AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 — AQUAEXCEL2020

D4.6 Suite of dissemination resources and tools

AquaTT

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Executive Summary

Objectives
The objective of Deliverable 4.6 (Suite of Dissemination Resources and Tools) is to facilitate AQUAEXCEL2020's communication and dissemination actions by developing a portfolio of dissemination resources and tools for the promotion and widespread awareness of the project and its achievements to a large audience over the course of the full project.

Rationale:
The portfolio of dissemination resources and tools is intended to help partners communicate the project and its results in a consistent and efficient manner. The first step in developing the portfolio started with developing a strong project branding suite. Based on the brand developed, Work Package 4 leader, AquaTT, have developed the full portfolio of dissemination resources and tools for AQUAEXCEL2020, including the project website, Twitter account, factsheet, PowerPoint templates (2 versions), poster template, pull-up banner, Innovative Output Catalogues, e-newsletters and project deliverable report template. Other partners have also developed videos for the AQUAEXCEL2020 project. All material and tools are available for all partners on the project management platform (INRA's intranet) or by contacting AquaTT, and will be maintained and updated as necessary. Further resources will be developed over the course of the project in line with the project's Description of Action (DoA) as well as in response to project results and stakeholder requirements.

Main Results:
This deliverable report presents an overview of the full portfolio of dissemination resources and tools that have been developed for project promotion. D4.6 was scheduled to be developed by M50 (November 2019) and has been achieved before this due date. Dissemination activities such as the bi-annual project e-newsletter, maintenance of the website and Twitter account, and release of press releases, promotional articles and promotional leaflets will be on-going activities until the end of the project.

Authors/Teams involved:
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1. Introduction

1.1. Objective

The AQUAEXCEL2020 Suite of Dissemination Resources and Tools has been developed to facilitate the promotion of the project and disseminate the project's objectives and findings to a variety of stakeholders and possible end-users. It is intended to help partners communicate the project and its results in a consistent and efficient manner. The portfolio includes:

- Project Logo
- Project Brand Guidelines
- Project Public Website
- Project PowerPoint Presentation Templates
- Project Poster Presentation Template
- Project Pull-up Banner
- Project Videos
- Project Twitter account
- Project Factsheet
- 11 Innovative Output Catalogues (with additional Innovative Output Catalogues to be developed as further innovative project OUTPUTS are produced)
- Project Press Releases (with additional press releases / promotional articles due in the future)
- 7 Project e-Newsletters (with additional e-newsletters due in the future)
- Project Deliverable Report Template

1.2 Rationale

The function of the AQUAEXCEL2020 Suite of Dissemination Resources and Tools (D4.6) is to provide a range of tools and materials to facilitate the promotion and widespread awareness of the project, its objectives, activities and results. Developing a strong brand is an important element of the project; the recognition and perception of a brand is highly influenced by its visual presentation in communication materials. Items such as the factsheet and e-newsletter are intended to help partners communicate the project in layman's terms in a consistent and efficient manner. The material developed in AQUAEXCEL2020 has built on the previous FP7-AQUAEXCEL project to reinforce the network's image, use the best practice, show continuity (although it is two different projects) and durably integrate the project in the research landscape.

1.3 Results

1.3.1 Project logo

The project logo is an integral part of the brand and is included in all project promotional material. The AQUAEXCEL2020 logo is constructed using a combination of bold lettering, colour choices and minimal illustration. The suite of logos is available on the project intranet and by contacting WP4 leader AquaTT (contact: rebecca@aquatt.ie). Guidance on the AQUAEXCEL2020 logo can be found in the AQUAEXCEL2020 Brand Guidelines (Annex 1).

Logo (colour)

Logo (black and white)

1.3.2 Project Brand Guidelines

The AQUAEXCEL2020 brand guidelines (Annex 1) offer the means by which all partners in AQUAEXCEL2020 can achieve the prescribed standards of presentation. The document includes information on the different versions of the project logo (typeface, colour palette, and their correct use), guidelines for using the Letter, PowerPoint and Poster templates, and details on the correct EU acknowledgement that must be included with all dissemination activities related to the project. The brand guidelines will be updated if needed over the course of the project. The brand guidelines are available on the project intranet and by contacting WP4 leader AquaTT (contact: rebecca@aquatt.ie).

1.3.3 One-Stop-Access Online Portal and General Website

The project online portal (www.aquaexcel2020.eu) is the main tool for promoting the project and disseminating the project's objectives, partnership, work plan and results to a wide audience including all stakeholders and possible end-users. The one-stop-access online portal has been designed to integrate and harmonise access to European aquaculture RI resources. Integrated aquaculture RI information in the AQUAEXCEL2020 portal helps the European aquaculture community to identify and gain access to a wide range of resources, services, facilities and knowledge.

The AQUAEXCEL2020 online portal has been developed following the EU's best practice guidelines for project websites. To ensure successful promotion of the project and to sustain the interest of the target audience and attract new users, the portal's content is being maintained, continuously updated and populated with new information throughout the project's lifetime.

The one-stop-access online portal plays multiple roles:

- A communication resource to promote the project, its objectives and partnership.
- A comprehensive inventory of the Research Infrastructures (RIs) of Europe. AQUAEXCEL2020 has further developed an all-inclusive inventory of the aquaculture RIs in Europe, building upon the information from FP7-AQUAEXCEL which has now grown into the most complete and dynamic aquaculture RI database hitherto available.
- A communication resource to update interested parties of progress, events, results and outcomes, and a repository for key deliverables.
- A location for customised tools and services to support the operation of the project.

Portal address: www.aquaexcel2020.eu

The portal structure follows an easy to use and intuitive pathway that allows the user to explore it easily. On the home page, the top menu bar contains buttons for sections of the website on 'About,' 'Transnational Access,' 'Interactive Map,' 'Training Courses,' 'Media Centre,' 'Results', 'AQUAEXCEL Archive' and other useful links to the projects intranet, sign-up for project news and a direct link to the project Twitter page. Snapshots of the website can be seen in the figures below:

Key features:

- Events section: events organised by the AQUAEXCEL2020 consortium, as well as events where AQUAEXCEL2020 partners are represented and any other events of interest to the partnership such as conferences and workshops related to AQUAEXCEL2020's domain;

- Interactive map: this map provides a comprehensive inventory of the Research Infrastructures (RIs) of Europe. Building on the consensus that the scientific community, industry stakeholders and policy-makers would benefit from a comprehensive inventory of the RIs of Europe, AQUAEXCEL2020 further developed the all-inclusive inventory of the aquaculture RIs in Europe that was set up in FP7-AQUAEXCEL. The inventory is growing into the most complete and dynamic aquaculture RI database hitherto available. It contains a legend, distinguishing between Research Infrastructures (RIs) which belong to the AQUAEXCEL2020 TNA program and other European RIs. RIs are further categorised by university, research institute, industry and other;

- TNA section: User-friendly interface to attract users and give easy access to information on TNA, detailed information on the features and opportunities provided at the TNA facilities, news, application forms, guidance documents for TNA, examples of past TNA projects;

- News section: is regularly updated with news items about the project as well as any external news items relevant to AQUAEXCEL2020;

- Results section: includes a list of open access scientific publications, articles, project deliverables, innovative outputs and any other significant outputs from the project as they become available;

- Media section: houses all dissemination products and activities including newsletters, press releases, videos and the project factsheet;

- Training courses: this section includes the upcoming and current AQUAEXCEL2020 training courses and access to application forms and registration information;

Google analytics is used to track traffic and monitor use of the website.

For more information see report "**D4.2 AQUAEXCEL2020 One-Stop-Access Online Portal and general website."**

1.3.4 Project PowerPoint Presentation Templates

AQUAEXCEL2020 PowerPoint templates have been developed to use at internal and external events when presenting the AQUAEXCEL2020 project and/or its outcomes (Annex 2). There are two versions of the template available – one regular and one wide-screen version. Both templates include one cover slide which includes the title of presentation and the speaker, 4 options for main body slides (including one with an image) and a 'Thank you' slide containing relevant contact details of the project. The PowerPoint template is available on the project intranet and by contacting WP4 leader AquaTT (contact: rebecca@aquatt.ie).

1.3.5 Project Poster Presentation Template

Three poster templates have been designed and developed for AQUAEXCEL2020 poster presentations (Annex 3), depending on the need of the user.

1. Basic template with no images
2. Including the same image as is used in the project factsheet and a small amount of information on the project
3. An alternative image to template #2 without the circles that include some basic project information.

The posters are designed for printing in full colour. The poster templates are available on the project intranet and by contacting WP4 leader AquaTT (contact: rebecca@aquatt.ie).

1.3.6 Project Pull-Up Banner

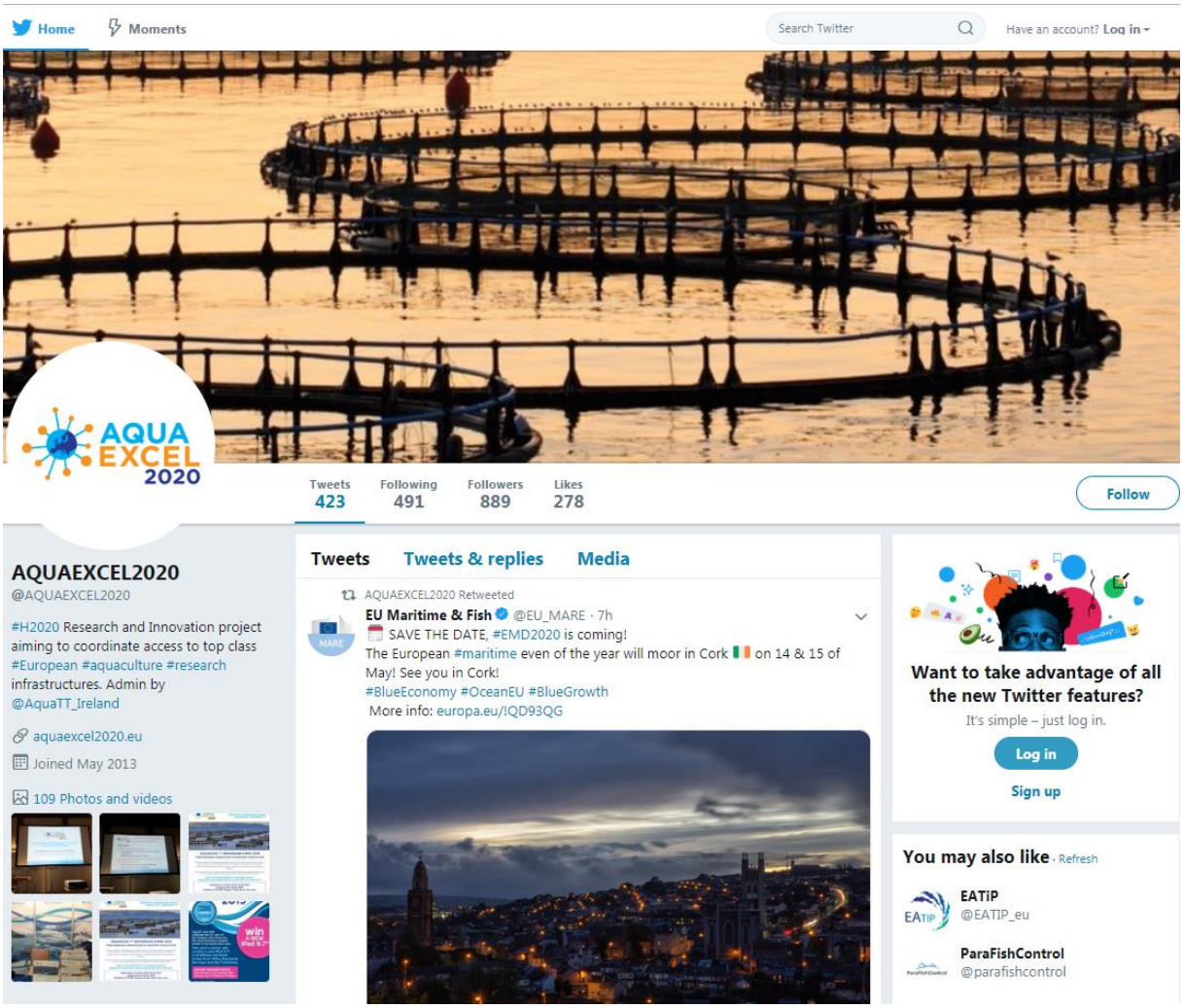
A project pull-up banner has been designed and developed to be showcased at AQUAEXCEL2020 related events (Annex 4). The pull-up banner has been made available on

the project intranet for partners to access and print if needed. Partners who wish to obtain full instructions on printing the banner should contact WP4 leader AquaTT (contact person: rebecca@aquatt.ie).

1.3.7 Project Twitter Account

Social networking is part of the AQUAEXCEL2020 communication strategy. A dedicated project Twitter account (@AQUAEXCEL2020) has been set up at the start of the project and is used to tweet AQUAEXCEL2020 relevant information. The Twitter page is maintained by WP4 leader AquaTT and project related tweets are posted regularly in accordance with the H2020 Programme Guidance Social media guide for EU funded R&I projects.

See below for screenshot of the AQUAEXCEL2020 Twitter page.



1.3.8 Project Factsheet

The project factsheet (Annex 5) was designed to give the general audience an overview of the AQUAEXCEL2020 project. The factsheet describes the project's challenges, its main objectives, consortium members, funding and expected results. It is used to raise general

awareness of the project. Partners are encouraged to distribute the factsheet through their networks and at relevant events.

The factsheet is available on the internal project management intranet, the AQUAEXCEL2020 website and can be requested from WP4 leader AquaTT (contact person: rebecca@aquatt.ie). Partners can also request the design of a translated version of the factsheet. Full details are available in the AQUAEXCEL2020 Dissemination and Exploitation Plan (DEP) (MS11).

1.3.9 Innovative Output Catalogues

As part of the knowledge management and transfer activities carried out through WP2, AquaTT develop Innovative Output Catalogues for the most innovative and industry-relevant outputs selected by the Industry Research Advisory Panel (IRAP) committee. Currently (October 2019) 11 Innovative Output Catalogues have been developed (Annex 6). These Catalogues are disseminated at relevant events, in particular the AQUAEXCEL2020 brokerage events (WP2), yearly Aquaculture Europe events and sector-specific events such as EATiP and FEAP AGM's. They have also been uploaded to the project portal, and they will contribute to the promotion of both the TNA and AQUAEXCEL2020 research results on a wider level. Further Innovative Output Catalogues will be developed over the remainder of the project.

1.3.10 Project Press Releases

Please see Milestone Reports MS8a, MS8b and MS8c for information on the project press releases to date.

1.3.11 Project e-Newsletters

AQUAEXCEL2020 publishes a dedicated project e-newsletter on a half-yearly basis, nine in total (M12, M18, M24, M30, M36, M42, M48, M54, M60), targeting an external audience. The project e-newsletter is a tool for promoting the project, its objectives, partners, progress and results to a wide audience including all partners, stakeholders and possible end-users. The AQUAEXCEL2020 e-Newsletter is sent out twice per year to partners and stakeholder contacts obtained through a GDPR approved database, that interested stakeholders can subscribe to through the project website. Seven e-newsletters have been released so far (October 2019). Please See Deliverable reports D4.3_1 to D4.3_7 for details.

1.3.12 Project Letter Template

A project letter template was developed to ensure a consistent and professional design to written communications external to the project (Annex 7). Partners can contact WP4 leader AquaTT (rebecca@aquatt.ie) for a copy of this letter template.

1.3.13 Project Videos

A number of project videos have already been developed in relation to the AQUAEXCEL2020 project partners and results (Annex 8). Two videos were created to promote the AEFishBIT project OUTPUT and one video was created to promote the University of Stirling's aquaculture facilities that are available to successful TNA applicants. If appropriate and depending budget allowances, more videos might be developed during the final year of the project.

1.3.14 Project Deliverable Report Template

A report template was developed for the project's deliverable reports (Annex 9). This template was designed so that deliverables were appealing for external stakeholders to read, rather than the usual administrative format of deliverable reports. The public deliverable reports are uploaded to the Results section of the website and creating a template with colours and images increases the readability of these reports.

Conclusion

The aim of deliverable D4.6 was to develop a strong project portfolio of dissemination resources and tools. This report highlights the key work done to date in developing this portfolio; numerous tools have been developed and are actively used to promote project activities and results. The AQUAEXCEL2020 portfolio currently (October 2019) includes the logo, brand guidelines, website, Twitter account, PowerPoint, letter and poster presentation templates, press releases, videos, pull-up banner, factsheet, 11 Innovative Output Catalogues and 7 e-newsletters. All these tools are available to partners on the collaborative workspace - https://intranet.inra-transfert.fr/

Document information

EU Project N°	652831	**Acronym**	AQUAEXCEL2020
Full Title	AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020		
Project website	www.aquaexcel.eu		

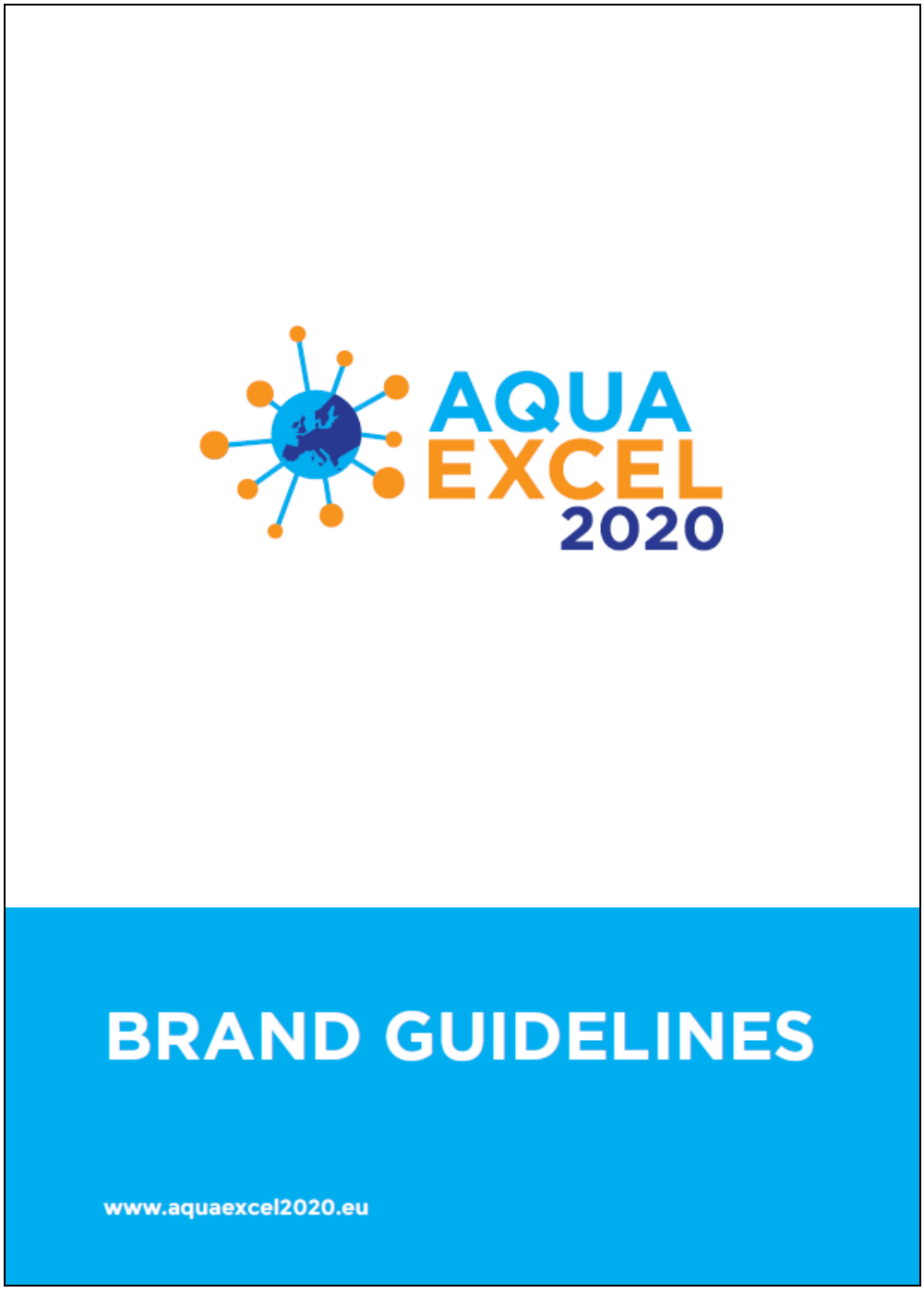
Deliverable	**N°**	D4.6	**Title**	**Suite of dissemination resources and tools**
Work Package	**N°**	**4**	**Title**	**NA4 – Integration, training, dissemination and cooperation**

Date of delivery	**Contractual**	11/2019 (Month 50)	**Actual**	11/2019 (M50)
Dissemination level	X	**PU Public, fully open, e.g. web**		
		CO Confidential, restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC.		

Authors (Partner)	AquaTT			
Responsible Author	**Name**	Marieke Reuver Rebecca Doyle	**Email**	**Marieke@aquatt.ie** **Rebecca@aquatt.ie**

Version log			
Issue Date	**Revision N°**	**Author**	**Change**
14/11/2019	1	Bénédicte Ferreira	First review

Annex 1: Project Branding Guidelines



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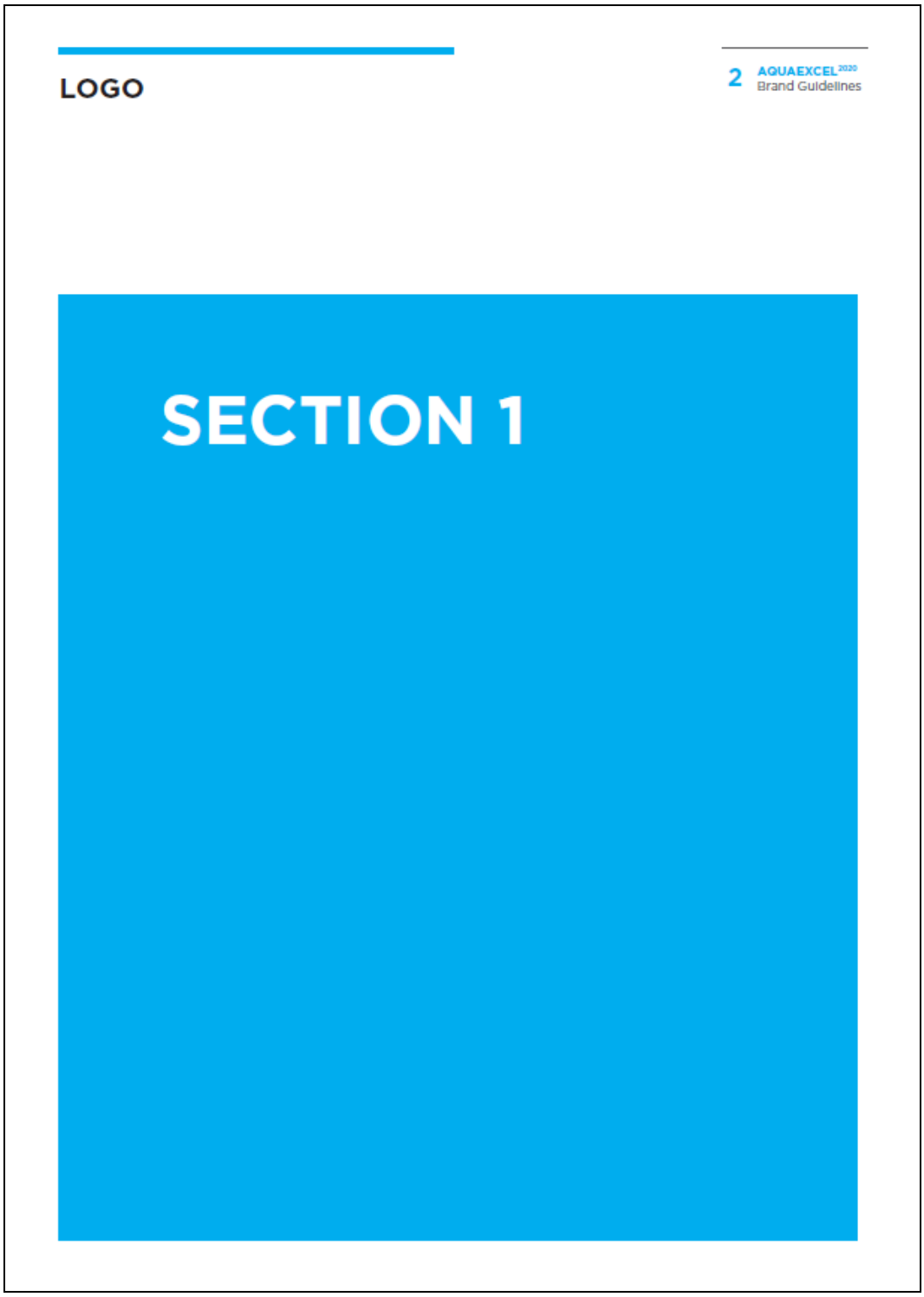
INTRODUCTION

Brand Guidelines

The brand guidelines set out in this manual for AQUAEXCEL2020 offer the means by which all partners in AQUAEXCEL2020 can achieve the prescribed standards of presentation.

It is recommended that partners follow the standards given in this manual to ensure a high standard of project presentation.

For any queries regarding the implemention of the AQUAEXCEL2020 branding guidelines, please contact Marieke Reuver (**marieke@aquatt.ie**).


LOGO
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SECTION 1

LOGO

The AQUAEXCEL2020 logo is constructed using a combination of bold lettering, colour choices and minimal illustration.

This section gives you guidelines on how to use the logo in any format, for example the recommended type face to use, the colour palette and best use of the logo on different backgrounds.

TYPEFACES

Primary - Gotham (Graphic Design Use Only)

Gotham is the primary AQUAEXCEL2020 typeface. This simple, modern font helps communicate ideas clearly and confidently. It is highly legible in both print and digital communications. It is available in a range of weights: from light to extrabold.

Gotham is primarily used for print design. For internal documents (such as Microsoft Office applications), please use the alternate typefaces on the following page.

It is recommended that no other typefaces are used.

Gotham is available for purchase from:: **www.typography.com/fonts/gotham**

Gotham Book

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @*?!&%+=”

Gotham Bold

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @*?!&%+=”

TYPEFACES

Secondary - Arial (Internal Use)
Arial is the secondary AQUAEXCEL2020 typeface. This font is intended for internal use. Arial reflects the clean look of the primary typeface and should be used whenever possible within Microsoft Office applications i.e. Word, Powerpoint, Excel etc.

Arial Regular is recommended for all standard communication materials e.g. letters/faxes/reports/ emails etc.

Arial Regular
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @*?!&%+=”

Arial Italic
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @?!&%+=”*

Arial Bold
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @*?!&%+=”

Arial Bold Italic
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789 @*?!&%+=”

COLOUR PALETTE

Print
The CMYK values are required when preparing materials for professional print jobs.

In-office printing will provide varied results depending on equipment and as a result, 100% colour accuracy cannot be expected.

Web
The RGB values are required when preparing materials for the web.

It is important to note that the calibration of monitors, desktop printers and projection equipment can vary. Please adhere to the RGB values provided to ensure consistency across all materials for the web.

AQUAEXCEL2020 Blue

C	100	R	0
M	0	G	174
Y	0	B	239
K	0		

AQUAEXCEL2020 Orange

C	0	R	247
M	50	G	148
Y	100	B	30
K	0		

AQUAEXCEL2020 Navy

C	100	R	43
M	95	G	57
Y	5	B	144
K	0		

AQUAEXCEL2020 Grey

C	0	R	83
M	0	G	85
Y	0	B	84
K	80		

BLACK & WHITE VERSION

Black and white versions are intended for applications that are restricted in colour, such as fax, memo etc. and any time it is not possible to use colour printing techniques.

CORRECT USE OF LOGO

Background Variations

The preferred background for the AQUAEXCEL2020 logo is white, but in some cases it is necessary to use the logo over colour. In all cases, it is important to ensure that all elements of the logo are clearly visible.

Correct
The full colour logo is only fully visible on a light background.

Incorrect
The full colour logo is not fully visible here as the background is too dark.

Correct
The full colour logo is only fully visible on a light background.

Incorrect
The full colour logo is not fully visible here as the background is too dark.

Correct
The black and white logo is fully visible on a light background.

Incorrect
The black and white logo is not fully visible here as the background is too dark.

Correct
The black and white logo is fully visible on a dark background.

Incorrect
The black and white logo is not fully visible here as the background is too dark.

CORRECT USE OF LOGO

Background Variations

The preferred background for the AQUAEXCEL2020 logo is white, but in some cases it is necessary to use the logo over images. In all cases, it is important to ensure that all elements of the logo are clearly visible.

Correct
The full colour logo is fully visible on a light image.

Incorrect
The full colour logo is not fully visible on a dark image.

Correct
The full colour logo is fully visible on a light image.

Incorrect
The full colour logo is not fully visible on a dark image.

Correct
The black and white logo is fully visible on a light image.

Incorrect
The black and white logo is not fully visible here as the image is too dark.

Correct
The black and white logo is fully visible on a light image.

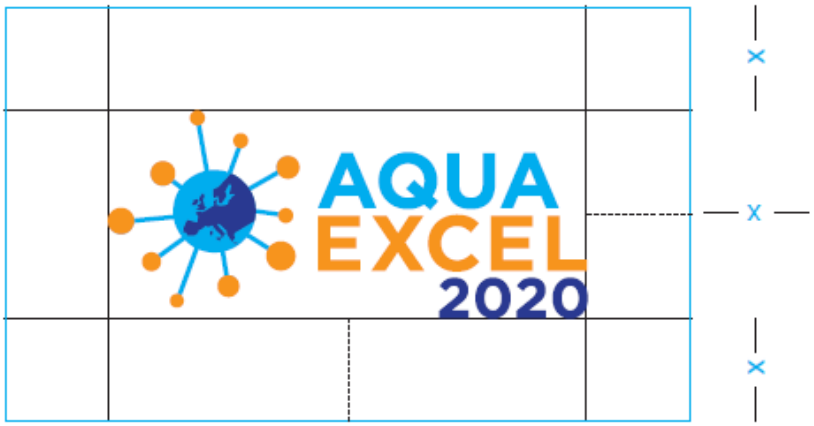
Incorrect
The black and white logo is not fully visible here as the image is too dark.

CORRECT USE OF LOGO

Clear Space

Clear space is the area surrounding the logo that must be kept free of other graphical elements. This is to ensure that the logo never appears cramped.

The minimum required space is marked by the letter X which is equal to half the height of the logo.



INCORRECT USE OF LOGO

What not to do

Never recreate elements of the artwork. Do not modify elements or alter colours. Please adhere to the guidelines below.

✖ Do not distort logo

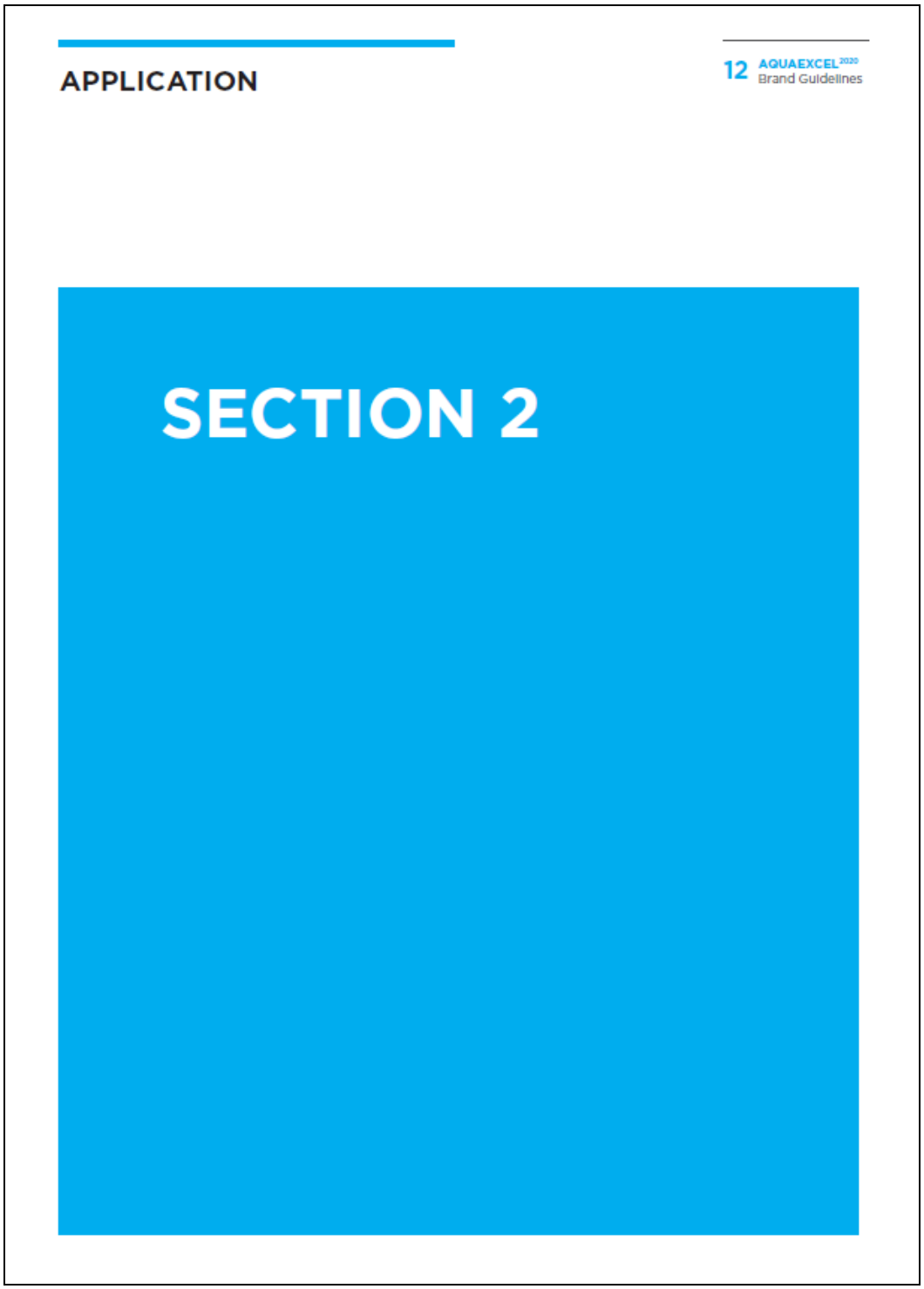
✖ Do not modify colours

✖ Do not rearrange elements

✖ Do not add elements

✖ Do not use elements alone

✖ Do not modify proportion


APPLICATION
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SECTION 2

STATIONERY

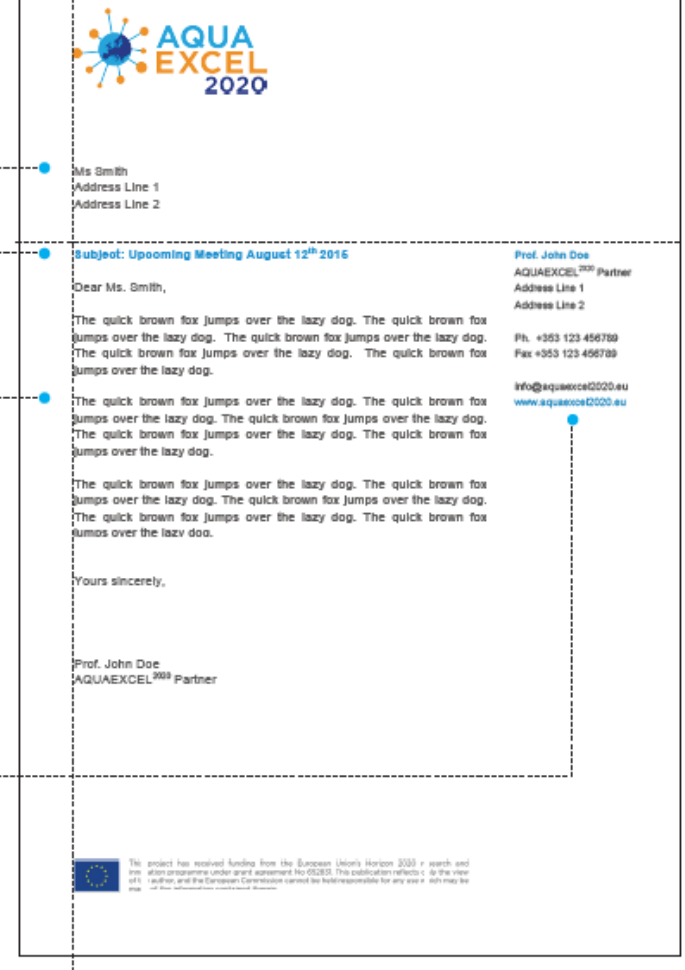
Letter Template
Finished size A4 297mm x 210mm. The recommended font is Arial. Recommended font size is 11pt.

Address
Arial Regular 11pt
Upper and lowercase
Aligned left

Subject/Date
Arial Bold 11pt
Upper and lowercase
Aligned left

Body Text
Arial Regular 11pt
Upper and lowercase
Aligned left

Contact Details
Arial Regular/Bold 9pt
Upper and lowercase
Aligned left



POWERPOINT

Cover & Closing Slides

AquaTT has developed a project PowerPoint presentation template based on the AQUAEXCEL2020 branding, for partners to use at internal and external events when promoting the project and its results.

PowerPoint Title
Arial Bold 36pt
Upper and lowercase
Centre-Aligned

Presenter Details
Arial Bold 28pt
Upper and lowercase
Centre-Aligned

Contact Details
Arial Bold 26pt, Regular 20pt
Upper and lowercase
Centre-aligned

POWERPOINT

Inner Slides

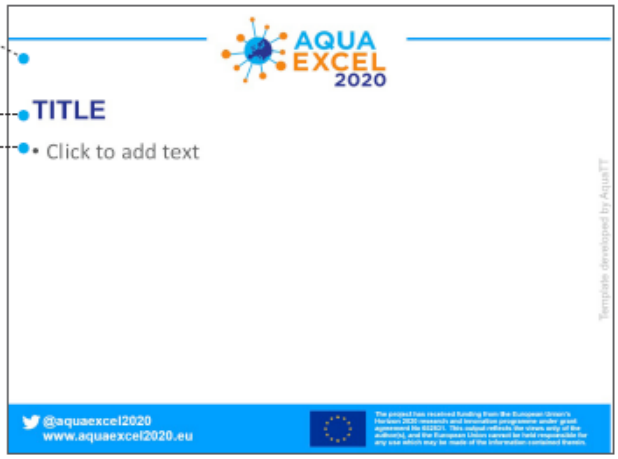
The recommended font is Arial. There are different styles of body slide provided.

Please note, it is recommended to use the slides without watermarks when using imagery such as tables, graphs and photography. Always ensure that all text and imagery is clearly visible.

Heading
AQUAEXCEL2020 Navy

Subheading
AQUAEXCEL2020 Blue

Body Text
AQUAEXCEL2020 Grey



POWERPOINT (WIDESCREEN)

Cover & Closing Slides
AquaTT has developed a project PowerPoint presentation template in widescreen format based on the AQUAEXCEL2020 branding, for partners to use at internal and external events when promoting the project and its results.

PowerPoint Title
Arial Bold 36pt
Upper and lowercase
Centre-Aligned

Presenter Details
Arial Bold 28pt
Upper and lowercase
Centre-Aligned

POWERPOINT (WIDESCREEN)

Inner Slides

The recommended font is Arial. There are different styles of body slide provided.

Please note, it is recommended to use the slides without watermarks when using imagery such as tables, graphs and photography. Always ensure that all text and imagery is clearly visible.

Heading
AQUAEXCEL2020 Navy

Subheading
AQUAEXCEL2020 Blue

Body Text
AQUAEXCEL2020 Grey

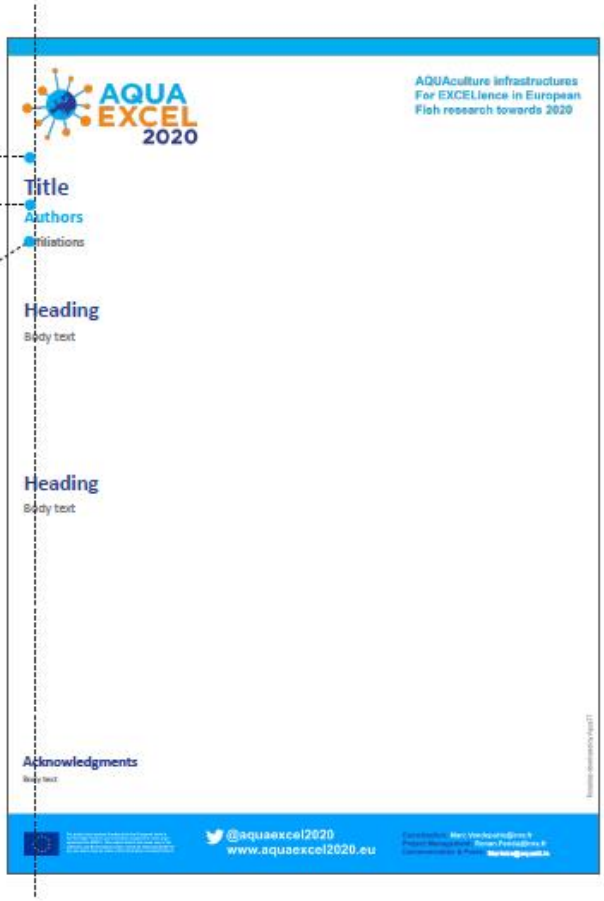
POSTER

Poster Template
The recommended font is Arial.

Heading
AQUAEXCEL2020 Navy

Subtitle
AQUAEXCEL2020 Blue

Body Text
AQUAEXCEL2020 Grey



EU ACKNOWLEDGEMENT

Acknowledgement of EU funding

All publications or any other dissemination relating to foreground should include the EU emblem and the following statement to indicate that said foreground was generated with the assistance of financial support from the European Union:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652831. This publication reflects only the view of the author, and the European Commission cannot be held responsible for any use which may be made of the information contained therein

A combined EU emblem and disclaimer graphic is available in the AQUAEXCEL2020 logo suite.

EU emblem

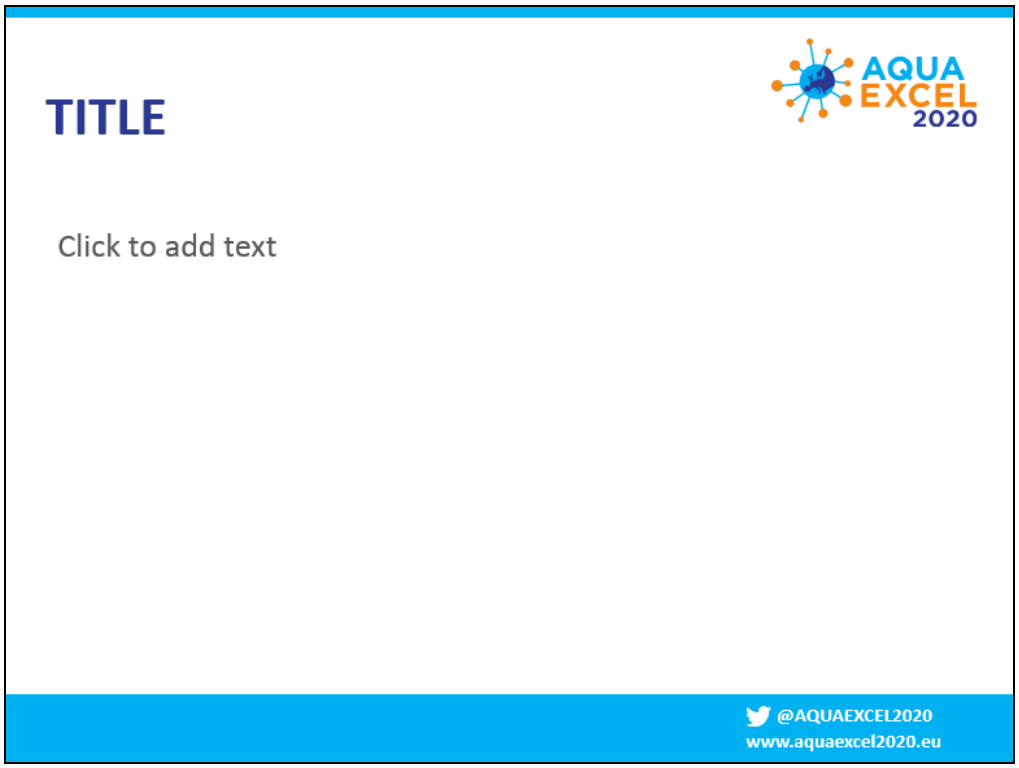
High-resolution versions of the EU flag can be found here: **http://europa.eu/about-eu/basic-information/symbols/flag/**

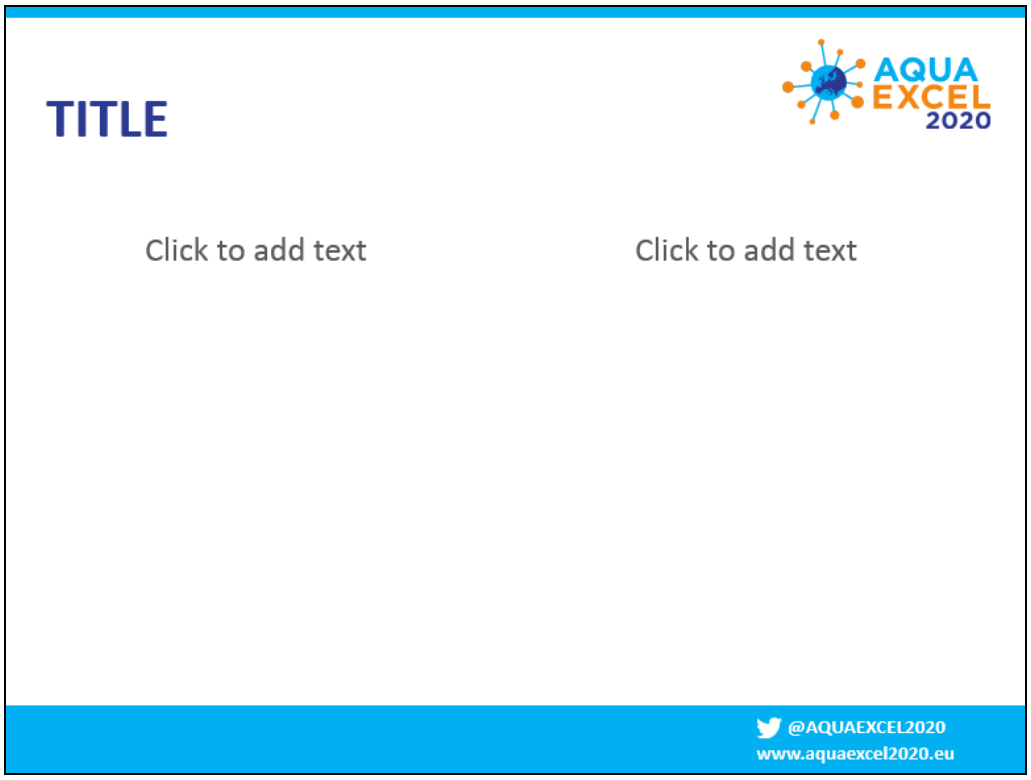
AQUAEXCEL2020
Brand Guidelines

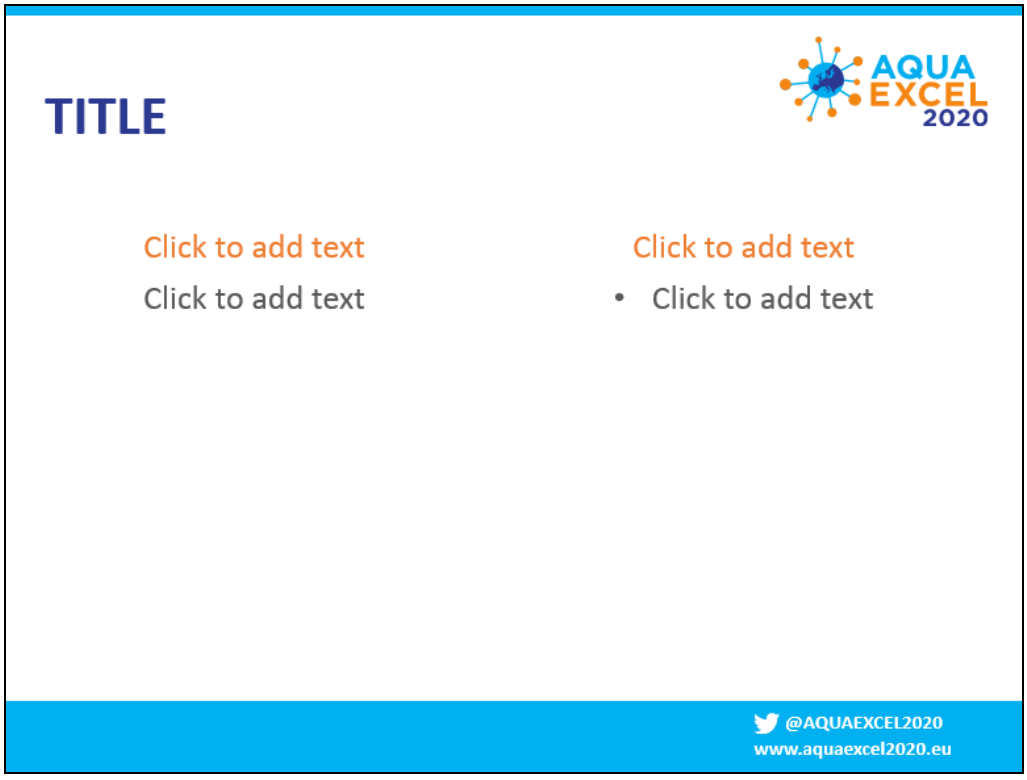
Designed and Developed by AquaTT

www.aquatt.ie

Annex 2: Project PowerPoint Template (normal version)




TITLE
Click to add text
Click to add text
@AQUAEXCEL2020
www.aquaexcel2020.eu


TITLE
Click to add text
Click to add text
Click to add text
Click to add text
@AQUAEXCEL2020
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no 652831 (AQUAEXCEL2020). This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.
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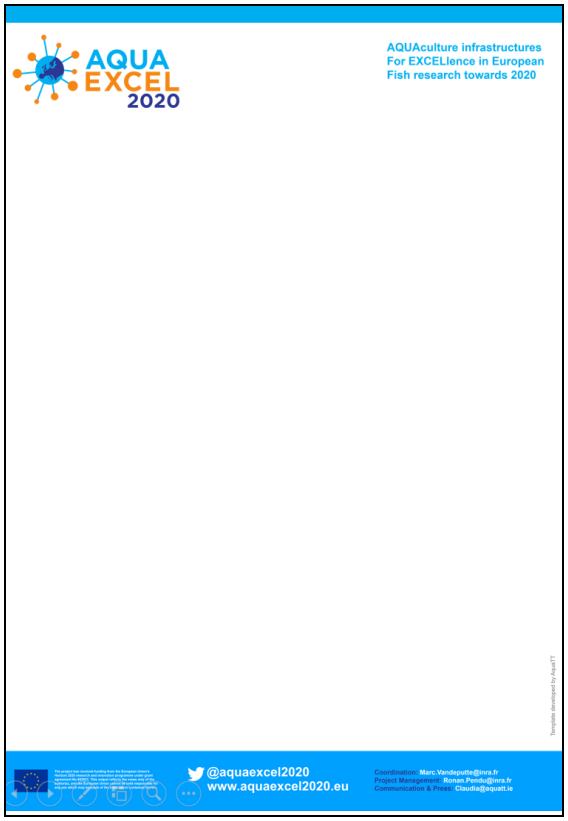
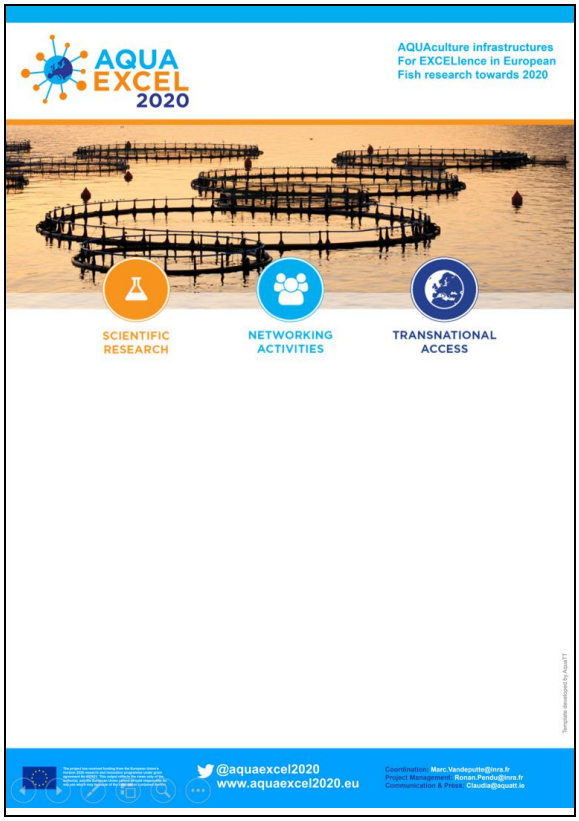
Annex 3: Project Poster Templates





Annex 4: Project Pull-up banner

Annex 5: Project Factsheet

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 - AQUAEXCEL2020

SCIENTIFIC RESEARCH

NETWORKING ACTIVITIES

TRANSNATIONAL ACCESS

AT A GLANCE

PROGRAMME: Horizon 2020 (INFRAIA-1-2014/2015)
TYPE OF ACTION: Research and Innovation Action
DURATION: 1 October 2015 – 31 October 2020 (61 months)
CONSORTIUM: 22 partners from 12 countries
COORDINATOR: Institut National de la Recherche Agronomique (INRA), France

THE CHALLENGE

As the global population is growing, there is an increasing need for fish. Aquaculture production is the way to meet this demand, but while the aquaculture sector is developing worldwide, it has stagnated in Europe in recent years. Sustainable growth of the European aquaculture sector, based on efficient and environmentally responsible production of high value fish products, can be achieved by ensuring excellent scientific research and by the results being translated into innovation and industrial growth.

PROJECT OBJECTIVES

European researchers need effective and convenient access to the best Research Infrastructures in order to conduct research for the advancement of knowledge and technology in the aquaculture sector. Building on the success of its predecessor AQUAEXCEL (2011-2015), AQUAEXCEL2020 aims to bring together, integrate, and open up highly diverse key national and regional aquaculture Research Infrastructures in Europe to all European researchers, from both academia and industry, ensuring their optimal use and joint development.

AQUAEXCEL2020 will provide Transnational Access to 39 Research Infrastructures covering:

WATER ENVIRONMENTS	SPECIES	FIELDS OF EXPERTISE	AQUACULTURE SYSTEMS	FACILITY SCALES
Freshwater, Marine, Cold, Temperate and Warm Water Environments	Salmonids, Cold and Warm Water Marine Fish, Freshwater Fish and Artemia	Nutrition, Physiology, Health & Welfare, Genetics, Engineering, Monitoring & Management Technologies	Cage, Pond, Recirculation, Flowthrough, Hatchery and Disease Challenge Systems	Small, Medium and Industrial Scales

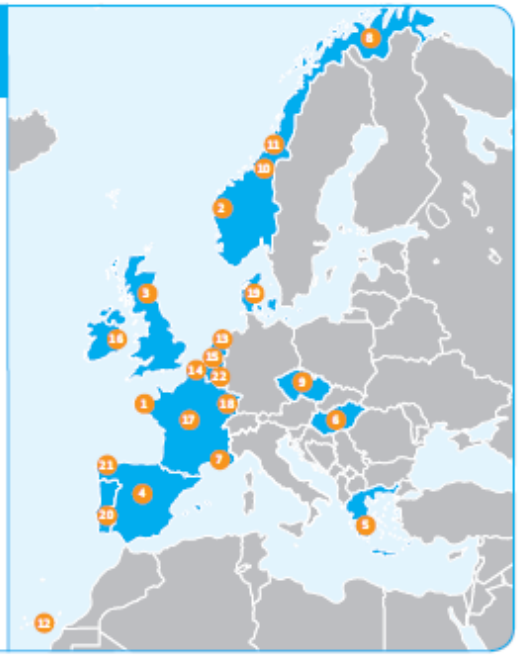
EXPECTED RESULTS

- An integrated portal providing one-stop information about and access to all 39 available AQUAEXCEL2020 research facilities, as well as details on the research generated.
- Standardised protocols for fish experiments, allowing high quality experimental designs and repeatability, including trait definitions, experimental conditions and procedures.
- An e-infrastructure for access to aquaculture research facilities providing both real access to running virtual experiments and remote access to actual experiments.
- Nine training courses on highly diverse relevant issues, including face-to-face and virtual activities.
- Definition of common standards and data interoperability across research infrastructures, fostering collaborative activities, including two infrastructures of the European Strategy Forum on Research Infrastructures (ESFRI): the European Marine Biological Resource Centre (EMBRC) and ELIXIR.
- Catalogues of fish lines available for Transnational Access, with reference phenotypic and genomic information.
- Innovative nano-sensors for remote logging of biological parameters of individual fish within a group.
- Access to a wide panel of more than 15 "new" fish species for Transnational Access experiments.
- Increased awareness of Research Infrastructures as innovation tools for the aquaculture sector.
- Exploitation and transfer of results from a wide variety of Transnational Access research projects in addition to the project's own networking and joint research activities.

CONSORTIUM

The consortium comprises 22 partners based in 12 European countries, who are considered leaders in their respective domains of expertise.

1. Institut National de la Recherche Agronomique (INRA)
2. Havforskningsinstituttet (IMR)
3. The University of Stirling (UoS)
4. Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC)
5. Hellenic Centre for Marine Research (HCMR)
6. Nemzeti Agrárkutatási és Innovációs Központ, Halászati Kutatóintézet (NAIK HAKI)
7. Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer)
8. Nofima AS (NOFIMA)
9. Jihočeská univerzita v Českých Budějovicích (JU)
10. Norges Teknisk-Naturvitenskapelige Universitet (NTNU)
11. SINTEF Fiskeri og havbruk AS (SINTEF)
12. Universidad de Las Palmas de Gran Canaria (ULPGC)
13. Wageningen University (WU)
14. Ghent University (UGhent)
15. Stichting Dienst Landbouwkundig Onderzoek (DLO-WLR)
16. AquaTT UETP CLG (AquaTT)
17. INRA Transfert S.A. (IT)
18. Université de Lorraine (UL)
19. Danmarks Tekniske Universitet (DTU)
20. Centro de Ciências do Mar do Algarve (CCMAR)
21. Instituto Español de Oceanografía (IEO)
22. European Aquaculture Technology and Innovation Platform (EATIP)



CONTACT US

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Communication & Press: rebecca@aquatt.ie

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Designed & developed by AquaTT

Annex 6: Innovative Output Catalogues

INSECT MEAL AS SUSTAINABLE FEED FOR JUVENILE EUROPEAN SEA BASS

SUMMARY

This research investigated the effect of fish meal replacement by insect mealworms (*Tenebrio molito*) in the diet of European (sea) bass (*Dicentrarchus labrax*) juveniles. Results showed that substitution of 25% ensures normal growth performance and feed utilisation of the juveniles. This finding comes at an important time for the European aquaculture industry as the updated EU 'Novel Food' Regulation (EU 2015/2283 – new rules to be applied as of January 2018) opens the door for the use of insects as an innovative food source in aquaculture.

KNOWLEDGE NEED

Fish farmers rely on sustainable feed that can make fish strong and healthy. The aquaculture industry is looking for alternative feed sources because the supply of a key ingredient of fish feed found in fish meal and fish oil is limited. However, completely replacing these with a different feed source in the fish's diet can lead to adverse effects on the fish, for example decreased digestion efficiency and increased susceptibility to diseases and stress. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their safe substitution levels must be established.

POTENTIAL IMPACT

- Substituting juvenile sea bass diets with mealworm meal reduces the need for fish meal and oil, which are costly, volatile and unsustainable sources. This could lead to a more sustainable and competitive aquaculture sector.
- The establishment of mealworms as a suitable feed substitution for juvenile basses opens the door for further research into its applicability for other aquaculture species.
- The findings contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.
- Economically, the substitution with mealworms is expected to reduce the feeding costs in European aquaculture as mealworms are expected to be a cheaper resource than fish meal and oil.

EATIP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 4- Sustainable Feed Production: Goal 1 and Goal 2. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xJx1AX**

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

UNDERLYING SCIENCE

Insects such as mealworms are natural food sources for many fish species. Farmed fish, fed with insect-based meals, are able to perform well, depending on the level of substitution. In this study, three levels of substitution of fish meal by mealworm were applied to the diet of juvenile sea bass: 0% (control group), 25% and 50%. The experimental trial lasted 70 days and three replicates were performed per diet, each containing 50 fish.

The following performance and functions were monitored: initial and final body weight (individual and total biomass); percentage mortality; weight gain; feed consumption and feed conversion rate; specific growth rate; protein efficiency ratio; and whole body composition (proximate analyses and fatty acids profile).

RESULTS

- **Substituting 25% of the diet with mealworms did not lead to adverse effects** on weight gain or changes in fatty acid composition.
- **Some negative effects were seen at the 50% substitution level**, with significant growth reduction, less favourable outcomes for specific growth rate and feed consumption ratio, as well as a change in fatty acid composition, particularly a decrease in the contents of omega-3 fatty acids.
- Protein efficiency ratio and feed consumption were **not affected** by either level of substitution.
- The whole-body proximate composition analysis **did not show any differences** between treatments.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture fish feed producers
APPLICATION: Developing and producing novel feed formulations based on alternative, safe and sustainable feed sources (like mealworms) with high biological value and low competitiveness with human nutrition.

END-USER 2: Aquaculture fish farmers
APPLICATION: Feeding of aquaculture fish stocks with cheaper and more sustainable fish feeds while keeping good production levels, leading to higher profits and reduced impact on the environment.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Promoting aquaculture as a sustainable, dynamic sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Scientific Community
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on many aspects (such as growth, health, taste of the final product, etc.), in both sea bass juveniles, adults and other fish species. This will support development of the aquaculture sector and contribute to increased levels of Technology Readiness, and progression towards commercialisation.

STATUS

Technology Readiness Level (TRL) 4 - the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Establish the precise optimal *Tenebrio* substitution rate in juvenile sea bass diets
- Investigate further effects of the *Tenebrio* diet substitution on other crucial elements such as digestive organs and their tissues, microbiota composition
- Understand changes in susceptibility to stressors under different diet compositions
- Explore suitability for other species and/or life stages
- Examine potential effects on the fish product, e.g. on texture, odour and taste
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment)

AT A GLANCE

TITLE: Insect Meal as Sustainable Feed for Juvenile European Sea Bass
KNOWLEDGE TYPE: Scientific publication
WHERE TO FIND IT: Gasco *et al.* 2016. Animal Feed Science and Technology 220, 34-45
STATUS: Published
TNA FACILITY USED: Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC), Hellenic Center for Marine Research, Heraklion, Crete, Greece
CONTACT DETAILS: Dr Laura Gasco, DISAFA, University of Turin, Italy; laura.Gasco@unito.it
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AquaIT

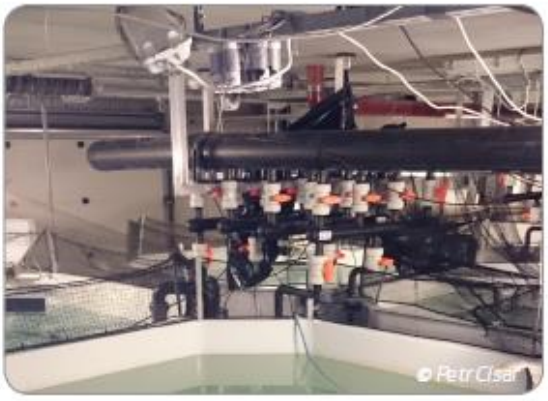
3DFISH – 3D FISH MONITORING SYSTEM FOR AQUACULTURE

SUMMARY

A novel infrared (IR) reflection system was developed for use as a suitable real-time 3D fish monitoring and measuring technique. The 3DFISH system is an inexpensive solution for real-time fish behaviour monitoring at indoor aquaculture facilities, and can also estimate fish weight. This will be of interest to aquaculture facilities looking to implement new 3D fish monitoring and measuring techniques or to improve upon existing techniques.

KNOWLEDGE NEED

Fish behaviour analysis can be used to address many questions related to nutrition, welfare, health and pathology, environmental interaction and aquaculture systems design. The basis of fish behaviour analysis is determining fish position and orientation at a particular time (called tracking). The automated analysis of fish tracks can provide information about individual fish behaviour, interaction and school behaviour, which can be used to monitor fish feeding activity and water quality, as well as enabling continuous contactless fish sampling. Existing technologies like 2D, single camera setups and stereo vision require either manual data analysis or are computationally intensive, causing problems with automated data processing.



POTENTIAL IMPACT

- 3DFISH enables non-invasive monitoring of fish behaviour and welfare indicators in real-time which allows for an efficient and cost-effective detection of behavioural abnormalities.
- Users of 3DFISH can detect potential problems in aquaculture facilities such as poor water quality and early disease signs earlier than in conventional systems, which will help reduce financial losses.
- The automated 3DFISH monitoring system requires less human labour, resulting in less human errors and higher profits.
- 3DFISH supports improved fish welfare because the fish do not need to be handled manually.

EATIP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 - Technology & Systems; Goal 4, Thematic Area 7 - Aquatic Animal Health & Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xJx1AX**

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

UNDERLYING SCIENCE

Several approaches exist for fish detection and tracking. In this study, three systems for the monitoring of fish behaviour in 3D have been compared and evaluated: stereo vision, structured light and the novel 3DFISH infrared (IR) reflection.

Each fish monitoring technique was tested with the following parameters:

- Octahedron shape fish tank with fresh water (0.83m x 2m)
- All cameras and light sources were placed in a horizontal plane 1.21m above the water level near the central axis of the tank
- The experiments were conducted using Atlantic salmon with lengths 29.5±2.5cm and weight 295±73g

RESULTS

- All three systems reviewed have approximately the same horizontal plane accuracy of 0.5cm which depends on camera resolution and image segmentation algorithms.
- The stereo vision based system showed the best accuracy, but it requires two cameras and high computational power for detection of the stereo pairs in both views.
- The maximum obtained monitoring depth for the IR reflection system was ~75cm at 10 frames per second.

The **IR reflection system is recommended in circumstances where high accuracy of 3D coordinates calculation is not required, as is the case for fish tracking.** It uses an external light source with a wavelength which is highly absorbed by water. The advantages of this system include the low price of the components and relatively low required computation power. Increase of the monitored water volume can be obtained by using a more powerful external illuminator.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture fish farmers
APPLICATION: Non-invasive monitoring of fish behaviour and various welfare indicators. If changes are seen, conditions can be reviewed and a veterinarian can be notified at an early stage of a problem. Furthermore, this real-time monitoring can aid in optimising feeding conditions, and allow for targeted fish sampling.

END-USER 2: Aquaculture veterinarians
APPLICATION: If an abnormal change in behaviour has been detected, veterinarians can investigate recordings and begin treatment much earlier if needed.

END-USER 3: Water treatment stations
APPLICATION: Water quality can be monitored indirectly through fish behaviour.

END-USER 4: Scientific community
APPLICATION: Researchers studying fish behaviour will be able to monitor any behavioural changes in real-time, for example in response to introduced stressors or alternative feeds.

STATUS

Technology Readiness Level (TRL) 6 - with respect to the fish weight estimation.

Next steps include:

- Redesigning the prototype for 24/7 usage
- Reimplementing the software to improve user interface

AT A GLANCE

TITLE: 3DFISH Monitoring System for Aquaculture
KNOWLEDGE TYPE: Peer-reviewed publication
WHERE TO FIND IT: Pausina *et al.* 2015. Aquacultural Engineering 69, 7–17
STATUS: Published, constant improvements and extensions of applications
TNA FACILITY USED: Nofima Centre for Recirculation in Aquaculture (Nofirma NCRA), Sunndalsøra, Norway
CONTACT DETAILS: Dr Petr Císař, University of South Bohemia, Czech Republic, cisar@frov.jcu.cz
PATENTS OR OTHER IPR EXPLOITATIONS: Software: protected by copyright; Hardware: a license for selling the system is planned

Designed and developed by AquaTT

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

A TOOLSET TO ASSESS INTESTINAL HEALTH BENEFITS OF FEED ADDITIVES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SUMMARY

A toolset was developed to evaluate the effects of adding an organic acid salt to high plant-ingredient substituted diets of gilthead sea bream to alleviate some of the detrimental effects of replacing fish meal and fish oil. The toolset was tested and validated using sodium butyrate, one of the most promising feed additives to be used in aquaculture. The tools and intestinal health testing approach can be adapted for other species and feed additives in development.

KNOWLEDGE NEED

Plant-based fish food is seen as more sustainable than that containing fish meal and fish oil. While some farmed fish species can survive without any or with a very limited supply of marine feed ingredients, they can suffer from detrimental effects such as decreased efficiency to digest food and increased susceptibility to diseases and stress. Feed additives that improve health and nutrition of farmed fish and lessen intestinal inflammation induced by plant-based ingredients are therefore needed.


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POTENTIAL IMPACT

- Use of the developed toolset will help with the understanding and assessment of the benefits of a feed additive, such as sodium butyrate, to a plant-based diet. As a simple "treatment" it can act as a first line of defence against diseases, improving health and welfare of gilthead sea bream fed on high plant-ingredient substituted diets.
- Similar positive effects could be assessed by making use of the toolset for a variety of other aquaculture species fed on similar diets when supplementing with sodium butyrate.
- The toolset will allow a better understanding of overall fish intestinal health as a result of a modified diet by providing more insight into the involved processes and dynamics.

EATIP - Strategic Research and Innovation Agenda (SRIA): Thematic Area 4 – Sustainable Feed Production; Goal 3, Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xJx1AX**

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UNDERLYING SCIENCE

Feeding experiments were conducted, all using the same dose of sodium butyrate supplementation (i.e. 0.4% BP-70 ®NOREL), applied to four different diets: a control diet containing 25% fish meal and three experimental plant-based diets containing only 5% fish meal and different levels of fish oil. The effects of these dietary changes were studied using the following toolset:

- Blood biochemical (Haemoglobin concentration)
- Histological
- Immunohistochemical
- Molecular (gene expression)
- Electrophysiological (trans-epithelial electrical resistance)

RESULTS

The toolset applied provided evidence that the plant-based diets had significant negative consequences on factors related to growth, immune-response, inflammation and defence against disease overall. In addition, the toolset also showed that with the addition of the sodium butyrate additive most of these modifications were returned to normal values. These results confirmed the **potential of the combined toolset used in the experiment to verify that a given additive can improve or reverse the detrimental effects of fish diet formulations** using a high plant replacement of fish meal and oil.

The tools and the intestinal health testing approach developed in this research and current studies can be used as a toolset for other species and for testing candidate feed additives or improving those already existing.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture feed producers
APPLICATION: The same histochemical, molecular, immunohistochemical, and electrophysiological toolset could be used to test the effect of plant-based diets and alternative feed additives.

END-USER 2: Aquaculture fish farmers
APPLICATION: The potential of an additive as a "treatment" can be tested in different aquaculture species or when disease risk in the production cycle is highest.

END-USER 3: Fish physiologists and pathologists (scientific community)
APPLICATION: The toolset will further investigations of the changes in intestinal health due to diet, infections and feed additives, to understand the fundamental processes across different species.

STATUS

Technology Readiness Level (TRL) 4 - the proof of concept has been successful on sea bream and butyrate under laboratory conditions.

Next steps include:

- Streamlining the toolset by optimisation e.g. inflammation assay, and reducing the test genes from 86 to the 20 most informative and reliable genes
- Investigating if the toolset can be extended to detect changes in the mucus protein and bacteria composition in a routine manner in the digestive system as a response to feed additives
- Understanding how these functional features are modified by genetic and epigenetic factors to establish a powerful model for the development of sustainable and healthy fish feeds
- Testing and validation of the toolset for different feed additives and species to confirm its universal applicability

AT A GLANCE

TITLE: A Toolset to Assess Intestinal Health Benefits of Feed Additives
KNOWLEDGE TYPE: Peer-reviewed publication
WHERE TO FIND IT: Estensoro *et al.* 2016. PlosOne 11(11): e0166564
STATUS: Published
TNA FACILITY USED: Institute of Aquaculture Torre de la sal (IATS-CSIC), Castellón, Spain; IATS-ANA (analytical), IATS-EXP (experimental)
CONTACT DETAILS: Dr Jaume Pérez-Sánchez, Nutrigenomics and Fish Endocrinology Group, IATS-CSIC, Spain; jaime.perez.sanchez@csic.es
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AgroBT

NUTRIENT AND ENERGY DIGESTIBILITY OF INSECT MEAL IN SEA BASS

AQUA EXCEL 2020

SUMMARY

This study evaluated and compared the nutrient and energy digestibility of sea bass diets in which 30% of fish meal was replaced by proteins from the insects *Tenebrio molitor*, *Hermetia illucens*, *Musca domestica*, *Zophobas morio* or *Alphitobius diaperinus*. The results indicate that the inclusion of *Musca domestica* and *Tenebrio molitor* had no adverse effects on the digestibility of the diets, and that fish meal can be successfully substituted by those insects in the diets of European sea bass at 30% replacement level. This study will be of particular interest to aquafeed producers who wish to use insects as an alternative food source.

KNOWLEDGE NEED

Fish farmers rely on sustainable feed that can make fish strong and healthy. The aquaculture industry is looking for alternative feed sources because the supply of key ingredients of fish feed found in fish meal and fish oil is limited. However, completely replacing these feed sources in a fish's diet can lead to adverse effects on its health, including decreased digestion efficiency and increased susceptibility to diseases and stress. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their safe substitution levels must be established.

POTENTIAL IMPACT

- Substituting sea bass (and other species') diets with insect meal reduces the need for fish meal and oil, which are costly, volatile, and unsustainable sources, potentially leading to a more sustainable and competitive aquaculture sector.
- The establishment of insect meal as a suitable feed substitution for sea bass opens the door for further research into its applicability for other aquaculture species.
- The findings could contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 4 - Sustainable Feed Production: Goal 1, Goal 2 and Goal 3; Thematic Area 2 - Technology & Systems: Goal 1. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

This experiment evaluated and compared the nutrient and energy digestibility of diets in which 30% of fish meal was replaced by proteins from the insects *Tenebrio molitor*, *Hermetia illucens*, *Musca domestica*, *Zophobas morio* or *Alphitobius diaperinus*. 18 groups of 15 fish were placed into 18 indoor 250L cylindroconical tanks equipped with a settling column. Diets were designed to be isoproteic (containing comparable amounts of protein) and isoenergetic (containing comparable amounts of energy) and to meet the nutrient requirements of sea bass. The apparent digestibility coefficients (ADCx), which provide estimates of nutrient availability in feedstuffs, were determined using 1% celite® as an inert marker. The nutrients examined were dry matter, organic matter, crude protein, crude fat, acid detergent fibre and energy.

RESULTS

- The diets containing *Musca domestica* and *Tenebrio molitor* showed overall digestibility similar to each other and to the one of standard fish meal (without insect replacement).
- Despite the poor digestibility of the *Zophobas morio* diet in terms of dry matter, organic matter and energy, the protein and fat digestibility were similar to standard fish meal.
- Acid Detergent Fiber (ADC_{ADF}), the fraction of the diet containing chitin from the insects but also lignin from plant ingredients, was significantly higher in *Zophobas morio* and *Alphitobius diaperinus* diets. Some studies have shown that chitin can interfere with fat digestibility, however in the present study no differences were found in ADC_{EF}.
- Overall, the results indicate that the inclusion of *Musca domestica* and *Tenebrio molitor* meal had no adverse effects on the digestibility of the diets and that fish meal can be successfully substituted by those insects in the diets of European sea bass at a level of 30% replacement.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Sea bass fish feed producers
APPLICATION: Developing and producing novel feed formulations based on alternative, safe and sustainable feed sources (like insect meal) with high biological value and low competitiveness with human nutrition.

END-USER 2: Sea bass farmers
APPLICATION: Feeding of aquaculture fish stocks with more sustainable (and potentially cheaper) fish feeds while keeping good production levels, leading to higher profits and reduced impact on the environment.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Supporting a sustainable, dynamic image of the aquaculture sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Aquaculture researchers
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on nutrient digestibility in sea bass and other fish species.

STATUS

Technology Readiness Level (TRL) 4 – the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Establish the precise optimal *Musca domestica* and *Tenebrio molitor* substitution rate in sea bass diets.
- Investigate further effects of the *Musca* and *Tenebrio* diet substitution on other crucial elements such as digestive organs and their tissues, and microbiota composition.
- Understand changes in susceptibility to stressors under different diet compositions.
- Explore suitability for other species and/or life stages.
- Examine potential effects on the fish product, e.g. on texture, odour and taste.
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment).

AT A GLANCE

TITLE: Nutrient and Energy Digestibility of Insect Meal in Sea Bass
KNOWLEDGE TYPE: Exploitable scientific result
WHERE TO FIND IT: Contact the output owner (details below)
STATUS: In progress
TNA FACILITY USED: Hellenic Centre for Marine Research (HCMR), Greece
CONTACT DETAILS: Stavros Chatzifotis, HCMR, Greece, stavros@hcmr.gr
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AquaIT

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EFFECT OF INSECT MEAL ON THE GROWTH OF EUROPEAN SEA BASS

SUMMARY

This research investigated the effect of fish meal substitution with three different insect meals on European sea bass (*Dicentrarchus labrax*) growth. Results show that 30% substitution of fish meal with either *Hermetia illucens* or *Musca domestica* larvae meal had no negative effects on growth performance and somatic indices. The results also reinforce previous observations that the dietary inclusion of *Tenebrio molitor* should be no more than 25%. This study will be of particular interest to sea bass farmers who wish to use insect-based meals as an alternative food source for their stock.

KNOWLEDGE NEED

Fish farmers rely on sustainable feed that can make fish strong and healthy. The aquaculture industry is looking for alternative feed sources because the supply of key ingredients of fish feed found in fish meal and fish oil is limited. However, completely replacing these with a different feed source in the fish's diet can lead to adverse effects on the fish, for example decreased digestion efficiency leading to lower growth rates. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their safe substitution levels must be established.

POTENTIAL IMPACT

- Partly substituting sea bass diets with insect meal reduces the need for fish meal and oil, which are costly, volatile and unsustainable sources. This could lead to a more sustainable and competitive aquaculture sector.
- The establishment of the optimum level of fish meal substitution with insect meal opens the door for further research into its applicability for other aquaculture species.
- The findings contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.

EATiP - Strategic Research and Innovation Agenda (SRIA): Thematic Area 4 - Sustainable Feed Production, Goal 1 and Goal 2; Thematic Area 2 – Technology and Systems, Goal 1. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

360 fish were randomly divided into 12 indoor 500 litre tanks. The fish were fed with formulated diets in which 30% of fish meal was replaced by insect proteins (*Tenebrio molitor*, *Hermetia illucens*, or *Musca domestica*). A control group was fed fish meal with no insect substitutions. Calculations were performed to obtain the specific growth rate, feed conversion ratio, viscerosomatic index, hepatosomatic index, mesenteric fat index (ratio of visceral to subcutaneous fat), relative gut length and the condition factor of the fish.

RESULTS

- Results show that 30% substitution of fish meal with either *Hermetia illucens* or *Musca domestica* larvae meal had no negative effects on growth performance and somatic indices of European sea bass.
- The fish fed with the *Tenebrio molitor* substitution diet at a level of 30% had a significantly higher feed conversion ratio, indicating poorer utilisation of food. These results reinforce previous observations that the dietary inclusion of *Tenebrio molitor* should be no more than 25%.
- The fish groups fed fish meal and *Hermetia illucens* had significantly higher condition factors than the groups fed on *Musca domestica* and *Tenebrio molitor*, which could indicate a better general condition.
- Fish from the *Hermetia illucens* group had higher mesenteric fat indices and viscerosomatic indices than the fish meal group.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Sea bass fish feed producers
APPLICATION: Developing and producing novel feed formulations based on alternative, safe and sustainable feed sources (insect meal) with high biological value and low competitiveness with human nutrition.

END-USER 2: Sea bass farmers
APPLICATION: Feeding of aquaculture fish stocks with more sustainable (and potentially cheaper) fish feeds while maintaining good production levels, leading to higher profits and reduced environmental impact.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Supporting a sustainable, dynamic image of the aquaculture sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Aquaculture research community
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on many aspects, such as growth, health, and taste of the final product, in sea bass and other fish species. This will support development of the aquaculture sector and contribute to increased levels of Technology Readiness, and aid progression towards commercialisation.

STATUS

Technology Readiness Level (TRL) 4 – the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Establish the precise optimal *Hermetia illucens* and *Musca domestica* substitution rate in sea bass diets.
- Investigate further effects of the *Hermetia illucens* and *Musca domestica* diet substitutions on other crucial elements such as microbiota composition.
- Understand changes in susceptibility to stressors under different diet compositions.
- Explore suitability for other species and/or life stages.
- Examine potential effects on the fish product, e.g. on texture, odour and taste.
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment).

AT A GLANCE

TITLE: Effects of Insect Meal on the Growth of European Sea Bass
KNOWLEDGE TYPE: Exploitable scientific result
WHERE TO FIND IT: To be published. Contact details below.
STATUS: To be published
TNA FACILITY USED: Hellenic Centre for Marine Research (HCMR), Greece
CONTACT DETAILS: Stavros Charzifotis, Hellenic Centre for Marine Research (HCMR), Greece, stavros@hcmr.gr
PATENTS OR OTHER IPR EXPLOITATIONS: No

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DEFATTED MEALWORM (*TENEBRIO MOLITOR*) LARVAE MEAL AS A SUSTAINABLE FEED SOURCE FOR EUROPEAN SEA BASS

AQUA EXCEL 2020

SUMMARY

This research investigated the effect of fish meal replacement by defatted mealworm (*Tenebrio molitor*) larvae meal in European sea bass (*Dicentrarchus labrax*) aquafeeds and showed that it is possible to replace up to 80% of fish meal by insect meal without impairing growth performance, digestibility and flesh quality. These results will be of particular interest to sea bass farmers who wish to use insect-based meals as an alternative food source for their stock.

KNOWLEDGE NEED

The European sea bass (*Dicentrarchus labrax*) is one of the most important fish species in European and Mediterranean aquaculture. A major challenge to efficient production of European sea bass and other species is the high cost of aquafeeds. Additionally, the supply of key nutrients found in fish meal and fish oil is limited. However, completely replacing these ingredients with a different feed source in the fish's diet can lead to adverse effects, for example decreased digestion efficiency and increased susceptibility to diseases and stress. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their optimum substitution levels must be established.

POTENTIAL IMPACT

- Substituting European sea bass diets with insect meal reduces the need for fish meal and oil, which are costly, volatile and unsustainable sources. This could lead to a more sustainable aquaculture sector.
- The establishment of the optimum level of fish meal substitution with insect meal for sea bass opens the door for further research into its applicability for other aquaculture species.
- The findings contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 4 – Sustainable Feed Production; Goal 1 and Goal 2.
To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

A feeding experiment was carried out to evaluate the effect of four different experimental diets with increasing replacement levels of fish meal by defatted *Tenebrio molitor* larvae meal: 0% (control diet), 40 (TM40), 80 (TM80) and 100% (TM100) of replacement. The effect of these dietary treatments were assessed through the analysis of growth performance, digestibility, nutrient utilisation, intestinal morphology, muscle total lipid content and fatty acid profile, muscle instrumental texture and colour, plasma metabolites and humoral immune parameters and expression of genes related to growth and lipid metabolism.

RESULTS

- The voluntary feed intake decreased in fish fed TM100, but these fish had the best FCR resulting in similar final body weight among treatments.
- Up to 80% replacement did not impair protein digestibility and the morphologic integrity of the intestine was maintained.
- Whole body lipid content and the hepatosomatic index increased in fish fed TM100, but flesh total lipid content, colour and texture remained similar among dietary treatments.
- Total replacement of fish meal did not alter the ACH50 and lysozyme activity but increased plasma peroxidase activity.
- The eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids remained unaffected in fish fed diets up to 80% replacement level.
- The hepatic expression of lipogenic enzymes (*elovl5, scd1b, fads2*) and key enzymes of bile acid biosynthesis (*cyp7a1*) was consistently down-regulated by defatted TM.
- Changes in the expression profile of myogenic factors evidence different compensatory mechanisms to preserve high muscle protein accretion with the inclusion of TM.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: European sea bass fish feed producers
APPLICATION: Developing and producing novel feed formulations for European sea bass (and potentially other species) based on alternative, safe and sustainable feed sources (insect meal) with high biological value and low competitiveness with human nutrition.

END-USER 2: European sea bass fish farmers
APPLICATION: Feeding of aquaculture fish stocks with more sustainable (and potentially cheaper) fish feeds while keeping good production levels, leading to higher profits and reduced environmental impact.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Supporting a sustainable, dynamic image of the aquaculture sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Aquaculture research community
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on many aspects (such as growth, digestibility, flesh quality, etc.), in European sea bass and other species. This will support development of the aquaculture sector and contribute to increased levels of Technology Readiness, and progression towards commercialisation.

STATUS

Technology Readiness Level (TRL) 4 – the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Investigate further effects of the *Tenebrio* diet substitution on immune status, microbiota composition and acceptability by consumers.
- Explore suitability for other species.
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment).

AT A GLANCE

TITLE: Defatted mealworm (*Tenebrio molitor*) larvae meal as a sustainable feed source for European sea bass

KNOWLEDGE TYPE: Peer-reviewed scientific publication

WHERE TO FIND IT: Not currently publicly available

STATUS: Expected to publish in 2020

TNA FACILITY USED: Institute of Aquaculture Torre de la Sal (IATS-EXP, CSIC), Castellón, Spain

CONTACT DETAILS: Ana Basto, Aquaculture and Seafood Safety Group, CIIMAR, Portugal; ana.basto@ciimar.up.pt

PATENTS OR OTHER IPR EXPLOITATIONS: No

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LACTIC ACID BACTERIA IMPROVE GROWTH AND REDUCE POTENTIALLY PATHOGENIC BACTERIA LEVEL IN JUVENILE PIKE-PERCH

Larval pike-perch cultivated in fish rearing facility in National Agricultural Research and Innovation Centre (NARIC) @ Ulas Ljubobratovic

SUMMARY

This research evaluated the effects of lactic acid bacteria (LAB), applied through different types of feed, on the health of larval pike-perch (*Sander lucioperca*). The results showed that administration of LAB through live feed (*Artemia nauplii*) improved fish growth and reduced skeletal deformities. Supplementation of LAB through commercial dry feed also reduced skeletal deformities and significantly reduced the number of potentially pathogenic bacteria. Both treatment types improved protein utilisation. These findings will be of particular interest to pike-perch feed producers and farmers.

KNOWLEDGE NEED

Pike-perch is a relatively new fish species for cultivation, and is considered to have high potential for inland aquaculture diversification in Europe. This is a result of increased demand due to the decline of wild catches, and also due to the pike-perch flesh quality (neutral taste and fillets without bones). Major bottlenecks for further expansion of the pike-perch culture industry in Europe include low larval survival, high incidence of deformities, and high sensitivity to stressors such as pathogenic bacteria. Overcoming these challenges is crucial for the successful expansion of pike-perch aquaculture production.

Preliminary screenings for evaluation of the effects of probiotics in *Artemia* culture at a laboratory scale. @ Jovanka Lukic

POTENTIAL IMPACT

- The administration of LAB through feed improves the growth, health and survival of pike-perch juveniles which could lead to an increase in production yield and an improvement in fish welfare.
- The potential for LAB to minimise fish pathogenic bacteria growth could minimise the ecological consequences of fish farming related to the spread of pathogens to the environment.
- The observations are promising in terms of usage of probiotics for more environmentally friendly production of pike-perch in Recirculating Aquaculture Systems (RAS).
- The findings could contribute to a better overall understanding of LAB action in RAS.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 3. Thematic Area 4 – Sustainable Feed Production; Goal 2. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

This study aimed to test the effects of lactobacilli applied to juvenile cultured pike-perch, either through commercial dry feed or through live feed. The effects examined were on fish growth, microbiota balance, and skeletal development. On the twelfth day post-hatching (DPH), the fish were divided into groups to receive different combinations of feed and LAB, including a control group which received the same feed minus the LAB. After 14 days of treatment, fish were assessed for digestive enzyme activity and microbiota composition. Skeletal deformities, individual total lengths and individual body weights were also recorded at the end of the treatments.

RESULTS

- Administering LAB through live feed had beneficial effects on larval growth, skeletal development and protein digestibility (trypsin to chymotrypsin activity ratio (T/C)).
- Application of LAB-processed dry feed was also associated with better skeletal development, and significantly reduced numbers of potentially pathogenic bacteria (*Aeromonas* and *Mycobacterium*).
- Both treatment types improved protein utilisation, as evidenced by digestive protease activities.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Pike-perch farmers
APPLICATION: Using optimal feed combinations for improved growth and health of larval pike-perch and reduction of pathogen burden.

END-USER 2: Pike-perch feed and nutrition manufacturers
APPLICATION: Developing novel feed combinations that will improve growth and health of larval pike-perch and reduce pathogen burden.

END-USER 3: Pike-perch breeders
APPLICATION: Support in the breeding of larval pike-perch during the weaning process, by reducing the costs and time associated with *Artemia* feeding through early transition of pike-perch to an inert diet. Additionally, supporting eco-friendly pike-perch rearing through antipathogenic potential of probiotics.

END-USER 4: Nutrition and microbiology research community
APPLICATION: Greater understanding of important nutritional demands of pike-perch larvae for growth and proper bone development. Additionally, it provides the opportunity for further research with other fish species, and also for further examination of proteolytic properties of lactobacilli using animal proteins as a substrate.

STATUS

Technology Readiness Level (TRL) 3 - Proof of concept has been demonstrated in experimental conditions

- The research is currently being exploited by the scientific community through a scientific publication (see 'AT A GLANCE' below).
- Further technical optimisation through additional testing in larger cohorts is required for industry exploitation.
- A follow-on project is currently in progress which builds on the results of this research. This project should support technological improvement of probiotic supplementation to larval pike-perch during weaning.

AT A GLANCE

TITLE: Lactic Acid Bacteria Improve Growth and Reduce Potentially Pathogenic Bacteria Level in Juvenile Pike-Perch

KNOWLEDGE TYPE: Scientific publication

WHERE TO FIND IT: Ljubobratovic et al. 2017. Supplementation of lactobacilli improves growth, regulates microbiota composition and suppresses skeletal anomalies in juvenile pike-perch (*Sander lucioperca*) reared in recirculating aquaculture system (RAS): A pilot study. Research in Veterinary Science 115, 451 – 462. DOI: 10.1016/j.rvsc.2017.07.018

STATUS: Published

TNA FACILITY USED: National Agricultural Research and Innovation Centre (NAIK), Indoor System for Fish Disease Challenge (SDC), Hungary

CONTACT DETAILS: Jovanka Lukic, Institute of Molecular Genetics and Genetic Engineering (IMGGE), University of Belgrade, Serbia; lukicjovanka@imgge.bg.ac.rs

PATENTS OR OTHER IPR EXPLOITATIONS: No

AE-FISHBIT: A SMART DEVICE FOR MONITORING FISH HEALTH AND WELFARE

SUMMARY

Researchers have designed a miniaturised tool called AE-FishBIT, to monitor individual farmed fish in a non-invasive manner. The device's simultaneous measurement of physical activity and respiratory frequency sets it apart from similar devices in the market. AE-FishBIT will be of interest to aquaculture farmers and other end users who can use it to monitor fish behaviour for selective breeding and for fine-tuned adjustment of environmental conditions.

KNOWLEDGE NEED

The assessment of overall production, health, welfare and stress is a major challenge for more efficient and ethical fish production. With the recent advent of MicroElectroMechanical System (MEMS) technology, biosensors are increasingly being used to non-invasively measure a wide range of variables. However, challenges with the technology so far include interference between transmitted signals which limits the use of a large number of sensors, and in the aquatic environment the use of low radiofrequency transmission is limited. AE-FishBIT overcomes current technological challenges with its small size, low power, and its capacity to measure physical activity and metabolic activity simultaneously.

POTENTIAL IMPACT

- Individual and non-invasive assessment of feeding behaviour, fish health and welfare status allowing farmers to select robust fish and make correct adjustments in the culture conditions, which ultimately contribute to improved productivity in the aquaculture sector.
- Better monitoring leads to more strict and reliable welfare standards, and a better perception of quality controls in aquaculture production, which could lead to improved consumer perception of aquaculture products.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 – Technology and Systems; Goal 4, Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

Weighing less than one gram, AE-FishBIT is a tiny programmable and reconfigurable tri-axial accelerometer for on-board processing of recorded data. The prototype is externally attached to the fish operculum to monitor physical activity by mapping accelerations in x- and y-axes, while operculum beats (z-axis) serve as a measurement of respiratory frequency. The device has been tested and validated in gilthead sea bream and European sea bass.

RESULTS

- AE-FishBIT can register jerk accelerations and operculum beats (two in one) as a direct measure of physical activity and respiratory frequency.
- Testing in swim test chambers allows a close correlation between O_2 consumption and calculated respiratory frequency in exercised fish.
- The device allows for the discrimination of fish with different proactive/reactive stress responses when facing different aquaculture stressors, including diet composition, oxygen levels and tank size.
- Using the device, it was also found that age, photoperiod, feeding time or enteric parasitic infections alter basal metabolism and diurnal/nocturnal activity of farmed fish.
- Visual observations regarding tissue damage, feeding behaviour and circulating levels of stress markers did not suggest a negative impact from device tagging.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture farmers
APPLICATION: Managing health and welfare by monitoring a number of "sentinel" fish, allowing farmers to make necessary adjustments in culture conditions with less trial-and-error than traditional methods.

END-USER 2: Aquaculture breeders
APPLICATION: Tool for selective breeding by monitoring changes in feeding behaviour and metabolic activity to identify fish with a more efficient energy use.

END-USER 3: Fish processors and wholesalers
APPLICATION: Good quality certification of aquaculture products through the monitoring of the welfare status of the fish, increasing its appeal to customers and potentially increased profitability.

END-USER 4: Aquaculture researchers
APPLICATION: Measuring reactions to variables such as a change in nutrition, rearing density or other environmental conditions by monitoring physical activity and respiratory frequency of fish in controlled experiments.

STATUS

Technology Readiness Level (TRL) 4 – the knowledge has been validated in a laboratory environment.

- To the best of the researchers' knowledge there is currently no other tagging device that provides a simultaneous measurement of both physical activity and respiratory frequency in a non-invasive manner.
- Additional tests of the device are planned in other farmed fish (Atlantic salmon, trout, sole, turbot), correlating adjustments at cellular-tissue level with the monitored AE-FishBIT parameters.
- Further developments to the AE-FishBIT device are envisaged to increase the autonomy of the system, make it more compact and easier to attach.

AT A GLANCE

TITLE: AE-FishBIT: A Smart Device for Monitoring Fish Health and Welfare
KNOWLEDGE TYPE: Prototype and Scientific Publication
WHERE TO FIND IT: vimeo.com/325943543; Martos-Sitcha et al. 2019. Ultra-Low Power Sensor Devices for Monitoring Physical Activity and Respiratory Frequency in Farmed Fish. Front Physiol 10, 667. DOI: 10.3389/fphys.2019.00667
STATUS: Published
TNA FACILITY USED: Consejo Superior de Investigaciones Científicas (IATS-CSIC), Spain; Universidad de las Palmas de Gran Canaria (ULPGC), Spain
CONTACT DETAILS: Jaume Pérez-Sánchez, CSIC, Spain; jaime.perez.sanchez@csic.es
PATENTS OR OTHER IPR EXPLOITATIONS: A patent for the device has been being registered (P201830305) with the goal of licensing it at international level before the end of the AQUAEXCEL2020 project.

Designed and developed by AquaIT

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AquaFishDEB: A FUNCTIONAL MODEL FOR FISH GROWTH, FEED INTAKE AND WASTE PRODUCTION IN AQUACULTURE

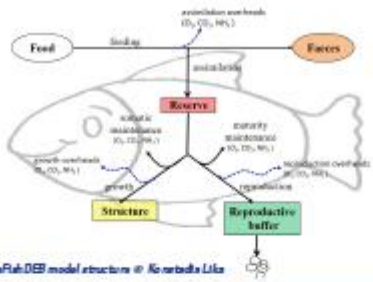
AQUA EXCEL 2020

SUMMARY

AquaFishDEB is a numerical model that captures the effects of feed quality, feeding schedule and water characteristics on individual growth, feed consumption, waste production (faecal and non-faecal nitrogen loss, faecal dry matter, CO_2) as well as oxygen consumption in three aquaculture species (Atlantic salmon, gilthead sea bream and rainbow trout). The model is one of the main components of the AQUAEXCEL2020 virtual laboratory for designing experiments in aquaculture research facilities. AquaFishDEB will be of interest to various end users in the aquaculture sector, including researchers, teachers, trainers and farmers.

KNOWLEDGE NEED

The impact of different management conditions on the growth and performance of species in aquaculture must be understood to ensure the highest standards in welfare and to optimise productivity. Experiments with fish typically involve extensive use of laboratory facilities and run for long periods of time. Both from an ethical perspective (3Rs) and from a cost perspective, there is a need to use alternatives such as models and tools for design and planning of experiments.



AquaFishDEB model structure © Konstadia Lika

POTENTIAL IMPACT

- Use of the AquaFishDEB model will help to optimise the use of experimental resources and improve experimental design, thereby greatly minimising the costs associated with traditional scientific experiments.
- The AquaFishDEB model will help to improve aquaculture management by predicting the results of feed quality, feeding schedule and water characteristics.
- The AquaFishDEB model will support researchers and teachers in designing experimental environmental conditions that optimise feed intake and growth, optimise the use of experimental resources, and improve experimental design.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 – Technology & Systems; Goal 2, Thematic Area 1 – Product, Quality, Consumer Safety and Health; Goal 3, Thematic Area 6 – Knowledge Management; Goal 2.
To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

The model is based on the Dynamic Energy Budget (DEB) theory, a powerful theoretical framework for modelling the metabolic dynamics of an individual organism throughout its life cycle making explicit use of energy and mass balances. For each species, the modelling procedure had two steps. The first step involved the parameterisation of the individual DEB model. The second step incorporated the obtained DEB parameters into the AquaFishDEB model that simulates the dynamics for a group of fish exposed to specified conditions. For gilthead sea bream and Atlantic salmon, parameters were estimated using data obtained from literature and from partners of the AQUAEXCEL2020 project. For rainbow trout, the parameter values were retrieved from the AmP database: **bio.vu.nl/thb/deb/deblab/add_my_pet**.

RESULTS

The result of this research is a functional model for growth, feed intake and waste production in farmed Atlantic salmon, gilthead sea bream and rainbow trout. Based on physiological rules for the assimilation and utilisation of energy and elemental matter, AquaFishDEB allows for the modelling of the processes of feeding, digestion, maintenance, maturation and growth for farmed fish. The model output includes growth (specific growth rate, weight-at-time) and feeding characteristics (e.g. feed conversion ratio, feed intake), as well as waste production (e.g. faecal and non-faecal nitrogenous loss) and gaseous exchange (O_2 consumption and CO_2 production).

END-USERS & POTENTIAL APPLICATIONS

- **END-USER 1: Aquaculture fish farmers**
  APPLICATION: To design and plan optimal fish husbandry conditions, thereby increasing productivity and hence profitability, and improving fish welfare.
- **END-USER 2: Aquaculture feed producers**
  APPLICATION: To get better insight into feed conversion ratios and feed intake in different life stages of fish or in different species, implementing this knowledge by improving their feed formulations.
- **END-USER 3: Aquaculture researchers and educators**
  APPLICATION: To get a better insight into growth dynamics under various experimental conditions and use the model as a tool to teach the design and planning of fish experiments, optimising the use of experimental resources and increasing fish welfare.

STATUS

Technology Readiness Level (TRL) level 4 – The prototype has been tested and shown that it can be integrated as a component with other modelling components.

- The sensitivity of the model is currently being evaluated.
- The model is currently being validated with independent data for salmon, trout and gilthead sea bream. Once the validation stage has been finalised the model has the potential to be used as an operational tool.

AT A GLANCE

TITLE: AquaFishDEB: A Functional Model for Fish Growth, Feed Intake and Waste Production in Aquaculture
KNOWLEDGE TYPE: Software / modelling tool
WHERE TO FIND IT: Not yet publicly available
STATUS: Currently validating the prototype model
TNA FACILITY USED: Hellenic Centre for Marine Research (HCMR), Greece ; University of Crete, Greece
CONTACT DETAILS: Dina Lika, Hellenic Centre for Marine Research, Greece, lika@uoc.gr
PATENTS OR OTHER IPR EXPLOITATIONS: No

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EARLY LIFE MANAGEMENT PROTOCOL FOR OPTIMAL PERFORMANCE OF SEA BREAM

SUMMARY

This OUTPUT is an early life management protocol of O_2 (oxygen) concentration levels in the aquatic environment of gilthead sea bream (*Sparus aurata*). The protocol is an improved management tool that will help to rear more robust sea bream. This fish species was shown to exhibit a high metabolic plasticity to cope with changes in O_2 concentrations. Moreover, gilthead sea bream demonstrated higher larval survival and improved metabolic performance later in life after exposure to low O_2 concentrations during a specific window of development (60-80 days post-hatching). This protocol will assist fish farmers and researchers to improve their fish management and research results during the production cycle.

KNOWLEDGE NEED

How fish are managed during early life stages affects their health and performance in later years. Therefore, good early life management of environmental factors, including O_2 concentration, is highly important to fully exploit productive traits of farmed fish. A progressive decline in O_2 concentration causes hypoxia, a condition in which fish are deprived of adequate O_2 supply at tissue level. To ensure that the physiological function of fish is not compromised, and to guarantee their welfare, changes in O_2 concentrations should be considered and well-regulated in aquaculture systems, exploiting also the potential benefits of hypoxia pre-conditioning at specific stages of the life cycle.

POTENTIAL IMPACT

- Applying this protocol will result in more robust and healthier sea bream at later stages in life, resulting in increased profits for sea bream farmers.
- Using a protocol to produce robust and healthy fish will result in higher quality and more efficient scientific experiments, leading to improved animal welfare and aquaculture profitability.
- Developing a protocol for O_2 supply during early life management can bring a uniform approach to managing fish across the aquaculture industry which would benefit both quality and welfare standards. Development of similar protocols for other fish species should be studied.

EATIP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 – Technology & Systems; Goal 3, Thematic Area 6 – Knowledge Management; Goal 1, Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 3. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

Acute and mild hypoxia was induced in sea bream juveniles to assess the resilience of this farmed fish to acute and chronic hypoxia exposure at different rearing densities. The impact of hypoxia pre-conditioning was assessed at the level of blood, tissue and whole organism by means of swimming tests and haematological, hormonal, and wide and targeted transcriptional analysis. Additional hypoxia challenges were conducted during early life stages to test the hypothesis that reduced O_2 levels at specific stages of development can assist fish farmers to improve fish management later in life through the involvement of epigenetic mechanisms.

RESULTS

- Blood physiological hallmarks demonstrate the enhancement of O_2-carrying capacity in addition to a reduced but more efficient aerobic energy production in juvenile fish exposed to acute hypoxia.
- Transcriptional analyses disclose the different contributions of liver, heart, muscle and blood to mild hypoxia and crowding stress responses in sea bream.
- Hypoxia pre-conditioning during juvenile stages allows improved swimming and metabolic performance at reduced O_2 concentration levels.
- Metabolic effects of hypoxia pre-conditioning during early life stages (60-80 days post-hatching) are more persistent than the effects resulting from hypoxia pre-conditioning during later life.
- The early life O_2 management protocol improves survival rates as well as growth and swimming performance of hypoxia-challenged fish later in life.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Marine biologists, aquaculture and biotechnology scientists
APPLICATION: Applying the protocol to better track growth potentiality and size heterogeneity of sea bream.

END-USER 2: Farmers of gilthead sea bream
APPLICATION: The protocol is an improved management tool that will help to rear more robust sea bream, thereby supporting individual fish welfare and profitability of the sea bream aquaculture industry.

STATUS

Technology Readiness Level (TRL) 4- the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Check and refine the tested protocol for different sea bream strains and culture conditions.
- Determine how long metabolic priming lasts over the course of the production cycle, assisting farmers to produce robust, healthy and high quality fish.

AT A GLANCE

TITLE: Early Life Management Protocol for Optimal Performance of Sea Bream

KNOWLEDGE TYPE: Guidelines/standards

WHERE TO FIND IT: Martos-Sitcha et al. (2017). Gene expression profiling of whole blood cells supports a more efficient mitochondrial respiration in hypoxia-challenged gilthead sea bream (*Sparus aurata*). Frontiers in Zoology 14, 34. DOI 10.1186/s12983-017-0220-2; Martos-Sitcha et al. (2019). Tissue-Specific Orchestration of Gilthead Sea Bream Resilience to Hypoxia and High Stocking Density. Front Physiol 10, 840. DOI 10.3389/fphys.2019.00840

STATUS: Additional articles will be published in 2020

FACILITY USED: Consejo Superior de Investigaciones Científicas (IATS-CSIC), Spain

CONTACT DETAILS: Jaume Pérez-Sánchez, CSIC, Spain; jaime.perez.sanchez@csic.es; Josep Calduch-Giner, CSIC, Spain; J.calduch@csic.es

PATENTS OR OTHER IPR EXPLOITATIONS: No

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REVELATION OF KEY MOLECULES DURING AMOEBIC GILL DISEASE (AGD) IN ATLANTIC SALMON

SUMMARY

This study investigated the expression of genes involved in Amoebic Gill Disease (AGD) pathogenesis in Atlantic Salmon (*Salmo salar*) during an experimental and a natural infection, including a post-freshwater treatment to eliminate the parasite. The results emphasise the importance of the studied genes in fish respiratory organs, and during AGD progression. This study also shows that freshwater treatment not only eliminates the parasite but also helps to restore gill homeostasis.

KNOWLEDGE NEED

Gill diseases, including AGD, are one of the main health challenges for the marine Atlantic salmon industry worldwide. Its impact has increased drastically in recent years due to the expansion of its geographic distribution and host range. Freshwater or hydrogen peroxide baths are the only available treatments, with no existing preventive measures. Epithelial proliferation and increased mucus secretion are common hallmarks of AGD, leading to respiratory distress in affected fish, followed by mortalities if left untreated. So far, the molecular mechanisms underlying these pathological changes are poorly understood. Characterisation of the proliferative host response in terms of expression dynamics of targeted genes is vital to improve our understanding of gill health and contribute to combating AGD.

POTENTIAL IMPACT

- The results can contribute to a more timely and accurate detection of AGD pathogen presence, key for aquaculture farmers to prevent stock losses, improve fish welfare and increase profitability.
- The findings are an important starting point for future characterisation of poorly-known fish mucins. Further research on Muc5 sequences, and their differential expression in different gill conditions of Atlantic salmon and other fish species, could improve our understanding of gill health.
- This research could provide a basis for development of tools for diagnostics and vaccines of AGD. Comparative pathology with other respiratory disorders can provide valuable insights into pathogenic mechanisms and potential therapeutic targets.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 7- Aquatic Animal Health and Welfare; Goal 1 and Goal 3. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

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UNDERLYING SCIENCE

The hallmark signs of AGD are hyperplasia of the lamellar epithelium and increased production of gill mucus. This study investigated the expression of genes involved in mucus secretion, cell cycle regulation, immunity and oxidative stress in gills using a targeted 21-gene PCR array. Gill samples were obtained from experimental and natural *Neoparamoeba perurans* infections, and sampling points included progressive infection stages and post-freshwater treatment.

RESULTS

- The results indicate a key role of Muc5-type mucins and Th2 cytokines (interleukin 4/13) in respiratory organs of fish, as in mammals. This shows the potential of these as biomarkers for AGD. Indeed, Muc5-type mucins are the principal components of airway mucus in humans, and over-expression is a hallmark of various airway diseases.
- The expression profile of the selected genes provided a strong measure on the advancement of the disease; there was an increased response upon disease severity.
- The results also demonstrate that treatment of the disease with freshwater is not only effective against the parasite (amoeba) but also supports the partial restoration of the host immune, mucosal, structural and antioxidant status, i.e. re-establishing gill homeostasis under field conditions.
- The predictive model constructed, based on the expression values of the selected genes from the experimental infection, was able to accurately predict the disease severity of the field samples, indicating the reliability of the experimental infection model as a tool to study this disease under controlled conditions.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Researchers in animal welfare, host-pathogen interactions and comparative immunology
APPLICATION: The results highlight the importance of several molecules and pathways on the progression of AGD. They enhance the information available on this disease and fish immune response and could be extrapolated to other fish species and related pathologies.

END-USER 2: Pharmaceutical industry
APPLICATION: The potential of Muc5-type mucins and interleukin 4/13 as biomarkers for AGD could support the development of tools for diagnostics, vaccines and/or disease treatment for AGD in salmon and other fish species.

END-USER 3: Aquaculture veterinarians
APPLICATION: The potential of Muc5-type mucins and interleukin 4/13 as biomarkers for AGD will support early detection and good management of AGD in salmon stocks.

END-USER 4: Aquaculture farmers
APPLICATION: The results will eventually help farmers with early detection and management of AGD in salmon (and potentially other fish species).

STATUS

Technology Readiness Level (TRL) 1 – basic principles observed. This is the first study exploring expression of gill mucins in Atlantic salmon during an infectious process.

- Further research on Muc5 sequences and their differential expression in different gill conditions of Atlantic salmon and other fish species is needed to improve our understanding of gill health.
- In the future, this study could form the basis for further research around diagnosing and vaccinating against AGD.

AT A GLANCE

TITLE: Revelation of Key Molecules during Amoebic Gill Disease (AGD) in Atlantic Salmon
KNOWLEDGE TYPE: Scientific publication
WHERE TO FIND IT: Marcos-López *et al.* 2018. Gene expression analysis of Atlantic salmon gills reveals mucin 5 and interleukin 4/13 as key molecules during amoebic gill disease. Scientific Reports 8, 13689. DOI: 10.1038/s41598-018-32019-8
STATUS: Published
TNA FACILITY USED: Consejo Superior de Investigaciones Científicas (IATS-ANA, CSIC), Spain
CONTACT DETAILS: Carla Piazzon, CSIC, Spain, carla.piazzon@csic.es
Mar Marcos Lopez, FishVet Group, Ireland, mar.marcos-lopez@fishvetgroup.com
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AquaTT

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Annex 7: Project Letter Template

AQUA EXCEL 2020

Prof. John Doe
AQUAEXCEL2020 Partner
Address Line 1
Address Line 2

Ph. +353 123 456789
Fax +353 123 456789

info@aquaexcel2020.eu
www.aquaexcel2020.eu

Ms Smith
Address Line 1
Address Line 2

Subject: Upcoming Meeting August 12th 2017

Dear Ms. Smith,

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

Yours sincerely,

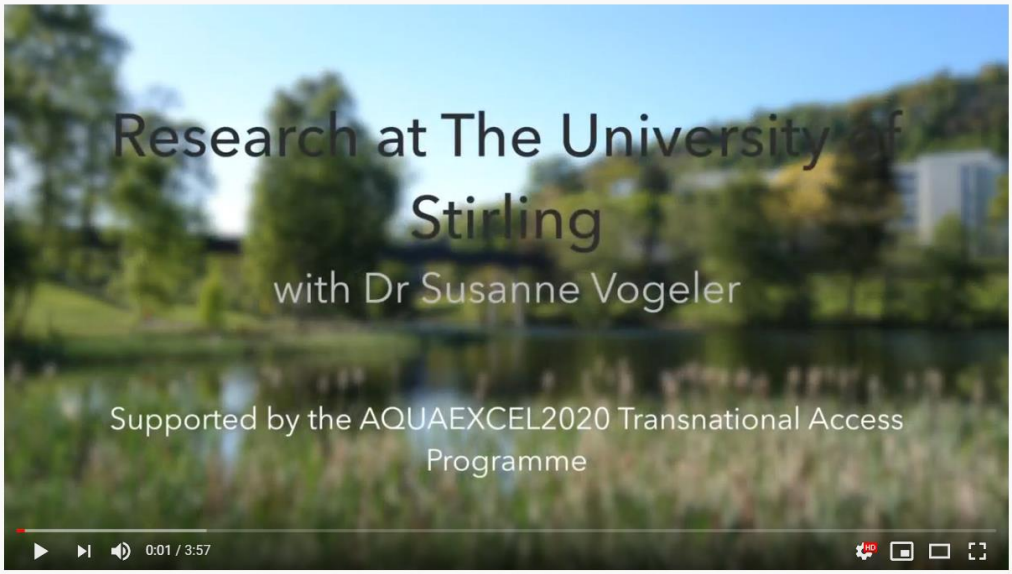
Prof. John Doe
AQUAEXCEL2020 Partner

This project has received funding from the European Union's Horizon 2020 research ar innovation programme under grant agreement No 652831. This publication reflects only the vie of the author, and the European Commission cannot be held responsible for any use which may t made of the information contained therein

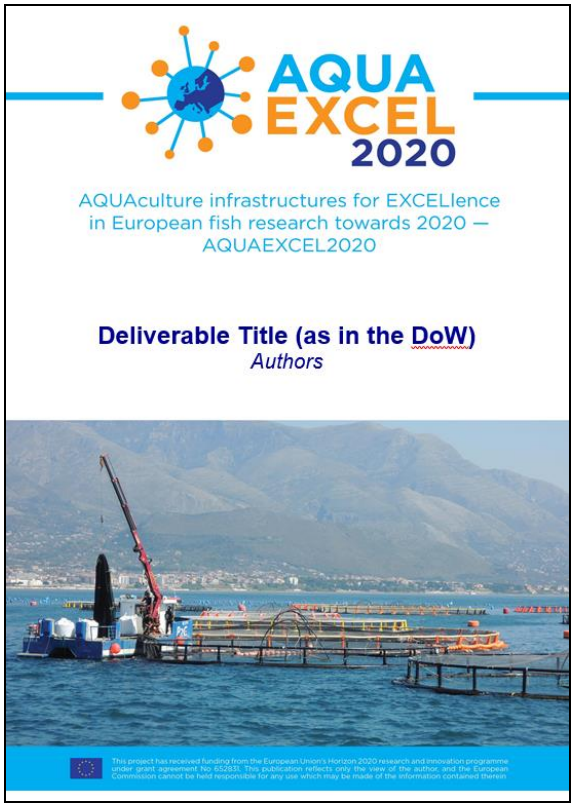
Annex 8: Project Videos

Videos created by Xènia Pérez Sitjà showing the AEFishBIT developed through the AQUAEXCEL2020 project.
Link 1: https://vimeo.com/325943543
Link 2: https://vimeo.com/186424644

University of Stirling: video of AQUAEXCEL2020 TNA facilities. Link:
https://www.youtube.com/watch?v=URQKBhca06o&feature=youtu.be



Annex 9: Project Deliverable Report Template



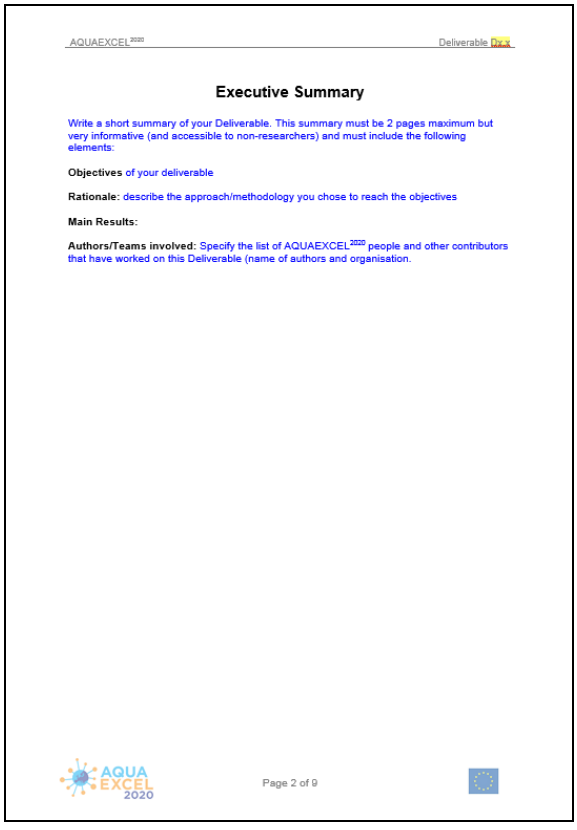
AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 – AQUAEXCEL2020

Deliverable Title (as in the DoW)

Authors

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652831. This publication reflects only the view of the author, and the European Commission cannot be held responsible for any use which may be made of the information contained therein



Executive Summary

Write a short summary of your Deliverable. This summary must be 2 pages maximum but very informative (and accessible to non-researchers) and must include the following elements:

Objectives of your deliverable

Rationale: describe the approach/methodology you chose to reach the objectives

Main Results:

Authors/Teams involved: Specify the list of AQUAEXCEL2020 people and other contributors that have worked on this Deliverable (name of authors and organisation.

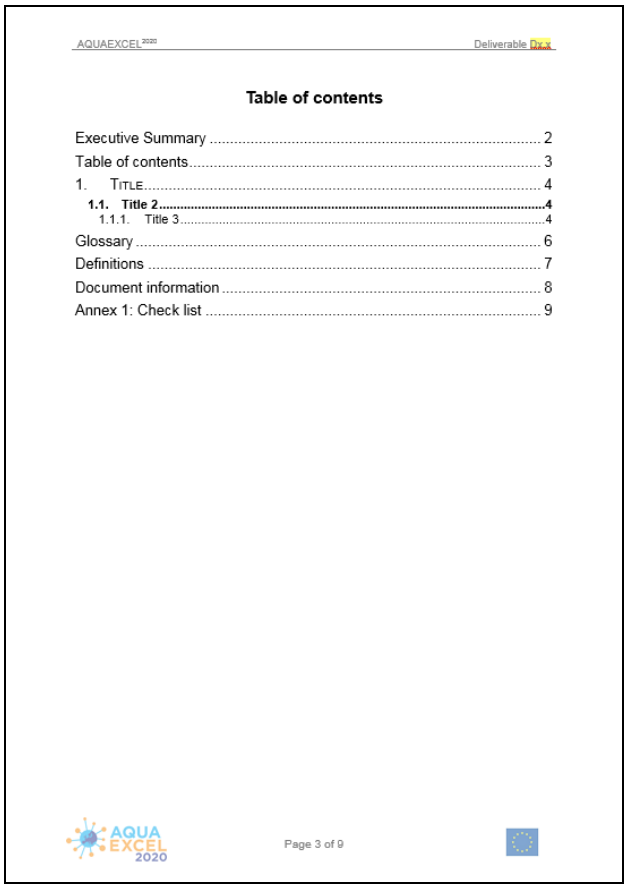
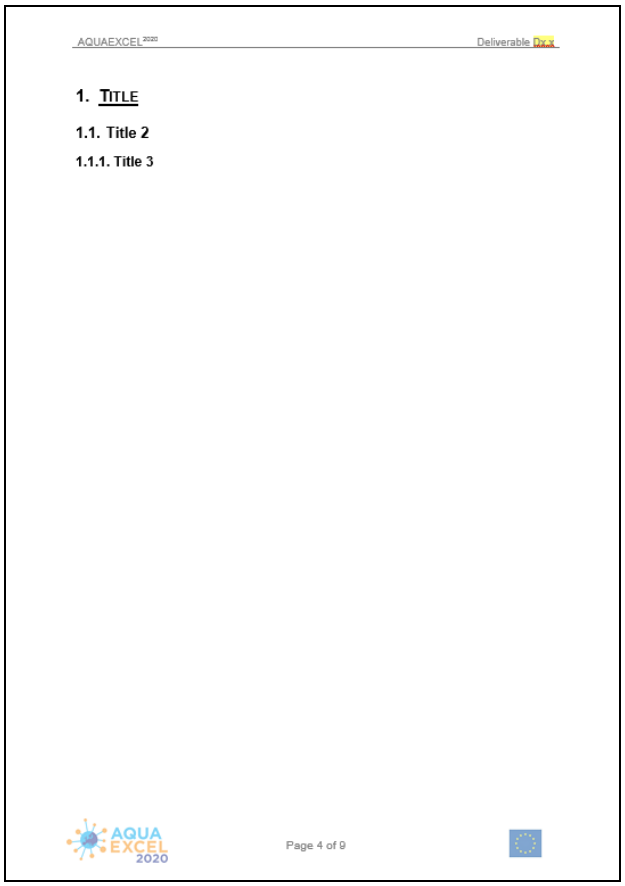


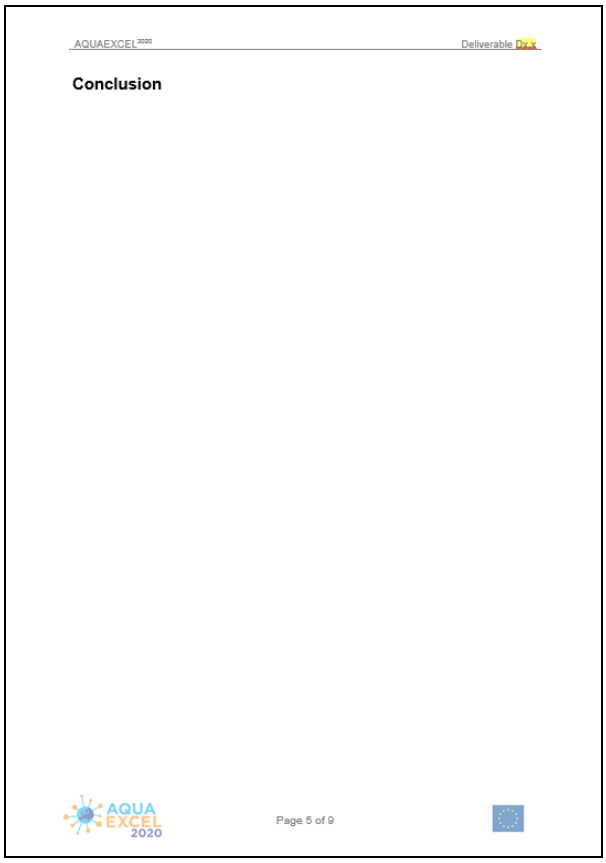
Table of contents



1. TITLE

1.1. Title 2

1.1.1. Title 3



AQUAEXCEL2020 Deliverable D4.6

Conclusion

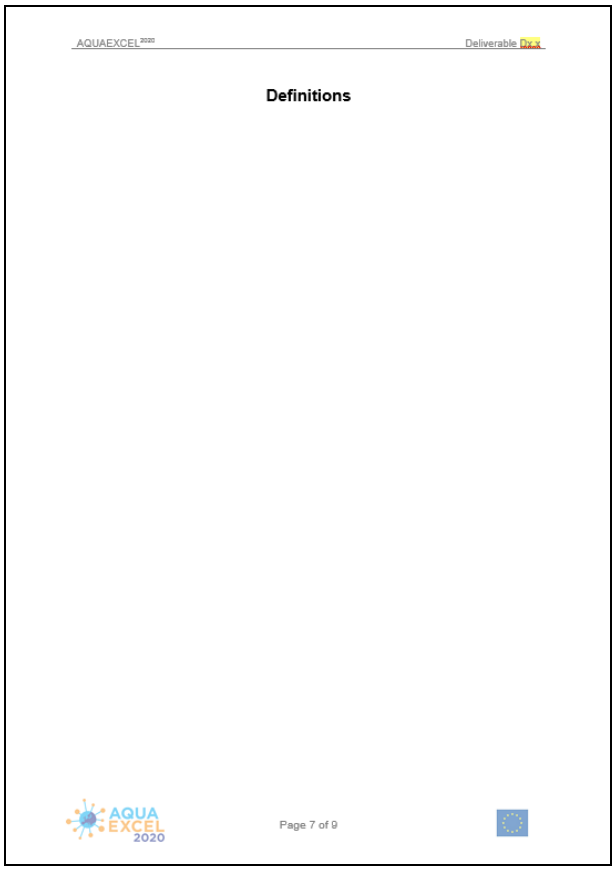
Page 5 of 9

AQUAEXCEL2020 Deliverable D4.6

Glossary

AQUAEXCEL2020: AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020

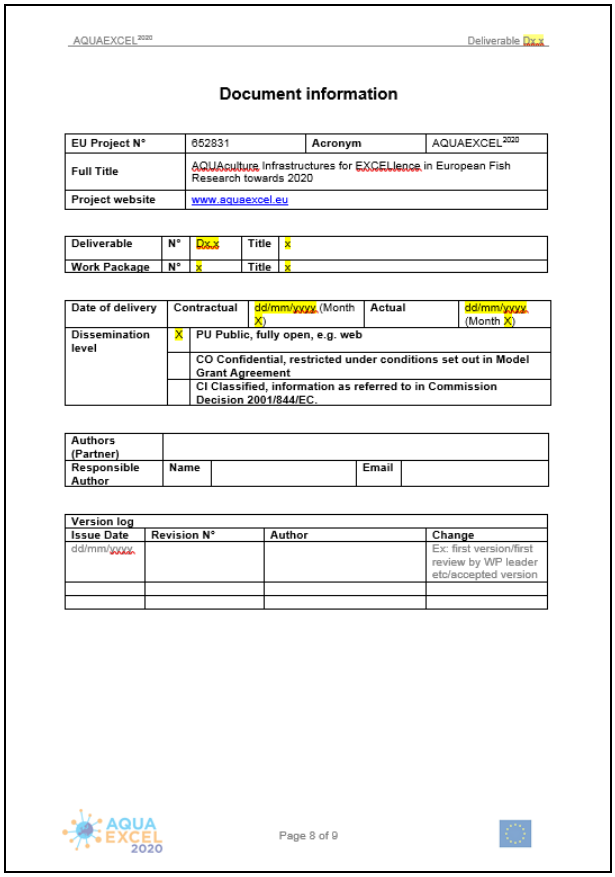
Page 6 of 9



AQUAEXCEL2020 Deliverable Dx.x

Definitions

AQUA EXCEL 2020 Page 7 of 9



AQUAEXCEL2020 Deliverable Dx.x

Document information

EU Project N°	652831	**Acronym**	AQUAEXCEL2020
Full Title	AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020		
Project website	www.aquaexcel.eu		

Deliverable	**N°**	Dx.x	**Title**	x
Work Package	**N°**	x	**Title**	x

Date of delivery	**Contractual**	dd/mm/yyyy (Month X)	**Actual**	dd/mm/yyyy (Month X)
Dissemination level	X	**PU Public, fully open, e.g. web**		
		CO Confidential, restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC.		

Authors (Partner)				
Responsible Author	**Name**		**Email**	

Version log			
Issue Date	**Revision N°**	**Author**	**Change**
dd/mm/yyyy			Ex: first version/first review by WP leader etc/accepted version

AQUA EXCEL 2020 Page 8 of 9

Annex 1: Check list

Deliverable Check list (to be checked by the "Deliverable leader")

	Check list		Comments
BEFORE	I have checked the due date and have planned completion in due time		*Please inform Management Team of any foreseen delays*
	The title corresponds to the title in the DOW		
	The dissemination level corresponds to that indicated in the DOW		*If not please inform the Management Team with justification*
	The contributors (authors) correspond to those indicated in the DOW		
	The Table of Contents has been validated with the Activity Leader		*Please validate the Table of Content with your Activity Leader before drafting the deliverable*
	I am using the AQUAEXCEL2020 deliverable template (title page, styles etc)		*Available in "Useful Documents" on the collaborative workspace*
The draft is ready			
AFTER	I have written a good summary at the beginning of the Deliverable		*A 1-2 pages maximum summary is mandatory (not formal but really informative on the content of the Deliverable)*
	The deliverable has been reviewed by all contributors (authors)		*Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.*
	I have done a spell check and had the English verified		
	I have sent the final version to the WP Leader, to the 2nd Reviewer and to the Project coordinator (cc to the project manager) for approval		*Send the final draft to your WP Leader, the 2nd Reviewer and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewers of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.*

Annex 10: Deliverable Check List

Deliverable Check list (to be checked by the "Deliverable leader")

	Check list		Comments
BEFORE	I have checked the due date and have planned completion in due time		*Please inform Management Team of any foreseen delays*
	The title corresponds to the title in the DOW		*If not please inform the Management Team with justification*
	The dissemination level corresponds to that indicated in the DOW		
	The contributors (authors) correspond to those indicated in the DOW		
	The Table of Contents has been validated with the Activity Leader		*Please validate the Table of Content with your Activity Leader before drafting the deliverable*
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The draft is ready			
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	I have sent the final version to the WP Leader, to the 2nd Reviewer and to the Project coordinator (cc to the project manager) for approval		*Send the final draft to your WPLeader, the 2nd Reviewer and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewers of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.*