

Project Working Groups and looking ahead



Dr Henk van Rein
Marine Monitoring and
Evidence Manager/

**Marine Natural Capital
Evidence Specialist**

Henk.vanrein@jncc.gov.uk



NMBAQC

NE Atlantic Marine Biological Analytical Quality Control Scheme



JNCC

Development of a Benthic Imagery Analysis Action Plan for the UK

Version: 0.3

Lead author: *Henk van Rein*

Release date: XXXXXX

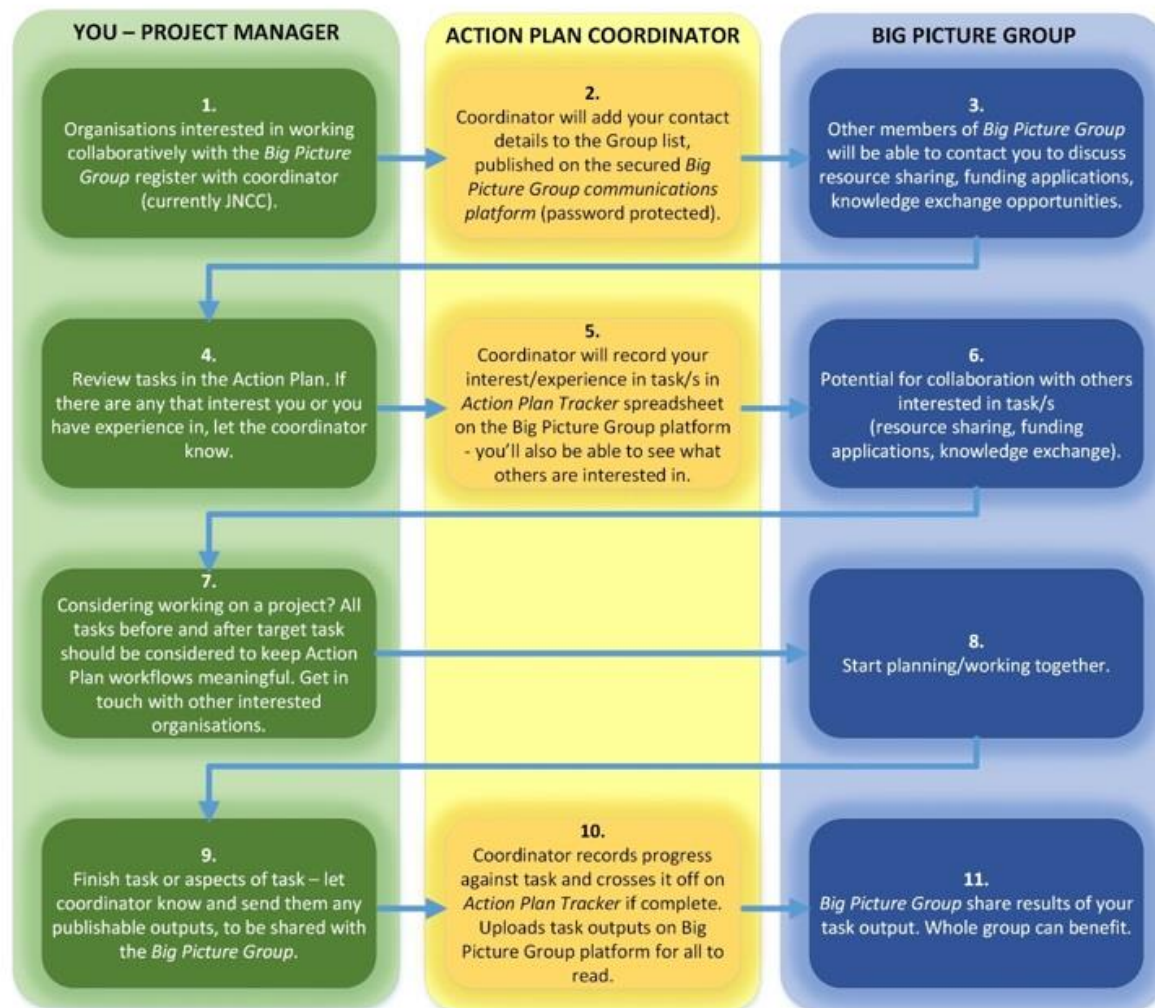


Figure 1. Proposed stages of carrying out a task from the Action Plan, including roles and requirements for each role at each stage.

Implementation of Benthic Imagery Action Plan

1. Carried out by organisations across the Big Picture Group
2. Identify Action Plan Coordinator role and Benthic Imagery Action Plan Task Tracker
3. Big Picture Group (BPG) needs to agree mutually beneficial ways of working

BPG Terms of Reference

‘Spirit of cooperation’
essential among participating organisations
(shared resources, solutions and opportunities)

Collaboration platform

3. Shift away from central facilitation to autonomous group work and coordination by Action Plan Coordination Committee

- **Two strategies for implementation:**

1. Align current work with Action Plan tasks and share outputs (**Passive**)
2. Organise ourselves into working groups with shared goals, to secure funding to tackle Action Plan tasks and then share outputs (**Active**)

1. Passive Implementation

Imagery annotation approaches



Guidance for entire imagery analysis work flow (design, analysis, randomisation, annotation, statistics), including decision tree flowchart

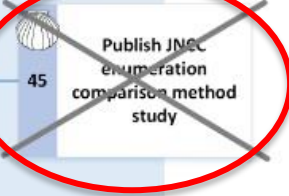


JNCC Report
No. 641

Optimisation of Benthic Image Analysis Approaches

Moore, J., van Rein, H., Benson, A., Sotheran, I., Mercer, T. & Ferguson, M.

Develop new enumeration approaches, including SACFOR, for benthic imagery



~~Publish JNCC enumeration comparison method study~~

Explore ways to improve the consistency of records made by enumeration techniques



Decide on future uses of SACFOR



Explore possibility of using a staged approach to object identification to improve efficiency and data quality



Consider development of standard checklists of taxa/morpho-groups for surveys



Identify standard requirements for grouped main purposes (CORE PURPOSES) and create standard table and decision tree flowchart



Develop the minimum requirements for enumeration approaches to suit different benthic imagery purposes

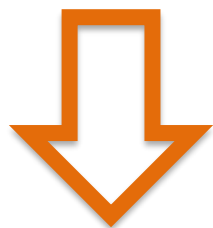


Create a decision-tree to support selection of enumeration approaches for different purposes and resourcing scenarios

2. Active Implementation

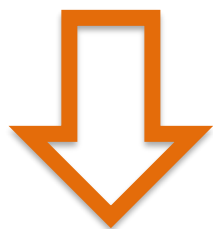
1. Active engagement within Big Picture Group required:
 - What everyone's up to (stock take)
 - What useful information we already have (current resources)
 - Who has time to work on Action Plan tasks (future resources)

*Benthic Imagery
Action Plan Tracker
Spreadsheet
(Sept 2020)*



2. Assemble cross-organisation Project Working Groups (PWGs) to tackle Action Plan tasks

*BPG November
workshop
(end Nov 2020)*



3. Milestone event to share initial progress and review process

*BIG PICTURE II
workshop
(Mar 2021)*

Benthic Imagery Action Plan Tracker

| ACTION PLAN TASK INFORMATION | | | | | | TASK OUTPUTS | | TASK DEVELOPMENT | | | | | ADDITIONAL TASK INFORMATION | |
|---|--|-------------------------------|---|----------|---------------------|---|--------------------------------------|---|---|---------------------|--|---|---|--|
| Theme | Task | Proposed way of | Suggested deliverable | Priority | Task status | Output link (weblink to download files) | Task leads (current/future interest) | Task collaborators/team (current/future interest) | Task steering group (current/future interest) | Task funding source | Project name | Current work in task area | Notes for task | |
| Governance & co-ordination | 1 Embed Action Plan in suitable governance structure (HBDSEG) | PDG working | HBDSEG Benthic Imagery Action Plan | H | Complete | http://www.nmbaqa.org/scheme-components/epibiotabenthic-imagery-action-plan/ | JNCC | Cefas, NCC, Envision Ltd, NRW, MSS | The Big Picture Group | Defra | Defra Marine Methodologies | | | |
| Governance & co-ordination | 2 Create an Action Plan managing body and systems for | Group coordination | HBDSEG Benthic Imagery Action Plan Coordinator | H | In progress | | JNCC, NMBAGC | | | | | | | |
| Governance & co-ordination | 3 Explore range of options and decide on optimum approaches for publishing and sharing new research findings, standards and recommendations for the working | Coordination | Recommended information sharing routes for imagery work | L | In progress | | PDG, Big Picture group | | | | | | | |
| Governance & co-ordination | 4 Create working group file-sharing and collaboration site | Lead action | File-sharing and collaboration site for Big Picture Group | M | On-going | | JNCC | | The Big Picture Group | Defra | Defra Marine Methodologies | JNCC have been trialling a collaboration site on Microsoft Teams since July 2019. | Other options under consideration are Huddle and Slack. | |
| Governance & co-ordination | 5 Explore imagery cost models for standard development, research, training and data dissemination | Coordination/ Review | Options for imagery cost models for standards development | H | Under consideration | | JNCC | | | | | | | |
| Governance & co-ordination | 6 Develop contract management guidelines for benthic imagery | Lead action | Improved imagery analysis contract specifications | M | Under consideration | | JNCC | SNH | | | | SNH - have stills analysis guideline examples | Task supported by CMA/SNCBs | |
| Governance & co-ordination | 7 Review imagery data culture in UK and explore possible incentives to share imagery data | Coordination/ Review | Range of options for incentives for sharing of imagery data across UK | L | Hasn't started | | JNCC | | | | | | Task supported by CMA/SNCBs | |
| Governance & co-ordination | 8 Discuss imagery standard requirements with Department of Business, Energy and Industrial | Coordination | BEIS collaboration for standard setting | L | Hasn't started | | | | | | | | | |
| Governance & co-ordination | 9 Identify taxonomic experts for all taxonomic groups | Group action and coordination | List of benthic taxonomic experts | M | In progress | | JNCC | | | | | | The Big Picture Group could collectively create this list | |
| Governance & co-ordination | 10 Create image analysis training body and governance structure to manage training materials and potentially carry out a range of courses/refreshers and publicise | Coordination | Imagery training body | L | Hasn't started | | | | | | | | Shouldn't this be the NMBAGC? | |
| Governance & co-ordination | 11 Create a machine learning and annotation user 'group' for the UK | Coordination | Machine learning and imagery annotation user group | M | Hasn't started | | JNCC | | | | | | Potentially split this into separate ML and annotation | |
| Overarching guidelines and purposes for imagery | 12 Identify and define range of main purposes for using benthic imagery | Project | Defined range of standard purposes for using benthic imagery | H | In progress | | JNCC | The Big Picture Group via questionnaires and interviews | The Big Picture Group | Defra | Defra Marine Methodologies; Development of a | | | |
| Overarching guidelines and purposes for imagery | 13 Identify standard requirements for grouped main purposes and create standard table and decision tree flowchart | Project | Core purposes for using benthic imagery and minimum requirements for each purpose | H | In progress | | JNCC | The Big Picture Group via questionnaires and interviews | The Big Picture Group | Defra | Defra Marine Methodologies; Development of a EpiBiotra QA system | | | |
| Overarching guidelines and purposes for imagery | 14 Guidance for entire imagery analysis work flow (design, analysis, randomisation, annotation, statistics), including | Action | Annotation order of imagery randomised in procedures | H | Hasn't started | | JNCC | | | | | | Could be supported by NMBAGC and MEDIN regarding data flows and standards | |
| Overarching guidelines and purposes for imagery | 15 Develop guidance on determining appropriate sampling units from imagery data sets, including aggregation criteria (e.g. randomness) to meet minimum sample size recommendations for | Project | Sampling unit guidance | M | Hasn't started | | JNCC | | | | | | Should link to guidelines in Task 18 | |
| Overarching guidelines and purposes for imagery | 16 Alignment of imagery acquisition parameters with minimum sample size recommendations and sample selection criteria for each | Multiple projects | Acquisition practices aligned with sample size and selection recommendations | H | Hasn't started | | JNCC | | | | | | | |
| Overarching guidelines and purposes for imagery | 17 Develop minimum data standards for imagery core purposes | Multiple projects | Imagery data output standards for standard purposes | H | In progress | | JNCC | | | Defra | Development of a EpiBiotra QA system for NMBAGC | | MEDIN protocols and BIGLE data outputs (JNCC) useful | |
| Overarching | Develop minimum requirements | Multiple projects | Minimum acquisition | M | Hasn't started | | | | JNCC | | | | Should build on existing NMBAGC guidelines. | |

Action Plan Task
Information

Task Development
Task Outputs

Additional Information

[illegible]

Identification approaches for benthic imagery

Enumeration approaches for benthic imagery taxa

Identification

Enumeration

Taxonomic identification

Morphology

Benthic imagery

Work in progress

41 Explore possibility of using a staged approach to object identification to improve efficiency and data quality

42 Consider development of standard checklists of taxa/morpho-groups for surveys

43 Reassess minimum requirements for taxonomic and morphological identification to meet different benthic imagery purposes

44 Consider what data should be shared and how it could be archived

45 Periodically update existing guidance on acquisition and analysis of imagery to reflect new developments, and monitor new guidelines where necessary

46 Assessment of data metrics (accuracy, precision, resolution, consistency) obtained from different image acquisition strategies (software or manual), to include aspects of working with different objectives or imagery

47 Develop the minimum requirements for approaches to suit different benthic imagery purposes

48 Identify standard requirements for grouped main purposes (CORE PURPOSES) and create standard table and decision tree flowchart

49 Create a decision-tree to support selection of enumeration approaches for different purposes and resourcing scenarios

50 Carry out pilot test to explore combined use of morphology based identification systems (e.g. COTSIMS and Software Identification Protocol (SIP))

Benthic Imagery Action Plan co-ordination

- 01 United Action Plan in national Governance structure (NAGGPA)
- 02 Create an Action Plan
- 03 Explore range of options and decide on optimum approach for publishing and sharing new research findings, standards and recommendations for the working group
- 04 Create working group following and collaboration site
- 05 Create a machine learning and annotation user 'group' for the UK
- 06 Create image analysis training body and governance structures to manage training materials and potentially core use a range of external reviewers and publicise workshops
- 09 Identify 'economic experts' for all economic groups

Benthic imagery analysis training scheme

Quality Assurance Framework for benthic imagery

The flowchart outlines the following steps and milestones:

- Identify taxonomic experts for all taxonomic groups** (Milestone 1)
- Explore creation of a 'Centre of Excellence for Taxonomy' in the UK** (Milestone 2)
- Develop online image identification tool of similar quality to Hobstar.org** (Milestone 3)
- Develop online common image library/catalogue to collate and share reference collections across the UK** (Milestone 4)
- Create pathways for reference collections imagery, especially from image annotation software, for training and training purposes** (Milestone 5)
- Develop Epiflora Identification Protocol (IP) to improve consistency of taxonomic nomenclature** (Milestone 6)
- Explore imagery cost models for standard development, research, training and data dissemination** (Milestone 7)
- Create a machine learning and annotation user 'group' for the UK** (Milestone 8)
- Explore potential uses and value of image annotation and machine learning approaches to support Quality Assurance framework training** (Milestone 9)
- Materials to meet imagery training needs, along with minimum training requirements (for each course), including materials for specific taxa using expert knowledge (e.g. Research guides) and machine training courses and support for benthic biologists and ecologists** (Milestone 10)
- Revises the effect training has on consistency of data and determine its limitations** (Milestone 11)
- Assess factors of analyst variability (Religion/Forma/ time of day) on imagery and develop recommendations for best practice** (Milestone 12)
- Evaluate for e-learning acceptance** (Milestone 13)
- Identify and develop a range of quality assurance (training tests?) for different imaging ports** (Milestone 14)
- Create training accreditation system** (Milestone 15)
- Development of an online training module system** (Milestone 16)
- Create working group for sharing and collaboration role** (Milestone 17)

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- Evaluate for e-learning acceptance** (Milestone 13)
- Identify and develop a range of quality assurance measures (e.g. metrics) for different imaging parts** (Milestone 14)
- Create training accreditation system** (Milestone 15)
- Development of an online training module system** (Milestone 16)
- Use all existing training materials, guidance and best practice and make available as a common resource** (Milestone 17)
- Create working group for sharing and collaboration** (Milestone 18)

[illegible]

The flowchart illustrates a machine-learning approach for benthic imagery, starting with data collection and annotation, followed by model training and evaluation. The process is divided into several key steps:

- Imagery annotation software**: This section includes a box for "Imagery annotation software" and a box for "Machine-learning software and machine learning".
- Consider what data should be shared and how it could be archived** (Step 64): This step involves defining data format specifications necessary for machine learning algorithms to work, as well as export formats for biologists to use (e.g. csv files).
- Develop online common image library/catalogue to collate and share reference collections across the UK** (Step 67): This step involves creating a pathway annotated imagery shared with small learning community common image data.
- Create a machine learning and annotation user 'group' for the UK** (Step 11): This step involves creating a machine learning and annotation user group for the UK.
- Explore use of google imagery to substitute machine learning needs** (Step 62): This step involves exploring the potential uses and value of image annotation and machine learning approaches to support quality assurance, monitoring, training, development of reference collections.
- Develop confidence assessment approaches for machine learning outputs** (Step 63): This step involves evaluating habitat variability giving examples of specific habitats and species to estimate acceptable levels of error.
- Evaluate habitat variability giving examples of specific habitats and species to estimate acceptable levels of error** (Step 62): This step involves periodically updating existing guidance on acquisition and analysis of imagery to reflect new developments, and produce new guidelines where necessary.

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Data flows

07 Review imagery data culture in UK and explore possible incentives

64 Consider what data should be shared and

17 Develop minimum data standards for imagery core

Benthic imagery data flows, archives and catalogues

09

37

39

Identify the need to improve consistency of taxonomic nomenclature

Create standardised UK-based morphology based system (CATAMIS) for use on benthic imagery, including lineage monitoring

64

69

70

For consistent data storage reference collections across the UK

Library of reference collection and, potentially, other associated imagery

Develop confidence assessment approach for image library reference collections

Identify knowledge gaps in reference collections and address

Benthic imagery technology reviews

Acquisition of imagery

- 14 Guidance for online imagery analysis work flow (design, analysis, randomisation, annotation, statistics), including decision tree flowchart
- 16 Alignment of imagery acquisition parameters with minimum sample size recommendations and sample selection criteria for each case purpose
- 20 Developing short guidance for minimum suitable conditions for imagery acquisition on surveys
- 21 Develop 'fit' methods for assessment of initial image quality while on survey

Data processing reviews

- 22 Review capabilities, requirements and limitations of different video formats (HD-4K-8K)
- 23 Review use of low-cost camera systems for acquisition of benthic imagery
- 25 Review citizen science approaches for using benthic imagery and other based methods
- 26 Review of ancillary equipment usage and
- 27 Review of environmental data acquisition and
- 28 Review potential uses of photogrammetry to meet different purposes and
- 29 Review potential uses of video monitoring to meet different purposes and requirements to be acquired live study

Periodically update existing guidance on acquisition and analysis of imagery to reflect new developments, and develop new guidelines where necessary (31)

- 32 Contact developers of imagery acquisition systems to learn about what they are developing and, potentially, influence future developments
- 33 Develop intercalibration salinity for different data acquisition systems, where value and benefit are possible

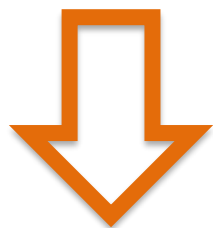
Interest in Action Plan tasks

| Proposed Project Working Group | Identification approaches for benthic imagery | Benthic imagery data archives and catalogues | Imagery annotation software | Machine-learning approaches for benthic imagery | Benthic imagery workflow guidance | Benthic imagery data flows | Benthic imagery analysis training scheme | Enumeration approaches for benthic imagery taxa |
|--------------------------------|---|--|-----------------------------|---|-----------------------------------|----------------------------|--|---|
| Action Plan Tasks | 6 | 9 | 7 | 6 | 10 | 4 | 4 | 8 |
| Organisation A | 100.0% | 55.6% | 14.3% | 33.3% | 70.0% | 75.0% | 75.0% | 0.0% |
| Organisation B | 83.3% | 44.4% | 14.3% | 83.3% | 90.0% | 75.0% | 25.0% | 25.0% |
| Organisation C | 0.0% | 22.2% | 14.3% | 0.0% | 20.0% | 25.0% | 0.0% | 0.0% |
| Organisation D | 0.0% | 33.3% | 14.3% | 33.3% | 0.0% | 50.0% | 0.0% | 12.5% |
| Organisation E | 83.3% | 55.6% | 57.1% | 50.0% | 70.0% | 0.0% | 25.0% | 25.0% |
| Organisation F | 33.3% | 100.0% | 85.7% | 0.0% | 0.0% | 50.0% | 0.0% | 0.0% |
| Organisation G | 33.3% | 55.6% | 0.0% | 0.0% | 30.0% | 0.0% | 25.0% | 12.5% |
| Organisation H | 100.0% | 11.1% | 14.3% | 0.0% | 40.0% | 25.0% | 75.0% | 25.0% |
| Organisation I | 50.0% | 11.1% | 0.0% | 33.3% | 50.0% | 0.0% | 75.0% | 75.0% |
| Organisation J | 50.0% | 11.1% | 71.4% | 66.7% | 70.0% | 100.0% | 25.0% | 50.0% |
| Organisation K | 66.7% | 66.7% | 42.9% | 66.7% | 20.0% | 25.0% | 25.0% | 25.0% |
| Organisation L | 100.0% | 55.6% | 71.4% | 0.0% | 100.0% | 25.0% | 25.0% | 75.0% |
| Organisation M | 66.7% | 66.7% | 14.3% | 16.7% | 30.0% | 0.0% | 25.0% | 12.5% |
| Organisation N | 33.3% | 33.3% | 42.9% | 16.7% | 50.0% | 25.0% | 0.0% | 0.0% |
| Organisation O | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 25.0% | 0.0% |
| Organisation P | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

2. Active Implementation

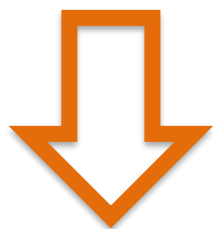
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Benthic Imagery Action Plan co-ordination

Benthic imagery analysis training scheme

Quality Assurance Framework for benthic imagery

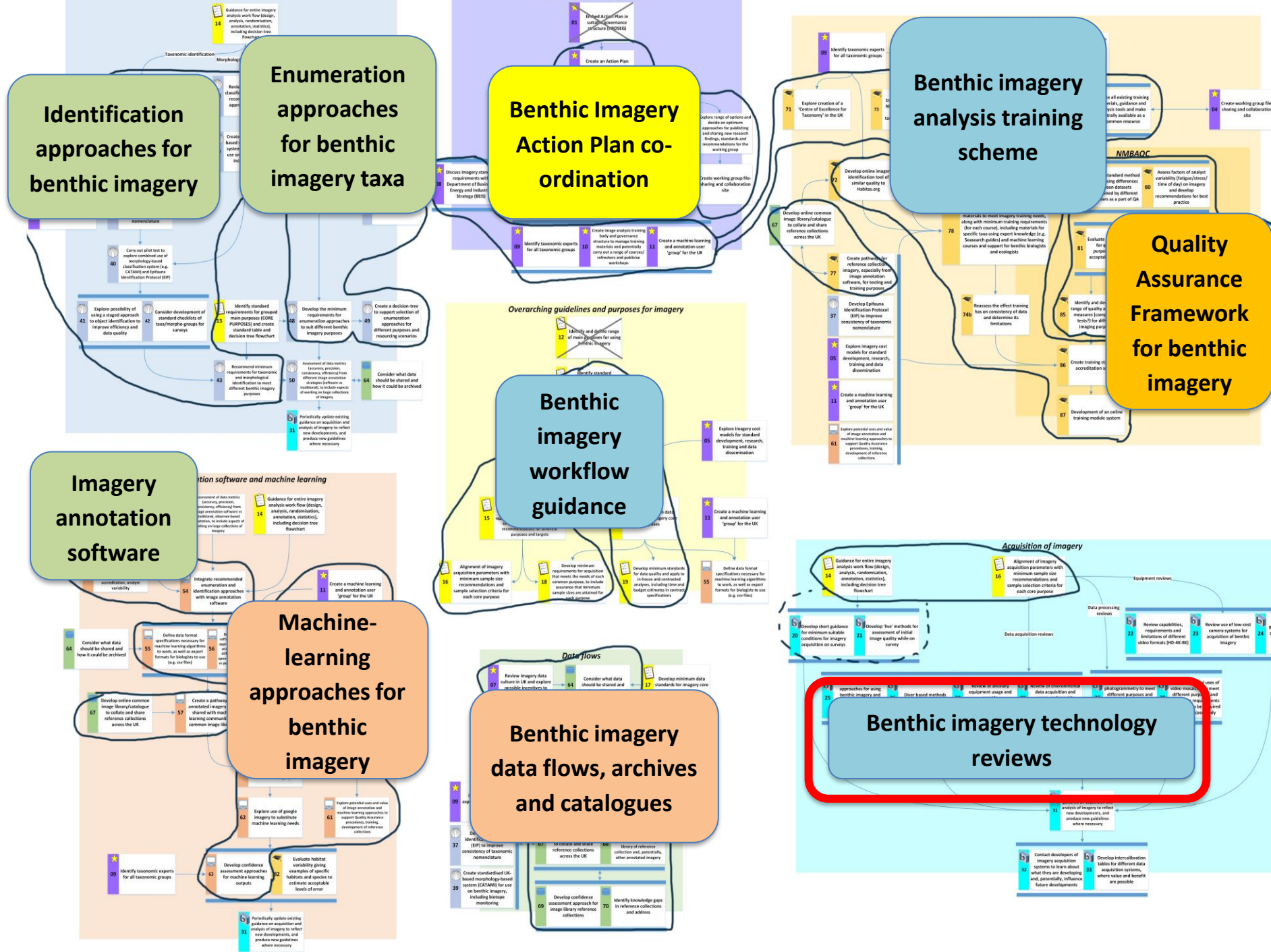
Imagery annotation software

Machine-learning approaches for benthic imagery

Benthic imagery workflow guidance

Benthic imagery data flows, archives and catalogues

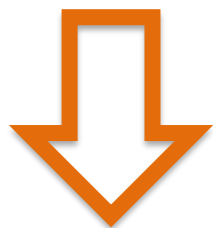
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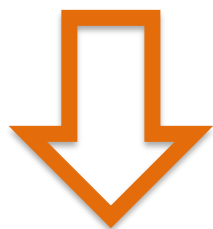
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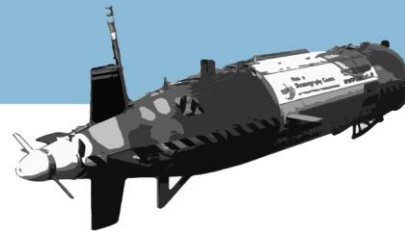
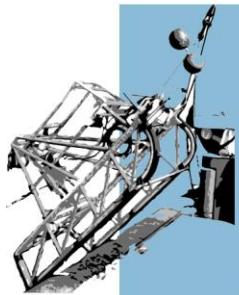
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Questions?

THE BIG PICTURE

Benthic Imagery Analysis Group



TheBigPicture@jncc.gov.uk