



# DTU Aqua

Bridging science and technology





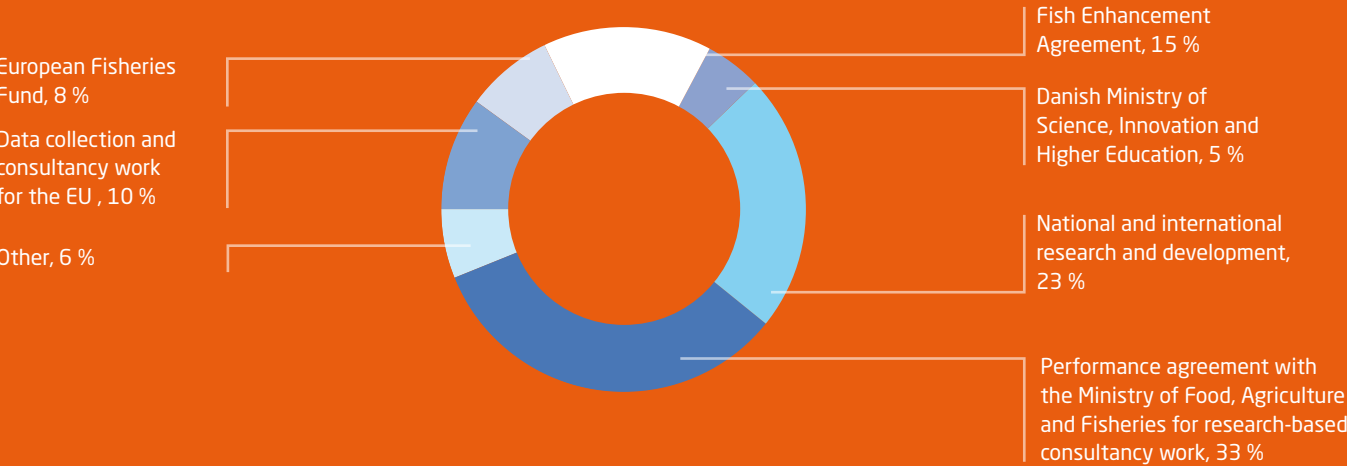
Foto:  
Colourbox.com  
Mikkel Adsbøl  
Martin Dam Kristensen  
Line Reeh  
Per Dolmer  
Finn Sivebæk  
Erik Selander  
Jens Astrup  
Maria Kaspersen



# DTU Aqua in figures

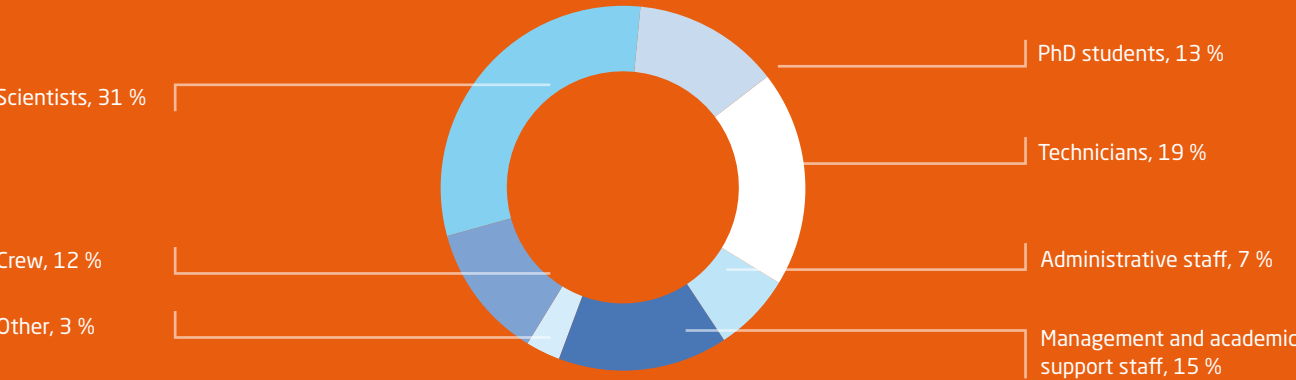
## Financial budget

The Institute’s total budget is around DKK 215-230 million (EUR 29-31 million) a year. Agreements on research-based services for public authorities make up about 70 percent of the overall financial framework and cover applied research, monitoring, and consultancy activities. Research funds, education, and innovative projects play an ever-increasing role.



## Staff

DTU Aqua has a total of 260 employees, including nearly 80 researchers and about 35 PhD students. We have departments in Charlottenlund, Silkeborg, and Hirtshals, where our ocean research vessel *Dana* is based. 26 percent of DTU Aqua’s researchers are foreign nationals.



DTU Aqua  
Bridging science and technology





Photo: Martin Dam Kristensen

| ABOUT DTU AQUA |

# Where science and technology meet

The National Institute of Aquatic Resources (DTU Aqua) carries out research, provides advice, educates at university level, and contributes to innovation in sustainable exploitation and management of aquatic resources. We investigate the biology and population ecology of aquatic organisms, aquatic physics and chemical processes and ecosystem structure and dynamics.

Our research and advisory work includes all levels of the aquatic ecosystem and the impact upon it caused by natural forces and human activity - from wind, currents, and climate to fisheries, fish farming and the effects of bridge construction, offshore windmills, and the extraction of raw materials.

The Institute has a strong international profile. We have well-established research partnerships with key research institutions in fisheries research and aquatic science in Europe and the rest of the world, and the researchers and advisers from the Institute contribute to the work of a wide variety of international bodies such as the International Council for the Exploration of the Sea (ICES), the European Commission, Regional Fisheries Management Organisations (RFMO), and the UN.

At the national level, DTU Aqua advises, among others, the Ministry of Food, Agriculture and Fisheries, the Ministry of the Environment, municipalities, NGOs, and the fishery and aquaculture industry.

DTU Aqua's achievements are made possible through collaboration with stakeholders from the fishing industry, the aquaculture industry, and recreational fishing organizations, for example fishermen, manufacturers of nets, producers of fish farming systems, technology, and feed for aquaculture, as well as the fish processing industry in Denmark and abroad.

Our key focus areas are Danish and European waters, coastal regions, lakes, and rivers, but we also carry out extensive research in the North Atlantic, Arctic and sub-arctic waters, especially in Greenland, and contribute our expertise in the application of knowledge and methods in other parts of the world.

DTU Aqua was formerly the sector research institution, the Danish Institute for Fisheries Research, which in 2007 merged with the Technical University of Denmark and became a university institute.

DTU Aqua's ambition is to deliver solutions to meet one of this century's key challenges: how to ensure the optimum utilization of living aquatic resources in the sea, coastal waters, and lakes and rivers, while at the same time maintaining a healthy aquatic environment. This calls for solutions that are both scientifically sound and technically operational.

Fritz Köster, Institute Director, DTU Aqua.



## | RESEARCH |

# Ecosystems, fisheries, aquaculture, and climate

DTU Aqua's research forms the basis for the Institute's advisory, monitoring, innovation, education, and communication activities.

We have a cross-disciplinary approach which combines the natural sciences with technologically operational solutions. Our projects typically involve data collection in the field (from routine monitoring to long expeditions), relevant experimental studies (from physiological experiments to, for example, the development of large-scale integrated farming systems), and statistical and process-based model development.

### DTU Aqua's research activities cover the following research areas:

- Oceanography and Climate
- Marine Populations and Ecosystem Dynamics
- Coastal Ecology
- Freshwater Fisheries and Ecology
- Individual Biology
- Population Genetics
- Monitoring Technology
- Fisheries Technology
- Marine Living Resources
- Fisheries Management
- Ecosystem-based Marine Management
- Aquaculture
- Shellfish Aquaculture and Fisheries

” At DTU Aqua, I found an inspiring cross-disciplinary environment where biologists, physicists, statisticians, and engineers all contribute with their own individual strengths and ideas to enhance our understanding of marine life. “

**Ken Haste Andersen,**  
physicist and Professor, DTU Aqua.

The research activities can be grouped into four main areas, which are briefly described on the following pages.

Read more about  
DTU Aqua's research on  
[www.aqua.dtu.dk](http://www.aqua.dtu.dk)

Photo: Mikkel Adsbøl





## | RESEARCH AREAS |

# Ecosystems – from oceans to coastal waters

DTU Aqua conducts research on how natural conditions and human activities affect marine life - from the smallest algae and crustaceans to mussels, fish, and marine mammals. We examine the importance of ocean currents, climate, and physical and chemical environments, such as temperature, salinity, carbon dioxide, and oxygen content as well as the effects of fisheries, aquaculture, raw material extraction, and construction work.

Through routine data collection, fieldwork, experimental studies, and theoretical calculations, we identify and analyze the most important processes operating in marine ecosystems. We study organisms' growth, reproduction, behavior and migration, age distribution within species, and how different species interact by competing for food or preying on each other.

This knowledge is used to develop concepts and models that can describe the dynamics and trends in populations and ecosystems.

### Coastal areas

DTU Aqua studies how factors such as climate change, fisheries, and the restocking of fish and shellfish affect coastal ecosystems. The Institute has, for example, developed the Danish framework used for assessing the environmental impact of mussel fishing in protected areas (Natura 2000).



Photo: Line Reeh

*”It is always exciting to see in which way the ecosystem has developed when we go underwater to explore how a newly established reef or a mussel bed has affected life at the bottom of the sea.”*

**Per Dolmer, Senior Adviser and professional diver, DTU Aqua.**



Photo: Claus Stenberg

### The struggle for space in the ocean

Should Dogger Bank be a nature reserve, fishing ground, or offshore wind park? DTU Aqua is involved in international efforts to develop scientific methods to provide qualified advice to authorities in matters concerning the often competing demands on ocean space and resources.

### Fieldwork in the Arctic

DTU Aqua is involved in a number of climate-related research programs, and our researchers are often on fieldwork in Greenland and the North Atlantic to study, among other things, how changes in sea ice cover and temperature affect the production of plankton.



Photo: Bo Normander

*”The breadth and quality of expertise on fisheries and marine ecosystems among my DTU Aqua colleagues provides me with an excellent environment for my work on climate impacts with the UN's Climate Panel and other international forums.”*

**Keith Brander, Senior Researcher at DTU Aqua and reviewer for the UN's Climate Panel, IPCC.**



Photo: Line Reeh

### The cycle of the ocean

DTU Aqua is project leader for the transatlantic project BASIN, which is a collaboration between researchers from Europe and North America. The project includes building a knowledge base and developing models to understand, for example, carbon transport in the Norwegian Sea and the North Atlantic, which contain the world's largest stocks of herring, mackerel, and blue whiting. We are especially interested in finding out how fish and fishing affects the ocean's ability to absorb carbon dioxide.



# Stocks, fisheries, and management



## Models and stocks

DTU Aqua is involved in assessing the stocks of all major species caught by Danish fisheries. Recently, the Institute introduced a model for assessing the stocks of sand eels in the North Sea, which takes into account the spatial distribution of sand eels, with the objective of avoiding local stock depletion. The model is the result of extensive research and data collected on sand eel biology and distribution.

DTU Aqua's research into stocks and fisheries provides the knowledge needed to utilize marine living resources in an optimal and sustainable way. We conduct research into fish and shellfish stocks, life cycles, feeding and distribution, and the impact of fisheries and other human activities on fish stocks.

The research forms the basis for advising the authorities who manage the fisheries and sea areas.

DTU Aqua has internationally recognized expertise in developing models which can predict trends in fish stocks and how construction work and other environmental factors affect fish populations and fishing.

Models integrating biology and economics are also important tools in evaluating the efficacy of various fishing regulations, for giving advice on biological sustainability when several fish stocks are exploited in the same fishery, and on how to achieve maximum possible economic returns from fisheries while minimizing possible environmental impacts.

”As chairman of the herring working group which forms part of the International Commission for the Exploration of the Sea, ICES, I am responsible to the international group for assessing trends in the European herring stock levels and obtaining the necessary knowledge to provide advice on herring quotas and other management initiatives.“

**Lotte Worsøe Clausen, biologist and Special Consultant, DTU Aqua.**



## Selective fishing gear

In collaboration with public authorities, the fishing industry, and fishing gear manufacturers, DTU Aqua is currently developing selective fishing gear and methods to reduce unwanted by-catch and minimize the impact of fisheries on the marine environment. We are developing complex simulation models and working on both a theoretical and a practical level to test equipment's selective properties.



## Development

TAC (total allowable catch) and quotas are central elements of the Common Fisheries Policy. However, the present system where quotas are given in the form of maximum quantities that can be landed has proven inefficient in controlling the total outtake of a stock. The Danish government has therefore suggested a catch quota management system where all fish caught are counted against the quota. DTU Aqua has developed a camera and sensor system that can provide the necessary documentation of the total catch of a fishing vessel.



## Effects of construction

DTU Aqua is engaged in evaluating the effects of construction work at sea, for example, how a permanent Femern Belt link is likely to affect fish stocks and the commercial fishing of cod, herring, and sprat. The work includes assessing the current status of fish stocks and fishing in and around the Femern Belt, as well as developing models to describe the likely effects of a fixed link, for example on fish migration, spawning, and fry survival caused by possible changes in the ocean currents generated by a bridge or a tunnel.



## | RESEARCH AREAS |

# Ecosystems in rivers and lakes



Photo: Finn Sivebæk

### Fish genetics

Salmon stocks in rivers in Jutland have been saved from extinction through targeted research and restocking programs. Genetic research and DNA tests developed by DTU Aqua have ensured that such programs were based on fish bred from the original wild salmon strains.

DTU Aqua's research into freshwater fisheries and ecology provides answers as to how wild fish populations can be maintained and utilized sustainably, while taking into account important societal interests.

The Institute examines which factors are important to fish when seeking out suitable habitats and investigates the distribution of fish in aquatic systems under differing biological and physical conditions. We study their response to changes in the environment, whether brought about by nature or by man.

Recreational fishing is extremely popular in Denmark with nearly 20 percent of Danes engaging in angling activities to a greater or lesser degree. We use our knowledge and experience to advise authorities and interest groups on how best to enhance, retain, and utilize freshwater fish stocks in a sustainable way.



Photo: Kristian Meier

### Telemetry

Tagging fish and shellfish with high-tech electronic tags is an effective tool for collecting valuable information about migration, temperature sensitivity, and behavior in oceans, lakes, and rivers. Among the freshwater fish DTU Aqua tags are pike, trout, salmon, zander, perch, roach, and bream.



Photo: Line Reeh

### Fish enhancement

DTU Aqua operates a fish enhancement program, financed by the sale of fishing licenses, to support the natural reproduction of fish stocks in Danish rivers, lakes, and coastal areas. For example, the Institute coordinates cooperation between angling associations, authorities, and researchers on breeding, stocking, and management of salmon and trout in Denmark. Similarly, we assist in developing and implementing recovery plans for endangered species.

”Thanks to targeted efforts to re-establish spawning and nursery areas and remove dams, far fewer fish than before need to be released into the wild to maintain trout stocks in Danish waterways. This has been made possible through research and successful collaboration with local angling associations and authorities.“

**Finn Sivebæk, Special Consultant on  
freshwater fisheries management, DTU Aqua.**



# Aquaculture – farming in freshwater and seawater

DTU Aqua’s research in aquaculture focuses on biological and technological aspects of farming fish, shellfish, and other aquatic organisms.

Aquaculture is growing rapidly worldwide to meet the rising demand for food from an increasing population. DTU Aqua is developing methods and systems that ensure efficient production, while at the same time minimizing the impact on the environment.

We carry out research and development into nutrition and feed development, and document how different breeding conditions affect fish growth and welfare. In collaboration with the industry and other research institutions, we are developing and testing innovative farming concepts for different species of fish, shellfish, and algae.

DTU Aqua runs the country’s largest test facility for aquaculture-related research and development, based in Hirtshals in Northern Jutland.



Photo: Helge A. Thomsen

### The future of fish and shellfish farming

In collaboration with other research institutions and the farming industry, DTU Aqua is looking into the feasibility of farming fish and shellfish in aquaculture facilities located in open sea areas. We are also investigating whether offshore windmill facilities can be used for the production of shellfish.

”Our research and achievements in developing viable recirculation technology for farming large trout and salmon in seawater on land is performed in close collaboration with key players from the aquaculture industry. There is just as much demand for collaboration, knowledge and results from these players as there is from the authorities we advise.“

**Per Bovbjerg Pedersen,**  
Head of Section, DTU Aqua.



Photo: Martin Dam Christensen

### Model Trout Farms

DTU Aqua has extensive experience in developing and implementing recirculation technology, whereby water is filtered and purified for reuse in the farming systems. An example of such systems is the Danish concept Model Trout Farms, in which recirculation technology significantly reduces nutrient discharge and environmental impact. The concept is now being further developed so that it can also be commercially applied to saltwater environments.



Photo: DTU Aqua

### Feed optimization

DTU Aqua carries out research into nutrition, growth, and efficient feed utilization in order to develop and optimize fish feed and to provide possibilities for including alternative raw materials in the feed. DTU Aqua plays a major role in supporting Denmark’s strong position in the fish feed industry through its research collaboration and innovative interaction with major stakeholders in the industry.

### Endangered eels

DTU Aqua plays a leading role in research into the reproduction of the endangered European eel and has achieved promising results with regard to producing eggs and fry. The Institute is coordinator for the project PRO-EEL, which is a joint project between leading research institutions in Europe and the aquaculture industry in Denmark.

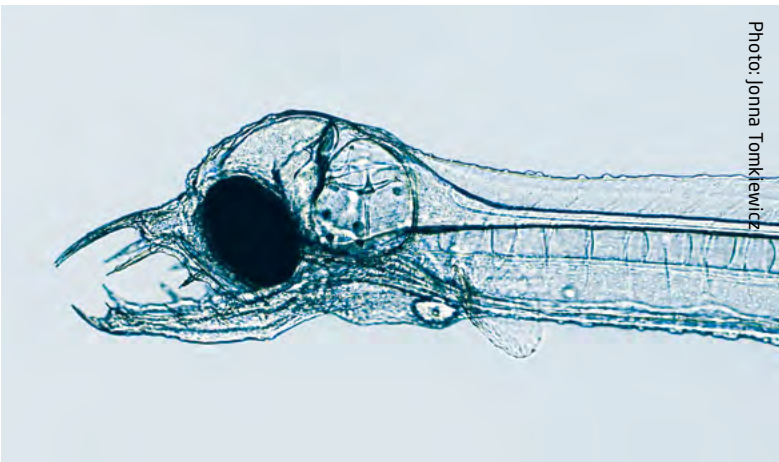


Photo: Janna Tomkiewicz



Data collection is carried out from the Institute's own research vessels, from commercial ships, in ports and through the use of landing statistics, information from logbooks, Vessel Monitoring Systems (VMS), etc.



Photo: Per Dolmer



Photo: Line Reeh

DTU Aqua assesses the current status of commercially important fish and shellfish stocks and gives advice on the sustainable utilization of these stocks.

## | RESEARCH-BASED CONSULTANCY |

# Advisory work and monitoring

”I’m responsible for, among other things, collecting samples of herring and mackerel from commercial fishing activities in the Skagerrak and the North Sea. “

**Tom Svoldgaard,**  
Fisheries Technician, DTU Aqua.

DTU Aqua assesses the current status of commercially important fish and shellfish stocks and gives advice on the sustainable utilization of these stocks. In addition, we advise on how fisheries affect the marine environment and vice versa, that is, how changes in the marine environment and ecosystems will affect the fishing industry.

The Institute's work is based on the monitoring of fisheries and fish stocks as well as on research into the status of aquatic ecosystems, the dynamics of fish stocks and fisheries, and the effects of management measures.

Our largest contract for research-based consultancy is with the Ministry of Food, Agriculture and Fisheries. In addition, we have a comprehensive monitoring and consultancy agreement with the EU Commission.

DTU Aqua provides advice on harvest control rules for fish and shellfish stocks and on the development of management planning for the fisheries exploiting the stocks. A significant proportion of our advisory work relating to the management of fisheries is done through the International Council for the Exploration at Sea, ICES, and the EU Commission's Scientific, Technical and Economic Committee for Fisheries, STECF.

In recent years, DTU Aqua has been actively involved in consultancy work on environmental matters. Furthermore, DTU Aqua advises the Ministry of the Environment on the implementation of the EU Marine Strategy Directive.

DTU Aqua has a cooperation agreement with the Greenland Institute of Natural Resources to represent Greenland in selected areas in international consultancy and fishery management bodies.

### Monitoring

DTU Aqua is involved in the common European initiative to monitor fisheries and the status of and trends in fish stocks. Data collection is carried out from the Institute's own research vessels, from commercial ships, in ports and through the use of landing statistics, information from logbooks, Vessel Monitoring Systems (VMS), etc.

Data collection includes biological data, such as the length, weight, and age of the fish, environmental factors and non-biological information about, for example, fishing equipment and the number of days spent at sea.

We work on developing and improving methods and technologies for monitoring, for example optical and hydro-acoustic systems which are used for the identification of shellfish and fish and for determining the density of shoals.



Photo: Line Reeh

The catch is sorted in the lab aboard DTU Aqua's research vessel Dana, which each year carries out surveys in the Baltic, North Sea, and Norwegian Sea.



# Research vessel *Dana*

DTU Aqua is the only Danish institution which has the research expertise and infrastructure to conduct multi-disciplinary research at sea and to carry out regular monitoring programs in European waters and the North Atlantic.

The *Dana* is DTU Aqua's largest research vessel. She was built in 1980 and last underwent renovation work in 2010. On board there are five wet and dry laboratories equipped with a broad spectrum of scientific instruments. In addition, the ship has extensive equipment for trawl fishing and for collecting samples from the water and the seabed.

DTU Aqua also has a number of smaller ships and dinghies which are used in lakes, in coastal areas for trawling as well as for collecting other samples.

## Danish Centre for Marine Research

DTU Aqua houses the secretariat for the Danish Centre for Marine Research (DCH). The aim of the center is to promote marine scientists' access to research vessels and equipment. DCH administers a fund that supports researchers who wish to charter the vessels.

Read more on [www.danskhavforskning.net](http://www.danskhavforskning.net)

1 The *Dana* on an expedition in Godthåb Fjord, Greenland.

2 The acoustic measuring equipment is checked and adjusted before the *Dana* departs for the Norwegian Sea to monitor the herring stock in the area. Here the so-called towed undulator - a piece of equipment that houses the echo sounder - is being lowered into the water.

3 Samples collected by the *Dana* are examined so that information can be included in the on-going work to assess trends in fish stocks. This work forms the basis for DTU Aqua's advice on fishing quotas and other fishery management initiatives.

4 Before the fishing trawl is submerged, the temperature, oxygen content, etc. are measured using a conductivity, temperature, and depth sensor (CTD).



Photo: Søren Rysgaard



Photo: Line Reeh

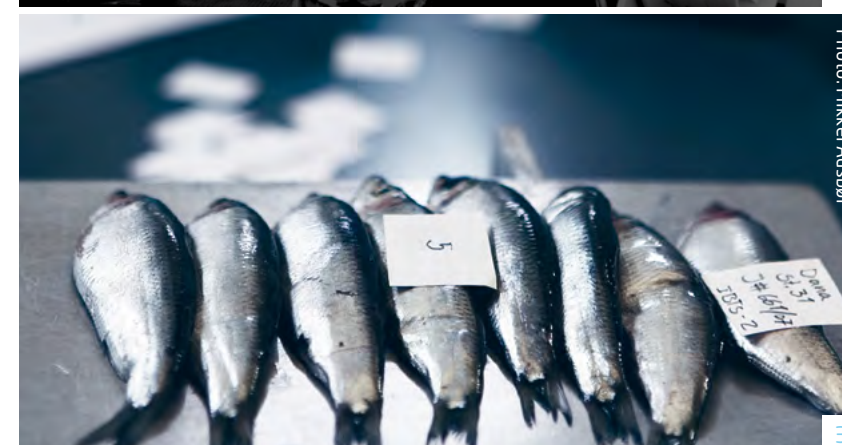


Photo: Mikkel Adsdal

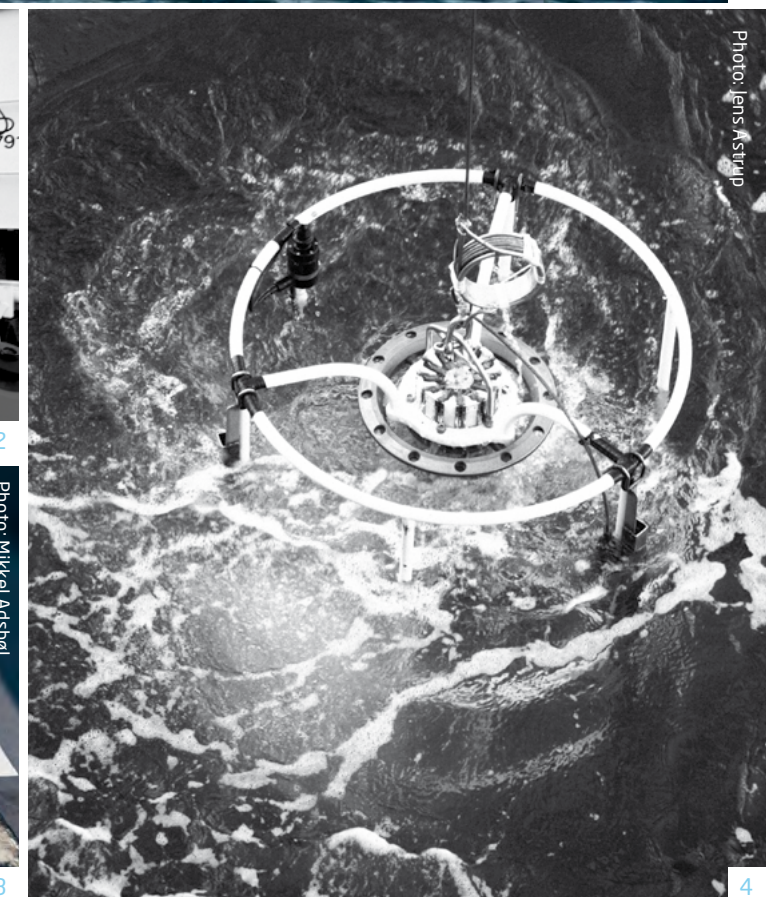


Photo: Jens Astum



## | MSC AND PHD SCHOOL |

# Aquatic Science and Technology

DTU Aqua trains graduates in one of the key development fields of the future: sustainable use of marine and freshwater living resources. DTU Aqua's MSc-program in aquatic science and technology is taught in English and offered in collaboration with the University of Copenhagen. It is the only master's program of its kind in Europe.

The unique combination of biological, technological, and mathematical subjects equips students to work with global issues within the fields of climate, environment, and future food supply. The students have a background in either engineering or the natural sciences.

The program provides a solid theoretical foundation that is combined with laboratory and fieldwork as well as offering opportunities to participate in the Institute's research.

Researchers from DTU Aqua are also much sought-after as teachers on programs at other institutions and universities, and the Institute's researchers regularly supervise undergraduate, graduate, and doctoral students from Denmark and abroad.

Read more on [www.aquascience.dtu.dk](http://www.aquascience.dtu.dk)

### PhD School

DTU Aqua has a PhD school with around 35 PhD students enrolled.

PhD projects reflect the Institute's cross-disciplinary profile and cover a wide range of scientific and technical fields.

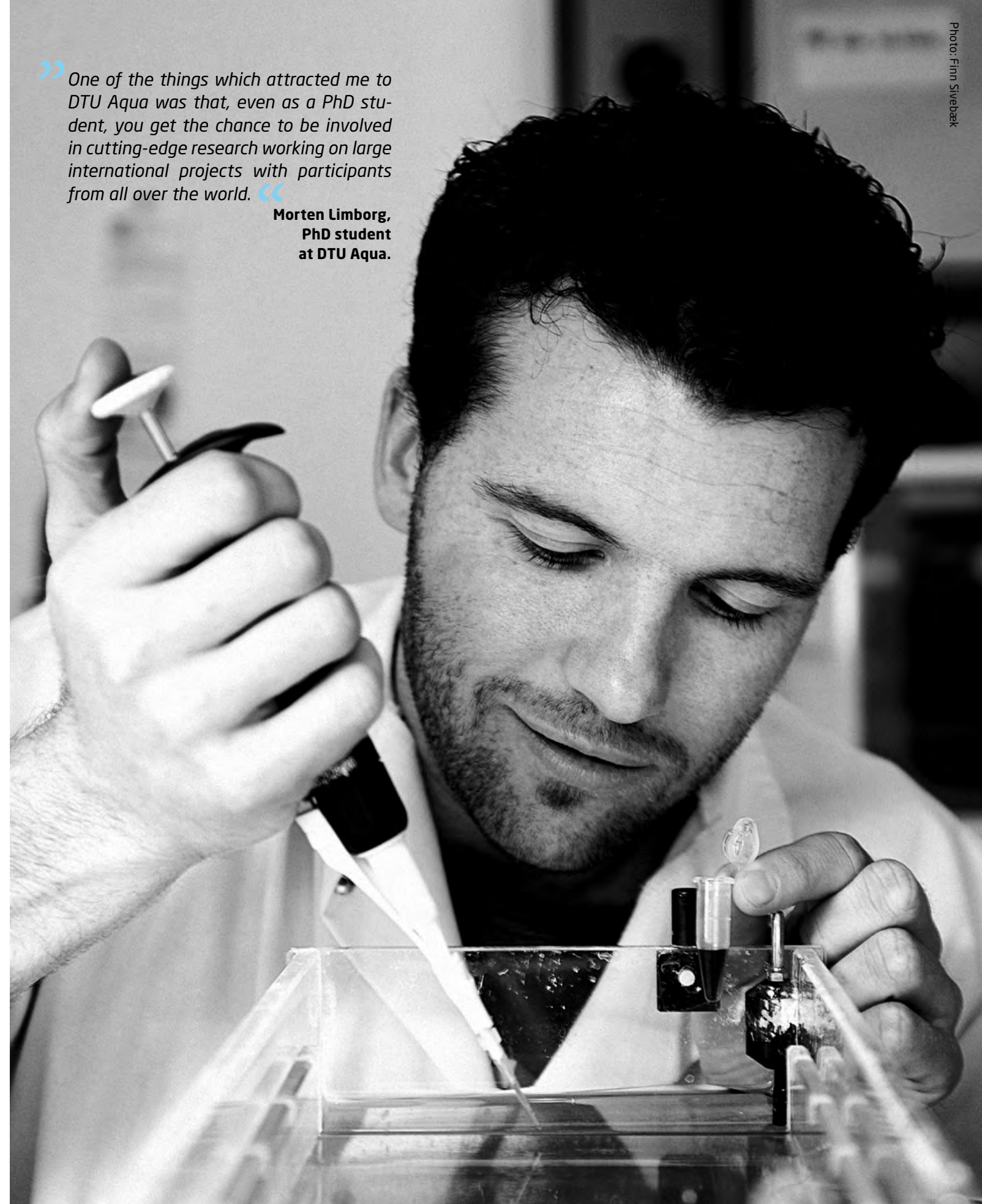
PhD positions are advertised on [www.aqua.dtu.dk](http://www.aqua.dtu.dk)

”By examining DNA from old otoliths (structures in the inner ear), I can compare fish populations' previous and current genetic profiles and get insight into how environmental changes and fishing has affected stocks over the past century. It is tremendously exciting to be personally involved in gaining new knowledge about the world we live in.”

**Nina Overgaard Therkildsen,**  
PhD student at DTU Aqua and  
recipient of the Ministry of Science's  
Elite Research Travel Grant.

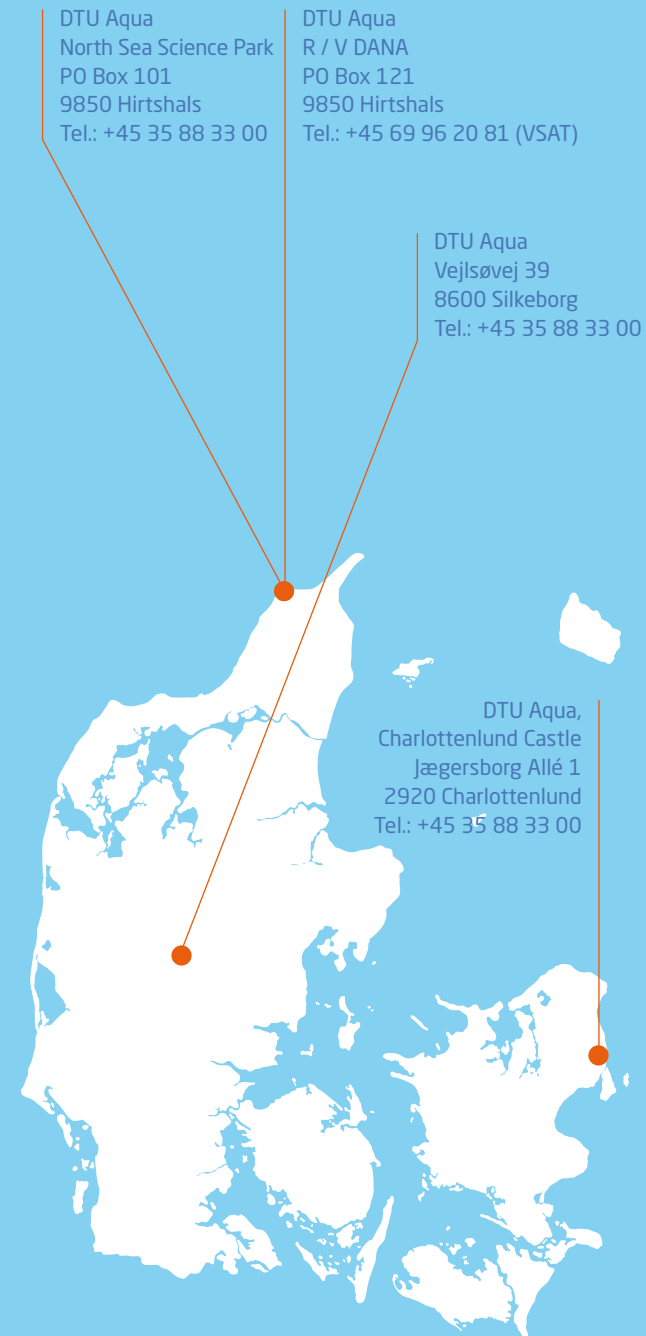
”One of the things which attracted me to DTU Aqua was that, even as a PhD student, you get the chance to be involved in cutting-edge research working on large international projects with participants from all over the world.”

**Morten Limborg,**  
PhD student  
at DTU Aqua.





# DTU Aqua Where?



---

## DTU Aqua National Institute of Aquatic Resources

Charlottenlund Castle  
Jægersborg Allé 1  
2920 Charlottenlund  
Tel.: +45 35 88 33 00  
Fax: +45 35 88 33 33  
Email: [aqua@aqua.dtu.dk](mailto:aqua@aqua.dtu.dk)  
[www.aqua.dtu.dk](http://www.aqua.dtu.dk)

---

### A PART OF DTU

DTU Aqua is part of the Technical University of Denmark (DTU), one of Europe's leading technical universities. DTU has 18 departments and 6000 employees made up of 2700 scientists, 2200 technical-administrative personnel, and more than 1000 PhD students (all figures based on yearly FTE's/full-time equivalents). Of the university's 7000 students, more than 600 are international graduate students. DTU's stated goal is to be among the top 10 technical universities in Europe. Several independent international rankings support the fact that the university has reached this position.