Development of MEDIN Compliant Export Functionality within ABACUS

Ref: OEL_MEDABA0518_TCR

Prepared for

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Report Title:	Development of MEDIN Compliant Export Functionality within ABACUS
Report Number:	OEL_MEDABA0518_TCR
Recommended Citation:	Ocean Ecology Limited (2018). Development of MEDIN Compliant Export Functionality within ABACUS. Report No. OEL_MEDABA0518_TCR, 9 pp

Version	Date	Description	Author(s)	Reviewer(s)
01	29/05/2018	Draft	Ross Griffin	Dan Lear & Matthew Arnold
02	01/07/2018	Final	Ross Griffin	Dan Lear & Matthew Arnold

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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.

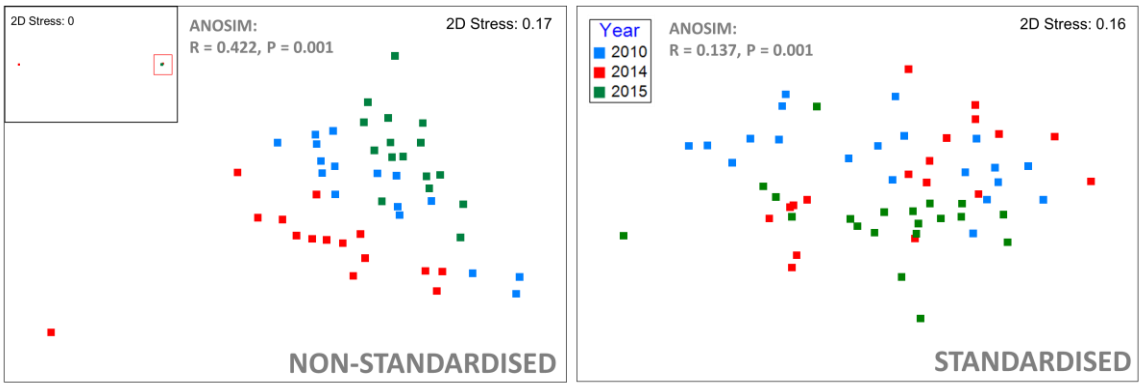

Figure 1 Non-metric MDS ordination plots of square-root transformed Bray-Curtis similarity epibenthic abundance data from single beam trawl samples taken during the pre- and post-construction surveys at a UK offshore windfarm. Left: inconsistent nomenclature over time. Right: standardised nomenclature 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.

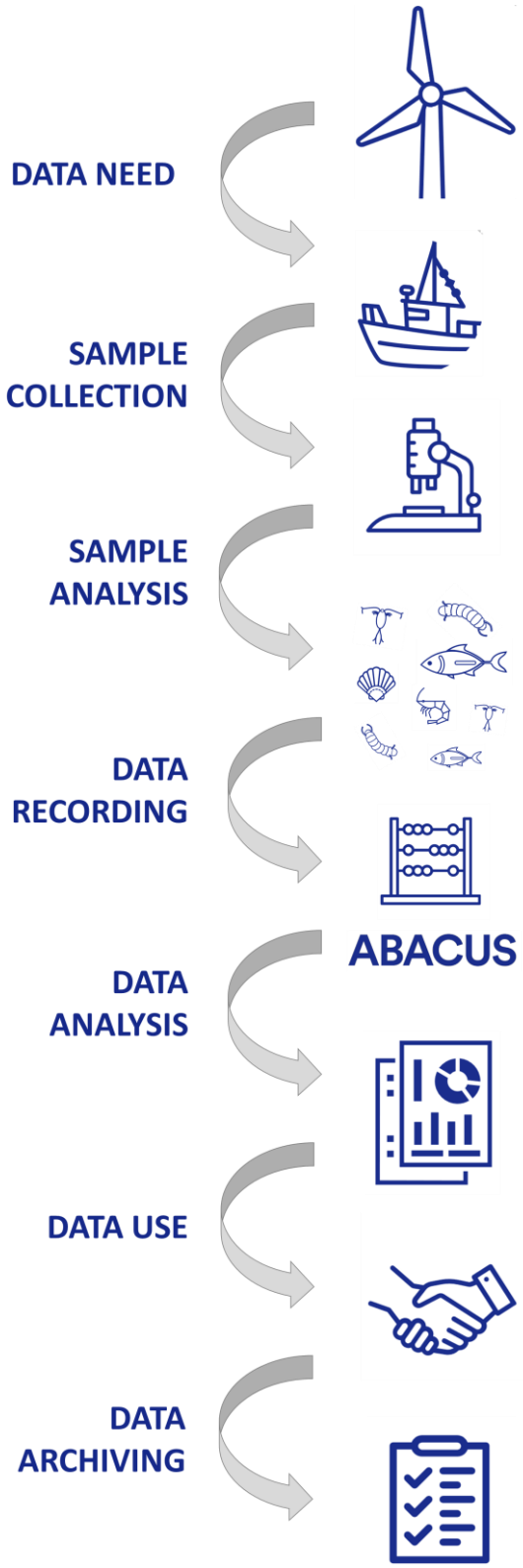

Figure 2 The role ABACUS plays in OEL's data management process.

2. METHODS

2.1. Development Process

ABACUS has been developed using the latest Microsoft technologies (ASP.NET CORE, MVC, C#, Microsoft SSQL 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 achieve its data with DASSH. To make this process simpler for it's 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.

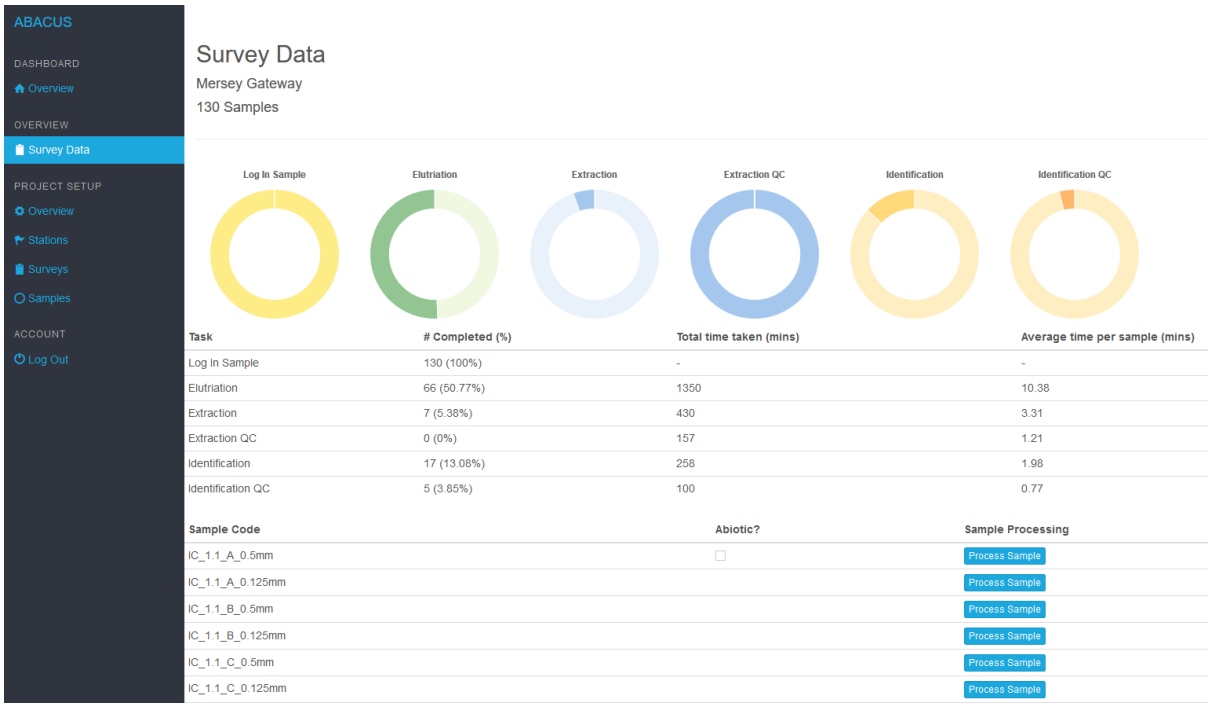

Figure 3 Sample tracking page in ABACUS.

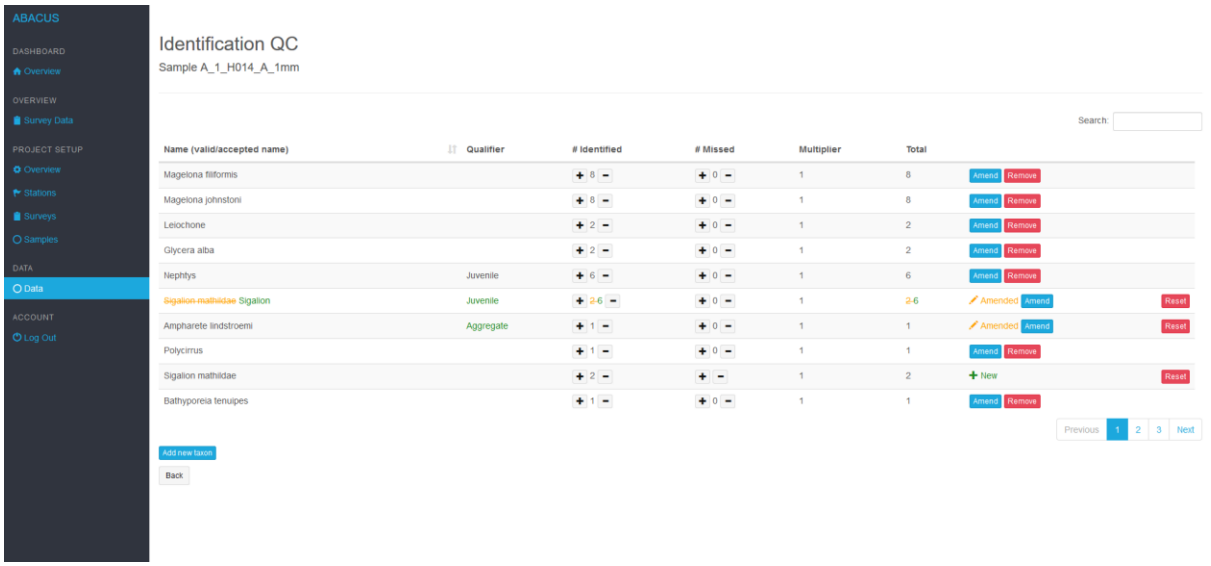

Figure 4 Identification Quality Control (QC) page for improving quality or for the supervision and training of less experienced analysts.

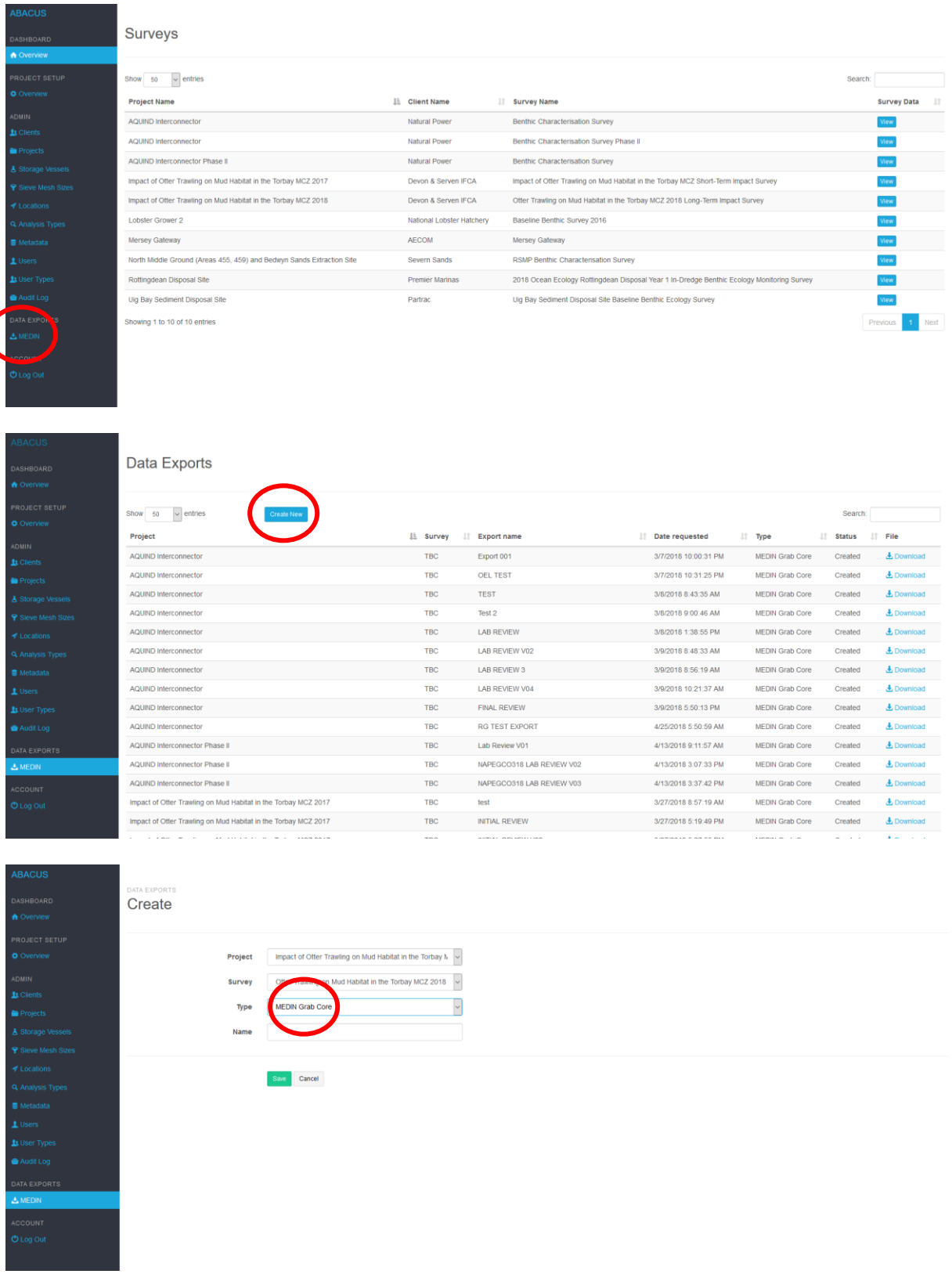

Figure 5 MEDIN export process in ABACUS.

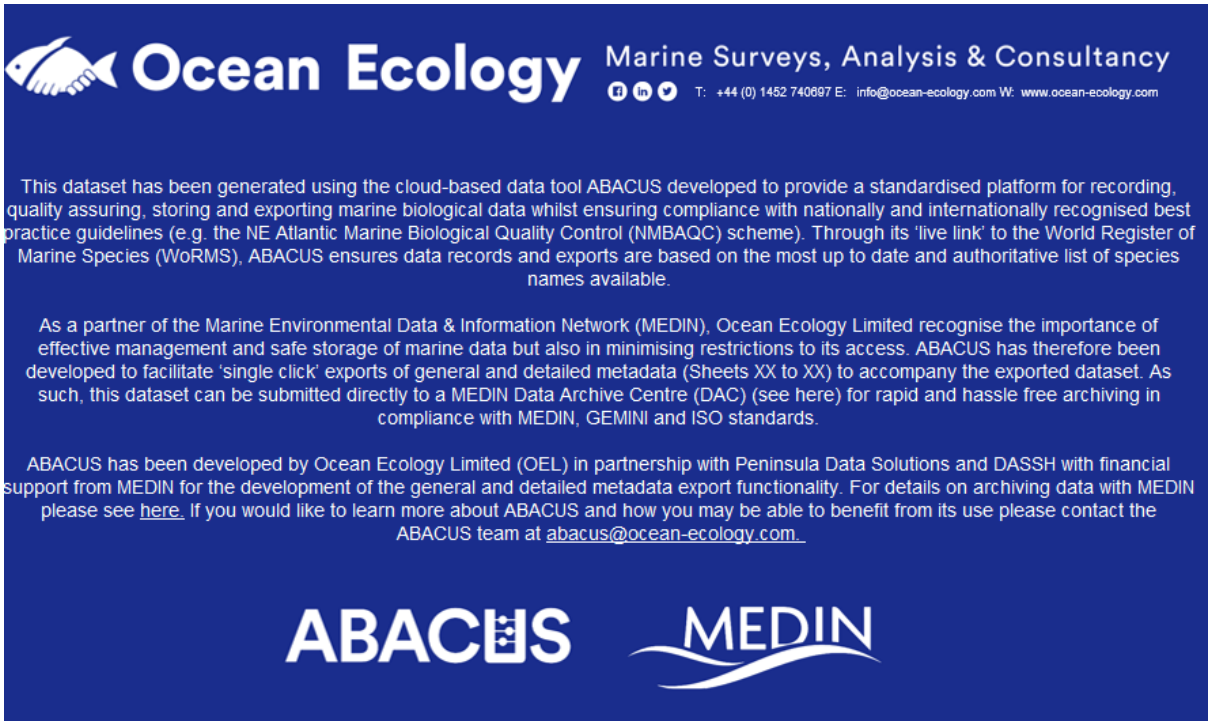

Figure 6 Preamble provided with all MEDIN compliant data exports from ABACUS describing how the data was generated and the process in which it can be easily archived with a MEDIN Data Archive Centre (DAC).