

Annual report 2010

Marine strategic area

Marine Coastal Development



NTNU – Trondheim
Norwegian University of
Science and Technology

The Norwegian University of Science and Technology (NTNU) is a university with a broad academic scope. It has been given the national responsibility for graduate engineering education in Norway. NTNU's research has an international focus and can be characterized by being at the leading edge in specific areas of technology, with a broad disciplinary scope and an interdisciplinary approach.

It is anticipated that the answers to the complex questions of the future must be searched for through interactions across the classical disciplines. NTNU established six thematic strategic areas as arenas and support processes for facilitation of interdisciplinary research and education:

- Energy and petroleum – resources and environment
- Information and communication technology
- Marine and maritime technology
- Materials
- Medical technology
- Globalization

VISION – Excellence in research and higher education supporting sustainable coastal development



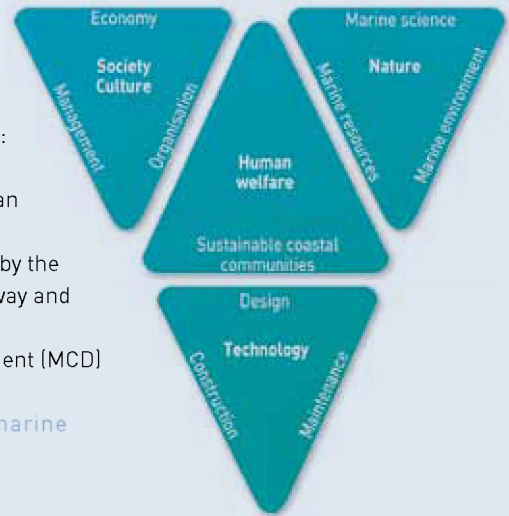
Figure: NTNU Marine Coastal Development – Science Plan 2020, a document describing the marine strategic research agenda at NTNU.

NTNU Marine Coastal Development will contribute to the sustainability of coastal communities through holistic and multidisciplinary research and education.

The Strategic Focus Area “Marine and Maritime Research” has two main pillars:

1. Centre for Ships and Ocean Structures [CeSOS], Centre of Excellence, funded by the Research Council of Norway and NTNU
2. Marine Coastal Development (MCD)

Visit us at www.ntnu.edu/marine



MANAGEMENT

Director: Prof. Yngvar Olsen, Dept. of Biology

Deputy Director: Prof. Harald Ellingsen, Dept. of Marine Technology

Manager: Ir. Alexandra Neyts, Dept. of Marine Technology

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Olav Jamtøy, Business Adviser, AKVAGroup ASA

Rita Tveiten, Adviser, Government relations

Sigurd Bjørge, Senior Advisor, County of South-Trøndelag

CONTACT: Alexandra.Neyts@ntnu.no



From left to right: Harald Ellingsen, Alexandra Neyts, Yngvar Olsen, Ingvald Strømme, Rita Tveiten, Olav Jamtøy, Jørund Larsen, Sigurd Bjørge, Karl Almås, Anders Endal, Frank Reier Knudsen (for Bjørn Jalving), Oddmund Bye, Oddvar Aam

MARINE COASTAL DEVELOPMENT – CORE ACTIVITIES

The marine strategic area covers the three main domains along the marine value chain:



Photo: Isak Kjerpeseth

OCEAN SPACE RESEARCH:
methodological and technological development for research on living and non-living resources

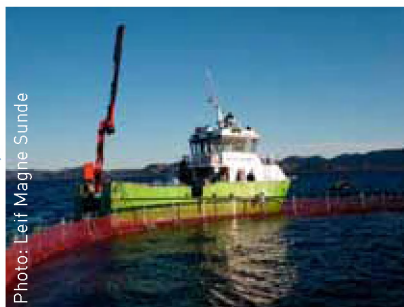


Photo: Leif Magne Sundt

FISHERIES AND AQUACULTURE:
science, engineering and societal research



Photo: Jan Ole Eivjemo

MARINE RESOURCE PROCESSING:
sustainable marine resource processing and technology

SCIENTIFIC CORE GROUP

Dept of Marine Technology:

Prof. Asgeir Sørensen,
Prof. Dag Myrhaug,
Prof. Bernt Leira,
Prof. Bjørnar Pettersen

Dept of Biology:

Prof. Geir Johnsen,
Prof. Augustine Arukwe,
Prof. Elin Kjørsvik,
Prof. Atle Bones

Dept of Biotechnology:

Prof. Olav Vadstein,
Prof. Kjell Morten Vaarum,
Prof. Sergey Zotchev,
Prof. Turid Rustad

Dept of Chemistry:

Dr. Murat Van Ardelan

Dept of Sociology and Political

Science: Prof. Jennifer Bailey

Dept of Engineering Cybernetics:

Prof. Jo Arve Alfredsen

Dept of Electronics and

Telecommunication:

Prof. Hefeng Dong

Dept of Hydraulic and

Environmental Engineering:

Prof. Tor Ove Leiknes

Dept of Energy and Process

Engineering:

Prof. Trygve Eikevik

Museum of Natural History and

Archaeology:

Fredrik Skoglund

Ocean Space Research

Ocean Space Research

Marine surveillance systems
Energy from the ocean
Marine ecosystems
Eco-toxicology
Marine archaeology and cultural history
Coastal zone development and infrastructure

Infrastructure

RV Gunnerus
Trondhjem Biological Station
Marine Technical Laboratory
ACE
NTNU and SINTEF Sealab

Monitoring of the marine environment and its resources through observations and measurements has evolved into a new scientific era with the generation of multiple data of high accuracy. NTNU has contributed to this development through research on surveillance technology and communication systems. Mounted on sub-sea installations or mobile platforms like the Gunnerus research vessel, remote operated vehicles, autonomous underwater vehicles and gliders, they offer complete marine observation systems. New tools become hence available both to marine ecologists and archaeologists. A sustainable management of the marine ecosystem also requires a better knowledge of the marine processes, such as species diversity, genetic resources, biology, hydrodynamics, chemistry and ecology, and of societal issues related to coastal zone development. The understanding of the effects of marine food web exposure to toxic compounds and CO₂, in particular in polar areas, has received special attention.

Applied Underwater Robotics Laboratory (AUR-Lab)

AUR-Lab was established in 2009 as a multi- and interdisciplinary research arena for improved environmental monitoring and mapping of the marine ecosystem using advanced underwater vehicles. The laboratory bridges the gap from theory to practice, through linking field observations with model-scale experiments and numerical simulations, and through joining strong theoretical research groups with operational experienced researchers. In 2010, the AUR-Lab team was extended to 11 researchers and PhD students, covering both engineering and marine biology. The group developed a Dynamic Positioning system prototype for NTNU's Remote Operated Vehicle (ROV) Minerva, and performed experimental workshops with Autonomous Underwater Vehicles (AUVs) at Svalbard, at the land-locked Bay of Hopavågen, and at the Telemark water system. The main activities were related to testing of robotics, experiments on seafloor photomosaics, underwater hyperspectral imaging, and detection of CO₂ seepage, gases and trace metals. An official opening of AURL-Lab is planned in 2011.

Contacts:

geir.johnsen@bio.ntnu.no;
asgeir.sorensen@ntnu.no;
fredrik.soreide@hf.ntnu.no



Photo: Asgeir Sørensen

Research vessel Gunnerus

In 2010, a considerable upgrading of the coastal research vessel was performed through the installation of new equipment, such as a multi-beam echo sounder, a catch control system, an electric trawl camera, a tension shackle, an acoustic doppler current profiler, a service vessel, and upgraded positioning and sea mapping tools. The total equipment value of Gunnerus reached a level of about 3 million NOK (ca. 375 000 €).

Gunnerus performed 180 cruise days, corresponding to a 100 % occupation, giving access to 1057 students, researchers and other users. Slightly more than 20 % of its capacity was used by commercial partners. User statistics show that Gunnerus is utilized as a platform for a wide range of disciplines such as marine technology, biology, chemistry, archaeology and geology.



Photo: Fredrik Skøglund

Contact: svenn.linde@ntnu.no

www.ntnu.edu/marine/gunnerus

CeSOS

CeSOS is the national Centre of Excellence for Ships and Ocean Structures, located at the Marine Technology Centre in Trondheim. Research at CeSOS aims at developing fundamental knowledge about how ships and other structures behave in the ocean environment, using analytical, numerical and experimental studies. This knowledge is vital, both now and in the future, for the design of safe, cost effective and environmentally friendly structures as well as in the planning and execution of marine operations. The engineering research carried out is inspired by the technology outlook, in a 20-25 years perspective, and involves topics within the following thematic areas:

- wave induced motions and strongly nonlinear loads
- wave and ice-induced load effects in marine structures, risers and mooring systems
- marine operations, with due account of automatic control and human factors with relevance for the oil and gas, shipping, renewable marine energy and aquaculture industry.

Contact: coe@marin.ntnu.no

www.cesos.ntnu.no

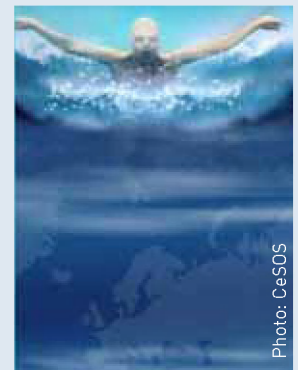


Photo: CeSOS

Ocean Space Centre

MARINTEK and NTNU are jointly developing plans on behalf of the Ministry of Trade and Industry for the establishment of an Ocean Space Centre, a world-leading multidisciplinary knowledge centre on important topics related to ocean space technology, like deepwater oil & gas exploration, novel technology and methods for fishing and fish farming, environmentally friendly shipping and renewable ocean energy.

Contact: atle.minsaas@marintek.sintef.no

PROJECTS AND ACTIVITIES – OCEAN SPACE RESEARCH

EUR-OCEANS

The EUR-OCEANS Consortium is a European scientific network building upon the scientific expertise and dissemination of knowledge on marine ecosystems in a context of global change. It aims at the long-term harmonization of European research efforts related to ocean ecosystems undergoing anthropogenic and natural forcings. In 2010, Prof. Egil Sakshaug was co-opted as an Executive Committee member of EUR-OCEANS.

Contact: egil.sakshaug@bio.ntnu.no
www.eur-oceans.eu

HYDRALAB IV

The co-ordinated and integrated approach of this EU funded project aims at structuring the access to unique and costly research infrastructures for studying interactions between water and environmental elements, sediment, structures and ice. Through networking, joint research and transnational access activities, HYDRALAB IV enhances the operation of these infrastructures beyond the present state-of-the-art. NTNU offers transnational access to the natural site at Hopavågen, which provides researchers with the possibility of in-depth studies of eco-hydrodynamics and transport processes relevant for marine chemists, biologists, physicists and geologists. The project was initiated on 1 October 2010 and will last for 4 years.

Contact: Alexandra.Neyts@ntnu.no
www.hydralab.eu



Photo: Kasper Hancke

IGLO – MP 2020

“Innovation in Global Maritime Production – 2020” is a knowledge-building project with user involvement (KMB). Its aim is to investigate how environmentally and society-sound practices may lead to innovations that strengthen the competitiveness of the Norwegian maritime industry. The creation of new knowledge, insight and the development of tools and methodologies were done in close collaboration between leading maritime companies, senior researchers at NTNU and MARINTEK and international expert groups. PhD-projects and master theses contribute to in-depth understanding and knowledge generation.

Contact: Annik.Fet@iot.ntnu.no
www.iglo-mp2020.no



Photo: Annik Fet

EMAR2RE

This European Transport Support Action was initiated to identify commonalities and strengthen cooperation between marine science and maritime industries. The project initiated the process of a holistic approach by identifying areas of common interest, of possible synergies and integration structures. Both communities are represented by the Waterborne Technology Platform and the European Science Foundation – Marine Board. The EMAR2RES deliveries will be the building blocks for a Marine and Maritime research Forum.

Contact: Annik.Fet@iot.ntnu.no

iCoast

The iCoast project, focusing on integrated coastal area management, was half-way completed by the end of 2010.

The project team is working out a joint framework for an environmentally, socially and economically sustainable development aiming to reduce the number of conflicts in the coastal zone and its adjacent waters. Among the studies carried out in 2010, the response of nutrient discharge from salmon farms on the marine food web was investigated. This is a hot topic of high relevance to environmental groups, policy decision-makers, the aquaculture industry and the public in general.

Contact: Yngvar.Olsen@bio.ntnu.no
www.ikyst.no

NORUS

NORUS or “Technology Development for Marine Monitoring and Ocean Observation” is a joint North America – Norway educational program for higher education. In 2010, several practical workshops were organised with student teams and staff members of NTNU, the University at Svalbard, California Polytechnic State University and Rutgers University. In the Arctic Ocean, autonomous underwater vehicles were run into the ice as well as under polar night conditions for environmental measurements and for vehicle performance testing under extreme circumstances. The Trondheimsfjord and NTNU Sletvik field station were used as demonstration, verification and test sites for innovative underwater vehicles and sensors. More in particular, an IVER2 underwater robot was used to fly trajectories in the Bay of Hopavågen for the mapping of dissolved oxygen.

Contact: Geir.Johnsen@ntnu.no;
kasper.hancke@bio.ntnu.no
www.norus-science.com

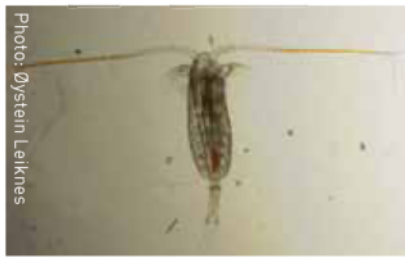


Photo: Kasper Hancke

HARVEST

The goal of HARVEST is to assess stocks of plankton and quantify ecological consequences of harvesting at lower trophic levels. The contribution from NTNU to this project is to clarify biological mechanisms and variables as input to mathematical models. One of the matters of dispute is whether *Calanus finmarchicus* selects algae or ciliates as their main food source. During 2010, two food selectivity experiments were performed in collaboration with the University of Kiel.

Contact: Oystein.Leiknes@bio.ntnu.no



Underwater Acoustic Monitoring and Communication

The objective of this national project is to develop new acoustic methods and technologies for observation and monitoring of the marine ecosystem. In 2010, several experiments were carried out in the Trondheimfjord, leading to an optimised underwater acoustic transmittance and transfer of data.

Contact: Hefeng.Dong@iet.ntnu.no



WAFOW

Through a comparative study of coastal ecosystems in Norway and Chile, the WAFOW project aims to develop a tool for managing anthropogenic waste discharges in coastal waters. In order to investigate whether waste emissions

from fish farms lead to changes in the structure of marine food webs, researchers from Norway, Chile, Kurdistan, the Netherlands, Turkey, Colombia and France, successfully completed a mesocosm experiment in Patagonia. In addition, field studies were performed to explore photodegradation of organic matter and UV effects on plankton in surface waters.

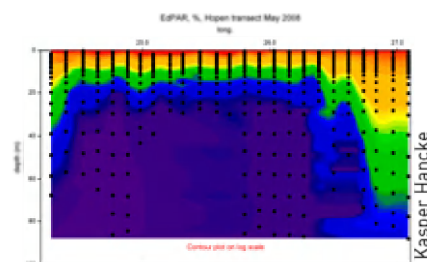
Contact: Murato@nt.ntnu.no



NESSAR – Ecosystem Studies of Subarctic and Arctic Regions

Through the International Polar Year program (IPY, 2007-09) researchers from NTNU and SINTEF have investigated the optical properties of the Central Barents Sea. The results have elucidated how light behaves in the ocean's photic zone. Bio-optical models were developed to improve the understanding of the Arctic ecosystem. The results are of high relevance to estimate the marine primary production and ocean carbon flux, and for remote sensing applications, and were presented at the official IPY conference (Oslo 2010).

Contact: Kasper.Hancke@bio.ntnu.no
www.ipy.no/prosjekter/Nessar



BEST COMBAT

The Beluga Sturgeon Community Based Tourism project explores how to combat illegal fishery of the Danube sturgeon through developing sustainable tourism around this fish as an alternative. Romanian fishermen and fishery managers visited Norwegian fishing communities to see how inhabitants there have adapted to former dramatic declines in herring and salmon fisheries, similar to the situation in fishing communities along the Danube when fishery of sturgeon was banned for ten years in 2006. Recent project developments are further investigation of the beluga migrations routes, the launch of the Caviar Road trail as a tourism concept and development of a prototype eco-neighbourhood. Best Combat is supported by Innovation Norway through the Norwegian Bilateral Cooperation Programme for Economic Growth and Sustainable Development in Romania, and by the Romanian Ministry of Environment and Forestry.

Contact: Oddmund.Otterstad@ntnu.no
www.bestcombat.cc-intro.com



Characterization of seabed properties

Seabed characterization is of importance for marine habitat assessment and for seafloor geotechnical engineering, whereas the shear wave velocity is a direct measure of the stability of sediment slopes. This project is developing several approaches for recording dispersion curves of seismic interface waves, and for measuring the shear wave velocity profile in the seabed as function of depth.

Contact: Hefeng.Dong@iet.ntnu.no

Seismic air gun signals and their effects on fish behavior

The high activity of seismic surveying in Norwegian waters has caused concerns about its environmental impact on marine life. There is evidence that the seismic noise can cause reactions on the behavior of the fish population resulting in reduced catches. In order to mitigate the problem and the conflict of interest between the fishing industry and seismic exploration interest there is a need to predict this impact. The first version of an acoustic - biological model is now ready and may be used in the design and planning of seismic surveys such that the disturbance to fishing interests is minimized.

Contact: Jens.M.Hovem@iet.ntnu.no

University Technology Centre (UTC)

The UTC "Performance in a Seaway" is a co-operation between Rolls-Royce Marine, MARINTEK and NTNU. The centre aims at promoting research with a commercial potential, in particular development of propellers, propulsion systems, ship designs, and various types of ship equipment. In 2010, the co-operation was extended for another five years. Andrea Califano graduated with a PhD on CFD calculations of intermittent ventilation of a marine propeller – the first time such calculations were performed.

Contact: sverre.steen@ntnu.no

FISHERIES AND AQUACULTURE

Fisheries and Aquaculture

Aquaculture engineering

Sustainable marine aquaculture and societal aspects

Biological basis of marine aquaculture

Marine harvesting technology

Sustainable fisheries

Social strategies of fisheries

Infrastructure

NTNU and SINTEF

Sealab Flume tank

RV Gunnerus

ACE

Marine Technical Laboratory

There is a clear trend that, whereas catches from the wild are stagnating, any future increases in seafood provision are to come from sea-based aquaculture. Although the situation for the fisheries and aquaculture industries is very different, both sectors need to focus on environmental sustainability and consumer attitude when developing further.

Aquaculture at NTNU has its main focus on aquaculture engineering of production systems, the sustainability of these systems, and the fundamental biological sciences of aquaculture engineering. By taking full advantage of the knowledge and developments made in other sciences and industries, such as the offshore oil industry, considerable technological progress can be obtained within this young industry. A better understanding and control of environmental impacts is crucial both from a production and a consumer perspective.

The goal of fisheries research at NTNU is to promote active multi-disciplinary problem-solving research, through close interaction among engineering, natural science and social sciences. Through the development of low energy catching technology, improved fishing gear, on board catch handling and flexible logistic- and distribution systems fisheries can gain efficiency. At the same time, it is important to counteract over-fishing problems through improved management strategies, catch monitoring, and sustainability documentation. Scientific approaches for the maintenance of sustainable coastal communities is also a focus area for fisheries research at NTNU.

AquaCulture Engineering – ACE

ACE is the new large-scale infrastructure designed and dedicated for sea-based aquaculture engineering research and education. It was established as a shareholder company in 2008, with SINTEF (51 %) and NTNU (16 %) as its major owners. ACE offers large-scale infrastructure, including plants, sites, boats and personnel, for research, development and testing of technology and equipment. When fully established, ACE will consist of ten different experimental facilities including farms with salmon, marine fish, shellfish and other sites without fish for testing of new technology. The first industrial scale salmon farm at Tristeinen (Bjugn) has been the site for more than 10 R&D and test projects in 2010.

Contact: Alexandra.Neys@ntnu.no
www.aceaquaculture.com



Photo: Tom Ek

CREATE

CREATE is a national "Centre for research based innovation in aquaculture technology". Through understanding, innovating and applying, the centre contributes to the creation of technology for cultivation of the sea. Research and development are focused on three main pillars and the integration of knowledge between them: Equipment and constructions; Operation and handling; Farming intelligence. Industry partners, being market leaders in supplying technology to the sector, have an important evaluating function within the consortium. The centre started its second term in 2010 after a successful mid-term evaluation.

www.sintef.no/Projectweb/CREATE

Gemini Centre for Sustainable Fisheries

A holistic approach is urgently required to face problems in the fisheries sector, such as overexploitation, poor selectivity of fishing gear, large post-harvest losses, poor utilisation of by-products, poor working conditions and energy-intensive operations. The Gemini centre, established in 2010, aims to promote problem-solving research involving close interaction among engineering, natural science and social sciences. It focuses on the biological framework for use of marine resources, on marine harvesting technology, and on social and fisheries management strategies.

Contact:

Jennifer.bailey@svt.ntnu.no
geminisenter.wordpress.com

EATiP – European Aquaculture Technology and innovation Platform

EATiP provides a structure for all relevant aquaculture stakeholder groups to come together to address issues for assuring a long-term sustainability of the aquaculture sector in Europe.

The EATiP 4th Stakeholders Meeting and 2nd Annual General Meeting of the Assembly was held in Brussels on 23 June 2010. EATiP has been involved in activities targeted to improve governance and direction for RTDi actions in Europe. Through the EU funded project 'Aquainnova' an operational framework for dialogue between the aquaculture industry, the research community and the policy makers was created. In 2010, the process of developing vision documents and strategic research agendas for the main thematic areas within the aquaculture value chain was initiated. NTNU was strongly involved in this work, as co-chairs for the thematic area "Integration with the Environment" and for the working group on "Research Infrastructures".



Photo: Alexandra Neils

Contact: Yngvar.Olsen@bio.ntnu.no

www.eatip.eu

EFTP – European Fisheries Technology Platform

EFTP was established as a forum to promote the transition from traditional fisheries to a competitive, sustainable and modern sector. It brings together European private and public stakeholders in order to create an enduring basis for structuring initiatives. The fishing industry is a fundamental part of the Technology Platform through the board of directors. The first EFTP General Assembly Meeting was organised in Brussels on 24 November 2010, and six different thematic working groups were established. NTNU was a founding member of EFTP.

Contact:

Harald.Ellingsen@ntnu.no
www.eftp.eu

Gemini Centre for Marine juvenile and plankton technology

The main activity of this interdisciplinary Gemini Centre is located at Sealab, where NTNU and SINTEF have several aquatic laboratories. Scientists from six NTNU departments and from SINTEF Fisheries and Aquaculture participate in the activity. The aim is to develop joint strategies and a strong working partnership between biological and technological disciplines to promote a high-level and robust research and educational community within the field of marine larval and plankton cultivation and utilisation.

Contacts:

Elin.Kjorsvik@bio.ntnu.no;
Jo.Arve.Alfredsen@itk.ntnu.no
www.ntnu.no/geminisenter/mtp

PROJECTS AND ACTIVITIES – FISHERIES AND AQUACULTURE

PROMICROBE

Seven international research partners study in this project microbes as positive actors for a more sustainable aquaculture. Through systematic gathering of novel information on microbial interactions in aquaculture ecosystems, new concepts for microbial management will be developed. These will be translated into new or adapted protocols to rear aquaculture organisms in a biological stable and economically efficient way.

Contact:

Olav.Vadstein@biotech.ntnu.no
www.promicrobe.ugent.be

INTEGRATE

The nationally funded project investigates the opportunities for integrated open seawater aquaculture, and develops technology for sustainable multi-trophic aquaculture of highly productive areas. The project results are to contribute to the next generation of knowledge based policy and management tools for localisation and management of aquaculture in coastal waters. In August 2010, an international workshop was organised in Trondheim, on the issue whether integrated multi-trophic aquaculture (IMTA) could be a strategy for improving the sustainability of aquaculture in Norway and add value to the productivity of fish farming sites. The workshop was a joint initiative of NTNU and SINTEF, and of the Yellow Sea Fisheries Research Institute, the Chinese Academy of Fisheries Sciences and the Ocean University of China.

Contact:

Aleksander.handa@bio.ntnu.no



Photo: Alexandra Neyts

PRO-EEL

The PRO-EEL project aims at breeding European eel (*Anguilla anguilla*) in captivity. Reproduction of eel in culture has become a focus research area due a severe decline of natural stocks and an increasing interest to breed eels for a self-sustained aquaculture. PRO-EEL is an international research project supported financially by the European Commission, with 15 international partners.

The objective of the project is to expand the current knowledge on eel reproduction and to develop standardized protocols for production of high quality gametes (eggs and sperm), viable embryos and feeding larvae of European eel. Methodology and technology will be established using small scale tests and validated in full scale experimental facilities.

Contact: Elin.Kjorsvik@bio.ntnu.no

www.pro-eel.eu

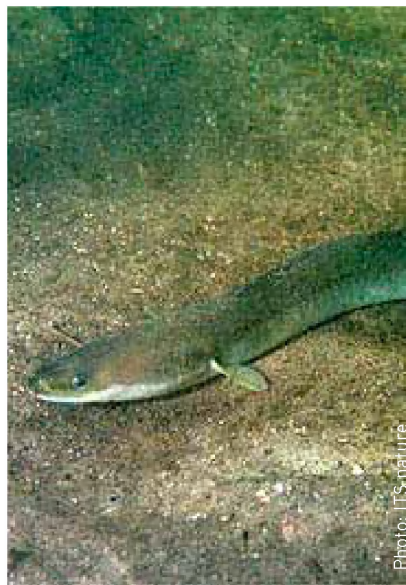


Photo: ITS-nature

Technology akvARENA

Through the formation of a regional cluster, the interaction and networking between aquaculture technology companies, research centres and organisations in Mid-Norway is strengthened.

Technology akvARENA stimulates the development and use of technology in the fish farming industry by enabling industry driven projects, and net-working, internationalising and recruitment activities. In 2010, a number of innovation and technology development projects were supported, and workshops, meetings and company visits were carried out.

Contact: Alexandra.Neyts@ntnu.no

www.akvarena.no



Photo: Alexandra Neyts

Aqua-tnet

Aqua-tnet is the European Thematic Network in the field of aquaculture, fisheries and aquatic resources management. The network is funded under the European Commission Lifelong Learning Programme, running from 2008 to 2011, and aims at reaching a greater compatibility and comparability of the systems of higher education in Europe. The Aqua-tnet web portal contains data bases on mobility opportunities, course databases, and innovative teaching resources. Aqua-tnet is planning to submit a new application for continued activity through the proposal Aqua-tnet 3 [phase 2011-2014].

Contact: Elin.Kjorsvik@bio.ntnu.no

www.aquatnet.com

LarvaNet

LarvaNet is a European network of researchers and producers working with fish larvae, funded by COST Action FA0801. It intends to integrate knowledge obtained in national and European research projects, as well as practical experience, in order to improve the quality of fish larvae used in aquaculture. It is funded through the European Commission COST action. The network offers training schools and travel funds for young scientists. It also hosts workshops in collaboration with international conferences such as Aquaculture Europe 2010.

Contact: Elin.Kjorsvik@bio.ntnu.no
www.larvanet.org

Fish telemetry

Acoustic fish telemetry enables remote monitoring and analysis of individual fish behaviour in the sea environment. NTNU is involved in projects where the aim is to develop fish telemetry technology into new application areas both within aquaculture and fisheries research. A telemetry system for the quantification of individual feeding behaviour of salmon in sea farms is being developed in the FeedTag project. The application of prototype transmitters allows the detection and analysis of feeding activity on fish in sea cages, and results will be used to improve feed utilization in sea cages. Other projects, ranging from development of autonomous receiver buoys to new transmitter designs for water quality assessment and fjord migration of salmon and sea trout, have also been targeted recently.

Contact:
Jo.Arve.Alfredsen@itk.ntnu.no



Photo: Martin Føre

CODE – Cod Development

CODE is a national knowledge platform for studies of the development of biological processes in early stages of Atlantic cod, linked to nutritional, environmental and management aspects. CODE brings together a broad mass of leading Norwegian scientists from nine partner institutions and several international partners, and is funded by the Research Council of Norway (2010-2014).

Contact: Elin.Kjorsvik@bio.ntnu.no
www.uib.no/rg/mdb/projects/code-cod-development

Molecular Ontogeny of Digestive Capability in Atlantic cod Larvae

The project is funded through the “Functional genomics programme of Central Norway” (FUGE). The researchers have used molecular and biochemical approaches to study the ontogeny of digestive capability and nutritional effects on growth and appetite in combination with stereology and gut maturation, and found some significant controlling factors. Furthermore, genes relevant for normal growth and development were identified and were found to be affected by larval nutrition during critical phases. The identified genes will be important for the formulation of new feeds and studies of diet depending growth. Functional genomics focusing on the patterns of gene regulation typical for early onset of growth and digestive capability may tremendously increase our understanding of the basis for the observed problems at the larval stages.

Contact:
Augustine.Arukwe@bio.ntnu.no



Photo: Augustine Arukwe

DANTEQ – Development & assessment of technology improving fishing operation & on board processing with respect to environmental impact & fish quality

The main goal of this project is to improve the fishing vessel operation, energy system design and the on board fish processing with respect to fish quality and environmental impact. The project is funded by the Research Council of Norway (2010–2013), with 11 research and industrial partners.

Contact: Elin.Kjorsvik@bio.ntnu.no

Intensive Production of Copepod Eggs in a Landbased Closed System

The main aims of this project were up-scaling and improved efficiency of copepod (*Acartia tonsa*) egg production, and to study effects of the use of cultivated copepods in start-feeding of fish larvae. The project was funded by Innovation Norway and several industrial partners.

Contact: Elin.Kjorsvik@bio.ntnu.no



Photo: Gunvor Øie

MARINE RESOURCE PROCESSING



An increasing demand for high quality fresh seafood products, and the high competitiveness on industry level creates new requirements for higher efficiency and optimised design of equipment and systems. NTNU research teams have contributed significantly to innovations on automation, chilling, freezing and drying of marine raw materials through enhanced process engineering and tailoring solutions. In addition, a more efficient management of the supply chain is planned through a holistic approach, involving production processes and traceability systems.

Techniques within blue biotechnology make it possible to extract novel products of high value from marine biomass and macromolecules, and to isolate genetic resources and biopolymers of the oceans. Research groups at NTNU focus on a better exploitation of by-products and unexploited marine organisms, and on bio-prospecting, which involves the search for new exploitable (micro-)organisms.

SEAFOODplus

This European research platform originates from the integrated project SEAFOODplus that was running in the period '04 – '08. The mission of the SEAFOODplus research platform is to initiate, stimulate and encourage international integrated multidisciplinary seafood research covering the whole production chain from aquaculture and fisheries to consumers' health and well-being. Further to influence the European research agenda with focus on seafood research related to human health, consumers' perception and well-being, process and product quality, product development, safety and aquaculture as source of seafood and to promote project ideas via the channels of the European Commission in addition to existing Technology platforms.

Contact:

Turid.Rustad@biotech.ntnu.no

Marine bioprospecting

Bioprospecting is the search for new biologically active molecules, genes and enzymes for the development of novel medicines and industrial processes. Marine bioprospecting at NTNU has been focusing on marine bacteria and metagenomes, i.e. DNA recovered from marine microbes. Besides the search for new antibiotics, also pigment producing bacteria were investigated. In addition, new tools for establishment and screening of marine metagenome libraries were developed. A comprehensive research network has been established with partners from Norway, Russia and Switzerland. Among thousands of extracts, seven novel active compounds were identified, and genes for biosynthesis of two compounds were cloned and analyzed. Genome mining revealed a hidden capacity of certain marine bacteria isolates to biosynthesize chemically diverse compounds, which cannot be identified through conventional screening.



Photo: Harald Bredholt

Contact:

Sergey.Zotchev@biotech.ntnu.no

Food for life – National Technology Platform

NTNU is a partner in the Norwegian Food for Life branch of the European Technology Platform. The platform focuses on the development of joint research and development priorities and strategies, the dissemination of scientific results and the collaboration between national and European research institutes in the field of food science, including the blue sector. A national working group was established, providing input to the research priorities in Norwegian funding programs and in the European Commission's 8th Framework Programme.

Contact:

Turid.Rustad@biotech.ntnu.no
www.f4l.no

PROJECTS AND ACTIVITIES – MARINE RESOURCE PROCESSING

LIPIDO

The project on Optimizing Lipid Production by Planktonic Algae is funded by N-INNER, the Northern European Innovative Energy Research Programme. It is a collaboration between six partners from Finland, Germany, Iceland and Norway. The Consortium addresses a so far neglected biomass source for biofuel and energy production: cultivated planktonic algae.

Contact:

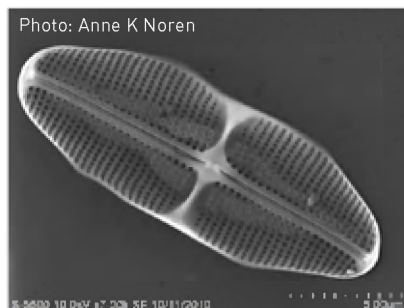
Olav.Vadstein@biotech.ntnu.no

SOLBIOPTA

The Biotechnological Production of Materials for Optimized Solar Cell Efficiency project studies the production and use of novel bio-nanomaterials from the microalgal group diatoms in solar cell applications. The project is funded by the Research Council of Norway.

Contact:

Olav.Vadstein@biotech.ntnu.no



Competitive Food Processing in Norway

The objective of this industry-driven project is to improve and secure a consumer oriented competitive marine and agricultural food processing industry in Norway. This is done by addressing and developing critical knowledge and

technologies for more effective processing and resource utilisation. NTNU is strongly involved in the activities related to superchilling mechanisms and critical process parameters for its implementation. A PhD on mathematical modeling of temperature effects when superchilling fish products was started in May 2010. In October 2010, a workshop on superchilling and new technology for efficient processing was organized in Stamsund.

Contact: Trygve.M.Eikevik@ntnu.no

CREATIV

The Center for Reduced Energy use through Advanced Technology Innovations is working on new, more energy efficient technologies for processing of food products, including automation of value added marine products. The national centre involves 22 partners, covering both the research and industry sector. The centre activities are coordinated by SINTEF Energy Research.

Contact: Trygve.M.Eikevik@ntnu.no

Stresscod

The main objectives of the Stresscod project are to determine effects of handling stress combined with storage conditions on quality of farmed cod (*Gadus morhua*), and to determine which biochemical changes that are important for the resulting sensory quality. One of the aims is to determine the proteins and activities of selected proteolytic enzymes that are important for the quality properties and to correlate results from proteome analyses, sensory and instrumental quality evaluation, using multivariate data analysis, to identify biochemical markers of handling stress that may be used for prediction of product quality. Results show that some

protease activities are little affected by storage, while collagenase activity is reduced. Handling stress had a little effect on protease activity.

Contact: Turid.Rustad@biotech.ntnu.no



EVENTS

Nor-Fishing 2010



The bi-annual fisheries fair was arranged from 17 to 20 August in Trondheim and celebrated its 50 years anniversary. H.M. King Harald V officially opened Nor-Fishing 2010. During the four days of the exhibition, meetings and seminars,

Nor-Fishing gathered more than 14 000 exhibitors and visitors from a total of 52 different countries.

Contact: Alexandra.Neyts@ntnu.no
www.nor-fishing.no

Nor-Fishing seminar

During the exhibition in Trondheim, a seminar on the consequences of free choice of fishing gear was organized jointly by NTNU, SINTEF and the Institute of Marine Research. The organizers and invited guests presented challenges in gear development related to fishing vessels, fishing management and regulations, carbon foot prints and handling of catches.

Contact: Harald.Ellingsen@ntnu.no

International collaboration – Vietnam

From 8 to 12 November, a NTNU delegation visited Vietnam to discuss collaboration possibilities with local authorities and potential industrial partners. Issues of joint interest involved the utilization of byproducts from the fisheries industry, which is a cornerstone of the Vietnamese economy, for the production of fish gelatin, chitin, chitosan and glucosamine. During the excursion, collaboration was strengthened between NTNU and Nha Trang University, the International University,



Photo: Kjell Morten Vaarum

and the Vietnam National University in Ho Chi Minh City.

Contact: Kjell.Morten.Vaarum@biotech.ntnu.no
www.ntu.edu.vn, www.hcmiu.edu.vn,
www.vnuhcm.edu.vn

International collaboration – China

The marine strategic research area joined the NTNU delegation to its excursion to China in May 2010. A memorandum of understanding was signed with the Shanghai Ocean University and collaborations were strengthened with the Zhejiang University, the Yellow Sea Fisheries Research Institute (YSFRI) at Qingdao and the Tsinghua University in Beijing. Later that year, representatives from YSFRI and the Ocean University of China repaid a visit to Trondheim, where areas for joint research projects and funding mechanisms were identified, and options for cooperation in education and training, including



Photo: Alexandra Neyts



exchange of personnel, were explored. The Chinese Ambassador in Norway visited the marine laboratories at NTNU SEALAB, and NTNU hosted a delegation from China together with representatives from the Ministry of Foreign Affairs and the Norwegian Minister of Industry. The Gunnerus research vessel was used for a demonstration cruise on the Trondheimsfjord.

Contact: Yngvar.Olsen@bio.ntnu.no

Marine Chemistry seminar

A cross-disciplinary seminar on “Changing Oceans and Changes in Ocean Chemistry” was held on 25-26 February 2010 at Bårdshaug. Marine chemistry related developments and challenges caused by increasing atmospheric CO₂ concentrations and shifts in weather patterns were discussed among the 25 attendants from NTNU, SINTEF, NGU, NINA, StatoilHydro and Scripps Institute of Oceanography.

Contact: Murato@nt.ntnu.no

EDUCATION

International Master of Marine Coastal Development (MACODEV)

MACODEV is a two-year international multidisciplinary Master of Science programme. It is especially designed to give the students a broad understanding of the complex interactions in the marine sector. The programme offers three specialisations which include an individual research project with publication of a Master Degree thesis according to international standards, i.e.

- Aquaculture
- Fisheries and Marine Resources
- Marine Biology and Biochemistry

Contact: studier@bio.ntnu.no
www.ntnu.edu/studies/msmacodev



Photo: Jon Arne Grøttum

Marine related Master programmes



Photo: Anne S. Barnes

At NTNU, a number of different marine studies can be chosen either as a Bachelor or a Master degree. The most marine-oriented study programmes are:

- Bachelor in Marine Biology and Aquaculture
- Master in Marine Technology
- Master in Coastal and Marine Civil Engineering
- Master in Fisheries and Aquaculture Cybernetics

An overview over the international Master's programmes at NTNU can be found at www.ntnu.edu/studies/international/master

Contact: studentservice@adm.ntnu.no

PhD education

NTNU provides extensive programmes for a doctoral degree in most marine disciplines. PhD students at NTNU are offered cutting edge research training, collaboration with fellow PhD candidates, and highly specialized instruction. Candidates must be admitted to a specific PhD programme, and undertake both research and coursework in order to earn a degree from NTNU.

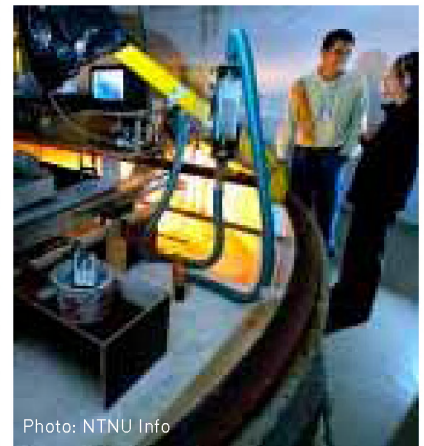


Photo: NTNU Info

PROJECTS AND ACTIVITIES – EDUCATION

“Sett Sjøbein”

In 2008, the Ministry of Fisheries and Coastal Affairs (FKD) allocated funds to “Sett Sjøbein”, a national project to increase recruitment into the marine sector. Actions were undertaken to enhance the attractiveness of a marine education included raising competence, more efficient collaboration and better dissemination of new knowledge. Decisions are taken jointly by representatives from the Norwegian industry organizations, schools, training institutions and universities. The project was extended with one year. NTNU joined the recruitment events in Trondheim and Frøya, and represented the higher education sector in Sett Sjøbein steering committee.

Contact: Alexandra.Neyts@ntnu.no www.settsjobein.no



Photo: Alexandra Neyts

DEPARTMENTS AT NTNU INVOLVED IN THE MARINE STRATEGIC AREA, AND THEIR MAIN FIELDS OF COMPETENCE (in alphabetical order)

Archaeology and Religious Studies	Marine archaeology, maritime history, cultural heritage
Architectural Design and Management	Harbour architecture
Biology	Marine biology, biological oceanography, aquaculture, eco-toxicology, coastal ecology, behaviour
Biotechnology	Marine biopolymers, biochemistry, chemical engineering, processing, marine biotechnology
CeSOS	Centre of Excellence for Ships and Ocean Structures
Chemistry	Trace metal chemistry, metal pollution
Centre for Rural Research	Regional policies, regional development, coastal communities, resource use/management, coastal industries
Civil and Transport Engineering	Coastal engineering, infrastructure, geotechnique
Electronics and Telecommunications	Acoustics, underwater communication
Energy and Process Engineering	Processing engineering, energy and value chain management
Engineering Cybernetics	Aquaculture and fisheries cybernetics, instrumentation, telemetry
Engineering Design and Materials	Design methodologies, sustainability and simulation. Structural integrity, metal forming and composites, collaborative engineering
Geography	Coastal geography, societies
History and Classical Studies	Fisheries and aquaculture history
Hydraulic and Environmental Engineering	Water processing technologies
Industrial Economics and Technology Management	Value chain management, Life Cycle Assessment (LCA), environmental management and innovation
Interdisciplinary Studies of Culture	Cultural perspectives of coastal communities
Marine Technology	Marine constructions, marine systems and operations, fisheries and aquaculture technology
Mathematical Sciences	Bio-modelling, statistics
Museum of Natural History and Archaeology	Marine archaeology, maritime history, cultural heritage, marine biodiversity
NTNU Social Research, Studio Apertura	Organisation studies, work processes and management in aquaculture
Physics	Marine optics
Product Design	Converging technology, design and marketing in the marine area
Production and Quality Engineering	Food technology and manufacturing
Sociology and Political Science	Fisheries politics, risk evaluations
Urban Design and Planning	Ecological based planning of coastal land use

Annual report 2010



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NTNU – The Norwegian University of Science and Technology.

The Norwegian University of Science and Technology (NTNU) in Trondheim represents academic eminence in technology and the natural sciences as well as in other academic disciplines ranging from the social sciences, the arts, medicine, architecture and the fine arts. Cross-disciplinary cooperation results in ideas no one else has thought of, and creative solutions that change our daily lives.

NTNU

NO-7491 Trondheim, Norway

Phone: + 47 73 59 50 00

Fax: + 47 73 59 53 10

www.ntnu.no

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