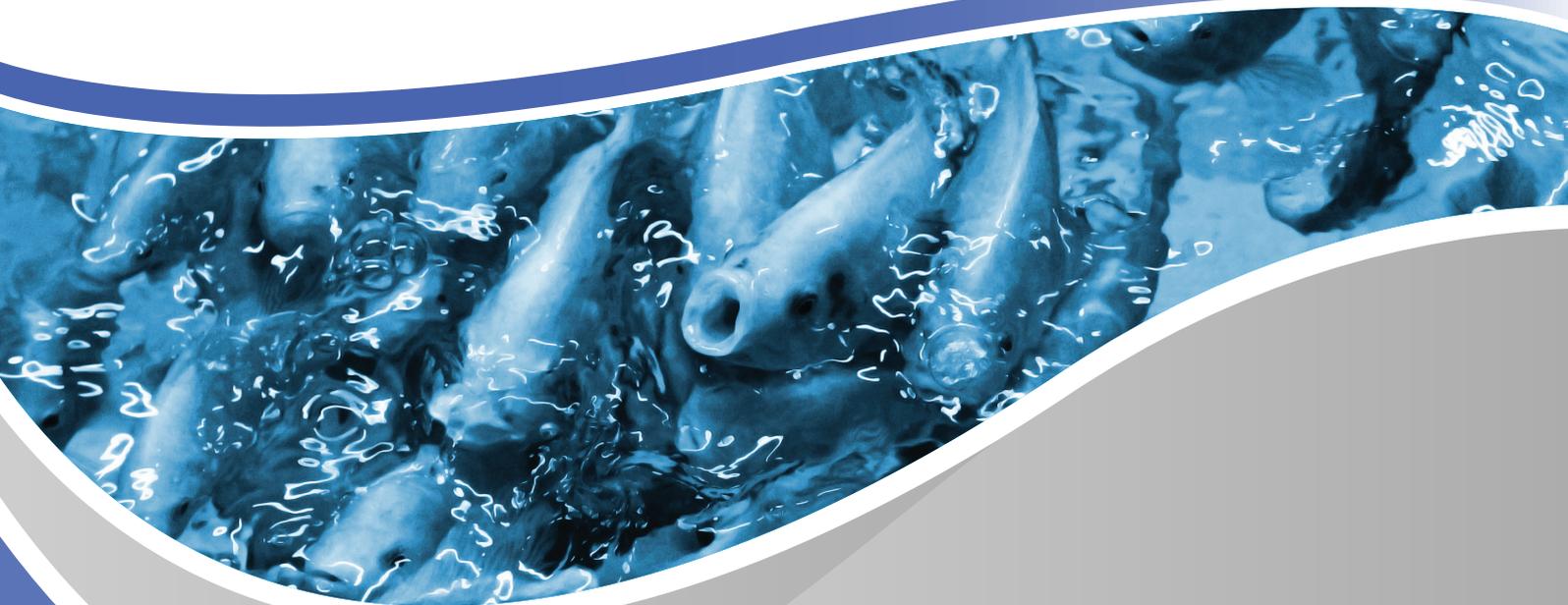




ABT Aquaculture

Capability Statement



Excellence through Innovation and Quality



ABT Aquaculture

Capability Statement

Created by AquaBioTech Group

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The **AquaBioTech Group** is an international aquaculture, fisheries and marine consultancy and engineering company. Its headquarters are strategically located in the centre of the Mediterranean, on the island of Malta, and operates globally with clients in over fifty-five countries.

The **AquaBioTech Group** undertakes a variety of aquaculture, fisheries and aquatic environmental projects through its regional offices and selected partners throughout the world. The vast majority of the company's work is related to the marine or aquatic environment, encompassing aquaculture developments, market research/intelligence, through project feasibility assessments, finance acquisition, project management, technology sourcing and technical support and training. Within the **AquaBioTech Group** there are various divisions that focus on different business areas:

ABT Aquaculture has developed a number of highly efficient and cost effective Recirculating Aquaculture Systems (RAS). These can be applied to hatcheries, broodstock, aquatic research, aquaponic systems and ongrowing operations. We constantly strive to be at the forefront of our industry by testing and developing innovative technologies.

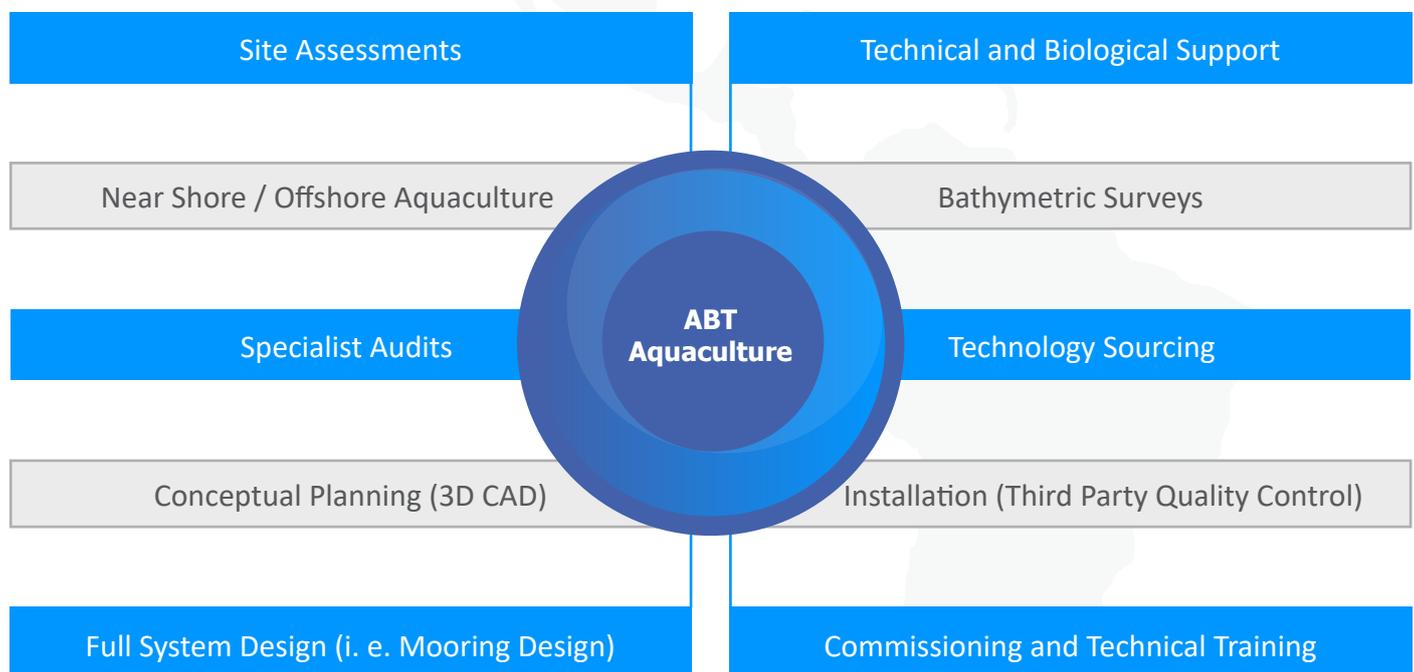
ABT Aquaculture also offers consultancy services for all aquaculture related projects. We have become well established as a provider of due-diligence and risk assessments for all forms of aquaculture

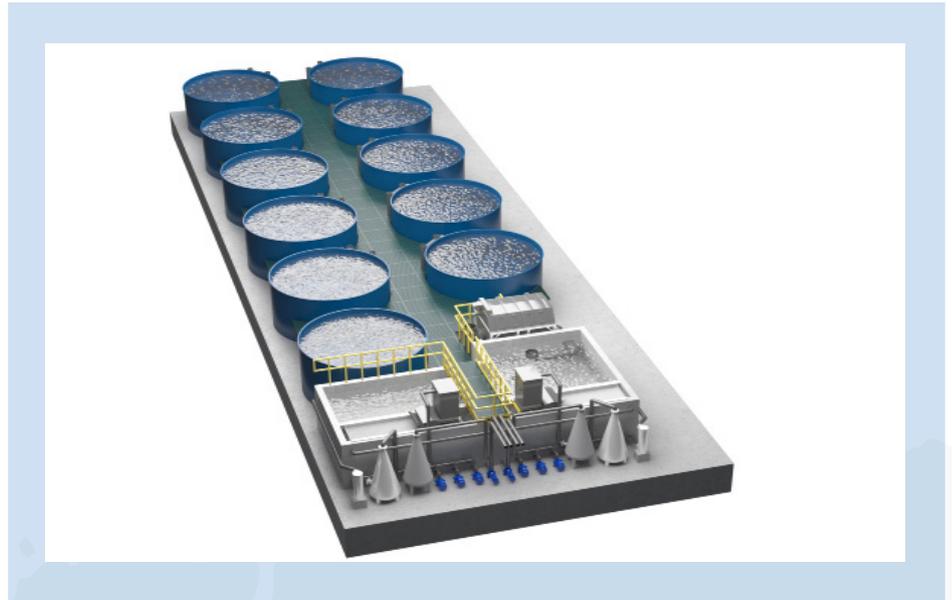
operations, as well as consulting on operational issues and improvements in hatcheries, fish farms and processing facilities.

ABT Innovia offers research services to support the development of vaccines, functional feeds, alternative protein sources, culture technologies and production techniques with a wide range of commercially important species under any combination of culture conditions in our fully licenced and bio-secure R&D facilities. The facilities include a total of seventeen (17) trial rooms with over twenty-eight (28) individual trial systems, all utilising the **AquaBioTech Group's** highly efficient and stable RAS technology.

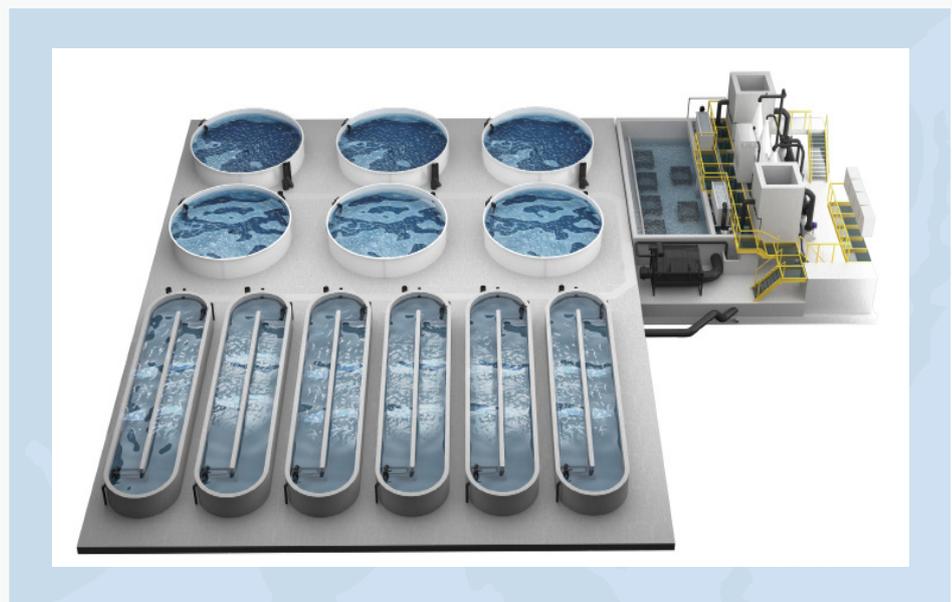
ABT Marine provides a range of services including marine surveying, construction support and mapping/GIS. The techniques we employ include bathymetric and side scan sonar surveys, bottom type assessments, ROV surveys, hydrodynamic measurements data confirmation and site inspections using both remote sensing and underwater video techniques.

ABT Aquatics main areas of work range from initial feasibility studies, outline planning with concept development, architectural & structural design with engineering, filtration and Life Support System (LSS) development, through to livestock supply, management support and turnkey operations for aquariums and ornamentals.





Recirculating Aquaculture Systems



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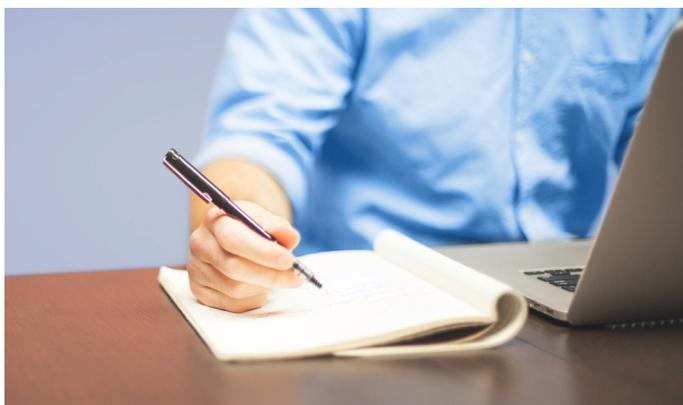
www.abtaquatics.com

www.aquacirc.com

■ FEASIBILITY STUDIES

For new developments, the **AquaBioTech Group** can undertake a complete assessment for projects, including site selection, financial reviews, risk assessments and technical / non-technical surveys.

For existing developments, the **AquaBioTech Group** undertakes complete technical assessments and troubleshooting for a variety of on growing operations, developing detailed proposals for problem mitigation. The **AquaBioTech Group** also advises on regulatory control, infrastructure requirements, environmental issues and other matters necessary to ensure sustainable aquaculture development.



■ BUSINESS PLANNING

Aquaculture entrepreneurs must identify their business structure before operations can begin. They must understand the ins and outs of their business, from its core operations to its customer service. This analysis of the business and its external environment

will help to drive business decisions and develop business strategies. In similar ways, investors, financial institutions and authorities require them to provide a comprehensive business plan in order to understand the concept behind the investment and to ensure the entrepreneur is well prepared.

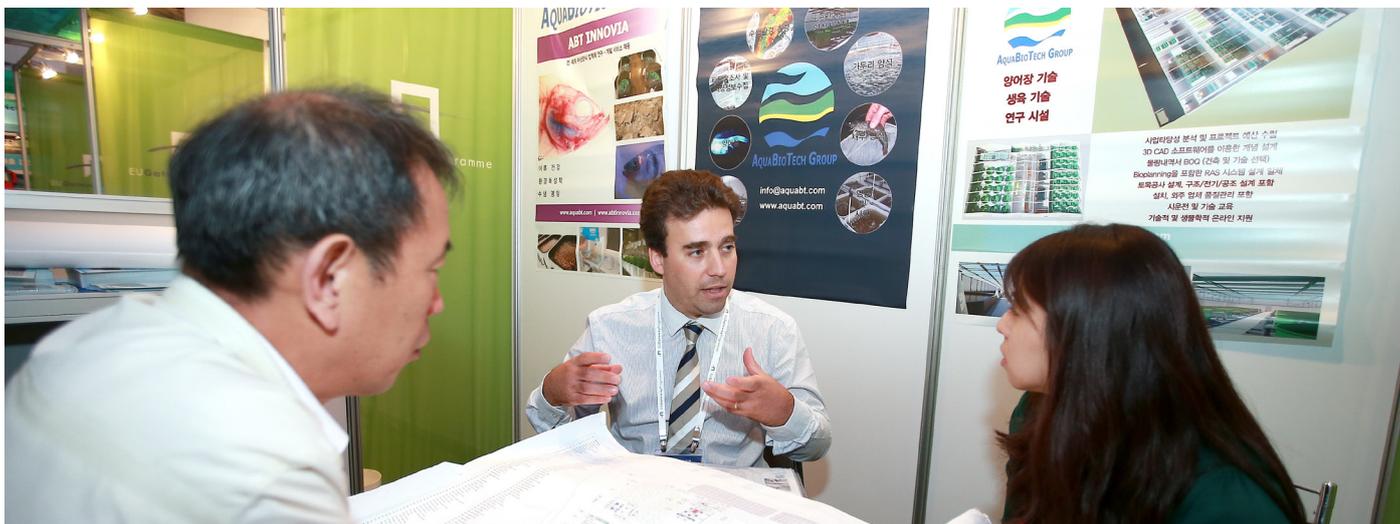
The **AquaBioTech Group** has provided business plan preparation services for aquaculture and fisheries projects for many years for a diverse range of projects.

■ SPECIALIST AUDITS

The **AquaBioTech Group** is often called upon to execute specialist assessments for aquaculture projects. These audits are undertaken for entities such as insurance companies, financial institutions, corporate investors, development agencies and public, private and intergovernmental bodies for all sizes and types of aquaculture operations.

■ DUE DILIGENCE AUDITS

Technical, operational and financial due diligence audits are undertaken in conjunction with legal and finance auditing teams to assess the overall status of a potential aquaculture investment asset. The **AquaBioTech Group** employs a unique approach based on extensive management expertise, market awareness and comprehensive technical knowledge of aquaculture operations to present detailed insight of an operation's strengths, weaknesses and opportunities.



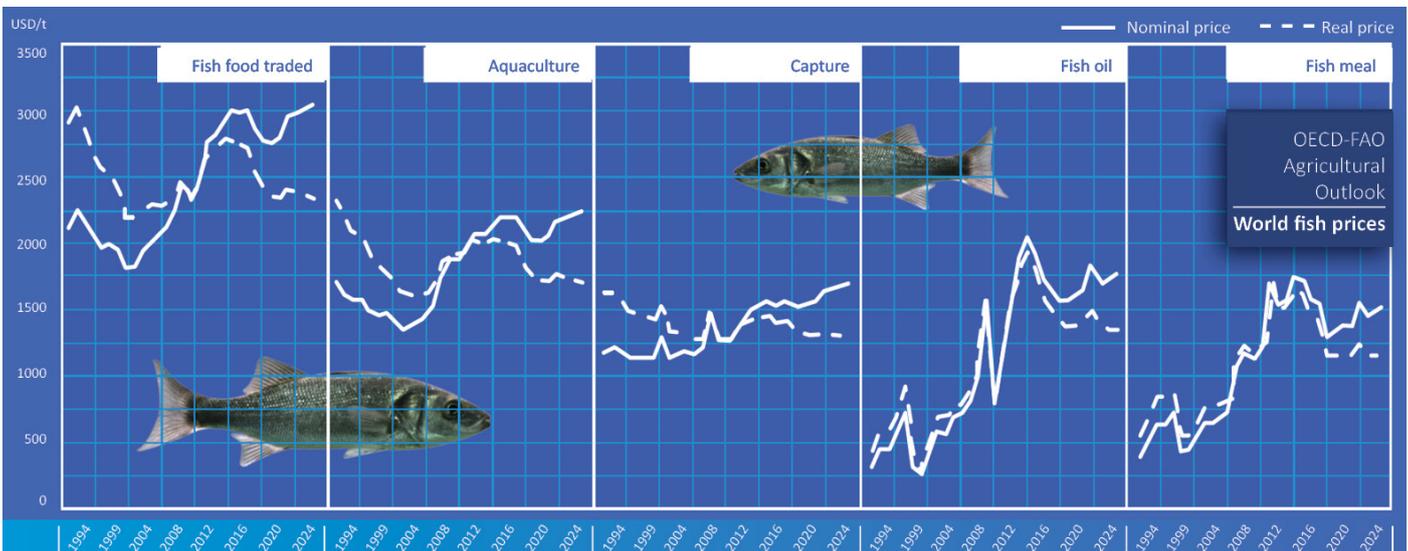
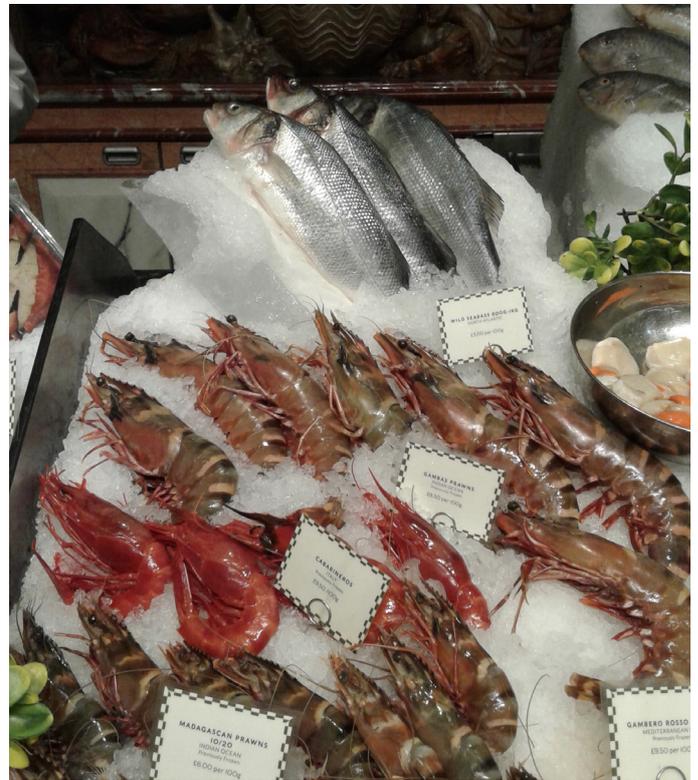
MARKET RESEARCH & INTELLIGENCE

The **AquaBioTech Group** has a dedicated market research and intelligence team providing specialised services for clients ranging from industry stakeholders, associations, public bodies, development agencies and financial institutions. Market research and intelligence assessments are commissioned primarily serving the specific knowledge of the blue growth industry covering subjects from aquaculture and fisheries to fish health, nutrition, research, financing and trade facilitation processes.



Our portfolio includes a number of services including product surveys, regional support services, GIS based studies, business intelligence research, channel/supply chain research, market sizing, and trade promotion preparedness studies. Complementary to market research and intelligence, the **AquaBioTech Group** provides several business and coaching services ranging from business planning and market entry assistance to export coaching and institutional and human resource development. The **AquaBioTech Group** ensures the legal and ethical collection and

analysis of information whilst treating the data with the highest level of confidentiality and integrity. Our international team, composed of skilled and experienced staff can provide access to valuable insight information of the markets. By working with local partners, we can provide accurate information and ensure data validation. Our team offers guidance in more than fifteen languages including English, Spanish, Italian, Portuguese, French, Polish, German, Dutch, Greek, Afrikaans, Arabic and Chinese. We work side by side with our clients to provide strategic guidance throughout the business development phase.





RISK MANAGEMENT AUDITS

For insurance purposes, project planning or as an internal exercise, risk management audits are an important tool to identify, assess and prioritise threats. The **AquaBioTech Group**, combining multidisciplinary expertise in aquaculture operations can offer a complete approach to aquaculture risk management, utilising quantitative and qualitative methods to assess risks and recommend cost-efficient mitigation measures.



BIOSECURITY CONSULTANCY

Biosecurity is one of the most important aspects in animal production since it prevents the introduction, spread and transmission of disease into, within and between animal production facilities. Although basic in principle, biosecurity is one of the most challenging aspects of food production, as it encompasses the design, implementation and monitoring of specific measures at each step of the animal production process.

Insufficient or absent biosecurity on the contrary, poses a risk to the sustainability and continuity of the food production business, as economical losses from disease event can be potentially catastrophic. Therefore, stand-alone biosecurity audits are a much sought-after service. These can be performed for producers, risk managers, insurance companies or aquaculture investors.

The **AquaBioTech Group** places emphasis on biosecurity and animal welfare in its daily work, both in its R&D facilities as well as projects conducted for clients. The **AquaBioTech Group** employs a comprehensive methodology to assess the exposure of a given animal production facility to disease risk, identify the critical control points for the implementation of biosecurity measures and propose risk mitigation measures based on cost-benefit analysis and industry-standard decision making tools. Moreover, our biosecurity consultancy services extend to offer education and training in best sampling practices, disease recognition, best disinfection practices, responsible use of pharmaceuticals and quality assurance for the purchase of fish stocks.

All the work undertaken by the **AquaBioTech Group** is based on the knowledge provided by the latest international publications and conferences, regional biosecurity status and global alerts regarding reported diseases across the different sectors of the aquaculture industry.

BIO-SECURITY VISITOR PROTOCOL



THIS IS A STRICT BIO-SECURE FACILITY.
YOU MUST THOROUGHLY READ AND COMPLY WITH THE INSTRUCTIONS BELOW.

Prior to visiting

-  Do not visit fish farms, pet shops or touch home aquaria
-  Do not wear short sleeve shirts and shorts
-  Do not wear open toe shoes

During Visit

-  You must sign the visitor logbook
-  Do not enter the facility without registered accompanying person
-  Do not enter with cellular phones or cameras or other equipment
-  Do not come in contact with fish or water
-  Keep your hand in your pockets at all times
-  Do not shake hands with any aquatic staff members
-  Do not lean over water tanks or touch the water
-  Wear protective boots and cloths upon entry
-  Disinfect hands using disinfection gel before entry
-  Stay only in the marked zone - All doors will be opened and closed for you
-  Do not make sudden movements or sounds or bang the tanks
-  Comply with all signs in the facility
-  Comply with your accompanying person instructions at all times
-  Follow the emergency exit signs in case of emergency evacuation

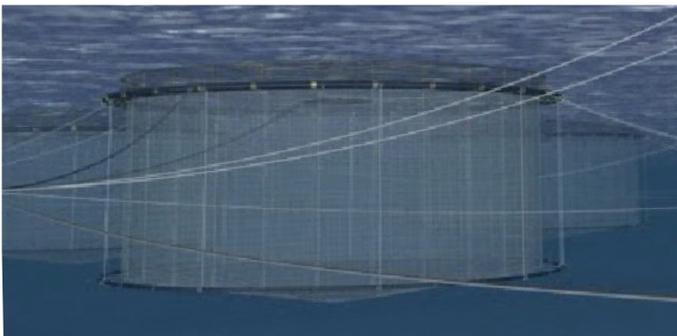
The **AquaBioTech Group** can provide a complete service from project design through to installation and commissioning. We have experience with cages from nearly all the major cage manufacturers as well as designing tailor made cage and mooring grids for specific projects.

■ SITE ASSESSMENTS

For new developments, the **AquaBioTech Group** can undertake a complete assessment for projects, including site selection, financial reviews and technical / non-technical surveys. For existing developments, **AquaBioTech Group** undertakes complete technical assessments and troubleshooting for a variety of on growing operations, developing detailed proposals for mitigation. The **AquaBioTech Group** also advises on regulatory control, infrastructure requirements, environmental issues and other matters necessary to ensure sustainable aquaculture development.

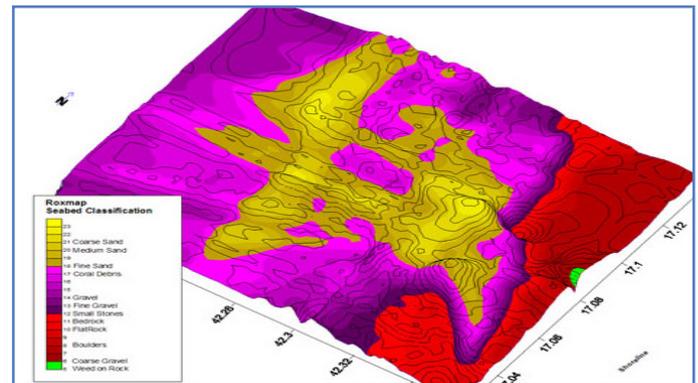
■ MOORINGS DESIGN

The design of any mooring grid is an essential part of any cage aquaculture project. The **AquaBioTech Group** is capable of preparing detailed structural plans for the creation of simple and complex mooring solutions for a variety of weather conditions.



■ BATHYMETRIC SURVEYS

Seabed assessments and bathymetric surveys are an integral part of any modern aquaculture development. The **AquaBioTech Group** uses a number of advanced survey and analysis methods so as to model and predict ideal site locations based on available and collected data.



■ EQUIPMENT

A large variety of technologies from various suppliers are required for any sort of new aquaculture development or existing venture. As part of the services the **AquaBioTech Group** offers its clients, the company sources a large variety of equipment ranging from nets, cages and vessels to oxygen meters and microscopes.

As the **AquaBioTech Group** does not manufacture any equipment of its own, we are able to offer our clients a truly independent assessment of which equipment is best for each project concerned. In conjunction with this and due to our extensive purchasing power, we are also able to secure the very lowest prices for our clients and ensure that all products are compatible and functional for the project concerned.



■ NEAR SHORE ACTIVITIES

Whilst the availability of near-shore locations is rapidly decreasing due to competition with other users, there are still several countries where near-shore cage operations are feasible.

Undertaking intensive aquaculture close to shore poses several environmental issues such as water exchange modelling together with bioremediation and biological issues such as adequate oxygen levels in the water. These and many other factors require adequate consideration and planning before commencement of operations.

■ IMTA

Integrated multi-trophic aquaculture (IMTA) combines multiple species from different levels of the food chain in one system. The system normally consists of fed aquaculture, inorganic extractive and organic extractive species to create a balanced environment. IMTA utilises the excess feed, wastes and nutrients of the finfish for the growth of shellfish and marine plants. For IMTA, species selection and positioning are essential. The system design is engineered to optimise the utilisation of waste products of the cage aquaculture.

The **AquaBioTech Group** is establishing a pilot IMTA system off the coast of Malta, to utilize the fish farm effluents for further shellfish production and evaluate the site assessment method. This research is supported by the EU H2020 research and innovation programme within the collaborative project “TAPAS – Tools for Assessment and Planning of Aquaculture Sustainability” (www.tapas-h2020.eu) under Grant Agreement No. 678396. Coupling dispersion patterns and benthic community data, the pilot project aims to assess the environmental parameters that influence the feasibility, design and optimal species for an Integrated Multi-Trophic Aquaculture (IMTA) system in the specific environment.

■ OFF SHORE ACTIVITIES

Offshore cage aquaculture is widely recognised as becoming in the future a major part of global aquaculture industry. Despite these projections technically there are still some major challenges that require high-level planning to make the operations feasible.

There is a number of companies that offer offshore cage solutions, but this is only one aspect of the operation and other technologies and operational procedures are just as important to consider. The **AquaBioTech Group** has experienced staff and personnel who can assist in all aspects of offshore cage farming from cages and moorings, to feeding, harvesting and service / support. Experienced in designing cage aquaculture projects in some of the most exposed sites, our engineers work with cage manufacturers and mooring experts to safely move fish farms further offshore.





■ OFF-SHORE MULTI USER PLATFORMS (MUP) AND MULTI-USE OF SPACE (MUS)

As maritime activity increases and coastal areas become more crowded, so does the competition for space. Expecting economic activities to move further offshore, smarter and more sustainable use of our seas is necessary. Mariculture technologies have a potential for combined use of sea space with other Blue Growth industries. Multi User Platforms integrating aquaculture facilities with renewable energy (wind, wave) and/or transportation facilities, share space and costs, and lead to reduced conflicts with other maritime users.

The **AquaBioTech Group**, with partners, is developing several projects that promote the synergy between aquaculture, marine renewables and desalination using the MUS and MUP approach. For instance wave energy devices can be installed close to a fish farm in locations up to six kilometres offshore. The wave energy device could then provide electricity directly to the fish farm reducing its costs and ensuring a supply of sustainable energy. Surplus energy could be brought onshore to satisfy the energy needs of the farm's onshore facilities.

In addition, within Marine Protected Areas low impact sustainable blue economy activities could potentially be developed.

■ SHRIMP FARMING

Shrimp farms from large-scale extensive to small-scale intensive operations can be designed in-house. The company also offers technical assistance to existing farms in areas such as broodstock domestication, maturation and hatchery production. Most shrimp grow-out farms consist of outdoor ponds using a Zero-Water Exchange system.

AquaBioTech Group's experts can assist to all the different aspects of the shrimp farming development including :

- Seed Supply
- Site selection
- Species culture
- Culture Techniques
- Water Quality Management
- Pond Design / System Design
- Feeding Management Strategies
- Environmental Impact Assessment



In addition, the company is working towards establishing successful business and operation models for the development of RAS shrimp farms.

With extensive global experience in the design and construction of recirculating aquaculture systems (RAS) for new projects and retro-fits, we offer a wealth of knowledge, assisting in management and monitoring of land-based production facilities. From flow-through systems to super intensive RAS, our company undertakes a variety of projects. These include anything from full project engineering, to specific biological aspects of production systems for mainstream and emerging species. All projects include an online monitoring system that allows our staff to continuously monitor the system's performance from our head office.

A large variety of technologies from various suppliers are required for any sort of new aquaculture development or existing venture. As the **AquaBioTech Group** does not manufacture any equipment of its own, we are able to offer our clients a truly independent assessment of what equipment is best for each project concerned. In conjunction with this and due to our extensive purchasing power, we are also able to secure the very lowest prices for our clients and ensure that all the products are compatible and functional for the project concerned.

FILTRATION SYSTEMS

As a result of the efforts of our own research and development department we have developed some of the most advanced and cost effective filtration solutions available on the market today. Filtration modules that can process from 2 m³ up to 10,000 m³ of water per hour are available, as well as custom-designed solutions that are specific for each client's requirements and budget.

HATCHERY TECHNOLOGY

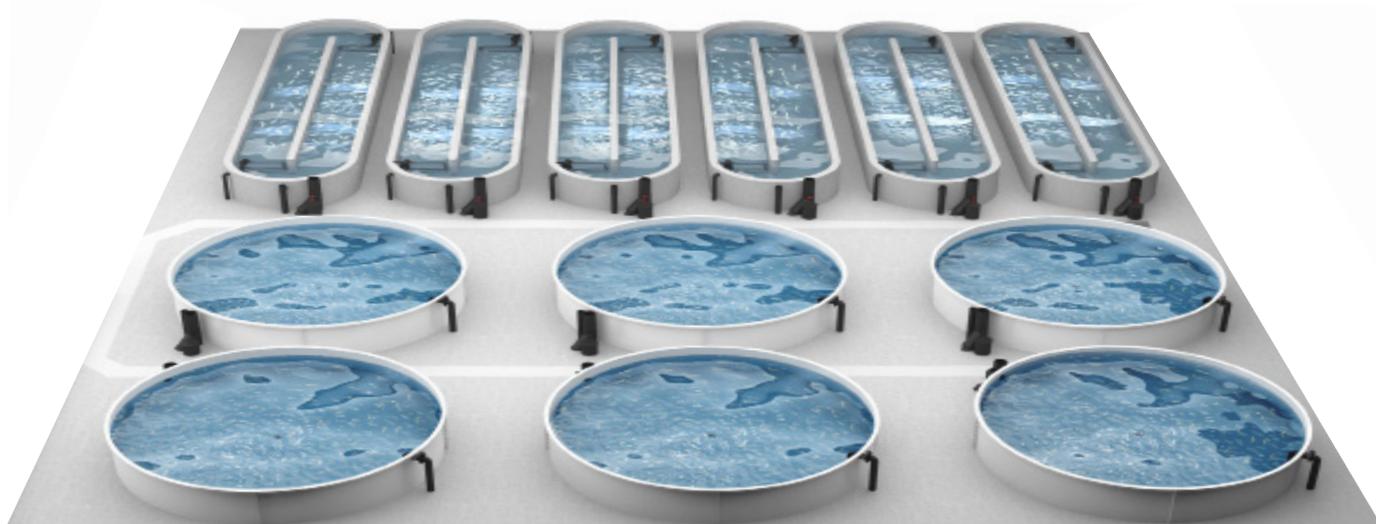
Using the very latest technology the **AquaBioTech Group's** research facilities host a number of recirculation systems that are able to function as a fully operational hatchery. Studies using our in-house capabilities have developed new techniques for improving hatchery production, efficiency and knowledge. The facility also provides our staff with valuable practical knowledge of how systems perform, therefore helping to consult and advise our clients and provide continuous technical and operational support.

GROW-OUT TECHNOLOGY

Our large scale recirculation systems are designed to produce optimal performance in terms of production, energy consumption and reduce water discharge. Complete systems are designed with biosecurity as a priority and include integrated online monitoring systems to enable our staff to provide remote support and advice to clients, long after the onsite training has been completed. The technology retains fundamental design aspects that we have found to be successful and adaptable to clients of varying requirements and to species specific requirements.

3D COMPUTER AIDED DESIGN

All projects undertaken are planned using the very latest CAD software and 3D modelling tools. This technology allows for a complete visualisation of the proposed project and integration of all aspects of the construction.



RAS TECHNOLOGY

The **AquaBioTech Group** offers design and engineering services for recirculating aquaculture facilities for both research and commercial use. Our design and engineering department is specialised in the newest and most efficient technologies. The resident team of engineers and architects can tailor projects to every requirement and support the client from start to finish on all technical and biological aspects including;

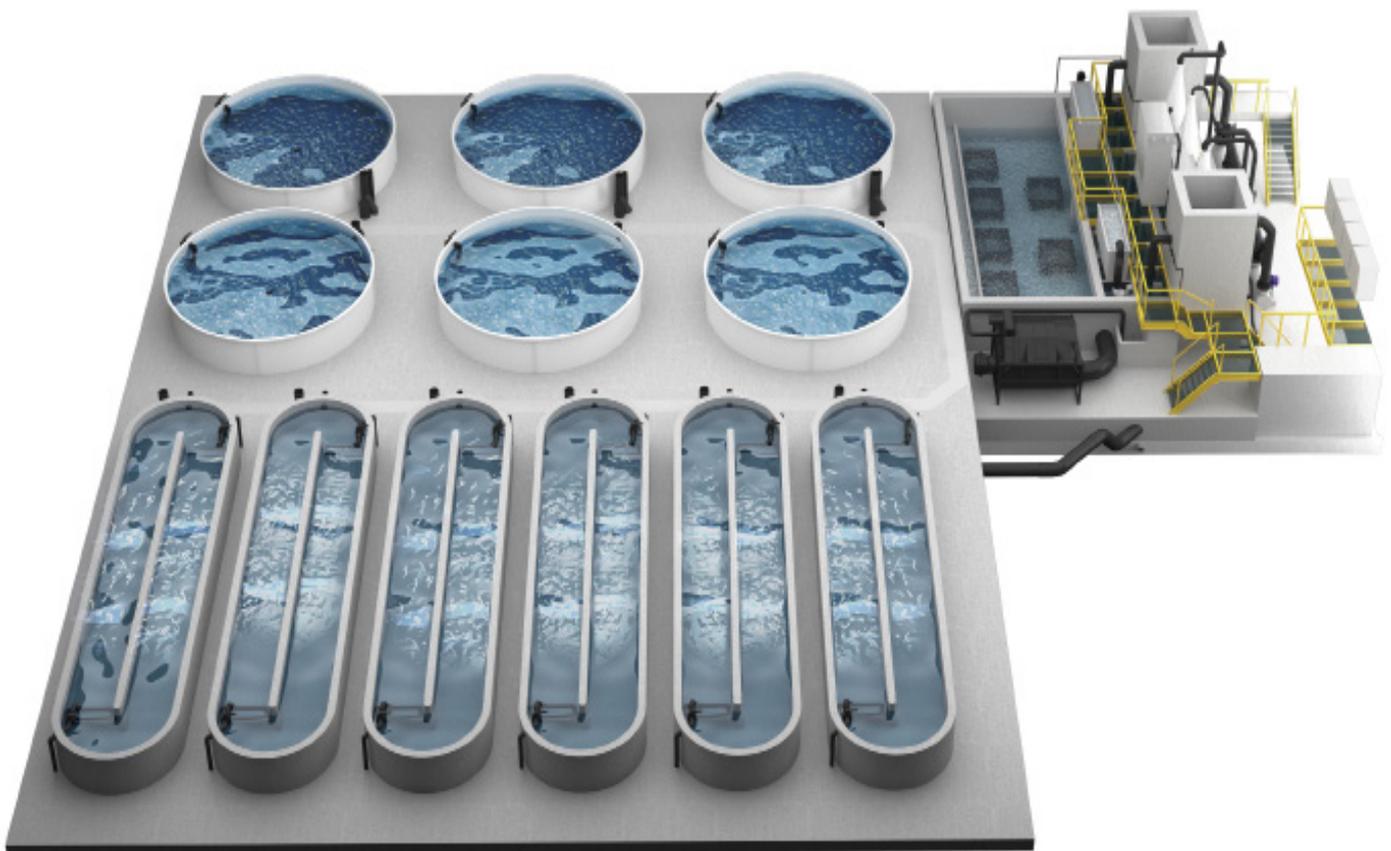
- Installation; third-party quality control
- Feasibility study and project budgeting
- Online technical and biological support
- Full RAS system design and bio-planning
- Conceptual planning using 3D CAD software
- Civil works design; structural, electrical & HVAC
- Bill of Quantities (construction and technology selection)

The **AquaBioTech Group** apply its expertise to the design and manufacturing of glass reinforced plastic equipment for aquaculture facilities:

- Solids separation devices (hydro cyclones and radial flow separators)
- Tanks for every application (fish tanks, biofilter tanks, sumps, etc.)
- Down flow bubble contractors (oxygen and ozone cones)
- Packed columns oxygenation and degassing
- Protein skimmers

Complete systems are designed with biosecurity as a priority and include integrated online monitoring systems to enable our staff to provide remote support and advice to the client, long after the onsite training has been completed.

As a result of the efforts of our own research and development department we have developed some of the most advanced and cost-effective filtration solutions available on the market today. Filtration modules that can process from 2 m³ up to 10,000 m³ of water per hour are available, as well as custom-designed solutions that are specific for each client's requirements and budget.



HATCHERIES

Hatcheries are a complex part of aquaculture and their design and operation is possibly the most difficult part of the aquaculture process. Careful thought and consideration must be placed in designing any new hatchery to ensure that an efficient and continuous production of fry is achieved. The **AquaBioTech Group** offers several hatchery solutions ranging from small and medium-scale units to full-scale commercial hatcheries.

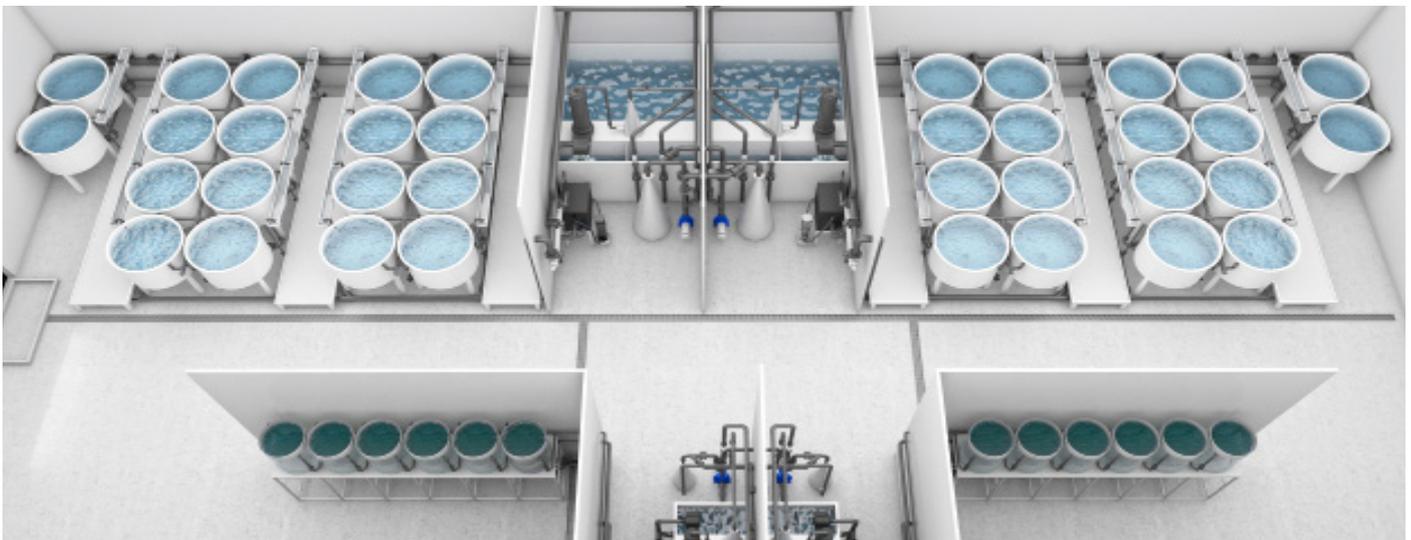
These designs include some of the very latest technologies that allow for complete recirculation of the culture water. Hatchery projects are undertaken for a wide range of species from salmon and trout, through to Asian seabass and shrimp. In designing or upgrading any hatchery operation, the selection of the correct technologies is essential for ensuring success. Location, economic circumstances and various other parameters have an impact on the final design of the facility and the level of the technology investment required.



The **AquaBioTech Group** can assist clients in ensuring that their broodstock are managed properly with adequate nutrition and environmental control. Selective breeding programmes are also possible for a variety of species of fish.

Live feed production, be it rotifers, copepods or artemia, are the fundamental basis of any hatchery feeding regime, but ensuring continuity and quality of this production is anything but easy. The **AquaBioTech Group** is able to assist clients in preparing production protocols and strategies for continuous and batch culture of rotifers, as well as technically and practically supporting existing operations with site audits.

Broodstock control and management is a difficult, yet essential part of any hatchery operation. Ensuring that the broodstock deliver the quantity and quality of eggs required at the right time involves considerable planning and understanding of broodstock nutritional requirements and environmental control. Broodstock selection is also another area of work that is becoming increasingly important as genetic mapping allows for a high degree of selective breeding to be undertaken.

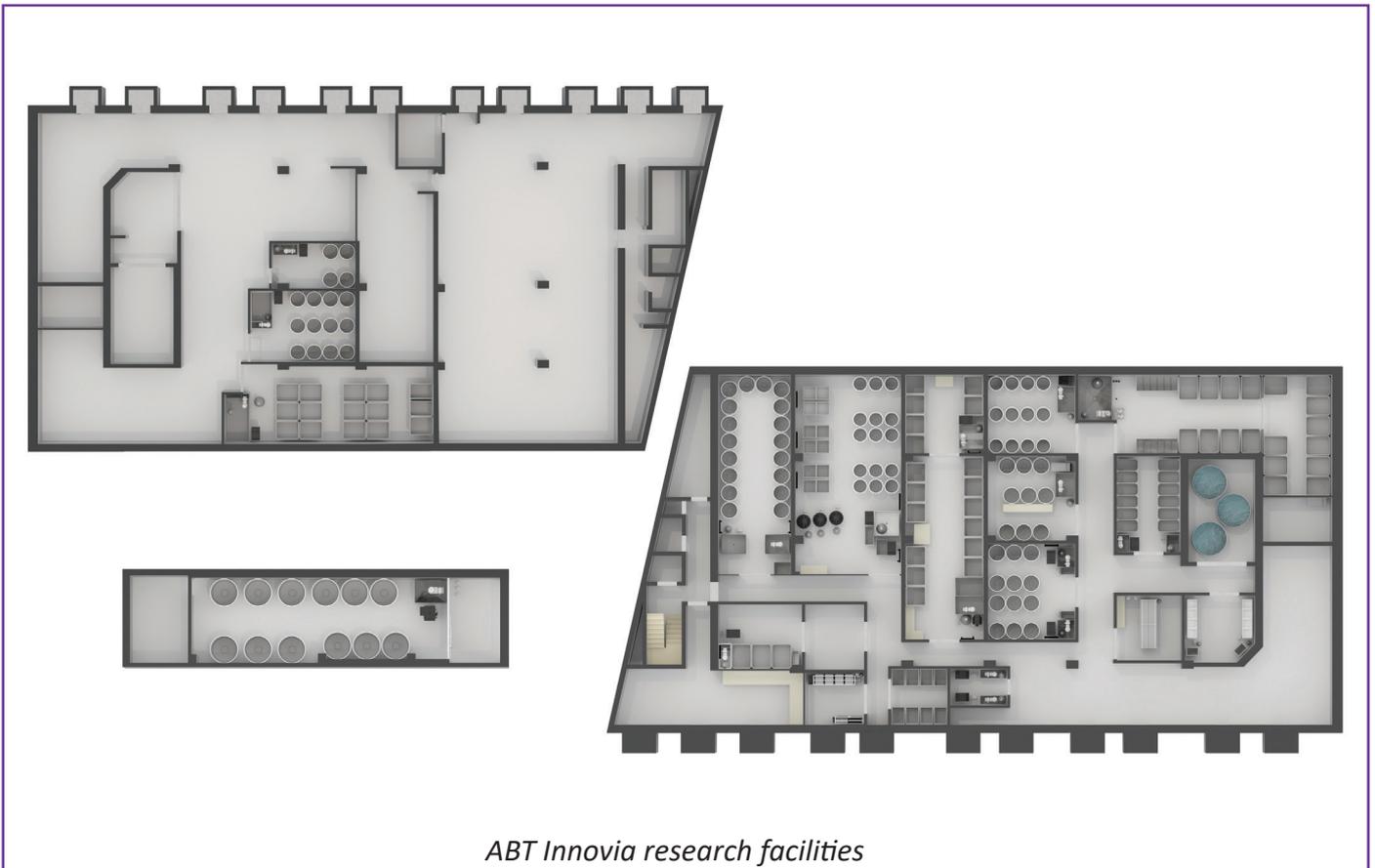


Research involving aquatic organisms is increasing and with this comes the need to create highly customised facilities. The **AquaBioTech Group** has been entrusted with designing, building and installing some of the most specialised aquatic research facilities in the world. The company is able to undertake projects for all types of medical, veterinarian, nutritional and biological / ecotoxicological research.

In 2011 the company was awarded for its corporate governance and environmental awareness, in 2012 for its energy efficient RAS design and received the European Business Award for Innovation. In 2015/16 was awarded for its internationalization strategy, in 2016/2017 for Innovation. In 2017 the company received the Middle East Aquaculture Innovation Award for its project in the United Arab Emirates, it was also listed in the 1,000 companies to inspire Europe List of the London Stock Exchange and the Ones to Watch List 2018 of the European Business Awards.

The research facility of **ABT Innovia** has become internationally recognised and has resulted in all of world's leading fish feed and aquatic vetericetual producers using the facility for independent testing and verification. Further recognition of our RAS technology performance was confirmed in 2012 when Pharmaq AS from Norway (now part of Zoetis, USA) awarded the **AquaBioTech Group** a six-year research and development

contract to help develop various aquatic vaccines using our RAS technology and disease challenge models.



ABT Innovia research facilities

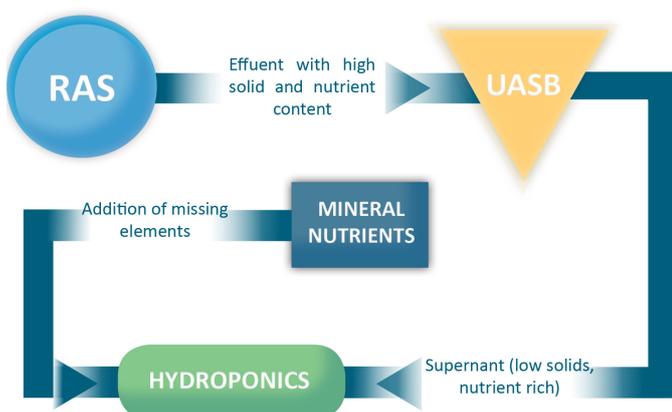
Aquaponics is an integrated approach to efficient and sustainable use of intensive soilless agriculture based on aquaculture effluents. It uses the nutrients that are usually discarded as aquaculture waste water. At the same time this system uses more than 90 % less water than traditional agriculture.

As a company that develops highly efficient recirculation aquaculture systems, we are fully aware of the potential value of the effluents released as well as the impact they have on our environment. The **AquaBioTech Group** has developed customised solutions by integrating innovative technologies into the proven horticulture concepts.

The aquaponic systems we design are:

- **Efficient:** using the latest plant cultivation, waste water treatment and aquaculture techniques
- **Modular:** can be adapted to existing hydroponic or aquaculture facilities, or designed as a complete system
- **Adaptable:** different plant and fish species can be grown according to the local market demands
- **Sustainable:** conserving water, energy and nutrients
- **Supported:** our internal and external horticulture and aquaculture experts can provide professional support and training

The **AquaBioTech Group** has established a highly efficient recirculating aquaculture system (RAS) which can be connected to its own biological reactor and connected to a hydroponic system. Either component can be adapted and added on to existing fish or hydroponic farms to create a working 'aquaponic' system or developed as an entirely new unit.



RAS: Recirculating Aquaculture System
UASB: Upflow Anaerobic Sludge Bioreactor

Our resident team of engineers and architects, along with external partners, can tailor projects according to the clients' requirements and provide support from start to finish on all technical, biological and production aspects including;

- Full aquaponic system design, including RAS and hydroponics
- Online and onsite technical and biological support
- Installation; including third-party Quality Control
- Feasibility studies and project budgeting
- Commissioning and technical training
- Consultancy on existing systems



■ PLANT PRODUCTION TECHNOLOGY

Utilizing the most efficient technology in the market makes our systems competitive with traditional hydroponics. By implementing integrated pest management (IPM) we minimize the use of phytopharmaceuticals.

■ NUTRIENT MANAGEMENT

Running a low environmental impact farm while remaining competitive, demands integral understanding of how the plants utilise nutrients and methods of renewing the enriched RAS waste water to keep the nutrients in balance.

■ MINERALISATION

Effluent with a high solids concentration from the RAS filtration system is collected in a biological reactor. In the process the solids are transformed to a form that is easily absorbed by the plants in the hydroponic farm. This can cut the cost of fertilizers by 70% and reduce the environmental impact by 80%.

Creating a new aquaculture operation or taking over / restructuring an existing operation is only the first step in the creation of a viable business entity. The **AquaBioTech Group** seeks to assist clients through every step of their business and provide timely information to clients so that their actions can be proactive and ahead of the competition.

Design and engineering makes an aquaculture facility work, and good management makes it successful. The **AquaBioTech Group** believes that it is our responsibility to not only provide the hardware to our clients, but also our knowledge of the efficient operation and management of RAS facilities. Therefore, all **AquaBioTech Group** systems come with a number of additional services as standard:

- Start-up Support
- Training manuals
- Maintenance schedules
- On-site training by our staff
- Daily checklists and task lists
- Standardisation & Documentation
- Technical passports of all components
- Training of facility staff at our facilities
- Standard operating procedures (SOPs)
- Remote assistance for troubleshooting
- System documentation & set-points for operation
- Remote-access to water quality data for diagnostics

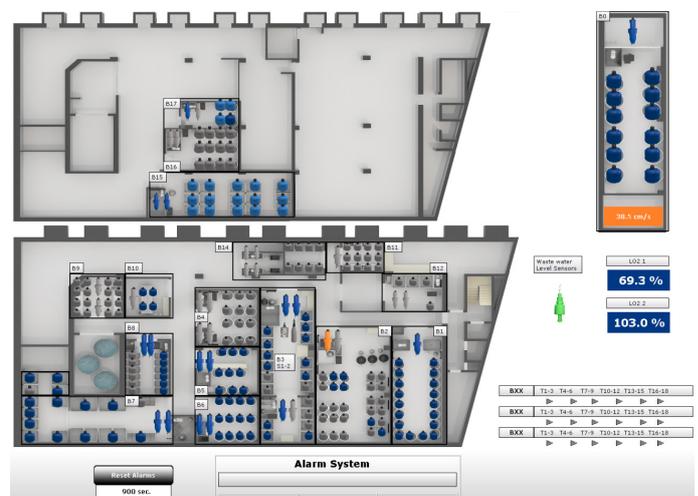
The **AquaBioTech Group** offers all the necessary documentation and support to take the RAS facility into operation smoothly and efficiently. All **AquaBioTech Group** systems come with full and comprehensive documentation on system configuration, operation and maintenance. The regular tasks of operation and maintenance are summarised in concise tasks list, and detailed information on the procedures is provided in a set of client-specific Standard Operating Procedures (SOPs).

For all the RAS projects the **AquaBioTech Group** provides technical support for the system operation for a period of one-year from the date of the technology commissioning at the project site, at no additional cost, as long as full access to all monitoring data is

provided by the end client to the **AquaBioTech Group**.

THE MONITORING SYSTEM

The monitoring unit is the brain and central nervous system of the entire farm and monitors and controls everything of importance, thus enabling the facility to sustain an intensive biomass at optimal conditions. Monitoring of the dissolved oxygen (DO) concentrations, temperature, ozone injection and ORP levels, pH and CO₂ monitoring and control, dawn-to-dusk phased lighting and a number of other alarm and check functions form the basis of the system. The system is also available as an online monitoring function, enabling staff to securely log-on and check on operational parameters. This monitoring system is also surveyed by our staff at our main offices in Malta enabling us to provide monthly diagnostics of the farms operation.



The supplied monitoring system is configured to keep track on the maintenance of the system components, and informs the user automatically when and where maintenance is required. Furthermore, the monitoring system allows for remote-access of the water quality data, which is essential for remote assessment of system performance and assistance in troubleshooting. Besides supplying a basic training manual to the facility staff, the **AquaBioTech Group** will also provide on-site training by experienced RAS specialists. Moreover the **AquaBioTech Group** also offers dedicated training sessions at its research facilities in Malta.

■ TECHNICAL TRAINING

As part of the service, we provide full technical training for the operational staff at newly built aquaculture facilities. This includes **AquaBioTech Group** experienced personnel instructing staff on how to operate the state of the art equipment on daily operations and in various other scenarios via a fully comprehensive set of SOPs and Technical Information (TIs) documentation as well as failure scenarios.

We also provide training on fish husbandry techniques to ensure that the facilities operate at top peak efficiency and the production or research targets are successfully met. Another feature of the technical training provided is how to use the most recent version of the monitoring system we provide as how to utilize all its features, including remote access from digital devices and alarm call outs. Accompanying this is the remote support we provide to the operators for several years after completion to help overcome any problems faced and ensure the overall smooth operation and longevity of the facility.

Besides providing training for RAS projects to clients, we also offer stand-alone training courses. We can provide tailor made training according to the needs of the project or business requirements.



■ MANAGEMENT CONTRACTS

The **AquaBioTech Group** also carries out medium and long-term management contracts for hatcheries, grow-out operations and research facilities. As a contract manager of public and private research and on-growing facilities the **AquaBioTech Group** emphasizes in establishing research and operation strategies that are looking at the benefits to society, the research community and the industry as well as reinforce national and strategies through a close to the market philosophy. As part of this it has established its own innovation management approach internally whereby the facilities become a centre for excellence and innovation.



■ PROCESSING FACILITIES

The **AquaBioTech Group** offers technical and scientific supervision for the designing and engineering of processing facilities. The **AquaBioTech Group** specializes in the design of facilities based on ISO, HACCP and OSHA principles. Such designs provide our customers with the capacity to increase revenues through the production of new products based on various processing and packaging options as well as access to niche markets. Solutions offered cover all production stages including harvesting, chilling, processing (gutting, trimming, skinning, slicing and filleting for added value), sorting, weighting, packaging and production lot traceability. The **AquaBioTech Group** has experience with a variety of processing and packaging technologies available in the market from nearly all the major processing providers as well as providers of customized processing and packaging solutions. The **AquaBioTech Group** also advises on local/regional/national regulatory control, secondary infrastructure requirements, environmental issues and mitigation of processing impacts on the environment and other matters necessary to ensure compliance to the regulations, certification standards and QA/QC requirements.



■ FISH FEED MILLS

The **AquaBioTech Group** can assist large scale integrated aquaculture and fishery projects that are seeking to scale up their operations incorporating the development of fish feed mill in their operation. The **AquaBioTech Group** offers scientific and technical advice for the design and installation of fish feed production lines based on modern technology

solutions. Advice offered supports high quality and efficient production of fish feeds suitable for all production stages and species with special attention to feed quality, production cost minimization, final product value and consumer welfare. Our services also include training support for the staff working in the new facilities.

■ LANDING FACILITIES / AUCTION HALLS

The **AquaBioTech Group** is able to provide scientific advice and engineering solutions for small scale fish landing facilities and fish monger auction markets especially in Third World countries. Designs are based on ISO and HACCP standards and OSHA guidelines to ensure product quality and the protection of consumer health. Proposed solutions range from small wholesale markets and stalls with small scale product preservation facilities (ice machines etc.) to large scale auction halls including ISO standard processing and packaging facilities, clean and unclean sectors as well as store, office and management facilities. The main objective of the proposed solution is the provision of high quality and healthy products to the market.



ABT Innovia is an independent aquatic biotechnology and aquaculture research and training entity with its own dedicated Research & Development (R&D) facilities based in Malta. With a large number of biosecure testing facilities using the latest RAS technology, we are able to undertake work on a number of species, ranging from coldwater Salmon, Trout and Charr, through to Tropical species such as Tilapia, Shrimp and Asian Sea bass.

The facility is able to provide tailored R&D services to clients from across the aquaculture sector, with needs ranging from the formulation, test-batch production and in-vivo testing of aquatic animal feeds, additives and enrichments, through to vaccine efficacy and safety testing. The facility also undertakes a large number of larval trials for various species, testing live feed enrichments, larval diets and production techniques using new technologies so as to benchmark hatchery and grow out systems.

ABT Innovia, as an independent testing facility, ensures experimental results of the highest integrity and quality, whilst all enquiries received, project discussions and results generated by **ABT Innovia** are treated in the strictest confidence with no intellectual property (IP) retained by the facility.

■ AQUATIC NUTRITION RESEARCH / STUDIES

The fish nutrition facility is available to international companies to benchmark commercially available products and carry out exploratory research on new products. Such as testing new formulations or specialised novel ingredients for providing new approaches to improving fish growth, reducing environmental impacts or improving fish health. In-depth detailed research, such as digestive physiology, metabolic biochemistry and quality issues can also be undertaken at the facility in a wide variety of species.

■ HATCHERY TECHNOLOGY AND PRODUCTION TECHNIQUES

The research facility hosts a fully operational hatchery using the very latest technology working towards developing new techniques for improving hatchery production/efficiency and knowledge of new species production in both commercial and ornamental aquaculture.

■ BIOMEDICAL / NUTRACEUTICAL RESEARCH BIOPROSPECTING

Research into various applications of aquatic based products for use in nutrition as well as human and veterinarian medicines is also available as the resources of the sea continue to yield many new products.



Main Research Areas

- Nutrition / feeding trials - Commercial and ornamental aquaculture species
- Vaccine, efficacy and safety testing and challenge trials
- Technology testing, commercial development and technical direction
- Hatchery training facilities, including live feed and larvae culture
- Product research and reporting / benchmarking
- Technical support and testing for new products
- New / alternative species research

TESTING FACILITIES AND CORE SERVICES

The wet-labs at the facilities are divided into separate areas so as to ensure maximum biosecurity and client confidentiality. Each of the wet rooms contains a set of holding tanks with self-contained recirculation systems providing high-level mechanical, chemical and biological filtration. All incoming water is stage filtered down to 1µm and the RAS units have the option of continuous UV, ozone or combined treatment. Systems operate with freshwater or seawater with operational temperatures ranging from 10°C to 32°C. Multiple RAS units can be operated within one Bay, isolating batches of tanks.

The fully operational research hatchery offers both research and training facilities with complete live feed production of rotifers, artemia and various phytoplankton species.

Each of the rooms can be used for a variety of research purposes including:

- Ornamental, novel and carrier species
- Veterinarian and pathology research
- Broodstock conditioning
- Aquatic toxicity trials
- Nutritional research
- Larviculture



QUALITY ASSURANCE

The **ABT Innovia** is a GMP (Good Manufacturing Practice) certified facility by UK VMD-DEFRA and Maltese VRD authorities for the “safety and potency testing of aquatic vaccines for batch release”.

The experimental challenge trials are performed according to GCP (Good Clinical Practice) under the principles of the International Cooperation on Harmonization of Technical Requirements for Registration of Veterinary Medicinal Products (VICH).

Part 2	
Veterinary Medicinal Products	
1 MANUFACTURING OPERATIONS	
1.6	Quality control testing
	1.6.4 Biological

Clarifying remarks (for public users)
Biological testing is restricted to the safety and potency testing of fish vaccines.

Ministry for Resources and Rural Affairs
CERTIFICATE NUMBER: VMAD/GMP/003/2015

CERTIFICATE OF GMP COMPLIANCE OF A MANUFACTURER^{1,2,3}

Part 1

Issued following an inspection in accordance with :
Art. 80(5) of Directive 2001/82/EC as amended

The competent authority of Malta confirms the following:
The manufacturer: *AquaBioTech Limited*
Site address: *Central Complex, Higgan Street, Targa Gap, Mosta, MST 1761, Malta*

Other:
has been inspected in connection with Manufacturing/Marketing authorisation(s) listing the company as a site of QC testing, in accordance with Art. 80(1) of Directive 2001/82/EC transposed in the following national legislation: Veterinary Services Act subsidiary legislation 437.47 Veterinary Medicinal Products Regulations

From the knowledge gained during inspection of this manufacturer, the latest of which was conducted on 2015-12-02, it is considered that it complies with

- The principles and guidelines of Good Manufacturing Practice laid down in Directive 91/412/EEC⁴

This certificate reflects the status of the manufacturing site at the time of the inspection noted above and should not be relied upon to reflect the compliance status if more than three years have elapsed since the date of that inspection. However, this period of validity may be reduced or extended using regulatory risk management principles by an entry in the Restrictions or Clarifying remarks field. This certificate is valid only when presented with all pages and both Parts 1 and 2. The authenticity of this certificate may be verified in EviasGMP. If it does not appear, please contact the issuing authority.

¹ The certificate referred to in paragraph 1(1)(2) of Directive 2001/82/EC and 80(5) of Directive 2001/82/EC, shall also be required for imports coming from third countries into a Member State.
² Guidance on the interpretation of this certificate can be found in the Help menu of the EviasGMP database.
³ These requirements fulfil the GMP recommendations of WHO.

On the EviasGMP: The key: 00020 Issuance Date: 2015-12-02 Registry: Central Page 1 of 2

In addition **ABT Innovia** is in the process of acquiring GLP certificate for its aquatic ecotoxicology work. The facility will be one of the few facilities in Europe certified and licensed to perform marine ecotoxicology work using a number of marine and freshwater species.



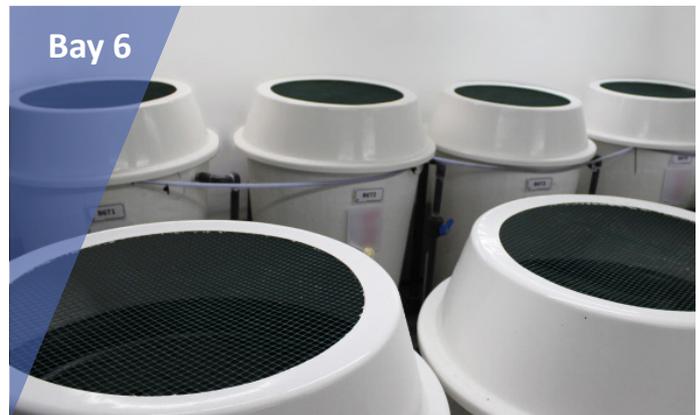
Twelve (12) tanks in system (1,500 L each) with full RAS and feed / faeces collectors. Freshwater or marine species system.



Eighteen (18) tanks in system (500 L each) with full RAS. The Bay can be operated for both feed or challenge trials. Freshwater or marine species system.



This bay has a dividing wall with two completely separate RAS units on each side. An interconnection is possible if required. The bay is currently used for quarantining and stock-holding of marine fish.



Twelve (12) tanks in system (300 L each) with full RAS. Freshwater or marine species system.



Eighteen (18) tanks (1,000 L each) for on-growing and immunisation. Freshwater- assigned to Tilapia / Pangasius / Asian Seabass or other similar species with an additional eight (8) tanks, (60 L) for fry on-growing and immunisation.



Fifteen (15) tanks in system (1,000 L each) with full RAS. Large surface areas for adult sized fish. Cold water or warm water. Freshwater or marine species system.

We have been working on expanding our list of challenge models. Work has also been completed on our cohabitation challenge models for streptococcosis on Nile tilapia (*O. niloticus*) in challenges with orally infected fish. New microbiological technologies have been studied for its application in the production of highly concentrated pathogenic bacteria vials that are also available to our clients, ready to use in our own bacterial strains but also ready to apply to any other organism requested.



■ OUR CHALLENGE MODELS INCLUDE

- Challenge by pathogen inoculation, through a bath or an oral/parenteral administration. Mortalities can be studied in the fish directly inoculated with the pathogen or in cohabitation groups according to the trial design
- Application of vaccine / therapeutic products by bath, oral or parenteral routes
- Application of environmental stressors when required by the experimental protocol

■ PARASITE CHALLENGE MODELS (UNDER DEVELOPMENT)

- Monogeneans (*Sparicotyle chrysophrii*, *Diplenactum aquaeans*)
- Myxosporeans (*Enteromyxum leei*, *Enteromyxum scophthalmi*)

■ ENVIRONMENTAL STRESSOR CHALLENGES

- Thermal stress: high and low temperatures, slowed and controlled rising / lowering levels
- pH stress: slow and rapid change
- Oxidative stress, low dissolved oxygen (DO): slow and controlled reduction of levels
- Carbon Dioxide (CO₂): static and controlled elevation of levels
- Stocking density and stress indicators: cortisol levels, heat shock proteins, etc.

Challenge Model List

- *Flavobacterium psychrophilum* – Trout; Bacterial Cold-Water Disease
- *Streptococcus agalactiae* – Tilapia; Streptococcosis
- *Streptococcus iniae* – Tilapia; Streptococcosis
- *Photobacterium damsela* subsp. *piscicida* - Sea bass; Pasteurellosis
- *Vibrio anguillarum* Serotype 01 - Sea bass; Vibriosis
- *Vibrio harveyi* - Sea bream; Vibriosis
- Cyprinid herpesvirus 3 – Common carp; Koi Herpesvirus Diseases
- *Aeromonas hydrophila* - Tilapia and Pangasius; Motile Aeromonas Septicemia
- *Aeromonas salmonicida* subsp. *salmonicida* - Trout; Furunculosis
- *Edwardsiella ictaluri* - Catfish; Enteric Septicemia of Catfish
- *Edwardsiella tarda* – Channel fish, Flounder; Edwarsiellosis
- Betanodavirus (RG NNV: Red Grouper Nervous Necrosis Virus) - Sea bass; Viral Nervous Necrosis

Different types of nutrition trials can be performed in our facilities:

- Benchmarking performance trials using different commercially available feeds where fish are grown for a period of time, and biometric parameters are recorded

Feed formulation trials, where desired raw materials or additives are included at different inclusion levels in experimental diets. Feeds can be formulated by the client or with the help of **ABT Innovia**

- Functional feed trials: where feeds containing special ingredients are fed prior to a particular challenge such as thermal stress, low oxygen or an immunological challenge
- Digestibility trials



INTERNAL ANALYSIS AND PRACTICES

- Tagging
- Histology
- Microbiology
- Spielberg test
- Digital Imaging
- Vaccine residue
- General biometry
- Optical microscopy
- Elastomer and PITs
- Examination via gross necropsy
- Physiological / Biochemical parameters

WITH PARTNER LABORATORIES AND RESEARCH CENTRES

- ELISA
- HPLC
- RT PCR
- Respiratory burst
- Sediment analysis
- Heat Shock Proteins
- Off flavouring geosmin / MIB
- Viral isolation and cell culture
- Enzymatic activity at tissue level
- mRNA expression in specific tissue
- Protein expression in specific tissue
- Proximate composition of whole body or target organs



Marine fouling causes enormous problems in the maintenance of vessels, aquaculture cages, ropes and moorings as well as intake pipelines, Reverse Osmosis (RO) plants and other structures. Our licensed facilities provide laboratories, testing tanks and field studies to assess the antifouling activity of active substances and antifouling products. In field studies, we provide an in-depth assessment of the antifouling performance using image analysis and identification of the fouling community.

LABORATORY SCREENING TESTS

Single species bioassays provide a fast and reliable screening method to identify effective active substances and formulations. Micro and macro-fouling model species currently in-house:

- bacteria
- bryozoan, hydrozoan
- barnacles and mussels
- microalgae, macroalgae

FIELD TESTS – HARBOUR AND OFFSHORE

- Dynamic Testing
- Static field tests in harbour (Panels- ASTM D3623-78a, D6990-05)
- Offshore field tests (Nets / Metallic Demonstrators)



Many regulations require ecotoxicological studies in order to fulfil applications for registration (e.g. REACH, BPR and certification of bioplastics). The EcoTox laboratory carries out standardised and specialised toxicity tests. Our facility has a close collaboration with local and international laboratories that are able to conduct physical and chemical analyses. New techniques can and are being developed for existing and new applications.

AREAS OF APPLICATION

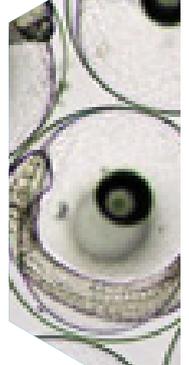
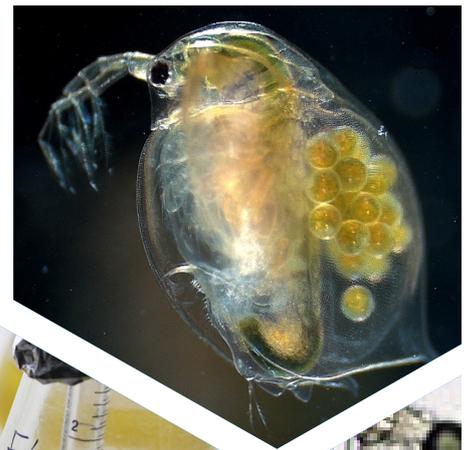
- Pharmaceuticals – Waste water
- Pesticides and Fertiliser Runoff
- Nanomaterials
- Microplastics
- Aquaculture

ECOTOXICITY TESTS (MARINE / FRESHWATER)

- Acute test with macroinvertebrates (*Daphnia*, *Artemia*, Rotifers)
- Embryo toxicity tests with sea urchin, fish (Zebrafish)
- Chronic test on fish – various species (OECD 215, 204)
- Algae growth inhibition (OECD 201)
- Plant growth tests (*Lemna* sp.)
- Rapid Toxkit microbiotests
- Coral larvae toxicity tests
- Sediment toxicity tests
- Pre-screening *Vibrio*

Biochemical Parameters

- Protein content
- Catalase activity
- Lipid peroxidation
- Acetylcholinesterase activity
- Lysosomal neutral red retention
- Gluthatione S-transferase activity

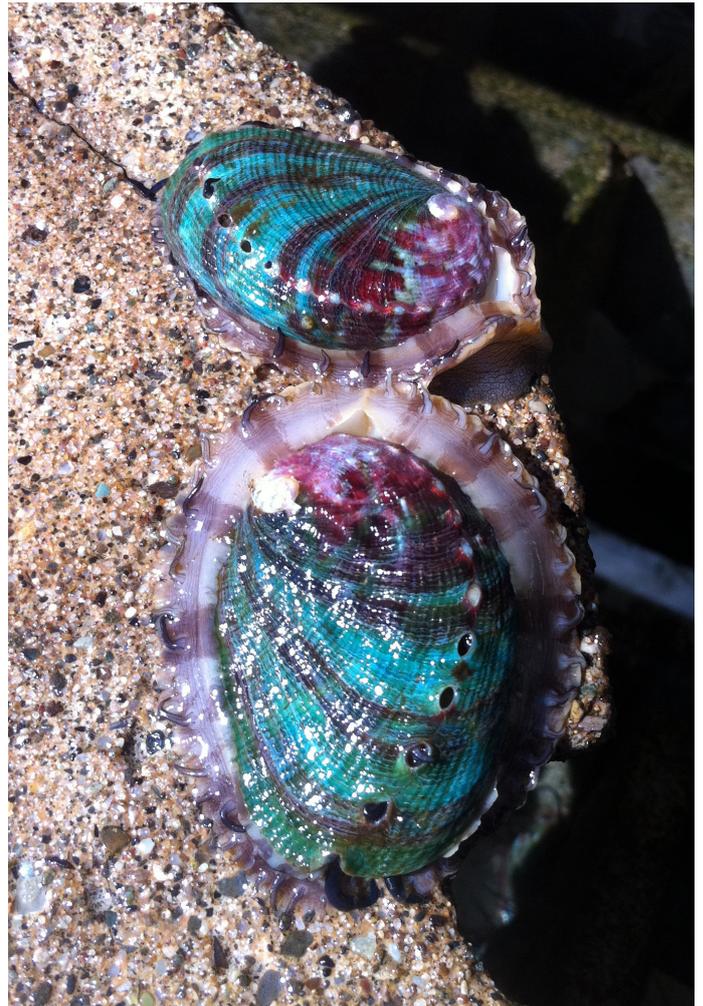


The **AquaBioTech Group** is actively involved in research and academic activities at both National and European level, either in collaboration with local universities and public bodies or as part of larger consortia which takes part in Europe's main research schemes.

In Malta: Collaboration with the University of Malta performing oceanographic work such as ROV surveys, seabed mapping and sampling work.

EU: Active involvement in H2020 projects and other initiatives. Currently **AquaBioTech Group** is involved in 2 on-going FP7 and 3 Horizon 2020 projects whilst many more have been completed.

International: Furthermore we do participate in a number of international and bilateral cooperation schemes such as the ERANETs, Interreg, Eureka, PRIMA Initiative and others to establish a long-lasting business and research collaboration with counterparts from Africa, Middle East, Asia, Latin America, USA and Canada.



THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

HORIZON 2020

The **AquaBioTech Group** provides ample opportunity for students and trainees to develop new skills and know-how in the various fields of activity in which it operates: fish rearing, aquaculture engineering, water chemistry, fish health and nutrition, toxicology, marketing, project management, business development etc.

We have been receiving an increasing number of trainees over the years, coming from all over the

world and contributing to enrich our international dimension. We are familiar with the EU framework and the Erasmus+ program, and are ready to provide the necessary help regarding the administrative and scholarship requirements.

We look forward to welcoming all applicants that wish to enhance their CV with a new, significant and professional experience for a duration of between 3-12 months.



Camilla Due Gitz
Business Development Intern
Denmark



Noemi Cubo
Water Quality Intern
Spain



Sam Clough
Aquaculture Technican Intern
England



Monika Šatková
Aquaculture Technican Intern
Slovakia



Alejandra Gimeno
Aquaculture Technican Intern
Spain



Gourav Kumar Thazhathillath
Laboratory QA & QC Intern
India



Karl Peebo
Applied Chemistry & Biotechnology Intern
Estonia



Elena Zarnier
Fish Health & Microbiology Intern
Italy

Canada

USA

Mexico

Costa Rica

Columbia

Venezuela

Brazil

Portugal

Spain

Ireland

UK

France

The Netherlands

Italy

Germany

Norway

Poland

Hungary

Slovenia

Greece

Bulgaria

Moldova

Turkey

Rusia

Vietnam

Malta

Marocco

Lebanon

Egypt

Saudi Arabia

Nigeria

Ghana

Uganda

Zimbabwe

South Africa

Australia

We believe that our first responsibility is to our clients who utilise our products and unique professional services. Meeting their needs and demands is our primary goal, pushing us to strive and carry out every task at the highest standard.

We constantly strive to reduce our costs in order to maintain reasonable prices, as this will enable our clients to obtain the best value for their money using our services. Our customer`s demands and problems are of the highest importance to us and are serviced promptly and accurately.

Experimenting with new ideas, developments, concepts and research is an ongoing process at the **AquaBiotech Group**, and innovative programs are constantly developed to offer new services and technologies.

In accordance with our mission statement, we continue our expansion. It is expected that a number of new wet labs and facilities will be available in order to satisfy the growing sectoral demand. These facilities will include additional quarantine and stock fish rooms and RAS facilities for fish nutrition and challenge trials.

The company also offers a licensed offshore marine experimental site area which is used for applied research and testing for a wide range of activities including the anti-fouling materials tests, water quality monitoring equipment and other oceanographic instrumentation / research activities.

“Quality is the customer coming back – not just the service”



Agra_{ME} | Aqua_{ME} | Vet_{ME}

AWARDS

WINNER 2017



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