



# OceanEcology

## Development of MEDIN Compliant Export Functionality within ABACUS

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Prepared for



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## SUMMARY

Over the last year MEDIN partner Ocean Ecology Limited (OEL) have been developing a novel web-based tool (ABACUS) for recording, managing and archiving the increasing volume of marine biological data generated by its NMBAQC participating laboratory.

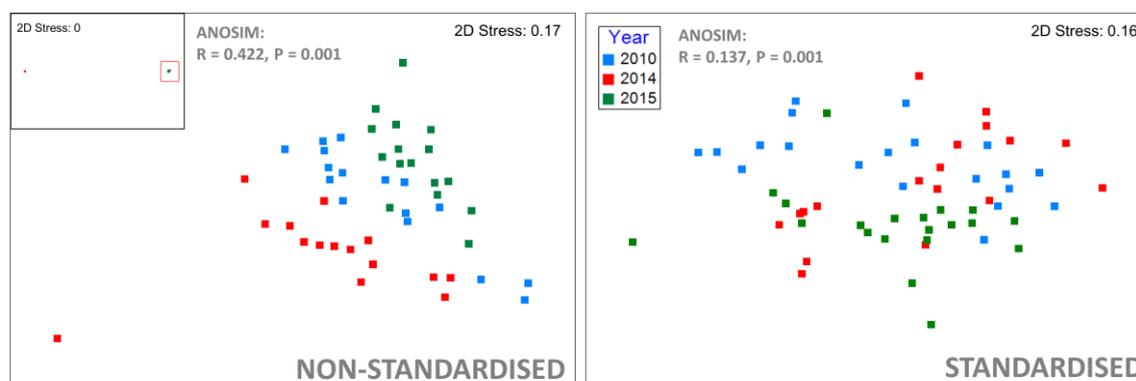
With the help of funding provided through MEDIN's Small Data Archiving Project initiative, OEL have developed a DASSH validated export functionality within ABACUS allowing for rapid creation of MEDIN compliant datasets reducing the administrative burden for commercial organisations involved with archiving data with MEDIN Data Archive Centres.

## 1. INTRODUCTION

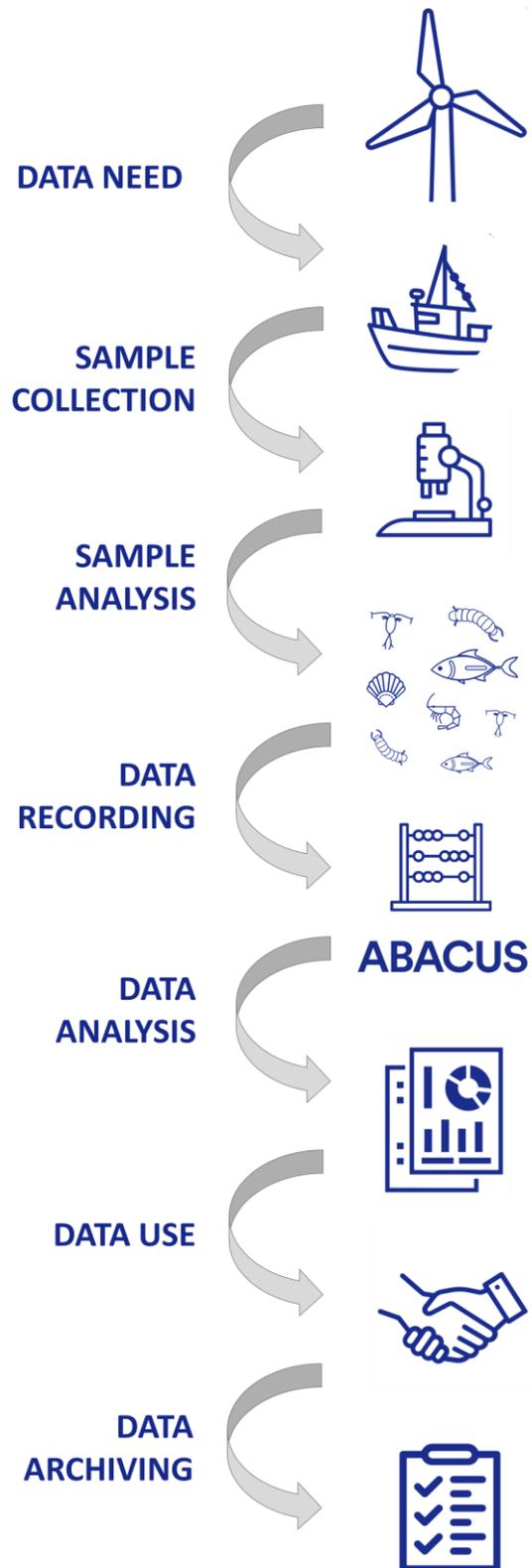
Many thousands of marine biological samples are collected and analysed on an annual basis to satisfy statutory monitoring commitments (e.g. Water Framework Directive (WFD), Habitats Directive) and conditions of marine licences granted for marine activities. These include seabed samples that undergo macrobenthic, particle size distribution and chemical analysis, water samples analysed to monitor planktonic communities and scientific trawl samples to assess fish and other mobile species. Despite the requirement for these analytical processes to be conducted by laboratories participating in recognised quality control schemes (e.g. the NE Atlantic Marine Biological Quality Control (NMBAQC) scheme), there remains fundamental issues surrounding the recording of non-standardised marine biological data. These issues stem from inter-analyst and inter-laboratory variability in sample analysis methodologies, recording practices, species naming, the use of taxonomic qualifiers and so on. This is thought to be the root cause for wide spread mis-interpretation of trends in marine biological communities which, in some cases, can have serious consequences for both Statutory Nature Conservation Bodies (SNCBs) and private sector organisations legally obligated to conduct robust marine ecological monitoring.

This is aptly demonstrated by the two very different results presented in Figure 1. Drawing conclusions based on the non-standardised data (left) would lead one to believe that there were clear and statistically significant differences between the species composition between years (demonstrated by the lack of overlap of points for each year). However, when considering the correctly standardised dataset (right) it is clear there was little difference between years (demonstrated by the overlap of points for each year). This type of oversight could potentially have serious consequences for private sector organisations planning marine developments and for regulatory bodies with legal duties to detect and report on impacts to protected habitats and species. To address this ever-apparent issue, Ocean Ecology Limited (OEL) have developed the web-based data management application 'ABACUS' (v1.0) that has been developed to act as a platform for marine scientists to record, quality assure, store and export standardised marine biological data in line with internationally recognised data standards (e.g. MEDIN, GEMINI, ISO).

In order to standardise species naming, OEL is collaborating with the World Register of Marine Species (WoRMS) who have granted access to make use of the WoRMS database via a 'live link' meaning the species nomenclature used and recorded by OEL's taxonomists will always be current and up to date. Being cloud based, ABACUS is accessible to OEL's taxonomists based at its laboratory but also to those based remotely. The long-term aim is to make ABACUS available to all UK laboratories undertaking similar analysis and potentially to laboratories, universities and other organisations globally.



**Figure 1** Non-metric MDS ordination plots of square-root transformed Bray-Curtis similarity epibenthic abundance data from single beam trawl samples taken during the pre- and post-construction surveys at a UK offshore windfarm. Left: inconsistent nomenclature over time. Right: standardised nomenclature over time. \*note that the non-standardised plot is presented as a subset of points (shown with red box) from the main MDS displayed within the top left.



**Figure 2** The role ABACUS plays in OEL's data management process.

## 2. METHODS

### 2.1. Development Process

ABACUS has been developed using the latest Microsoft technologies (ASP.NET CORE, MVC, C#, Microsoft SSOL Server Database) and is encrypted using industry standard SSL and HTTPS. As part of the development of v1.0, a number of demonstration versions were tested by a team of taxonomists during analysis of hundreds of macrobenthic samples at OEL's laboratory. Further testing and developments are underway with the aim of making v2.0 available to other organisations later in 2018.

### 2.2. Species Recording

Samples can be tracked through key analysis stages including log in, elutriation, extraction, identification, biometric measurements and biomass (see Figure 3). Quality Control (QC) stages are available for extraction and identification to improve quality or for the supervision and training of less experienced analysts (see Figure 4). During the identification analysis stage, a web service provides a direct link to the WoRMS database. Typing a few characters of valid or scientific name will automatically return a list of matching taxa. Selecting one of the taxa will retrieve a collection of data from the WoRMS database including classification data, authority, AphiaIDs and other attribute data (e.g. AMBI groups) as well as other species information including Species Directory Codes (SDCs).

### 2.3. MEDIN Compliant Data Exports

Marine Environmental Data and Information Network (MEDIN) compliant data export functionality is provided as standard, which has been funded by MEDIN and validated through liaison with DASSH. Fully MEDIN compliant exports can be created and downloaded with just a few clicks, skipping error-prone and slow manual processes (see Figure 5). Going forward this will allow OEL to rapidly archive its marine environmental data with DASSH. OEL do not however always hold ownership of the data outputs its laboratory produces and is therefore frequently required to submit the datasets to its clients who may not feel it necessary to archive its data with DASSH. To make this process simpler for its clients, the MEDIN compliant exports generated from ABACUS include a cover page describing how the data has been produced and how it can easily be archived with DASSH for safe keeping (see Figure 6).

### 2.4. Users

Being cloud based, analysts can sign into ABACUS via a web browser from any device with an internet connection. Selected users can manage access permissions of others via an admin dashboard as well as creating user profiles for external partners. When signed in, user activity can be recorded providing a full audit trail of all data recording, quality control actions (e.g. amending a species name) and data exports.

## 3. OUTPUTS

### 3.1. Ingestion of Data into MEDIN

Since the inception of this project, all of the marine biological data generated by OEL's laboratory has been recorded and stored in ABACUS and will, once the final improvements and adjustments are made to the MEDIN export functionality, be archived with DASSH (pending client approval).

### 3.2. Dissemination

Despite ABACUS still being in its development stage and only being used as a data management tool internally, OEL have been activity promoting it through liaison with the NMBAQC committee and via a poster presentation at a recent conference in New Jersey, US (International Offshore Wind Partnering Forum). OEL also intend to compile an article to for inclusion in the next MEDIN Marine Data News publication and have submitted an abstract for consideration as a talk to be presented during the Data Services and Tools in Ocean Science session at the International Marine Data and Informations Systems Conference (IMDIS) in Barcelona in November 2018.

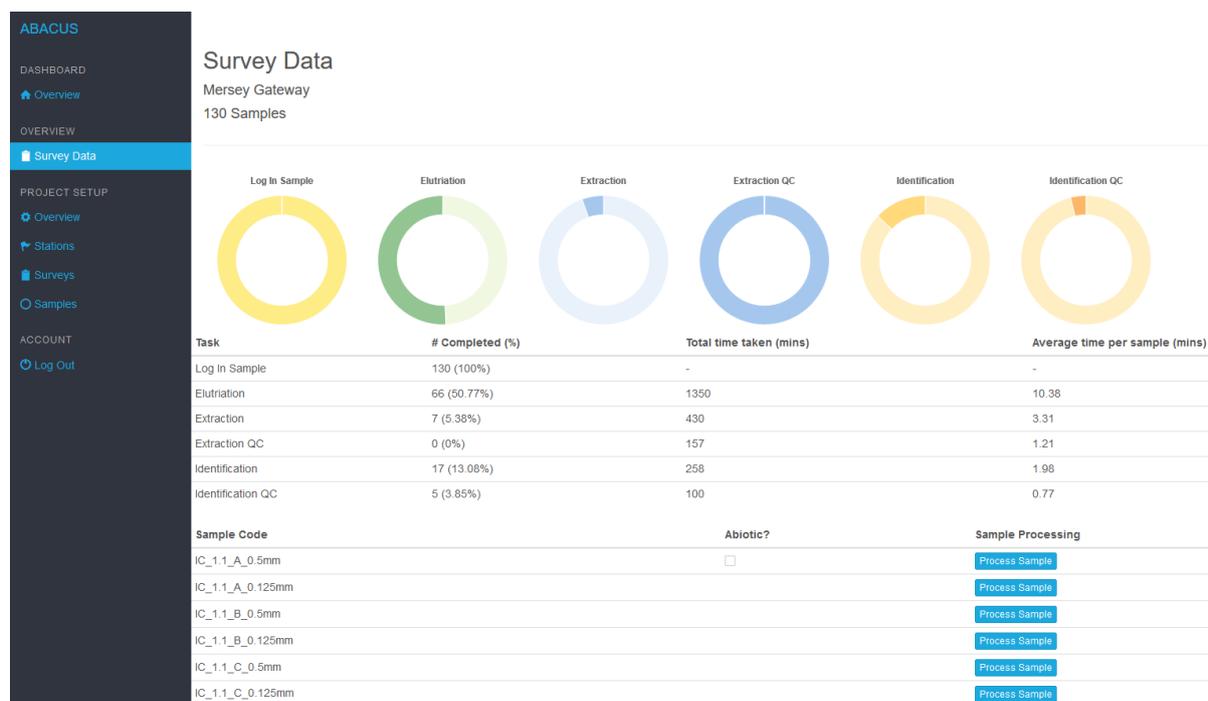


Figure 3 Sample tracking page in ABACUS.

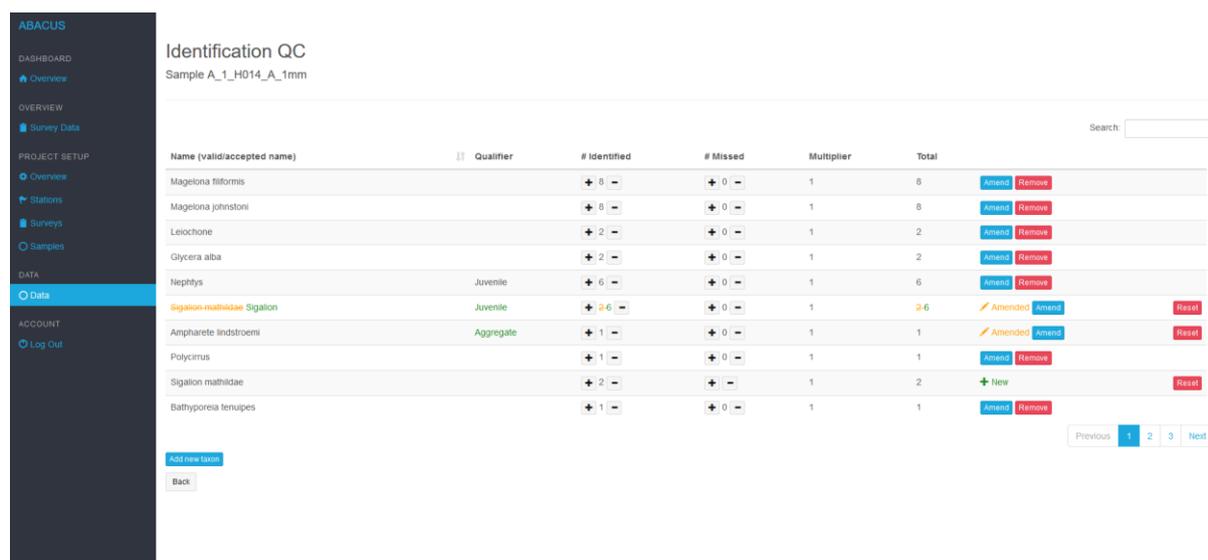


Figure 4 Identification Quality Control (QC) page for improving quality or for the supervision and training of less experienced analysts.

The figure consists of three screenshots from the ABACUS web application, illustrating the MEDIN export process.

**Top Screenshot: Surveys**  
 This screenshot shows the 'Surveys' page. The left-hand navigation menu has 'DATA EXPORTS' selected, and 'MEDIN' is highlighted with a red circle. The main content area displays a table of surveys with columns for Project Name, Client Name, Survey Name, and Survey Data. A search bar and a 'Show 50 entries' dropdown are at the top. The table lists various projects such as 'AQUIND Interconnector' and 'Impact of Otter Trawling on Mud Habitat in the Torbay MCZ 2017'. A 'Previous 1 Next' pagination control is at the bottom right.

**Middle Screenshot: Data Exports**  
 This screenshot shows the 'Data Exports' page. The 'Create New' button is circled in red. The table below lists existing exports with columns for Project, Survey, Export name, Date requested, Type, Status, and File. The 'MEDIN Grab Core' type is used for all listed exports.

Project	Survey	Export name	Date requested	Type	Status	File
AQUIND Interconnector	TBC	Export 001	3/7/2018 10:00:31 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	OEL TEST	3/7/2018 10:31:25 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	TEST	3/8/2018 8:43:35 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	Test 2	3/8/2018 9:00:46 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	LAB REVIEW	3/8/2018 1:38:55 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	LAB REVIEW V02	3/9/2018 8:48:33 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	LAB REVIEW 3	3/9/2018 8:56:19 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	LAB REVIEW V04	3/9/2018 10:21:37 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	FINAL REVIEW	3/9/2018 5:50:13 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector	TBC	RG TEST EXPORT	4/25/2018 5:50:59 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector Phase II	TBC	Lab Review V01	4/13/2018 9:11:57 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector Phase II	TBC	NAPEGCO318 LAB REVIEW V02	4/13/2018 3:07:33 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
AQUIND Interconnector Phase II	TBC	NAPEGCO318 LAB REVIEW V03	4/13/2018 3:37:42 PM	MEDIN Grab Core	Created	<a href="#">Download</a>
Impact of Otter Trawling on Mud Habitat in the Torbay MCZ 2017	TBC	test	3/27/2018 8:57:19 AM	MEDIN Grab Core	Created	<a href="#">Download</a>
Impact of Otter Trawling on Mud Habitat in the Torbay MCZ 2017	TBC	INITIAL REVIEW	3/27/2018 5:19:49 PM	MEDIN Grab Core	Created	<a href="#">Download</a>

**Bottom Screenshot: Create**  
 This screenshot shows the 'Create' form for a new MEDIN export. The 'Type' dropdown menu is circled in red and set to 'MEDIN Grab Core'. The form includes dropdowns for Project and Survey, and a text input for Name. 'Save' and 'Cancel' buttons are at the bottom.

Figure 5 MEDIN export process in ABACUS.



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This dataset has been generated using the cloud-based data tool ABACUS developed to provide a standardised platform for recording, quality assuring, storing and exporting marine biological data whilst ensuring compliance with nationally and internationally recognised best practice guidelines (e.g. the NE Atlantic Marine Biological Quality Control (NMBAQC) scheme). Through its 'live link' to the World Register of Marine Species (WoRMS), ABACUS ensures data records and exports are based on the most up to date and authoritative list of species names available.

As a partner of the Marine Environmental Data & Information Network (MEDIN), Ocean Ecology Limited recognise the importance of effective management and safe storage of marine data but also in minimising restrictions to its access. ABACUS has therefore been developed to facilitate 'single click' exports of general and detailed metadata (Sheets XX to XX) to accompany the exported dataset. As such, this dataset can be submitted directly to a MEDIN Data Archive Centre (DAC) (see [here](#)) for rapid and hassle free archiving in compliance with MEDIN, GEMINI and ISO standards.

ABACUS has been developed by Ocean Ecology Limited (OEL) in partnership with Peninsula Data Solutions and DASSH with financial support from MEDIN for the development of the general and detailed metadata export functionality. For details on archiving data with MEDIN please see [here](#). If you would like to learn more about ABACUS and how you may be able to benefit from its use please contact the ABACUS team at [abacus@ocean-ecology.com](mailto:abacus@ocean-ecology.com).

**ABACUS** **MEDIN**

**Figure 6** Preamble provided with all MEDIN compliant data exports from ABACUS describing how the data was generated and the process in which it can be easily archived with a MEDIN Data Archive Centre (DAC).