**AQUASPACE**

Ecosystem Approach to making Space for Aquaculture

EU Horizon 2020 project grant no. 633476

Deliverable 6.3

CPD Course Manual

'Planning and Managing the Use of Space for Aquaculture'

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| Lead Beneficiary | **University College Cork (UCC-MaREI)** |
| Deliverable authors | **O’Hagan, A.M. and Gault, J. (UCC-MaREI)** |
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# INTRODUCTION

This is a manual intended to accompany the CPD Course on Planning and Managing the Use of Space for Aquaculture. The course is an outcome from Task 6.3 'Research and Develop a Continuing Professional Development (CPD) course'. The CPD course is designed to complement the Masters Module on MSP for Aquaculture, produced as Deliverable D6.1, which is a suite of materials including a syllabus, lectures, practical exercises, presentations, etc. which lecturers and students can use via a self-taught format available online. The CPD Course uses some of the same materials but these have been customised for a professional audience. Both courses utilise materials available from the AquaSpace Toolbox.

The main content of the present report is a manual outlining the possible contents of a Continuing Professional Development course on planning and management of space for aquaculture, tailored to the interests and concerns of professionals from within the aquaculture industry, but also regulators, research professionals, representatives from other maritime industries and interest groups. It is not designed for direct roll-out but rather provides a general framework which can be tailored to suit local conditions and the different levels of knowledge that may exist across the industry, regulatory and research community. The materials referred to in this manual are available on the Aquaspace website ([www.aquaspace-h2020.eu](http://www.aquaspace-h2020.eu)).

Course materials benefit from the experience of the AquaSpace consortium coupled with a range of example situations derived from the case study sites in the project, providing real and practical instances of aquaculture site planning and management for different countries, species, environment (marine and freshwater), management issues and potential future challenges. These materials also have the advantage of having had input from the industry partners, such as Longline Environment (UK) and Sagremarisco (Portugal), in the project. Furthermore the tentative course content was discussed with aquaculture producers in Ireland with a view to determining what exactly industry would expect and desire from a CPD module such as this.

# Content and target audience

This is a web-based, open-access, set of materials for use by:

* any person who, or organisation that, wants to construct, validate and deliver such a CPD Course, or draw on any part of it for teaching purposes;
* any interested person who wishes to learn more about aquaculture planning and management frameworks.

The materials can be used to develop a detailed and critical knowledge of societal and environmental contexts for the use of space by aquaculture, including

* an understanding in principle of how to develop and apply EU, national and regional spatial planning and management frameworks for aquaculture;
* a critical understanding of social and environmental concepts relevant to planning and managing space for aquaculture;
* the knowledge needed to understand and critically select tools from the Aquaspace toolbox and other sources of tools.

One completed, participants will have obtained a broad overview of the management of the marine and coastal resources as well as an awareness of how these can and have been implemented in a variety of spatial contexts. Participants will have an appreciation of the scientific basis underpinning the management of marine, coastal and land based aquaculture resources. This will enable those successfully completing the course to operate within their own professions and be familiar with the emerging and evolving fields of marine governance, planning and management.

# Course structure

The lectures are based around 11 topics, representing a course which could be conducted over a two and a half days. A sample timetable is included in Annex 1 for reference. The course is designed so that there is ample discussion time thereby contributing to mutual learning of all participants. Please note that no support can be provided for use of this material. For each topic we provide a set of slides containing exercises and sources of further reading, if required. In other cases we direct users towards resources on the AquaSpace website or external resources. These act as a framework for the content to be covered but with the caveat that material should be added to reflect the local context and specificities of the aquaculture sector in that region/country.

# List of TOPICS

This material reflects AquaSpace's work on the Ecosystem Approach to Aquaculture (EAA), the issues, tools and case studies that the project utilised and investigated.

1. **Introduction to** **Aquaculture in a Global Context** (João Ferreira, Longline Environment Ltd.)
2. **Current frameworks for aquaculture planning and management** (Anne Marie O’Hagan, MaREI-UCC)
3. **Maritime Spatial Planning in Europe: Opportunities for Aquaculture** (Lucy Greenhill, SAMS and Anne Marie O’Hagan, MaREI-UCC)
4. **Ecosystem Approach to Aquaculture (EAA)** (Paul Tett, SAMS; Anne Marie O’Hagan, MaREI-UCC and José Aguilar-Manjarrez, FAO)
5. **Introduction to the AquaSpace Tool for use in spatial planning** (Vanessa Stelzenmüller and Antje Gimpel, Thünen Institute)
6. **Tools - Geographic Information Systems** (GIS) (David Miller, Chen Wang, Gillian Donaldson-Selby, Dave Miller, Margaret McKeen, James Hutton Institute; and Antje Gimpel, Thünen Institute)
7. **Tools - Remote Sensing for Marine Spatial Planning** (Sónia Cristina, Bruno Fragoso and John Icely, Sagremarisco Lda)
8. **Tools - Visualisation issues and tools** (David Miller, Gillian Donaldson-Selby and Chen Wang, JHI)
9. **Tools - Social investigation and engagement tools** (Suzi Billings, SAMS)
10. **Tools - Sea lice and salmon aquaculture** (Tom Adams, SAMS)
11. **Forthcoming Issues for Aquaculture and Spatial Planning** (Anne Marie O’Hagan and Jeremy Gault, MaREI-UCC)
12. **Case studies (optional)**

# Topic Content

**1. Introduction to Aquaculture in a Global Context**

This presentation sets the context for the CPD course in terms of the current status of the aquaculture sector. It provides an overview of global patterns in fisheries and aquaculture production and worldwide consumption and future trends. It also presents the current situation in the EU. Information is presented on the species and technologies utilised as well as carrying capacity and sustainability challenges. The presentation concludes with a synthesis of these topics covering aspects such as production models for the future, approaches to planning in regions that are data poor and how to increase participation in development planning. It should be noted that these slides are a suggested guide only utilising information correct at the time of writing but acknowledging that this information and particularly the statistical data will change regularly as production changes over time.

**2. Current frameworks for aquaculture planning and management**

This presentation provides information on EU legislation that impacts upon the aquaculture sector as contained in the Regional review conducted under AquaSpace (O’Hagan et al., 2017). Specifically it looks at the legal basis for EU law on environment, fisheries and aquaculture; the key EU legal instruments for marine and coastal management; the main nature conservation instruments and Impact Assessment processes which may apply to aquaculture planning and operation including Strategic Environmental Assessment, Environmental Impact Assessment and Appropriate Assessment under the Habitats Directive. It is suggested that these slides are supplemented with the relevant national legislation and how the various processes work in the country where the course is being held. Some examples from Ireland are included for reference. A discussion on current management frameworks in place and how these facilitate or impede aquaculture development is recommended as an exercise. This will help highlight critical issues for management currently which can then be contrasted with newer approaches to management and the tools recommended later in the course.

**3. Maritime Spatial Planning in Europe: Opportunities for Aquaculture**

This topic explores the potential opportunities for aquaculture from Maritime Spatial Planning (MSP), a new management approach legally required under EU law and advocated internationally as a means to improve and deliver more integrated marine governance. The lecture outlines what MSP is, how it differs from existing approaches to management, its status of implementation, the requirements of the EU Directive on MSP, the opportunities for aquaculture and possible challenges to the implementation of MSP. This could be supplemented with information on MSP in the country/region where the course is being hosted: if MSP is not implemented, a discussion on how management processes could be more integrated could be facilitated considering alternative approaches such as integrated coastal management, land-based planning that includes coastal waters, etc. A list of additional recommended reading is provided in the presentation directing users to a wide range of guidance materials and peer-reviewed papers which explore MSP and aquaculture. In addition, course participants can also avail of the Unit Study Guide for this topic available on the AquaSpace Toolbox under the Masters Module, which follows a similar structure to the material presented in this topic.

**4. Ecosystem Approach to Aquaculture (EAA)**

The Ecosystem Approach to Aquaculture, as developed by the UN Food and Agriculture Organization (FAO), was one of the central tenets of the AquaSpace project, particularly how it could be made operational at different levels of governance. This unit traces the origins of the EAA, how it is related to spatial planning, and the steps that form part of the EAA. Course participants are directed towards the recently published FAO Handbook on aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture (FAO and World Bank, 2017). That Handbook This publication describes the steps related to the various steps in EAA, the rationale for and objectives of each step, together with the ways and tools available to implement it. Recommendations for practitioners and policy-makers are also included in the Handbook. It is advised that material associated with certain AquaSpace case study sites could be useful when covering this topic, depending on where the course is being conducted.

**5. Introduction to the AquaSpace Tool for use in spatial planning**

During the AquaSpace project, stakeholders identified the need for a spatial planning tool that could integrate over indicators of both risk and opportunity and the AquaSpace Tool was developed. This lecture looks at the tools and methods that could support implementation of the EAA, where there are gaps together with stakeholder opinions on what is needed to support an EAA. This leads to material on the development of the AquaSpace Tool, a GIS-based tool for an integrated assessment of spatial planning trade-offs with aquaculture. This explains how the user can assess individual marine site locations planned for aquaculture in terms of essential biological, ecological, economic, physical and social aspects. All the resources and training necessary to use the tool are available from the AquaSpace website in the Toolbox. Participants are invited to carry out the exercises contained in the lecture and in that way have the opportunity to apply their learning in using the AquaSpace Tool to a specified situation.

The following **five lectures** are focused around different tools that can be used for different aspects of aquaculture planning and management. Whilst the course coordinator may decide to go through each lecture sequentially as part of the CPD Course, an alternative approach would be to focus on specific tools – perhaps those that are least familiar to the participants. This should be decided on a case-by-case basis.

**6. Tools: Geographic Information Systems (GIS)**

The AquaSpace Tool, referred to in the previous topic, is GIS-based but it is important to learn that GIS has many other potential applications in spatial planning and aquaculture. This lecture is designed to introduce GIS and, therefore, includes definitions and descriptions of basic elements of GIS, clarification of distinctions to be made between commonly used but often misunderstood terms, and examples of its use in AquaSpace. The examples relate to a small set of basic GIS functions and two applications within the AquaSpace project namely the case study areas of Argyll and Bute, Scotland, and the south-east North Sea, Germany. Information is provided in the relevant slides on where to locate more details of these applications. The lecture is not a tutorial on the use of GIS. Some video tutorials are included as reference material.

**7. Tools: Remote Sensing for Marine Spatial Planning**

This topic sets out what Remote Sensing is providing examples of satellites and sensors, products and their contribution to the selection of aquaculture sites and other applications. The advantages of Remote Sensing for MSP and specifically how it can be used in site selection and management is covered with reference to case studies in the Algarve coast (Portugal); North Adriatic Sea; Mont Saint-Michel bay (France); and the Eastern Passage / Halifax Harbour (Canada). Part of the lecture focuses on SNAP software to explore the application of earth observation for marine aquaculture. Exercises on the use of this software are included covering installation, extraction of imagery and subsequent extraction of data that could be used in site selection. References are provided as a source of additional material.

**8. Tools: Visualisation issues and tools**

This topic introduces visualisation tools and associated issues including definitions and descriptions of basic elements of visualisations, 3D models, and tools. The examples of its use are as applied in the AquaSpace project particularly relating to consideration of landscapes and seascapes (e.g. landscape concepts of stewardship, naturalness, openness), and the representation of factors in the 3D models and interaction using the visualisation tools (e.g. ephemera of weather, reflections off water, shadows, movement). Information is provided in the relevant slides on where to locate more details of these applications. This is not a tutorial on the development of a 3D model or the use of any specific visualisation tool but rather seeks to inform participants about the potential of such tools in future planning. The evolution of visualisation and mapping tools has contributed to their uptake in relation to assessing consequences of drivers of change in coastal areas, such as aquaculture, renewable energy, housing and transport and, as such, these could be a very important tool in future planning processes.

**9. Tools: Social investigation and engagement**

An introduction to some of the social investigation and engagement tools that can be used for inquiry into public attitudes to aquaculture and thus to understand the extent to which an aquaculture operation has ‘social licence to operate’ is the focus of this topic. Course participants will become familiar with the two main approaches used in social inquiry as well as some examples of methods for their use. Benefits of and methods for public engagement within the aquaculture sector are also covered. The example of salmon fish farming in Scotland is presented to provide context. In light of the importance of public acceptance for the development of aquaculture and particularly the expansion of existing operations, special emphasis is placed upon the concept of “Social Licence to Operate” (SLO) and its importance for aquaculture operations. Research on the role of SLO in the aquaculture industry is limited, but there is an increasing recognition that aquaculture’s environmental impacts create social costs which can lead to conflict and at the extreme end of the scale, litigation (Kruase et al, 2015). Reading material and possible exercises are included in the Unit Study Guide for this topic available on the AquaSpace Toolbox under the Masters Module.

**10. Tools: Sea lice and salmon aquaculture**

Disease is an ongoing challenge for aquaculture operators and also for planning of future operations. This lecture covers sea lice and salmon aquaculture covering the life cycle and dispersal of sea lice in the water column, how they infect and affect wild and farmed fish. Approaches to reducing their abundance, including efforts to model their spread, is also included. Management of sea lice, covering both site management and cage treatments, are discussed. This also deals with resistance to chemicals as well as new approaches to lice management like the use of cleaner fish and barrier technologies. Finally a synopsis of mathematical and computational models used to understand the dynamics of sea lice populations, and spatial management approaches, are presented as tools to help address this challenge. It is suggested that someone with a background in aquaculture disease, parasitology or another relevant discipline is utilised to deliver this component of the course.

**11. Forthcoming Issues for Aquaculture and Spatial Planning**

This topic draws out the emerging policy and other issues relevant to future spatial planning for aquaculture, building on the key messages put forward in earlier topics. Emerging policy trends are presented which also captures the challenges already identified by the EC in relation to spatial planning of aquaculture. There is scope to discuss new governance approaches such as those more based on economics or community-based management. A synthesis of the key challenges surrounding the implementation of the EAA are explained together with suggestions for examples of good practice from around the world. A list of possible future needs is included to stimulate further discussion capturing the various pillars of sustainability, technical and policy requirements.

# Case studies

A set of slides are available for each Aquaspace case study site, supplemented by more comprehensive reports authored by Strand and Bergh (2017) as Aquaspace Deliverable 4.2. The following list gives location, type of aquaculture and main issues investigated. These case studies provide an evidence-base for the topics, approaches and issues covered in the lecture topics. It is intended that these examples could be used in conjunction with the PPT files to demonstrate a particular issues, how it was managed and learning transferable to that particular set of circumstances.

1. **Adriatic Sea, Italy:** bottom and suspended cultivation of bivalves; issues were proximity to protected area and conflicts with tourism and fisheries
2. **Algarve Coast, Portugal:** cage and pond cultivation of finfish and suspended and bottom culture of shellfish; issues were co-use, optimising space allocation, and disease connectivity
3. **Basque County, Spain:** suspended culture of shellfish; issues were making space for, and changing social attitudes to, aquaculture
4. **Békés County, Hungary:** freshwater shellfish cultivation in ponds and tanks; issues were proximity to bird reserves, availability of clean water
5. **Carlingford Lough, Ireland/UK:** shellfish (trestles, bottom); issues were: complex governance, co-use by several sectors.
6. **Great Bay (Piscataqua, New Hampshire) and Long Island Sound (Connecticut), USA:** shellfish (trestles, bottom); issues were: legal constraints and use conflicts
7. **Houtman Abrolhos Islands, Western Australia:** shellfish (suspended), finfish (cages); issues were: conservation area, co-use, potential for disease spread
8. **Mediterranean Sea:** cage culture of warm-water finfish; issues were: co-use with other sectors; complex governance; Multiple EEZ
9. **Normandy and Cancale (the Bay of Seine and the Normandy-Brittany Gulf), France:** shellfish (bottom, suspended); issues were: multiple conflicting uses, complex governance
10. **North Sea (Helgoland Bight), Germany:** shellfish (bottom), finfish (cages); issues were: co-use with other industry, increase of production level, complex governance
11. **Norwegian (western and northern) Coast, Norway:** cold-water finfish (in cages); issues were: sea lice connectivity, space availability, co-use;
12. **Nova Scotia Bays, Canada:** cold-water finfish (in cages); issues were: enhancing social licence; user/fisheries conflicts
13. **Zhangzidao Island and Sangou Bay, China:** seaweed, shellfish (suspended); issues were: competition for space with other industry; increased production
14. **Argyll and Bute, Scotland, UK:** cold water finfish in cages; community opposition, space availability, landscape/seascape impacts, sea lice connectivity; increased production;
15. **Pelorus Sound, Marlborough, New Zealand:** shellfish (suspended); Variable production/yield.

# The Aquaspace Toolbox

Figure 1 shows the relationships between the several parts of the Aquaspace toolbox website. This document is related to the CPD course but utilises material from the Masters course. Users may need to access other pages of the toolbox to download, for example, materials relating to specific tools, videos, reports and papers of interest. The Toolbox page includes:

* factsheets relating to tools tested, and in some cases, developed by Aquaspace,
* examples of applications of a range of tools in the Aquaspace case studies.



**Figure 1:** Overview of AquaSpace toolbox

# Attribution

These materials were developed as part of the AquaSpace project (2015-2018) and constitute project Deliverable 6.1. They may be used under a Creative Commons Attribution-ShareAlike 4.0 International License, with attribution as follows:

* ATTRIBUTION FOR USE OF MULTIPLE PARTS OF THE MATERIAL: Aquaspace (2018). Material from a Masters Module on `Planning and Managing the Use of Space for Aquaculture', prepared as part of the AquaSpace project (Ecosystem Approach to making Space for Aquaculture), which received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633476.
* ATTRIBUTION FOR THE USE OF ANY SINGLE DOCUMENT: Author(s) name(s) and their Organisations (2018) Document title. Prepared as part of the AquaSpace project (Ecosystem Approach to making Space for Aquaculture), which received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633476.

# References

* Aguilar-Manjarrez, J., Soto, D., and Brummett, R. (2017). Aquaculture zoning, site selection and area management under the Ecosystem Approach to Aquaculture. A handbook. Report ACS18071, Food and Agriculture Organization of the United Nations, and The World Bank, Rome.
* Krause, G., Brugere, C., Diedrich, A., Ebeling, M.W., Ferse, S.C.A., Mikkelsen, E.I., Pérez Agúndez, J.A., Stead, S.M., Stybel, N. and Troell, M. (2015). A revolution without people? Closing the people-policy gap in aquaculture development. Aquaculture, 444, pp 44-55.
* O’Hagan, A.M., Corner, R.A., Aguilar-Manjarrez, J. Gault, J., Ferreira, R.G., Ferreira, J.G., O’Higgins, T., Soto, D., Massa, F., Bacher, K., Chapela, R. and D. Fezzardi. (2017). Regional review of Policy-Management Issues in Marine and Freshwater Aquaculture. Report produced as part of the Horizon 2020 AquaSpace project. 170pp.
* Strand, Ø. and Bergh, Ø., editors (2017). Deliverable 4.2: Case Study Final Report. H2020 project 633476 Aquaspace, Oban.

# Suggested Timetable

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| **DAY 1** |
| **Time** | **Session Title and Information** | |
| 09:00 – 09:15 | **Welcome / Introduction / Aims of Module** | |
|  | Local Module Co-ordinator | |
| 09:15 – 10:00 | **National MSP Context** | |
|  | 20 mins presentation  25 mins facilitated discussion | - Government/Regulatory Representative  - Local Module Co-ordinator |
| 10:00 – 10:45 | **Industry Perspective / Understanding of MSP** | |
|  | 20 mins presentation  25 roundtable discussion | - Industry Representative  - Local Module Co-ordinator |
| 10:45 – 11:00 | **Coffee** | |
| 11:00 – 12:30 | [**Topic 1: Introduction to Aquaculture in a Global Context**](#Topic1) | |
|  | * 45 mins presentation * 45 mins facilitated discussion | - Based on Ferreira presentation - augmented with national, local examples  - Local Module Co-ordinator – context of participants operation |
| 12:30 – 14:00 | **Working Lunch:** Initial thoughts / share experiences on MSP for aquaculture | |
| 14:00 – 15:30 | [**Topic 2: Current frameworks for aquaculture planning and management**](#Topic2) | |
|  | * 45 mins overview presentation * 45 mins facilitated discussion | - Based on O’Hagan presentation - augmented with national and local examples  - Local Module Co-ordinator – legal requirements under MSP (and other legislation) |
| 15:30 | **Coffee** | |
| 16:00 – 17:30 | [**Topic 3: Maritime Spatial Planning in Europe: Opportunities for Aquaculture**](#Topic3) | |
|  | * 45 mins presentation * 45 mins facilitated discussion | - Based on Greenhill & O’Hagan presentation – augmented by local case studies  - Local Module Co-ordinator – MSP opportunities and issues |

| **DAY 2** |
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| **Time** | **Session Title and Information** | |
| 09:00 – 10:30 | [**Topic 4: Ecosystem Approach to Aquaculture (EEA)**](#Topic4) | |
|  | * 45 mins presentation * 45 mins facilitated discussion | - Based on Tett / O’Hagan / Aguilar-Manjarrez presentation - local, national and international examples  - Local Module Co-ordinator – using the approach in practice |
| 10:30 – 11:00 | **Coffee** | |
| 11:00 – 12:30 | [**Topic 5: Introduction to the AquaSpace Tool for use in Spatial Planning**](#Topic5) | |
|  | * 40 mins overview and examples * 50 mins hands-on use of tools | - Based on Stelzenmüller & Gimpel presentation  - Local Module Co-ordinator / demonstrators – examples of application |
| 12:30 – 13:00 | **Working Lunch: use of tools** | |
| 13:30 – 15:00 | [**Topic 6: Tools: Geographic Information Systems (GIS)**](#Topic6)  [**Topic 7: Remote Sensing for Marine Spatial Planning**](#Topic7) | |
|  | * 30 mins overview presentation on each topic * 30 mins hands-on exercises | - Based on Millar et al. and Cristina et al. presentations but augmented with national, local examples of application  - Local Module Co-ordinator / demonstrators – applied examples |
| 15:00 – 15:30 | **Coffee** | |
| 15:30 – 16:30 | [**Topic 8: Tools - Visualisation issues and tools**](#Topic8) | |
|  | * 40 mins overview presentation * 20 mins practical exercises | - Based on Millar et al. presentation but augmented with locally available technology and expertise  - Local Module Co-ordinator / demonstrators – applied examples |
| 16:30 – 17:30 | [**Topic 9: Tools - Social investigation and engagement tools**](#Topic9) | |
|  | * 30 mins presentation * 30 case study examples | - Based on Billing presentation – with relevant local, national and international examples  - From industry AND other marine users (+ve and –ve experiences) |

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| **DAY 3** |
| **Time** | **Session Title and Information** | |
| 09:00 – 10:30 | [**Topic 10: Tools - Sea lice and salmon aquaculture**](#Topic10) | |
|  | * 40 mins presentation * 50 mins facilitated discussion | - Based on Adams presentation – augmented with national, local examples of application  - Local Module Co-ordinator – the use of MSP for disease control |
| 10:30 – 11:00 | **Coffee** | |
| 11:00 – 12:30 | [**Topic 11 Forthcoming Issues for Aquaculture and Spatial Planning**](#Topic11) | |
|  | * 15 mins research perspective * 15 mins regulator perspective * 15 mins industry perspective * 45 mins facilitated discussion | - Based on O’Hagan & Gault presentation – with facilitated discussion / HEI / Research Centre  - Government official  - Local / National industry  - Local Moderator |
| 12:30 | **CLOSE** | |

# Appendix

**Topic 1: Introduction to Aquaculture in a Global Context**

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**Topic 2: Current frameworks for aquaculture planning and management**

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**Topic 3: Maritime Spatial Planning in Europe: Opportunities for Aquaculture**

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**Topic 4: Ecosystem Approach to Aquaculture (EAA)**

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**Topic 5: Introduction to the AquaSpace Tool for use in spatial planning**

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**Topic 6: Tools – Geographical Information Systems**

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**Topic 7: Tools - Remote Sensing for Marine Spatial Planning**

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**Topic 8: Tools - Visualisation issues and tools**

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**Topic 9: Tools - Social investigation and engagement tools**

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**Topic 10: Tools - Sea lice and salmon aquaculture**

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**Topic 11: Forthcoming Issues for Aquaculture and Spatial Planning**

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