-Service</i> facility enabling users to access a fully-fledged RStudio® working environment directly from the VLab. This environment is integrated with the rest of VRE \ VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace.
<b>Note</b>	

### 3.1.6 PRINCIPLES AND METHODS OF BROADBAND/WIDEBAND TECHNOLOGIES: APPLICATION TO FISHERIES ACOUSTICS

<b>Dates</b>	8 – 13 December 2016
<b>Venue</b>	Bergen, Norway
<b>Instructors</b>	Dezhang Chu, Northwest Fisheries Science Center (NWFSC), NOAA/NMFS, USA; Lars N. Andersen, Simrad-Kongsberg Maritime, Norway; Gavin J. Macaulay, Institute of Marine Research (IMR), Norway; Egil Ona, Institute of Marine Research (IMR), Norway; Rolf J. Korneliussen, Institute of Marine Research (IMR), Norway;

<sup>7</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.

<b>Participants<sup>8</sup></b>	29
<b>Objective &amp; Content</b>	The course provides participants with the knowledge and skill of interpreting and processing acoustic broadband/wideband data with confidence and to be well-prepared for moving broadband/wideband technology forward into routine acoustic research and survey applications in fisheries science. The course will cover both the theoretical background and how to apply the theory to actual fisheries acoustics through case studies and exercises with synthetic, previously recorded, and real-time data collected during the course.
<b>VRE \ VLab exploitation</b>	A specific VLab named “ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics (ICES_FIACO)” [2] <a href="https://i-marine.d4science.org/web/ices_fiaco">https://i-marine.d4science.org/web/ices_fiaco</a> has been created and operated to support the course. This VRE provides its users with the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members.
<b>Note</b>	

### 3.2 IRD KNOWLEDGE BRIDGING

The French National Research Institute for Sustainable Development (IRD), is an internationally recognised multidisciplinary organisation working primarily in partnership with Mediterranean and inter-tropical countries. The IRD has an extensive network of researchers, engineers and technicians, and the network ranges to fifty or so countries. It takes an original approach to research, expertise, training and knowledge-sharing, to the benefit of countries and regions that make science and innovation key drivers in their development. Therefore, the infrastructure can be a vital tool in facilitating the dissemination of research and results, as well as a powerful tool in modelling and data processing.

IRD has been involved in the organization of workshops dealing with tuna stock assessment, mainly Bluefin tuna in collaboration with ICCAT (The International Commission for the Conservation of Atlantic Tunas) [7]. The schedule of the workshops has been defined by ICCAT as BlueBRIDGE workshops and it will become part of the usual ICCAT meetings for bluefin tuna working groups.

Up to December 2016 IRD has offered three courses which have made use of the BlueBRIDGE VRE facilities.

#### 3.2.1 ECOPATH WITH ECOSIM (EWE) MODELING APPROACH, NEW FEATURES OF EWE, HOW BLUEBRIDGE CAN SUPPORT EWE

<b>Dates</b>	14-18 Sep 2015
<b>Venue</b>	Natal, Brazil
<b>Instructors</b>	Marta Coll (IRD/EII); Jeroen Steenbeek (IRD/EII); Ronaldo Angelini (UFRN);
<b>Participants</b>	18

<sup>8</sup> This figure includes all the actors exploiting the VRE, e.g., course participants, instructors, training coordinator, and supporting secretary.



<b>Objective &amp; Content</b>	<p>On September 2015 a basic course on the Ecopath with Ecosim (EwE) modeling approach was held in Brasil. The course introduced the current capabilities of the EwE desktop software (<a href="http://www.ecopath.org">www.ecopath.org</a>) focusing on the advanced features for parameterization of EwE models through online databases such as FishBase and WoRMS.</p> <p>The course was structured between presentations and computer time. Local participants were invited to use their own models for the course. During the course specific sessions were dedicated to introduce to participants how BlueBRIDGE can support the EwE models. The material used for the course, as well as suggested readings, are available online<sup>9</sup>.</p>
<b>VRE \ VLab exploitation</b>	<p>Course participants experienced with BlueBRIDGE facilities by mainly using the Stock Assessment VRE [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a>. This VRE provides the basic functionalities, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of algorithms and methods specifically conceived to support Stock Assessment including EwE [6].</p>
<b>Note</b>	

### 3.2.2 ECOPATH WITH ECOSIM (EWE) MODELING APPROACH, NEW FEATURES OF EWE, HOW BLUEBRIDGE CAN SUPPORT EWE

<b>Dates</b>	7-11 March 2016
<b>Venue</b>	Hobart, Tasmania, Australia
<b>Instructors</b>	<p>Villy Christensen (University of British Columbia);</p> <p>Marta Coll (IRD/EII);</p> <p>Jeroen Steenbeek (IRD/EII);</p> <p>Carl Walters (University of British Columbia);</p>
<b>Participants</b>	28
<b>Objective &amp; Content</b>	<p>The course introduced the current capabilities of the EwE desktop software (<a href="http://www.ecopath.org">www.ecopath.org</a>) focusing on the advanced features for parameterization of EwE models through online databases such as FishBase and WoRMS.</p> <p>The course was structured between presentations and computer time. Local participants were invited to use their own models for the course. During the course specific sessions were dedicated to introduce to participants how BlueBRIDGE can support the EwE models. The material used for the course, as well as suggested readings, are available online<sup>10</sup>.</p>
<b>VRE \ VLab exploitation</b>	<p>Course participants experienced with BlueBRIDGE facilities by mainly using the Stock Assessment VRE [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a>. This VRE provides the basic functionalities, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of algorithms and methods specifically conceived to support Stock Assessment including EwE [6].</p>
<b>Note</b>	

<sup>9</sup> <https://sites.google.com/site/ewecoursenatal2015/home>

<sup>10</sup> <https://sites.google.com/site/ewecoursehobart2016/home>

## 3.2.3 MODELLING AQUATIC ECOSYSTEMS WITH ECOPATH, ECOSIM AND ECOSPACE

<b>Dates</b>	30 May – 3 June 2016
<b>Venue</b>	Institute of Marine Sciences, Barcelona
<b>Instructors</b>	Villy Christensen (University of British Columbia); Marta Coll (IRD/EII); Isabel Palomera (Institut de Ciències del Mar - ICM-CSIC); Jeroen Steenbeek (IRD/EII);
<b>Participants</b>	22
<b>Objective &amp; Content</b>	The course introduced the current capabilities of the EwE desktop software (www.ecopath.org) focusing on the advanced features for parameterization of EwE models through online databases such as FishBase and WoRMS.  The course was structured between presentations and computer time. Local participants were invited to use their own models for the course. During the course specific sessions were dedicated to introduce to participants how BlueBRIDGE can support the EwE models. The material used for the course, as well as suggested readings, are available online <sup>11</sup> .
<b>VRE \ VLab exploitation</b>	Course participants experienced with BlueBRIDGE facilities by mainly using the Stock Assessment VRE [2] <a href="https://i-marine.d4science.org/web/stockassessment">https://i-marine.d4science.org/web/stockassessment</a> . This VRE provides the basic functionalities, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of algorithms and methods specifically conceived to support Stock Assessment including EwE [6].
<b>Note</b>	

## 3.3 KNOWLEDGE BRIDGING PROGRAMMES

The knowledge bridging programmes cover a different type of course, which are aimed at the world of academia, at the masters, PhD and post-doctoral level. In these courses the goal is to present and showcase how the e-Infrastructure and its facilities can be exploited to address problems in the domains of biodiversity, stock assessment, ecology monitoring and beyond. The technology involves a broad range of the D4Science e-Infrastructure facilities including (i) e-Infrastructure baseline facilities, workspaces, messaging system, social networking, (ii) data management, harmonisation and access facilities: Tabular Data Manager, Databases Manager, BiOnym, Species Products Discovery, (iii) services for visualizing and producing GIS data: GIS Viewer, GeoExplorer, Statistical Manager, THREDDS, Geoserver, GeoNetwork; (iv) artificial Intelligence algorithms for Ecological Modelling: Neural Networks, Markov models, Monte Carlo methods, Bayesian methods, Maximum Entropy models; (v) forecasting and signal processing methods for stock assessment: Singular Spectrum Analysis, Short-Time Fourier Transforms; and (vi) stock assessment models: FAO MSY, ICCAT VBA, CMSY and Vessel Data Interpolation. Moreover, during these courses, instructors are expected to make use of the facilities developed in the other domains and VREs [6][8][9][10].

Up to December 2016 six courses falling under the knowledge bridging umbrella which have made use of the BlueBRIDGE facilities have been organised.

<sup>11</sup> <https://sites.google.com/site/ewecoursebarcelona2016/home>

## 3.3.1 USING E-INFRASTRUCTURES FOR BIODIVERSITY CONSERVATION

<b>Dates</b>	25 <sup>th</sup> November 2015
<b>Venue</b>	University of Paris VI (Université Pierre-et-Marie-Curie - Sorbonne Universités)
<b>Instructors</b>	Gianpaolo Coro, Istituto di Scienza e Tecnologie dell'Informazione, National Research Council of Italy;
<b>Participants</b>	30
<b>Objective &amp; Content</b>	<p>The goal of the course was to introduce students from the Masters Programme in Oceanography to the offerings and solutions resulting from BlueBRIDGE.</p> <p>The courses covered the following topics: (a) General introduction to e-Infrastructures and to the BlueBRIDGE project, (b) Inspect species distribution maps, (c) Produce a species distribution maps, (d) Analyse species observation trends, (e) Inspect species occurrence data, (f) GIS maps and geo-spatial datasets visualization and access, (g) Taxa names discovery, (h) Data mining of occurrence records.</p>
<b>VRE \ VLab exploitation</b>	<p>Course participants had the opportunity to experience with the majority of the BlueBRIDGE facilities by using the Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a>. This VLab provides its users with basic functionality, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of facilities for either accessing datasets (biodiversity, geospatial, research products) or executing analytics tasks (more than 100 algorithms are made available ranging from approaches to produce a species distribution map by means of either an expert system or a machine learning model to approaches for analysing climatic changes and their effects on species distribution, approaches for estimating similarities among habitats, and approaches for stock assessment). Moreover, the VLab is equipped with the facilities enabling users to inject their methods into the working environment.</p>
<b>Note</b>	

## 3.3.2 DEMONSTRATION AND TRAINING ON THE FEATURES OF THE BLUEBRIDGE E-INFRASTRUCTURE

<b>Dates</b>	11-12 April 2016
<b>Venue</b>	CNR offices, Pisa, Italy
<b>Instructors</b>	Gianpaolo Coro, Istituto di Scienza e Tecnologie dell'Informazione, National Research Council of Italy;
<b>Participants</b>	10
<b>Objective &amp; Content</b>	<p>The course is targeted at potential BlueBRIDGE users, within the communities of ICES, UoA and IRD, to make them familiar with the technology and the methods hosted by the D4Science e-Infrastructure to manage the BlueBRIDGE topics.</p>
<b>VRE \ VLab exploitation</b>	<p>Course participants had the opportunity to experience with the majority of the BlueBRIDGE facilities by using primarily the Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a>. This VLab provides its users with basic functionality, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of facilities for either accessing datasets (biodiversity, geospatial, research products) or executing analytics tasks (more than 100 algorithms are made available ranging from approaches to produce a species distribution map by means of either an expert system or a machine learning model to approaches for analysing climatic changes and their effects on species distribution, approaches for estimating similarities among habitats, and approaches for stock assessment). Moreover, the VLab is equipped with the facilities enabling users to inject their methods into the working environment.</p>

<b>Note</b>	
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### 3.3.3 SIGNAL PROCESSING AND MINING OF BIG DATA: BIOLOGICAL DATA AS CASE STUDY

<b>Dates</b>	2-6 May 2016
<b>Venue</b>	University of Pisa, Pisa, Italy
<b>Instructors</b>	Gianpaolo Coro, Istituto di Scienza e Tecnologie dell'Informazione, National Research Council of Italy;
<b>Participants</b>	26
<b>Objective &amp; Content</b>	A 20 hour course in the PhD in Computer Engineering. The course shows practical applications of Big Data analytics, with focus on several signal processing and machine learning-based techniques. The course clarifies the general concepts behind these techniques, with an educational approach making these concepts accessible also to students with intermediate mathematical skills.
<b>VRE \ VLab exploitation</b>	Course participants had the opportunity to experience with the majority of the BlueBRIDGE facilities by using the Biodiversity Lab [2] <a href="https://i-marine.d4science.org/web/biodiversitylab/">https://i-marine.d4science.org/web/biodiversitylab/</a> . This VLab provides its users with basic functionality, as a workspace for sharing objects of interest and a social networking area for supporting the discussions among members, plus a set of facilities for either accessing datasets (biodiversity, geospatial, research products) or executing analytics tasks (more than 100 algorithms are made available and new one can be injected by users).
<b>Note</b>	All the participants passed the exam. The course has been accepted and scheduled by the PhD council for the next year.

### 3.3.4 BLUEBRIDGE: CLOUD INFRASTRUCTURE SERVING AQUAFARMS

<b>Dates</b>	10-12 November 2016
<b>Venue</b>	2nd International Congress on Applied Ichthyology and Aquatic Environment 'HydroMediT 2016', Mesolonghi, Greece
<b>Instructors</b>	Gerasimos Antzoulatos (i2S); Charalampos Dimitrakopoulos (CITE); Eleni Petra (UOA); Stella Tsani (ICRE8);
<b>Participants</b>	18
<b>Objective &amp; Content</b>	The goal of this course was to showcase the BlueBRIDGE facilities, in particular those stemming from the Blue Economy activity [8][1].  The course captures the following aspects: Introduction to BlueBRIDGE & VREs, Performance evaluation, benchmarking and decision making in aquaculture facilities, Strategic Investment analysis and Scientific Planning/Alerting facilities.
<b>VRE \ VLab exploitation</b>	A specific VLab named "Aquaculture Training Lab" [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a> has been created and operated to support this course as well as other similar ones (cf. Sec. 3.3.5 and 3.3.6). This VLab was conceived to provide its users with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis.
<b>Note</b>	

### 3.3.5 BLUEBRIDGE: CLOUD INFRASTRUCTURE SERVING AQUAFARMS AND SUPPORTING MODELS

<b>Dates</b>	7 December 2016
<b>Venue</b>	International Centre for Research on the Environment and the Economy (ICRE8), Athens, Greece
<b>Instructors</b>	Gerasimos Antzoulatos (i2S); Charalampos Dimitrakopoulos (CITE); Eleni Petra (UOA); Stella Tsani (ICRE8); Phoebe Koundouri (ICRE8);
<b>Participants</b>	16
<b>Objective &amp; Content</b>	The goal of this course was to showcase the BlueBRIDGE facilities, in particular those stemming from the Blue Economy activity [8][1].  The course captures the following aspects: Introduction to BlueBRIDGE & VREs, Performance evaluation, benchmarking and decision making in aquaculture facilities, Strategic Investment analysis and Scientific Planning/Alerting facilities, Social and environmental monetization models for Blue Economy.
<b>VRE \ VLab exploitation</b>	A specific VLab named “Aquaculture Training Lab” [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a> has been created and operated to support this course as well as other similar ones focusing on Blue Economy (cf. Sec. 3.3.4 and 3.3.6). This VLab was conceived to provide its users with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis.
<b>Note</b>	

### 3.3.6 BLUEBRIDGE: CLOUD INFRASTRUCTURE SERVING AQUAFARMS AND SUPPORTING MODELS

<b>Dates</b>	8 <sup>th</sup> December 2016
<b>Venue</b>	University of Athens, postgraduate course “DATA BASE MANAGEMENT SYSTEMS”
<b>Instructors</b>	Gerasimos Antzoulatos (i2S); Charalampos Dimitrakopoulos (CITE); Eleni Petra (UOA); Stella Tsani (ICRE8); Phoebe Koundouri (ICRE8); Nikolas Laskaris (UOA); Panagiota Koltsida (UOA);
<b>Participants</b>	5
<b>Objective &amp; Content</b>	The goal of this course was to showcase the BlueBRIDGE facilities, in particular those stemming from the Blue Economy activity [8][1].  The course captures the following aspects: Introduction to BlueBRIDGE & VREs, Performance evaluation, benchmarking and decision making in aquaculture facilities, Strategic Investment analysis

	and Scientific Planning/Alerting facilities, Social and environmental monetization models for Blue Economy, Geoanalytics platform, architecture and technologies.
<b>VRE \ VLab exploitation</b>	A specific VLab named “Aquaculture Training Lab” [2] <a href="https://i-marine.d4science.org/web/aquaculturetraininglab">https://i-marine.d4science.org/web/aquaculturetraininglab</a> has been created and operated to support this course as well as other similar ones focusing on Blue Economy (cf. Sec. 3.3.4 and 3.3.5). This VLab was conceived to provide its users with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis.
<b>Note</b>	

#### 4 BLUE SKILLS PLANNED COURSES AND OPPORTUNITIES

A comprehensive and complete picture of the courses characterising the forthcoming projects months is going to be produced by 'MS18 Blue Skills VRE Plan: Revised Version' at January 2017. In this section it is provided a preliminary list of candidate courses and opportunities.

The ICES 2017 course programme will be released in January, at which point, courses appropriate to use the infrastructure will be identified based on topic and requirements. A preliminary list is in [Table 3](#).

**Table 3. ICES 2017 Planned Courses**

Course Name	Date	Instructors	Location	Note
<b>Stock assessment introduction</b>	June '17 (tentative)	Steve Cadrin TBC	ICES Secretariat	Awaiting second instructor
<b>Acoustic survey course</b>	12-16 June '17	Paul Fernandez John Horne	ICES secretariat	Confirmed
<b>Introduction to R</b>	September '17 (tentative)	Bjarki Þór Elvarsson, Marine Research Institute, Iceland Einar Hjörleifsson, Marine Research Institute, Iceland	ICES secretariat	Awaiting date confirmation
<b>Management Strategy Evaluation, an introduction</b>	28 August – 1 September '17	Jose de Oliveira Carryn de Moore	ICES secretariat	Confirmed
<b>Bayesian network analysis with social science objectives</b>	TBC	Laura Uusitalo TBC	ICES secretariat	Awaiting second instructor
<b>ICES methods for setting proxy MSY reference points</b>	25-26 January '17	Anne Cooper Scott Large Casper Berg Alexandros Kokkalis	ICES secretariat	Also a two day online course to follow. This course is by invitation only.
<b>Approaches to integrated assessment of status and trends in marine ecosystems</b>	TBC	Christian Möllmann Rabea Diekmann	ICES secretariat	Not confirmed yet
<b>Principles and methods of broadband/wideband technologies: Application to fisheries acoustics</b>	December '17 (tentative)	Dezhang Chu Lars N. Andersen Gavin J. Macaulay Egil Ona	Norway	

		Rolf J. Korneliussen		
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A new training course has been accepted, to run in May 2017 at the University of Pisa, on the use of e-Infrastructures for Biodiversity Conservation-Infrastructures and for Virtual Research Environments. The course is intended to target PhD students in Computer Engineering, and expects to draw 25 participants. The course will cover practice with the D4Science e-Infrastructure, geospatial data visualization and representation, statistical models for species distribution modelling, signal processing of biodiversity-related observations, machine Learning applied to species observation records and cloud computing applied to biodiversity analyses

The University of Athens (UoA) is planning courses supporting the educational activity to three Greek Universities (two dealing with fisheries and one in computer science):

- The Department of Ichthyology and Aquatic Environment – University of Thessaly;
- The Department of Fisheries – Aquaculture Technology – T.E.I of Western Greece;
- The Department of Informatics and Telecommunications, University of Athens.

The target audience of the courses run through the UoA are scientists operating on marine related and fisheries topics, students that intend to broaden their knowledge on tools and their effectiveness on marine and fisheries as well as students of the computer science that participate in the courses related to data science, open and big data.

Based on the central departmental academic directions the two first departments UoA focuses on the following possible scenarios. Firstly, building a new e-learning lesson based on the already established platform by the University of Athens, namely – Open e-class. This lesson will provide generic training concepts such e-infrastructures, data infrastructures and their usefulness, data models and environments, VREs – specific environments from European projects like iMarine, BlueBRIDGE, etc, providing the description and the functionality of the specific tools. Alternatively, an e-learning generic scenario on the above ideas on Moodle environment is under consideration. The above two scenarios are planned to be developed in 2017 and to be inserted in a separate session to the Department of Informatics and Telecommunications as well.

In the coming years, while new results will be obtained from BlueBRIDGE, an experimental implementation of a simulation tool presenting the functionality of the performance measurements, developed in WP6, is planned to be inserted embedded to the working laboratories of the two ichthyology and fisheries Universities.

In parallel, a one-day workshop in optimization of aquaculture production in cooperation with the two departments will also take place. It is called Analysis and Design of information system, e-infrastructures, VREs in general and on infrastructures' architecture and standards, will take place on the 25-28 January in Athens, Greece, and will aim to reach 50 participants, all making use of the VRE.

Furthermore, the FAO is also planning courses which will make use of the infrastructure in 2017:

- Regional database development and stock assessment, to take place in the WECAFC region, instructed by Y. Laurent and N. Cummings, intending to reach ca 10 participants.
- Data limited methods for stock assessment, taking place at FAO HQ in Rome, intending to reach 15-25 participants (Instructor still to be confirmed).
- Tuna data visualization for developers, with E. Anello as the instructor, aiming to reach ca 5 participants.



In addition to these courses, there are also tentative plans for further development of training courses, on the topic of an, Aquaculture atlas for Indonesia (FAO FIAA; 10 participants), Aquaculture atlas for another Central American country (FAO FIAA; 10 participants) and the development of the Regional database / stock assessment for Regional Fisheries Bodies (FAO FIAS; 5-10 participants). These are however still in a planning phase.

## 5 LESSONS LEARNT & TRAINING PLAN EVOLUTION

The main aim of the Blue Skills work package in the first period of the project has been to make use of the provided virtual research environments, design and develop new ones, try them in various human capacity development activities, and to provide detailed, constructive feedback. The developed ICT tools and services have been made available to the partner organizations and applied to their training programmes supporting both education and research. In spite some of initial resistance to learn and adapt the new tools into training programmes, the e-infrastructure has proved open new possibilities to trainers and trainees and to ease communication between students and instructors on all training stages. In fact, in the last period the development of specific VLabs was enhanced. Overall, 15 courses have been supported by BlueBRIDGE VREs and VLabs [2] with the creation of 7 dedicated VLabs: [\*Aquaculture Training Lab\*](#) was deployed to provide its users with a demonstrative / training environment of the aquafarming assessment tools to perform the evaluation growth analysis and techno economic investment analysis; [\*ICES Training Course in the R Environment \(ICES\\_TCRE\)\*](#) was deployed to support the ICES Training Course in the R Environment (TCRENV), 29 February - 4 March 2016, ICES HQ, Denmark; [\*ICES Training Course on Data Limited Stock Assessment \(ICES\\_DALSA\)\*](#) was deployed to support the ICES training course on Data Limited Stock Assessment, 12 - 16 September, Reykjavik, Iceland; [\*ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes \(ICES\\_DASC\)\*](#) was deployed to support the ICES training course on Design and analysis of statistically sound catch sampling programmes, 12-16 September 2016, ICES, Copenhagen, Denmark; [\*ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics \(ICES\\_FIACO\)\*](#) was deployed to support the ICES training course “Principles and methods of broadband/wideband technologies: application to fisheries acoustics”, 8-12 December 2016, Bergen, Norway; [\*ICES Training Course on Social Science Methods for Natural Scientists \(ICES\\_TCSSM\)\*](#) was deployed to support the ICES training course on Social Science Methods for Natural Scientists, 26-28 May 2016, Faculté Victor Segalen, Brest, France; [\*ICES Training Course on Stock Assessment Advanced \(ICES\\_SA\)\*](#) was deployed to support the ICES training course on Stock Assessment Advanced, 28 November-2 December, ICES HQ, Copenhagen, Denmark.

The forthcoming period is expected to be more proficuous in terms of courses benefitting from BlueBRIDGE facilities because of several factors including: (i) the availability of innovative facilities specifically developed to serve BlueBRIDGE scenarios and use cases [6][8][9][1][10], (ii) the availability of a set of ready to use VREs and VLabs conceived to serve specific cases and scenarios [2], (iii) the experience gained in the first project period and the familiarity with BlueBRIDGE technology opportunities.

The trainers made the following recommendations that in some cases have been already transformed into development requirements [7]:

- Improve support to trainers in integrating software; a training of trainers is recommended, especially to port existing software (from e.g. github) to a multi-user environment;
- Ensure the required software is available on-line; e.g. in the case of Ecopath, the courses were planned before the BlueBRIDGE project started, and the models were not available during some courses. The trainers had to limit to a show the capabilities of the infrastructure to access resources;
- Develop training materials for trainers; how to organize an on-line course, how to organize materials and invite participants, prepare course data, and make a course repeatable;
- Develop an ‘course appraisal’ for trainers to track participants progress, and a feed-back survey;
- Provide a clear overview of legal and copyright issues of material that is hosted in BlueBRIDGE;
- Ensure that the computational needs of a training are known before the training starts.

The BlueBRIDGE project will certainly further boost the partner training activities, allowing them to reach a new volume, and to reach new levels of efficiency. The e-infrastructure will continue to allow course

participants to properly prepare for the courses beforehand, and use the tools after the course, when applying own data for individual purposes, thus making the courses more targeted. Introduction of web-based e-training, where learning can take place at the trainee's own pace irrespective of geographical location, reduces costs and time effort.

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