



MCAST

Malta College of Arts, Science & Technology

MQF Level 6

AG6-03-19

**MCAST Bachelor of Science (Honours) in Fish
Management**

Course Specification

Course Description

This course offers students a very thorough understanding of aquaculture and fisheries sciences and includes a wide range of aspects that will give them a better understanding of these sectors which are so important to the economy of the Maltese Islands. The units revolve around the aquaculture and fisheries sciences and relate to the production and management of aquaculture facilities, giving a better understanding of the highly complex field of fisheries. The course is intended for those that want to delve deeper into the fish management sciences and who thus want to start a career in this sector. After successful completion of the first 120 ECTS that relate to the first 2 years of the programme, the student will be awarded a higher diploma in fish management.

Programme Learning Outcomes

At the end of the programme the learner will be able to:

1. Understand the production processes of aquaculture facilities
2. Evaluate the operations of aquaculture enterprises
3. Assess the fishing industry's management, economics and governance
4. Evaluate different fishing practices and technologies.

Entry Requirements

MCAST Advanced Diploma in Fish Management

or

2 A-Level passes and 2 I-Level passes

Preferred: Biology

Key Units

A key unit is a unit which is considered fundamental to a specific course. According to the University College Regulations, a student shall not be allowed to progress from one year to the next if such student fails in a key unit

Unit Title	ECTS
Aquaculture, management and policy	6
Fishing Practice and Technology	6
Research Project	6
Fish Anatomy and Physiology	9

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Current Approved Programme Structure

Unit Title	ECTS
Aquaculture ,Biotechnology and Genetics	6
Aquaculture, Management and Policy	6
Aquatic and Coastal Environments	6
Aquatic Health and Disease	6
Fish Nutrition, Formulation and Feeding	6
Fisheries, Economics and Marketing	6
Fisheries Governance	6
Fishing Practice and Technology	6
Introducing Fisheries an Fishing	3
Research Project	6
Aquaculture Production and Husbandry	6
Aquaculture Systems Design and Engineering	6
Aquaculture , the Environment and Sustainability	6
Fish Anatomy and physiology	9
Fisheries, Biology and Ecology	6
International Fisheries Management	6
Marine Zoology	6
Maritime Law	6
Fish Processing, Quality and Safety	6
Development of Land and Sea-Based activity	6
Advanced Fisheries Studies	6
Water Analyses in Fish Farming	12
Recirculating and Integrated Aquaculture	6
Business Planning	6
Dissertation	12
English	6
Critical Thinking	6
Entrepreneurship	6
Total ECVET/ECTS	180

Aquaculture, Biotechnology and Genetics

Unit Level (MQF): 5

Credits: 6

Unit Description

The aquaculture industry has been increasing substantially both worldwide and in Malta. This is partly due to developments in biotechnology and genetics which have assisted in optimizing the growth of fish in confined conditions. A detailed understanding of fish genetics will help in planning and conducting a successful breeding program that will further express traits essential to make the aquaculture industry more profitable. Thus, aquaculture will keep contributing to an ever-increasing demand while making optimal use of the resources allocated.

This unit will cover the principles related to genetics as they relate to the fish husbandry sector. This will lead the learner to understand how such principles can be applied in fish breeding and, thus, how aquaculture can exploit such principles for the benefit of the industry. The concept and industrial application of concepts such as inbreeding, gynogenesis, androgenesis, crossbreeding, hybridization and sex reversal will be evaluated.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand general principles of gene variation and expression.*
2. *Understand general principles in genetics as they are used in the aquaculture sector.*
3. *Discuss the importance of fish sex reversal.*
4. *Know the basic principles of breeding program design.*

Aquaculture, Management and Policy

Unit Level (MQF): 5

Credits: 6

Unit Description

Good management of an aquaculture facility is vital for the effective and efficient operation of the enterprise. This should give rise to increased productivity and maximization of resource utilization. But this will depend on the manager's understanding of the problems and on the right decisions that s/he will take in light of the present policies, economics of production, management of human resources and other factors.

This unit complements many of the other units delivered as part of this course. The good management of production and husbandry, of fish health, of breeding programs etc. are covered in other units. Good management of these aspects of an aquaculture facility is essential and will can either make or break the enterprise under consideration.

This unit will, rather, focus on management of aquaculture aspects not particularly related to the rearing of fish. Enterprise costs, human resource management and decision-making tools are three major aspects of aquaculture management that will be covered in this unit. Moreover, the aquaculture industry as it is regulated by various policies and legislations will be discussed. This will be done by understanding the evolution of aquaculture policy throughout the years and how the present aquaculture policies and strategies are impacting the industry.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the economics of production of an aquaculture facility.*
2. *Appraise the decision support systems utilized in an aquaculture facility.*
3. *Understand how changes can improve management and business performance.*
4. *Evaluate present policies as they effect the aquaculture industry.*

Aquatic and Coastal Environments

Unit Level (MQF): 5

Credits: 6

Unit Description

Understanding aquatic and coastal environments is essential for learners that intend to enter the aquaculture and/or fisheries sectors. Nowadays, these sectors are strictly regulated to minimize their environmental impacts. Hence, a good understanding of the aquatic and coastal environments will provide the learner with comprehensive knowledge of the subject matter to enter the sector equipped with the necessary tools to contribute to a more sustainable sector.

The unit will first provide an overview of the factors that contribute to the coastal form and processes. This will include investigations on geology, geomorphology and ocean dynamics. Subsequently, the ecosystems found in the Mediterranean Sea will be evaluated. The dynamics between the different components and levels of these systems will be analyzed and the effects of habitats on life-forms discussed.

The unit will then proceed to investigate Geographic Information Systems (GIS)- a widely used tool in mapping and environmental studies. The learners will be given an overview of the general concepts of the system and then shown how it can be applied in the aquaculture and fisheries sectors.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand how geology, geomorphology and ocean dynamics have an effect on coastal form and processes.*
2. *Understand the differences between the ecosystems found in rocky shores, soft shores and marine systems.*
3. *Understand the basic principles of Geographic Information Systems (GIS).*
4. *Use GIS for a range of aquatic applications.*

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Aquatic Health and Diseases

Unit Level (MQF): 5

Credits: 6

Unit Description

Maintaining the health of fish is essential in any fish rearing facility. It is of vital importance that any infectious and non-infectious ailments are diagnosed promptly and cured immediately. Furthermore, it is essential to provide ideal rearing conditions to reduce stressors that might compromise the health of the aquatic species being reared. This is vital if any aquaculture facility wants to meet its objectives and grow the fish for the market. Ill or stressed fish will decrease yield and can be economically catastrophic.

This unit will investigate a wide range of infectious and non-infectious diseases in the aquaculture industry. It will go in depth into the life-cycle, biology, conducive environmental factors for proliferation and other epidemiological factors of viruses, bacteria and fungi that infect fish and other aquatic species. For each of these, diagnostic symptoms and suitable treatments will be discussed.

The unit will also cover aspects of non-infectious diseases such as physical injuries, genetic disorders, effects of poor abiotic factors and nutritional imbalances. For each of these, diagnostic symptoms and suitable treatments will also be discussed.

Learning Outcomes

On completion of this unit the student will be able to:

- 1. Discuss how rearing conditions can affect the health of fish growing in an aquaculture facility.*
- 2. Describe the life-cycles and diagnostic symptoms of a range of viral, bacterial and fungal infections effecting fish growing in aquaculture.*
- 3. Describe the causes and diagnostic symptoms of a range of non-infectious disorders.*
- 4. Compare and contrast a range of treatment methods for a range of diseases and disorders.*

Fish Nutrition, Formulation and Feeding

Unit Level (MQF): 5

Credits: 6

Unit Description

Fish nutrition constitutes an ever-increasing area of research and interest due to the fact that it is a fundamental for the success and sustainability of the aquaculture industry. Poor nutrition would lead to stress, diseases, poor fish growth and environmental pollution and thus a thorough understanding of the requirements of the fish's nutrition together with how such requirements are met is essential.

This unit provides an in depth analysis of how to determine the requirements of different aquatic species for the different nutrients. It will then proceed to discuss how such requirements are met and what are the major differences between the nutrition of a range of aquatic species at different stages of their life. The unit will also discuss the different feeds used by aquaculture and what are the needs for alternatives to be found. Thus the learner will get a good understanding of the way aquaculture provides the best nutrition for the species being cultured and how essential this is in the way of enterprise economics.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand how energetics and metabolism determine the nutrition requirements of aquatic species.*
2. *Compare and contrast different feeds used in the aquaculture industry.*
3. *Comprehend the general principles of larval and juvenile nutrition, formulation and feeding.*
4. *Comprehend the general principles of grow-out and broodstock fish nutrition, formulation and feeding.*

Fisheries, Economics and Marketing

Unit Level (MQF): 5

Credits: 6

Unit Description

This module shall provide the basis of the economic theory which will help the students to understand the economic dynamics of the fisheries sector. It shall provide an understanding of the central economic problem which deals with the issues of scarcity followed by choice. The module will look into the theory of demand and supply and how their interaction will determine market prices. Students will gain an insight with regards to the tools used by policy makers to apply the theory of demand and supply to control the market. The module will also look into the theory from the fisher's point of view and will provide an understanding of the theory of production and the various types of costs associated with it.

The module shall evaluate how micro economic theory is applied to the whole economy. It will furnish the students with an understanding of the various economic indicators used to measure the performance of the economy and the policies used to achieve goals from a macroeconomic point of view.

The objective of this module is to extend the basic economic theory (module 1) to the fisheries sector. It will provide the students with an understanding of the relationship between economic growth and environmental problems and thus the need to consider tradeoffs between material benefits and environmental preservation. It aims to gain an insight into a number of concepts that explain why a free market does not necessarily result in the best solution in relation to the environment, resulting in the need to correct such market failure by putting a monetary value on the use of the environment. These concepts will provide the basis of the theory of open access equilibrium. The latter aims to equip the students with a tool to determine the quantity of fishing effort at which point the fishers' costs are equal to the revenue. The module will look into the types of policy instruments used to control an open access resource such as fisheries.

The last part of the unit will delve into the theory of marketing and how this can be applied in the aquatic products industry. An overview of the marketing research techniques and how a marketing plan can be implemented will be provided. This will be followed by discussions on the market size and consumer purchase decisions.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the basic concepts and principles of micro- and macro- economics.*
2. *Apply basic economic theory to the fisheries and aquaculture sector.*
3. *Explain the important role marketing has to play in the selling of fish and other seafood.*
4. *Identify types and uses of market research.*

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Fisheries Governance

Unit Level (MQF): 5

Credits: 6

Unit Description

The importance of this module lies in the theoretical appraisal of fisheries governance which forms the basis for the management of fisheries. This module represents the epistemological and ontological concepts that underline the theory of governance, encompasses an appreciation of the various types of governance that are applied within contextual frameworks, and how governance structures relate to fisheries management. This module shall seek to distinguish between community-based governance, also known as decentralized governance, at one end of the spectrum, as opposed to state-based top-down governance also known as centralized governance, that lies at the other end. The theoretical review shall incorporate the theory of co-governance, interactive governance and participatory governance. Effectively, through understanding the initiation of democratic pragmatism within fisheries governance, the students will be able to understand the importance of participatory mechanisms for fisheries management. Effectively, the students will be engaged in critical thinking of the role of governance structures and identify the advantages and shortcomings of the different types.

This module shall present the students with the empirical foundations of fisheries governance pertaining to various contexts. This module involves a clear explanation of the role of the EU and its distinctive panels in the formation of policies and regulations, including the roles of the EU Commission, the EU Council and the EU Parliament. Through an analysis of the nested governance structures that delineate the discourse of fisheries management, the students shall be able to understand the process of the EU in policy-making through the enactment of regulations and thereof. This module shall focus on the various legal frameworks of the Common Fisheries Policy including the role of the various governing structures in reaching the targets set within these legal parameters. These shall include a detailed analysis of the implementation of the maximum Sustainable yield (MSY); the discard ban; the landing obligation as well as the concept of regionalization. This will lead to a more in-depth analysis of the enforcement basis that are laid within the control regulation and the irregular, unregulated and unreported (IUU) fishing.

The students will be able to learn about the role of EU Member States in regards to the implementation of policies. This module shall present the students with an understanding of the local administrations in terms of policy-making, the scientific expertise and other governance-related responsibilities that are led through the public institutions in Malta. Through this module, the students can better understand the involvement of Malta in data collection schemes as per obligation of the Data Collection Framework and the GFCM, as well as the defined role of Malta in presenting the Government's position during the various technical, expert and political meetings that take place in Brussels and during other regional meetings of the GFCM, ICCAT and the alike.

This module is indispensable in the light of the whole degree since it provides an academic front that furnishes the students with the capacity to critically acknowledge the role of governance within fisheries management. It bridges the whole spectrum of fisheries governance since it fuses the integrative functions of science, management, policies and enforcement; and the roles of the scientists, managers, policy-makers and officers respectively. Upon completion of this module, the students will be able to academically analyse and critically appraise the theoretical standpoints of fisheries governance and its empirical achievements and fallacies at the international, regional and national scales.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand different types of Fisheries governance.*
2. *Analyze Laws, Regulations and Policies related to the Fisheries sector.*
3. *Appraise the roles of a range of entities as they influence the Fisheries sector.*
4. *Understand the general concepts of the European Union Common Fisheries Policy.*

Unit: ASFSH-506-1518 - Fishing Practice and Technology

Unit Level (MQF): 5

Credits: 6

Unit Description

This module deals with the practical side of the fisheries sector. It is based on an appraisal of fisheries activity and its evolution from the hunter-gatherers society through to the present technology-driven systems. This shall address the various types of fishing gear used for various fisheries stocks including demersal, pelagic and benthic species. These shall encompass the fishing techniques such as the use of purse seines, trawling, dredging, gillnets, trammel nets, long-lining, demersal pots and traps, and the relevant seasons and zones within which these are utilized. An appreciation of the benthic dynamics and the geological and geomorphological profile of the seabed would be beneficial for the understanding of fishing zones. Essentially, as a prototype explication, this module shall stress the artisanal fishery constituents which are the base of the Maltese fisheries. By focusing on the main fishing seasons targeted in Malta, the students will acknowledge an in-depth knowhow of the cognitive and practical skills implemented for each type of fishery.

The strength in this module lies in the comparative analysis of the various types of methods including their benefits and drawbacks through their utilization. This is central in understanding fisheries management since it encompasses the activity in itself and how the use of the fishing gear interacts with the ecosystem at large. Students will be able to appreciate the various gear specificities and how their design has undergone changes to realize the potential of sustainable fishing. These include for example the increases in mesh sizes or hook sizes that are preventive of bycatch or undersized species, along with the technological advancement for efficient fishing.

This module shall present the students with the technological and modernization aspects regarding the different devices used for fishing (e.g. fish finder) and how they have rationalised the activity to make it more sustainable and economically efficient. It addresses the activity of fishing in its entirety commencing from the preparation of the fishing trip to the entry back into the fishing port. It shall look into the preparation of the fishing tackle, equipment and bait at the shore, to the storing of fish on board following the catch, and general information on the mending of gears. In regard to the organizational aspect of the fishing activity at sea, this module shall

address the elements of crew management. This will focus on the various roles and responsibilities assigned during a fishing trip.

This Unit involves a considerable amount of practical substance, hence, the pedagogy will include direct observation of fishing activity and potential hands-on fieldwork. This module is of fundamental importance since it is framed within a sustainable framework approach that encompasses the social, economic and environmental parameters of the fishing activity and the techniques implemented along with the managerial competences that are necessary for a holistic comprehension within the module of fishing practice and technology.

Learning Outcomes

On completion of this unit the student will be able to:

- 1. Understand how fishing technology evolved throughout the years.*
- 2. Evaluate various fishing methods that are currently being utilized.*
- 3. Evaluate the present modernization and technological advancement in the current fishing gear and technological equipment being developed.*
- 4. Compare and contrast the different types of vessels used for fishing.*

Introducing Fisheries and Fishing

Unit Level (MQF): 5

Credits: 3

Unit Description

This module is of an introductory nature and shall acquaint the students with the basics of fishing and fisheries. Through introducing the various ontological realms that deal with the study of fisheries, the students shall be able start appreciating the complexity of fisheries affairs through an integrated approach. This shall encompass the social, cultural, political, economic, and environmental affairs that collectively enable an exploratory philosophy concerning fisheries studies. This module introduces the understanding of fisheries as an evolution from a subsistence activity to a capital-oriented industry. This will be sought through a multiple-lens approach of fisheries at the global, regional and national scales.

This module shall present the students with the foundational theoretical standpoints that will be utilized throughout the whole degree. This module shall present the students with the various epistemological and ontological frameworks of the major domains that pertain to the fields of biology, economics, management, governance, social, anthropology and navigation. This shall frame the relevant conceptualizations that will be further delved into throughout the successive modules. Essentially, this module should prepare the students with the academic ability to start appreciating and criticizing the philosophical thoughts that surround the disciplines of fisheries studies.

The strength of this module further lies in its formative approach towards the comparative stance of fisheries around the world. At the heart of the module lies the discussion of fish as a source of food security and the heated debates about fish sustainability that surround the biological, economic, environmental and political discourses. This module shall also present the students with an observatory-oriented fieldwork that will enable a closer look of fisheries at the national and local levels. The interactive approach of this module through a pedagogical fusion of fieldwork and academic appraisals is central to the fundamental thinking that shall be ensued through the subsequent modules.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the different types of worldwide aquatic systems and fisheries.*
2. *Understand the evolution of fishing around the world.*
3. *Appraise the role of fisheries as it provides food to a wide range of communities.*
4. *Compare and contrast single-stock and mixed-species fisheries.*

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Research Project

Unit Level (MQF): 5

Credits: 6

Unit Description

This unit prepares students for their independent research project linked to Fisheries or Aquaculture. In both cases, students are guided in the process of carrying out a research enquiry from initial concept to final report. The unit will demonstrate methodological approaches to collecting and analysing data and will address ethics in research.

Another key aspect of this unit is the development of a working relationship between the student and their supervisor(s) and this will be addressed through the recommended timeline and activities.

Finally, the unit will guide students in how to write critically and objectively in producing their final project and how to correctly cite and reference the work of others in their own original work.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Develop a research enquiry from initial objectives and a review of others work, through the proposed research.*
2. *Complete the research through to the final report.*
3. *Evaluate findings and results of research project.*
4. *Present the proposal and findings of the project.*

Aquaculture Production and Husbandry

Unit Level (MQF): 5

Credits: 6

Unit Description

The production of fish is a process that involves the optimization of numerous biotic and abiotic factors that will provide the ideal conditions for a particular fish species to grow. The production and husbandry of different fish species is different and depends on the biology and life-cycle of the species under consideration. Furthermore, different life stages of a particular species require specialized conditions and thus specific husbandry tasks in order for the fish in that life stage to grow well.

This unit will cover the above for the commonest aquaculture species in the Maltese Islands. The production and husbandry of these species will be evaluated from the egg/juvenile to harvesting.

Husbandry of the fish species does inevitably come across some challenges of a varied nature (biological, systematic, logistical, etc.) This unit will provide an overview of the common problems arising during fish production and will suggest solutions to these different problems.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the factors involved in the selection of species to be reared in an aquaculture facility.*
2. *Understand how the different stages in the life cycles of algal and invertebrate species are managed in the aquaculture sector.*
3. *Understand how the different stages in the life cycles of various fish species are managed in the aquaculture sector.*
4. *Recommend solutions for problems that might arise in the production and husbandry of different aquaculture species.*

Aquaculture Systems Design and Engineering

Unit Level (MQF): 5

Credits: 6

Unit Description

This unit will give a broad overview of the technical aspects of designing an aquaculture facility. The rearing and production of fish needs prior understanding of the fish's needs so that one can proceed to design a facility which is good for purpose. This designing process involves the planning and subsequent choosing of systems and their components which one deems ideal and suitable for the functions and objectives of the facility under consideration. Facilities in this case can involve sea-based fish farm, hatcheries, recirculating aquaculture systems, aquarium systems and others.

This unit aims to make the learner understand how the biology of aquatic species and engineering of holding facilities have a reciprocal effect on one another and how a very good understanding of both is essential for the appropriate rearing of any type of aquatic species.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Comprehend how a system's carrying capacity influences an aquaculture system design.*
2. *Understand the piping and pumping requirements of an aquaculture facility.*
3. *Evaluate structures that help to maintain optimum water quality.*
4. *Evaluate systems and components used in different production stages.*
5. *Understand how the design and structure of a fish farm are important to meet the requirements of the fish being produced.*

Aquaculture, the Environment and Sustainability

Unit Level (MQF): 5

Credits: 6

Unit Description

The rapid increase of aquaculture worldwide has increased fears about what impact this industry is having on the surrounding environment. The aquaculture industry has a number of negative environmental externalities that has triggered research and discussion as to how such problems can be overcome. A particular aquaculture facility can be managed in such a way as to reduce its environmental impacts and thus be more sustainable. Facility location, design and day-to-day operations and decisions will substantially determine whether this facility is contributing to adverse environmental impacts.

This unit will evaluate the range of environmental impacts of aquaculture facilities including effluents, pathogen spread, biodiversity impact, etc.

Moreover, the unit will discuss the efforts being undertaken by the aquaculture industry to mitigate such impacts and how the execution of measures to reduce such impacts can influence other aspects in the sector.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the impacts of aquaculture waste production on the environment and how they can be reduced.*
2. *Understand how the siting and design of a farm can mitigate its impact on the environment.*
3. *Discuss the environmental impacts of the spreading of escapees originating from an aquaculture facility.*
4. *Evaluate the routes that the aquaculture industry is taking to become more sustainable.*

Fish Anatomy and Physiology

Unit Level (MQF): 5

Credits: 9

Unit Description

A fish's anatomy and physiology makes it adapted to live in the habitat it has evolved to inhabit. Furthermore, a life in the sea puts certain pressures on the body of the fish that are reflected in the way it adapted its anatomy and physiology to swim through water in an effective and efficient manner.

An understanding of this is vital for learners wanting to enter the fisheries and aquaculture sectors. Having a thorough understanding of the way the body of a fish works equips the learner with the necessary tools to comprehend better the needs and requirements of fish that are being reared for harvesting. It will provide the learner with a realization of the rationale behind certain tasks in aquaculture.

This unit is related to other units dealing with fish health and production and should be delivered prior to or in tandem with such units as this unit will provide learners with the theoretical foundations that will be applied in the aforementioned units.

The unit will go into detail about anatomical and physiological processes of fish including locomotion, gaseous exchange, transport, homeostasis, reproduction and neurophysiology. Each physiological process will be analyzed in considerable detail so that the mechanisms of each process are understood thoroughly.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the processes behind locomotion in fish.*
2. *Know how gaseous exchange and transport occurs in fish.*
3. *Know the processes behind homeostasis and reproduction in fish.*
4. *Understand the major processes of neurophysiology in fish.*

Fisheries, Biology and Ecology

Unit Level (MQF): 5

Credits: 6

Unit Description

The aim of the modules on fisheries biology and ecology is to give students a broad understanding of the importance of these aspects in fisheries science.

The objective of the module on fisheries ecology and production processes is to provide an overview of how physical and biological processes drive the production of fished species, and how the environment influences the distributions and abundances of different types of commercially exploited marine species. Students will be introduced to the concepts of food chains and food webs, and thus gain an insight into the links between primary production and the production of fished species. Students will learn how the coupling of biological and physical processes on many scales governs the potential yields of fish stocks.

The module on dynamics of exploited populations will discuss how commercially exploited species reproduce, and focus on the links between life-history traits such as growth, reproduction and mortality. The module will look into critical life cycle stages, in particular the relationship between recruitment and the size of spawning populations. Understanding natural life cycles will equip students to understand how fished species as well as marine communities and ecosystems are affected by commercial fisheries. The module will introduce the concept of fishing effort, and illustrate how catches are ultimately determined by both fishing effort and natural fluctuations in the abundance of exploited species.

Successful fisheries management relies on accurate fisheries data collection and the appropriate interpretation of such data in models for fisheries evaluation. The module on fisheries data collection shall explain the concept of fish stocks, how stocks are treated as the basic management units, and the methods used to identify stocks and estimate parameters that describe their dynamics. Students will become familiar with fisheries dependent and fisheries independent data collection systems and methods used to ensure accurate parameter estimation through representative sampling. The module will emphasize the importance of collecting data on discards and bycatches,

and explain why data collection on non-target species plays an increasingly important role in fisheries science and management.

The module on models for fisheries evaluation will provide students with an overview of how to make basic quantitative assessments of fisheries, and how to calculate estimates of input parameters required for such assessments. Students will gain an insight into the importance of combining information from different sources (social, economic and biological) and how such data can be analysed to provide information required for fisheries management purposes. The module will provide students with an introduction to the challenges faced by fisheries scientists, and place an emphasis on the modelling requirements of the implementation of an ecosystem approach to fisheries management.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the ecology of fisheries and production processes.*
2. *Assess the dynamics of exploited populations.*
3. *Understand the importance of fisheries data collection.*
4. *Use models for fisheries evaluation.*

International Fisheries Management

Unit Level (MQF): 5

Credits: 6

Unit Description

This module is central for the understanding of fisheries management and its application in different parts of the world. It looks into the various types of fishing management systems and the conceptual thinking that frames such approaches. The significance of this module lies in the proficiency that will equip students with the knowledge to engage in critical thinking of the different fisheries management practices and the structural processes within which they function. This will encompass the various management applications including an overview of the fishing capacity and effort established at national and regional levels; the introduction of Total Allowable Catches (TACs) and quotas for fish species (e.g. the Bluefin Tuna); the establishment of minimum sizes of landed fish species (e.g. the swordfish); the restriction on types of fishing gear (e.g. number of hooks, mesh sizes) and the establishment of marine protected areas and marine reserves, amongst others.

The module shall provide a theoretical understanding of the pillars of management namely traditional fisheries management and the ecosystem-based management (EBM). This will illustrate the fundamental differences between the two regimes, with an accentuation on the EBM as the emerging paradigm towards a holistic approach to natural resource management. This will stress the relevance of marine uses in their entirety as opposed to traditional management that seeks to manage the marine area on a sector basis. This will introduce students to concepts of marine spatial planning and integrated coastal zone management. Through a global analysis of the different techniques and their relevance in different contexts, this module shall present the students with an overview of the economic, political, geographical, biological, sociological and anthropological affairs that circumvent fisheries management.

The centrality of this module lies in its all-encompassing approach towards the understanding of fisheries management both as a theoretical framework and as a toolkit for the application of systems to the real-world scenario. This shall incorporate an analysis of the Common Fisheries Policy as the main management framework that establishes the legal parameters of fishing in European waters and beyond. This module shall also look into the various international and regional management organizations that deal with fisheries management (e.g. ICCAT, GFCM, FAO). Effectively, upon completion of this module, the students will be able to appreciate

the complexity of the concepts of management and underline the integration of the subject matter that will be dealt with in the various modules throughout the degree.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Know the difference between the various types of fishing management systems.*
2. *Evaluate concepts related to fisheries management.*
3. *Compare and contrast different fisheries management practices being undertaken in different countries around the world.*
4. *Assess the sociological and anthropological aspects of fisheries management.*

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Marine Zoology

Unit Level (MQF): 5

Credits: 6

Unit Description

The sea is full of different types of organisms which live in a wide range of habitats and communities. The biodiversity in the Mediterranean Sea is considerable and efforts are continuously being expended to try and understand better and thus conserve the resources present in the sea around us.

The understanding of marine zoology is important for a number of reasons. Learners that aspire to work in the fisheries sector need to be able to identify and appraise the species that live in communities together with the target species. This will ensure that the management of fisheries is undertaken in a holistic manner and taking into consideration the whole ecosystem. This appreciation of marine species is also essential when evaluating the environmental impact of aquaculture farms.

This unit will investigate the differences in the biology between the different groups of marine vertebrates and invertebrates. This will lead the learners to start identifying different marine species that live in the Mediterranean Sea. The unit will put special emphasis on zooplankton and its vital roles in a marine ecosystem and the aquaculture industry. An overview of species invasiveness will also be provided with general discussions on the factors leading to the spread of such species and the impacts of these species on native ones.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the differences between the biology of the main groups of marine vertebrates and invertebrates.*
2. *Recognize a wide range of teleost and elasmobranch fish.*
3. *Assess the roles of zooplankton in marine ecosystems.*
4. *Identify marine invasive species in the Mediterranean Sea.*

Maritime Law

Unit Level (MQF): 5

Credits: 6

Unit Description

The unit will start with a general overview of the nature of Law especially with regards to the roles, powers and duties of international organizations. Various types of Laws will be discussed and basic principles enshrined in Conventions will be assessed. The unit will proceed with an evaluation of different Laws related to the sea starting with international and local safety and navigation legislations and proceeding with legislations related to the marine environment, fishing and labour. These Laws will be discussed in relation to the fishing sector and the way they affect local fishermen. Each piece of legislation will be reviewed in detail especially with regards to the obligations, rights and roles of the different parties.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand basic generic principles on the nature of Law.*
2. *Evaluate different maritime safety and navigation Laws.*
3. *Comprehend the significance of different marine environment and fishing legislations.*
4. *Assess the roles of the United Nations Convention on the Law of the Sea and the Maritime Labour Convention in the Fishing Industry.*

Fish Processing, Quality & Safety

Unit Level (MQF): 6

Credits: 6

Unit Description

The processing of fish and other seafood is a well-developed industry in various countries and holds promising potential for fish producers and other entrepreneurs that want to venture into this sector. Fish can be processed using various techniques and a very wide range of products can be attained using these different methods. The unit starts by giving a thorough overview of the biochemical processes that take place in harvested fish. This should provide a good background against which the subsequent learning outcomes are set. The second learning outcome deals with the different post-harvesting processes that are undertaken industrially and on small-scales to process the different fish products. The last two modules build on the previous two and goes in depth on the techniques and measurements used to determine the fish quality parameters. The various checks and balances and legislations followed to ensure safe fish products are covered in the last module.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Know a range of biochemical processes that take place in harvested fish.*
2. *Be familiar with post-harvesting processes in the fish industry.*
3. *Understand how fish quality is determined.*
4. *Be familiar with systems utilized to ensure safety of fish products.*

Development of Land and Sea-Based Activity

Unit Level (MQF): 6

Credits: 6

Unit Description

This unit is essential for learners to understand the process that must be taken if they decide on setting up a business related to aquaculture and other related sectors. It starts by providing learners with a thorough understanding of the administrative procedures that must be followed for a fish-related business to be set up. It spans the whole process- from acquisition of land or premises to taxes and farm registration. The second module deals with the financial aspects of setting up business with a detailed overview of taking loans, having a business plan and applying for start-up funds. The unit then delves into the process one should follow to complete an EU application. The last module goes into detail on the setting up and management of a Cooperative/Producer Organization and discusses the benefits and challenges of fishermen in starting or joining such an enterprise.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Manage administrative procedures needed to set up and run a fish enterprise.*
2. *Manage financial procedures needed to set up and run a fish enterprise.*
3. *Fill in an EU projects application for funds related to aquaculture, fisheries or other related sector.*
4. *Organize a Cooperative and a Producer Organization.*

Advanced Fisheries Studies

Unit Level (MQF): 6

Credits: 6

Unit Description

The objective of the module on the use of applied techniques, in particular software packages, in fisheries management is to provide an overview of how computing analyses are implemented in understanding the multiple factors that influence the stocks of different types of commercially exploited marine species. The assessment of fisheries resources often requires the collection of large volumes of long-term monitoring data, and computing packages provide the right platform as databases and analytic tools. Learners will be introduced to the concepts of sampling, statistical, graphical, parametric and spatial applications to gain an insight of the tools that are applied for fisheries management scenarios. Learners will become familiar with fisheries data collection systems and methods used to ensure accurate parameter estimation through representative sampling.

The module on the R-software will provide learners with a theoretical account of the system and its practical application through class-based exercises. In the first part of the module, the learners will learn how R, which is an open-source statistical software, is well suited to the management and analysis of large datasets. Successively, the module shall demonstrate the versatility of R in a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, multi-variate analysis) and graphical techniques, and its application in regional fisheries management with a specific emphasis on how it is utilized at the Mediterranean level. Learners will gain an insight into the importance of combining information from different sources (social, economic and biological) and how such data can be analyzed to provide information required for fisheries management purposes. Given its versatility and ubiquity, a working understanding of R is an important asset for learners of fisheries science. By the end of this course, learners will be able to use R for data manipulation, the generation of basic descriptive statistics and the implementation of statistical analysis.

Successful fisheries management and ecosystem-based management are also implemented through spatial analysis of marine areas and fisheries ecosystems. Managers and scientists are increasingly using geographic information systems (GIS) to

manage, map and analyze the resources. Learners will learn how GIS as the main platform for spatial evaluations offers a way to view, query, interpret, and visualize various sorts of spatial data to reveal geographic relationships, patterns, and trends in fisheries management. Through practical case studies, learners will learn how to create shapefiles and spatial layers, and apply geometric tools to illustrate variables such as fishing effort, density and type of fishing. By the end of the course, the learners will learn how to produce maps, charts and analytical reports derived from the data stored in a GIS to explain spatial patterns and relationships.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the importance of various software techniques for adequate fisheries management.*
2. *Evaluate the sampling methodology used in fisheries management.*
3. *Use the R-software to develop fisheries statistics, graphs and analysis.*
4. *Use the GIS software to develop spatial modelling of fishing activity and density.*

Water Analysis in Fish Farming

Unit Level (MQF): 6

Credits: 12

Unit Description

The unit commences with an overview of the structure of the atom to help them understand the major types of bonding. The students are then given a broad overview of the main types of chemical reactions encountered.

Some basic principles of physical chemistry, such as chemical equilibria, are briefly reviewed, with the purpose of helping the students to appreciate the importance of chemical changes.

Furthermore, an overview of some basic concepts of organic chemistry are provided to help students understand biological organic molecules such as carbohydrates, fats, etc. and to appreciate that physiological phenomena such as digestion are, in fact, organic reactions.

This unit aims to equip learners with the skills and knowledge associated with water quality analysis. Learners will gain an understanding of the factors that impact on water quality including human activity. Physical, biological and chemical factors will be investigated and a thorough understanding of their influence on water quality will be gained.

Analytical chemistry plays a key role in identifying chemical substances in a mixture and detecting trace elements. There are many applications of analytical chemistry particularly in monitoring the quality of water in the aquaculture and other fish-related sectors.

Determination of unknown quantities of a substance requires mathematical and practical skills that ensure accuracy. This often requires standards that can be used as reference points so that comparisons can be made with the unknown substance to determine its identity or quantify its value. For example, determination of the unknown concentration of a solution requires standard solutions with known concentration. Preparations of primary and secondary standard solutions require calculating the amount of solids needed for making up the stock solution. This stock

solution can also be diluted to make a series of solutions with different concentrations. In this unit, the learners will discover the importance of standard solutions and the methods used to accurately determine the unknown concentration of substances.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Relate the chemical and physical properties of elements to the atomic structure and distinguish between different types of chemical reactions.*
2. *Demonstrate knowledge of basic principles of physical chemistry.*
3. *Review the properties and uses of organic compounds.*
4. *Measure the factors that impact on water quality.*
5. *Perform quantitative analysis using standard solutions.*
6. *Use spectroscopic techniques to identify and quantify substances.*
7. *Use chromatographic techniques to separate, identify and quantify substances.*

Recirculating and Integrated Aquaculture

Unit Level (MQF): 6

Credits: 6

Unit Description

Recirculating aquaculture is a relatively efficient way to rear fish. The understanding of the processes, dynamics and chemistry of the system are essential in the development and maintenance of such systems. It is thus that the unit dedicates the first two units to go in depth on the design and components of the system. These modules will cover the different available options for the different components and the way they can be integrated in the system. Waste management, an extremely vital link in a recirculating system, is dealt with extensively together with the needed operations and monitoring options. The unit branches into other systems that rely on recirculating aquaculture for their operation and goes into detail about the components, design and execution of aquaponics and polyculture setups. This will provide a holistic and complete account of the current and potential uses of recirculating aquaculture as a closely controlled and efficient way to grow fish with the possible integration with the cultivation of plants or rearing of other animals.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Explain how a re-circulating aquaculture system is set-up.*
2. *Describe ways how waste is managed in a recirculating system and how system is maintained.*
3. *Define the rationale behind polyculture systems.*
4. *Explain the principles behind the operation of an aquaculture polyculture.*

Business Planning

Unit Level (MQF): 6

Credits: 6

Unit Description

Business planning is not just for financing purposes. This course will provide students with a broader view of business planning as a tool that helps business people in making their decisions.

This course should also help students to begin to think outside the box. Almost anyone can purchase a business plan software program and fill in the blanks. Attendees of the course should be able to create their own blanks by finding their way and sharing their passion for business.

With a blend of management, marketing and finance, this course takes students through the entire process of conceiving and planning a business venture. They will learn-by-doing through development of their own business plan project. The business plan has to be developed through completion of assignments.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Collect and analyse data that will help with taking decisions in a particular business.*
2. *Understand the importance of strategy in business management.*
3. *Develop the operational plan of a business venture.*
4. *Make decisions of a financial nature based on available information.*