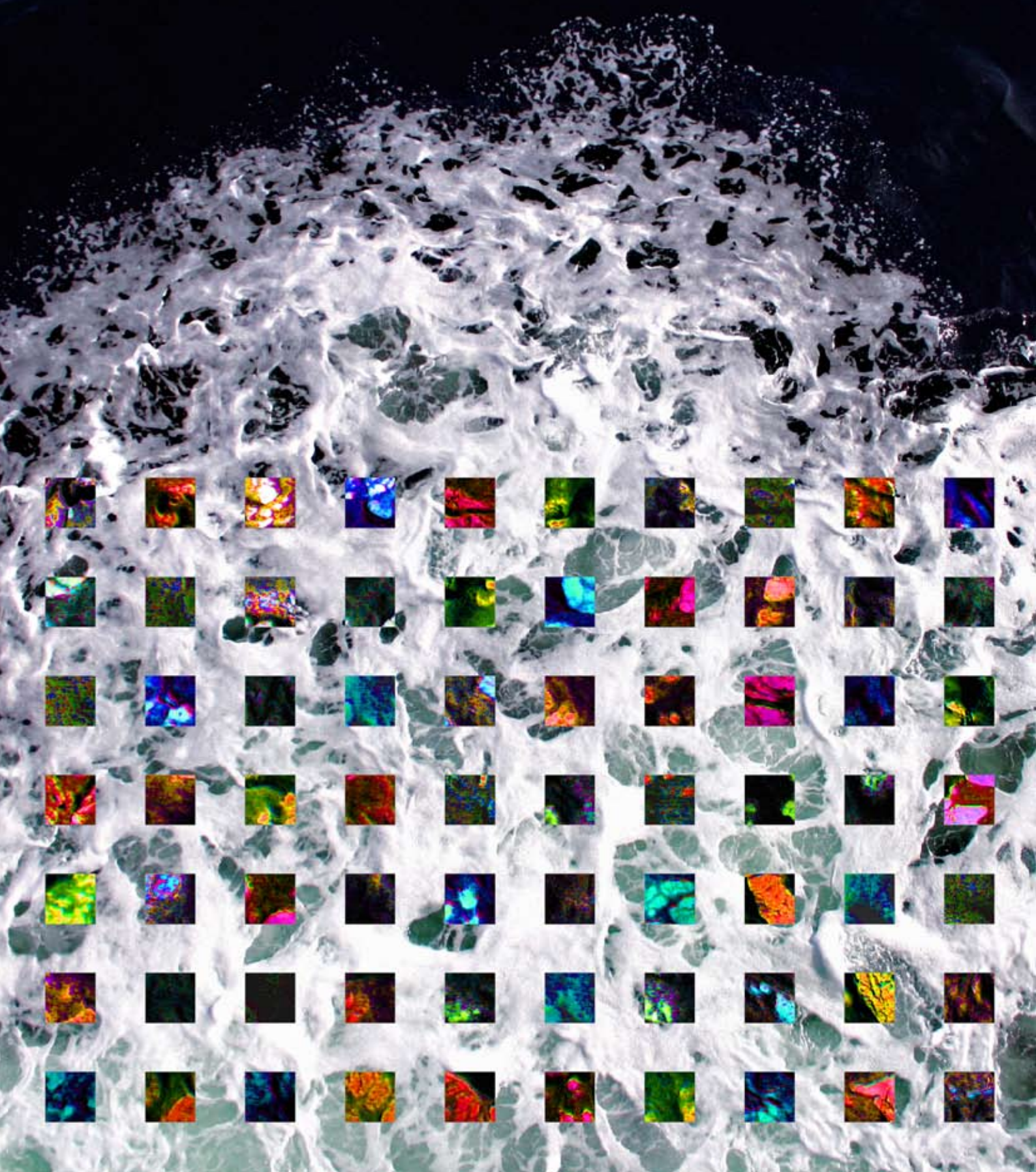


Prospects

within Biotechnology in the Tromsø region



Prospects

The goal for the Tromsø region is to be an international centre for biomarine research and innovation. This is an ambitious yet achievable goal as Tromsø has a number of natural advantages: close to untouched marine resources in the Arctic, a highly developed infrastructure and a good interplay between industry, commerce, public authorities and research communities.



© Keesi Heiland MARBIO

Biotechnology is a combination of natural science and engineering science and is defined as all technology which makes use of microorganisms, plant and animal cells, or parts of these, to produce or modify products for use in medicines or other technical uses, to improve plants and animals and to develop microorganisms for specific application.

Tromsø has been able to build up vast expertise within biotechnology by following a long-term strategy. The Tromsø region is particularly well known for its developments within biomarine fields, encompassing all aspects; from research and education to innovation and commercial developments. This strategy has given birth to a number of new companies involved in the marine value chain, from processing of raw materials to biotechnological products.

Over the past three decades, biomarine companies have seen a significant development and today are principally regarded as knowledge-based enterprises with highly qualified personnel in key positions.

The combination of sustainable knowledge-based aquaculture and fisheries and the emergence of a new marine

biotechnological industry provides uncharted potential to create added value in the decades to come. Entrepreneurs, established companies, researchers, expertise, politicians, the public policy system and financial institutions – these will all have different roles to play in an industrial and commercial development which centres around the organisms in our seas.





YNGVE OLSEN SÆBBE

Within the Tromsø region, the different parties involved have achieved a high level of cooperation which in turn opens the door to innovation and further development of all the different fields of biomarine technology.

A number of research groups are now established and work on Arctic and biomarine fields. Their research has won major international acclaim.

A strategic program related to Arctic and biomarine fields has, in recent years, resulted in increase in the level of internationalisation, whereby well over 100 researchers from other countries have been recruited to positions in Tromsø's research and educational institutions.

The strategies followed have also allowed for a continuous development in infrastructure, including research ships, facilities for research on live organisms and aquaculture and a number of essential laboratories where fundamental research can be carried out on molecules and bioactivities.

The Tromsø region has other geographic advantages with its long coastline, well-suited to aquaculture and proximity to huge stretches of ocean, home to vast amounts of biomarine resources. New expertise opens the doors to a world of potential to increase added value for the future. The Norwegian government has an ambition to make Tromsø an internationally leading centre for marine bioprospecting.

This brochure illustrates the unique nature of the city of Tromsø and its surroundings, its cluster of biomarine knowledge-based enterprises, an emerging biotechnological industry and the opportunities presented to the region with the further development of this specialist community together with biomarine industries.

© Sindre Birkely, MARBANK



Marine bioprospecting can be described as purposeful and systematic exploration for constituent parts, bioactive compounds or genes in marine organisms. These are charted to identify whether they have an impact/activity which can be exploited for medicines or at the point of intersection between other important industries such as oil and gas, renewable energy, chemical and food industry.

Tromsø

Tromsø is the capital of North Norway with a population of close to 70,000 and around 9,000 students. The city is a centre of education and research and has the world's northernmost university, the University of Tromsø.



KODIAK

Climate in Tromsø

- Thanks to the Gulf Stream, Tromsø has a moderate climate in relation to its latitude. The coldest month is January when the average temperature is minus 4.4 degrees Celsius, while the warmest month is July when temperatures average 11.8 degrees.
- Tromsø is located at the very centre of the Northern Lights belt and is one of the best locations for observing this magnificent natural phenomenon.
- The midnight sun in Tromsø lasts from 21 May to 21 July. Summer temperatures can range from 5 to 30 degrees Celsius.
- The Polar Nights is from 21 November to 21 January, when we celebrate the traditional sun day in Tromsø.



KODIAK

The vitality of a large city in a small town

Tromsø is a lively place with a busy town centre. It has a vast range of nightlife, entertainment and outdoor activities and a wonderful and ambitious cultural diversity all enjoyed by the flamboyant, often humorous and sociable locals. The population grows every year by around 1,000 – certain proof that people enjoy life here in Europe's northernmost “capital city”.

Surveys of living conditions indicate that the inhabitants of Tromsø live good lives. This may be attributable to the level of higher education among the inhabitants, combined with the vast range of leisure and cultural activities on offer in the city. Sports and outdoor pursuits are in plenty – from pétanque and



KODIAK

golf to tennis, basketball and football. With Tromsø's unique location, city life is easily combined with life in the great outdoors.

The city itself is quite compact and most parts of city are within walking distance. The city provides high quality facilities for nurseries, schools and health care, and is home to some of the best restaurants in Norway. Tromsø also hosts the world's northernmost University, a botanic garden – the world's northernmost Arctic-alpine Botanic



Garden, salt water aquarium, golf course, top division teams within a number of ball sports, a majestic cathedral, a Catholic seat, mosque and glassblowers.

Industry and commerce

The technology, research and university centre of Tromsø plays a leading role in Norway, and is at the forefront internationally within space industry, and polar, fisheries and Northern Light research. A major share of Norwegian fish exports are sold from Tromsø. The

city is not only home to numerous private export companies, it is also the headquarters for the Norwegian Seafood Export Council. The Norwegian Polar Institute is a paramount scientific institution within the Polar Environmental Centre. As a direct result of the University's considerable efforts targeting biomarine research and the excellent cooperation between industry, commerce and public authorities, the region has now fully established the perfect foundations for a biotechnological industry.



Tromsø International School

The establishment of an international school in Tromsø will make the city more attractive to foreign and Norwegian workers. It is vital for the region to ensure competence and a solid workforce if Tromsø and northern Norway are to compete nationally and internationally. Tromsø International School is scheduled to open in the autumn of 2010. An estimated 55 students will attend the first year. And when fully operating in 2014, the school expects to have 150 students.

Tromsø

The scenery in and around Tromsø will take your breath away: You are surrounded on all sides by fjords, sounds, islands and mountains.



YNGVE OLSEN/SÆBBE

Bukta Open Air Festival takes place at the start of July every year and attracts around 8,000 visitors.

Other festivals in the region:

- TIFF Tromsø int. film festival
- The Northern Lights festival
- The National Reindeer Sledding Championship
- NUFF Nordic youth film festival
- The Latin Festival
- Riddu Riddu, international indigenous festival (Kåfjord)
- Karlsøy festival, music and cultural festival (Karlsøy)
- Kalottspel, folk music and dance festival (Målselv)
- Døgnvill, music festival
- Insomnia, festival for future music and technoculture
- Barentsjazz, int. jazz festival
- Tromsø World Music Festival
- Ordkalotten, Int. literature festival
- Tromsø int. church music festival

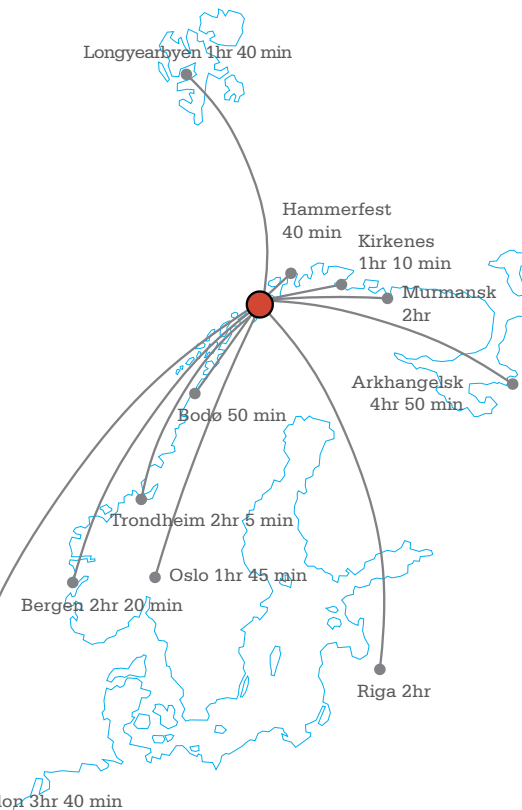


YNGVE OLSEN/SÆBBE

Cultural adventures

Around 7,000 people buy close to 60,000 tickets for the five-day long Tromsø International Film Festival (TIFF) which is held just as the sun comes back over the horizon, after the two-month long Polar Nights in January. One week after TIFF, the Northern Lights Festival is arranged. This is a musical festival, presenting quality music and dance from all genres, but with a focus on our neighbours in the east. In total, Tromsø hosts 24 annual festivals, providing the very backbone for a vital cultural life found in centres such as KulturHuset, the Driv student centre, Kulta, the city's bars and pubs, the municipal schools of culture, the music conservatory and many others.

KODIAK





Travelling to Tromsø

In 2009, Tromsø Airport operated 100 different flights, both domestic and international. The airport is only 4 km from the town centre. Passengers can, for example, choose from 12 direct flights to and from Oslo, with a flight time of 1 hour and 45 minutes. Other destinations included Evenes (Harstad-Narvik), Alta, Kirkenes, Bodø, Trondheim, Bergen, Rygge, Murmansk, Archangel, Svalbard, Riga and London. You can also travel by boat to neighbouring towns in the region.

The Coastal Express Steamer (Hurtigruten) has daily departures both northwards and southwards all year round.

A network of tunnels has been built under the town, making it quick and easy to drive around the island, over the island to the airport and under the sound leading to the mainland, taking some of the load off the Tromsø bridge.

The great outdoors

Many people choose to live in Tromsø because of the beautiful scenery and unspoilt countryside. The city is surrounded on all sides by natural beauty, with fjords, narrow sounds, islands and majestic peaks. Every type of skiing and skating sport is represented here, with a huge number of winter sports clubs. The city even has several groups of people who go swimming in the ice cold sea, popularly known as ice bathing. No matter the weather, you will see them every Friday afternoon down on the beach on the southern end of the Tromsø island. You don't have to travel far from Tromsø to reach the mountains, with the Lyngen Alps starting within the town boundary. This stunning range of peaks is becoming increasingly popular with local and European off-piste skiers. At only 6 km from the city centre, Tromsø has its very own skiing centre with several lifts and different slopes for all ages and capabilities. Cross-country skiers hardly have to leave the city with the wonderful network of floodlit trails and tracks nearby the most densely populated



areas. These are in use all year round, on skis or on foot. The cable car is open all year, carrying passengers up to the Fjellheisen restaurant which sits at a height of 420 metres over the city. The land around the restaurant is gently rolling and perfect for cross-country skiing. One of the most demanding yet popular peaks to climb in the area is the characteristic Tromsdalstinden, at 1238 metres. Not to forget the coast: with the vast stretches of sea, myriad islands and the beautiful archipelago off the coast of Tromsø, this is naturally the perfect setting for clubs and associations for sailing, windsurfing, kayaking, diving and all other sports and activities related to water and the sea. Tromsø even has its very own "spa boat" – an old fishing boat which has been converted into a "spa boat" with sauna, hot tub, Turkish bath etc.

Development of expertise

Tromsø plays host to a number of research institutions and the University of Tromsø with specific biomarine science competencies.



Bioprospecting in Tromsø

A project has been established to systematically chart the biological diversity in the Arctic waters and bioactive compounds in the organisms collected. This project has, as an example, to date identified novel compounds with antibacterial effect. Based on the finds made and the expertise found within the Tromsø region, the Norwegian government has an ambition to make Tromsø an internationally leading centre for marine bioprospecting.



RODOLFO CANENS

The University of Tromsø

The University of Tromsø's focus on marine science, biomedicine, telemedicine, physics, linguistics, multiculturalism and research related to the Saami and indigenous people. In biomarine science, the University offers educational programs in marine biotechnology, fish health and seafood science. The general biology program contains a number of elective courses where it is possible to choose among courses which cover different fields of aquatic biology.



The University of Tromsø, Nofima Marin, the Norwegian Polar Institute, The Northern Research Institute and the Institute of Marine Research are leading national and international players in their respective areas and roles, and carry out world class biomarine research. In total, approximately 500 researchers at some 10 institutions are engaged in biomarine research in Tromsø. Their activities cover a broad spectrum, but are to a certain extent concentrated in clusters. The two largest of these are within marine bioprospecting (e.g. the MabCent-SFI) and within marine ecology (the ARCTOS network).



TROMSØ

Tromsø
Science
Park and
the Barents
BioCentre

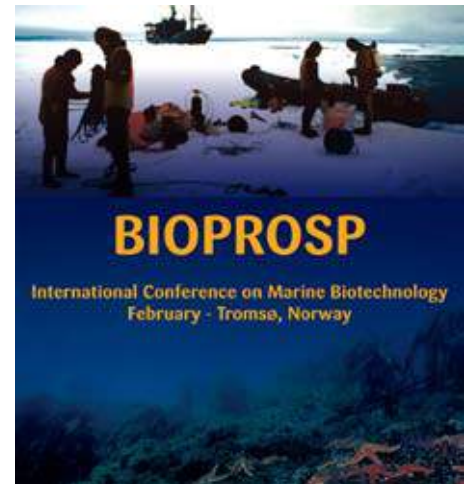
The
University
Hospital of
North Norway

The
University
Campus

Both geography and available infrastructure are favourable for the development of strong research clusters and derived businesses within biomarine areas in the Tromsø region. We have some of the richest and least exploited marine natural resources in the Arctic.

In order to manage this responsibility and make sustainable use of the natural resources while developing the potential in aquaculture in a sustainable way, we rely heavily on scientific knowledge. Only through a deep understanding of the natural resource potential and knowledge of the ecosystems in the region, can we manage the region in a sustainable manner.

Tromsø plays host to a number of major conferences, including:



BIOPROSP is an International Conference on Marine Biotechnology organised by the commercial actors and research communities in Tromsø in February every second year. BIOPROSP attracts around 250 delegates and the target groups are academic and industry researchers, decision makers, regulatory experts, investors and public facilitators. BIOPROSP will showcase applications and industrial utilisation of discoveries based on bioprospecting.



GULLAUME DRESEAUD

Arctic Frontiers is an annual, week-long conference held in January which attracts around 600-700 scientists, politicians and businesspeople. The subjects discussed and analysed during the conference focus on the Arctic region – from its environment and living conditions to legislation and future business opportunities. Although the conference is broadcast directly via the Internet (with Russian translation), international media such as National Geographic, Stern, Al Jazeera have shown a significant interest in the conference.

Science base

University of Tromsø



www.uit.no

Norwegian College of Fishery Science (NCFS)

Research and education within marine biotechnology cover key elements of aqua medicine (fish health), seafood science and bioprospecting. The core activity is located at the University campus in Breivika - the NCFS-building and Tromsø Science Park (MabCent, Marbio and Marbank).

- Research on the immune system and mechanisms of immunity in fish and invertebrates
- Mechanisms of pathogenicity - host-pathogen interactions between fish and virus or bacteria
- Development of new vaccine concepts and use of immune stimulators to improve vaccine efficacy and animal welfare in the aquaculture industry
- Quality of seafood – lipid oxidation and degrading of fish muscle
- Functional food – beneficial effects of marine lipids and marine peptides on human health
- Utilisation of unused resources from the seafood processing industry for high-value products
- Development of high quality fish feed for the aquaculture industry
- Isolation and characterisation of bioactive molecules from marine organisms
- Marine bioprospecting and drug discovery
- Metagenomics: the exploration of the microbial gene pool in marine environments in the search for new bioactive molecules



HENRIK TOMSAAS

Department of Arctic and Marine Biology

Research activities include marine, freshwater and terrestrial ecology, functional genomics in fish, plants and microorganisms, physiological and functional adaptations to sub-Arctic and Arctic climate conditions. The research covers the chain from the gene to the ecosystem and includes studies on individual organisms as well as interactions between organisms.

- Parasitic and symbiotic systems in plants and their biotechnological exploitation
- Plastid systems biology: from cryptic plastids in human pathogens to seed plant chloroplasts
- Discovery of peptides with antibiotic effects
- Chemical profiling of northern diatoms and detection of novel pharmaceuticals

Department of Medical Biology

The research activity is concentrated on biomedical and basal biological projects, which also include marine biotechnology and bioprospecting in a health benefit perspective.

- Drug discovery in sea anemones and corals based on deep-sequencing transcriptomics and reverse genetics
- MicroRNA profiling and whole genome transcriptomics in Atlantic cod based on deep-sequencing and bioinformatic approaches
- Mitogenomics in codfish and flatfish
- Health benefits of marine proteins and lipids
- Basal studies of the immune defence system in fish



STENAB D. JOHANSEN

Department of Pharmacy

The Department educates professional pharmacists and participates in the fields of “Drug discovery for compounds from marine organisms with anti-cancer and anti-microbiological activities”

- Isolation and structural characterisation of natural products
- Drug technology, biopharmacy, and quality assessment
- Drug synthesis and analysis



NORMA / FRANK GREGERSEN

Department of Chemistry

Research activities include medicinal chemistry, drug discovery, functional genomics, systems biology and enzyme technology, using methods of organic synthesis, biomodelling, macromolecular crystallography, spectroscopy, and calorimetry. State of the art NMR, MS and X-ray instrumentation highlight excellent department facilities. Marine biotechnology activities include extensive involvement in the Tromsø marine bioprospecting initiatives.

- Development of new biocatalysts from marine genome and metagenome libraries
- Discovery of potential drugs from marine bioprospecting efforts
- Design and chemical synthesis of anticancer and other targeted drugs
- Systems biology studies of marine microorganisms

MabCent-SFI

www.mabcent.no

MabCent-SFI is one out of fourteen Research-Based Innovation Centers initiated by the Research Council of Norway, but the only one within the field of bioactive compounds and drug discovery based on bioactives from marine organisms. Thus MabCent-SFI maintains a focus on bioactives from Arctic and sub-Arctic organisms searching for compounds for innovation and commercialisation, in areas where Norway currently has the potential to achieve a strong international position. The four commercial MabCent partners are parts of an R&D synergy although at different levels and areas (pharmaceuticals, nutraceuticals, research tools etc.). Through their interaction with the interdisciplinary expertise at the University of Tromsø and academic partners, the MabCent initiative will positively nurse research and innovation and set standards for future marine-based discovery and development within the field of marine bioprospecting/biotechnology.



ARCTOS

www.arctosresearch.net



ARCTOS is an Arctic marine ecosystem research network, organised as a research project based at the University of Tromsø. The scientists conduct science over a broad range of marine ecology topics in the Barents Sea and around Svalbard, and in most of the northern waters. Several institutions in Norway and important institutions in Russia, North America and the EU collaborate within the frame of ARCTOS, giving this research a pan-Arctic perspective.

NorStruct

www.uit.no/norstruct



The Norwegian Structural Biology Centre (NorStruct) is a national research and service centre within the national initiative for functional genomics (FUGE). The Centre continues to offer consultancy, service, courses and collaboration to the Norwegian research community in structural biology techniques.



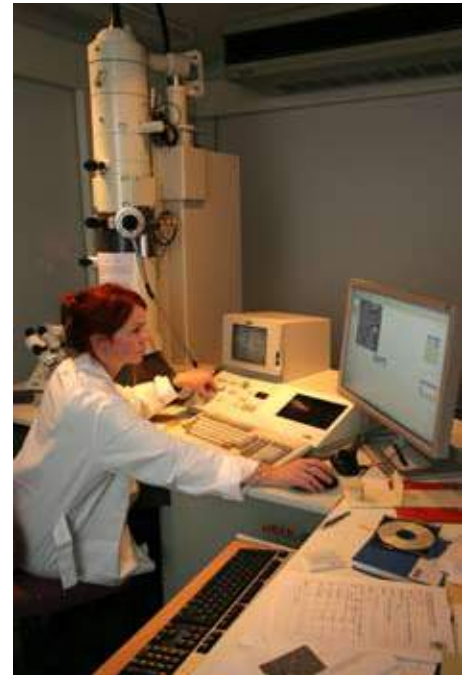
Additional institutions

Nofima Marin

www.nofima.no

Nofima's expertise in biotechnology is first and foremost located within the research groups Fish Health and Marine Bioprospecting. The company also operates its own experimental pilot plant and hosts a shared bioprocess laboratory facility equipped for upscaling of biotechnological processes.

- Expertise in enzymes and bioactive compounds from marine, coldwater organisms
- Evaluation and characterisation of antibiotic marine components
- Production of biochemicals/special products (oils, proteins, DNA etc.) from marine biproducts for application in nutrition/health foods, cosmetics, medicines and biotechnology
- Research into viral and bacterial diseases in various farmed species
- Development and formulation of feed for the fry of marine fish
- Development of bioproduct based feed for new farmed species such as sea urchins, king crab and Atlantic cod
- Responsibility for running the cod breeding station and research into spawning and genetics in the context of developing cod as a farmed fish species
- Process and product development of seafood



NOFIMA / FRANK GREGERSEN



Northern Research Institute - Norut

www.norut.no

Marine Biotechnology and Bioprospecting Platform "MolDoc" is established as a research and technology platform for proteins, lipids and small organic molecules. The platform is developed in close cooperation with the University of Tromsø, and includes:

- Documentation (chemical, biochemical and biological)
- Chemical and biochemical optimisation of biological activities
- Through a close cooperation with the University of Tromsø, Norut will help commercialise results from the R & D activities at the University



Institute of Marine Research

www.imr.no

The main task is to provide advice to Norwegian authorities on aquaculture and the ecosystems of the Barents Sea, the Norwegian Sea, the North Sea and the Norwegian coastal zone. IMR's headquarters are in Bergen, but important activities are also carried out at the department in Tromsø.



Polar Environmental Centre

www.polarenvironment.no



Centre for the environment and co-operation in the Polar areas and the Barents region. The Polar Environmental Centre is Norway's focal point for research, environmental monitoring and advisory services in the Polar areas and the Barents region. A number of large national research and administrative institutions have been gathered in the centre, and with a staff of over 200 people, the centre comprises a significant and unique collection of knowledge, in terms of broad academic perspective as well as in-depth research.

Norwegian Polar Institute

www.npweb.npolar.no



Norway's central institution for research, environmental monitoring and mapping of the Polar regions. The institute is the Norwegian authorities' consultant and supplier of knowledge, and contributes to the best possible administration of Norwegian Polar areas. Through active participation in the national and international bodies, the Polar Institute is central in providing data and knowledge regarding research and management of the Polar environment.

Akvaplan-niva

www.akkvaplan.niva.no



Provides consultancy, research and laboratory services to companies, authorities, NGOs and other customers worldwide. Services include environmental monitoring surveys: impact and risk assessments; environmental, ecotoxicological and biodiversity research; aquaculture design and management consultancy; and R&D on new aquaculture species, and a number of accredited environmental and technical analyses.

Bioforsk Nord

www.bioforsk.no/nord



Bioforsk, The Norwegian Institute for Agriculture and Environmental Research, conducts applied and specifically targeted research linked to multifunctional agriculture and rural development, plant sciences, environmental protection and natural resource management.

- Secondary metabolites produced in plants
- Seaweed farming
- Management of freshwater fisheries

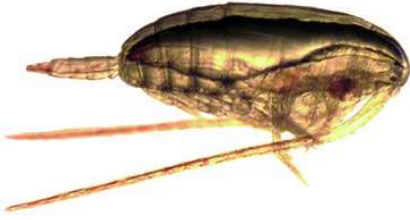
Genøk

www.genok.org



GenØk – Centre for Biosafety is an independent research organisation located at the University and the Science Park of Tromsø. GenØk is engaged in research, advisory services and capacity building related to biosafety. The centre focuses in particular on the environmental and health related consequences of the application of new bio- and nanotechnology.

Support structures



Calanus finmarchicus is a small (3 mm) copepod and a central organism in the marine ecosystem as feed for pelagic fish. *Calanus finmarchicus* goes through twelve different stages in its one year lifecycle and is very rich in fatty acids. The annual production in the North Atlantic is many times higher than the total biomass of all fish and mammals together in the same oceans. *Calanus finmarchicus* may represent a new resource for commercial utilisation with a wide range of applications. Harvesting commercial quantities of this copepod is possible due to new harvesting technology.



The silvery herring offers golden opportunities

The project aims to add significant value of yet unexplored bio-activities (enzymes, drugs, lipids and functional proteins) from by-products of Norwegian spring-spawning herring. Collaboration between Nofima Marin, SINTEF Fisheries and Aquaculture and the fishing industry.

There are a number of local and nationwide funding programmes aiming to establish favourable conditions for competitive enterprises in the Tromsø region and the high north. Funding may be applied for to mobilise increases in R&D efforts, in order to contribute towards innovation, internationalisation and promotion.

Some of the most central funding programmes, investment funds, central infrastructure and commercialisation actors/innovation companies are presented in the table below.

National and regional funding programmes

Innovation Norway

www.innovasjon Norge.no



The Research Council of Norway

www.forskningsradet.no



MABIT – R&D program within
Marin Biotechnology in Northern Norway

www.mabit.no

MABIT

RDA2-Tromsø

www.rdatromso.no



Troms Fylkeskommune

www.tromsfylke.no



Business development

Norinnova – Northern Innovation

www.norinnova.no



TTO Nord – Technology Transfer Office

www.ttonord.no



Tromsø region Biotechnology Organisation

www.nftr.no/no

Bioindustry Forum North-Norway

www.aksjonsprogrammet.no/FBN/FBN_main.htm

Investment funding

Norinnova invest

www.norinnovainvest.no



KapNord invest

www.kapnord.no

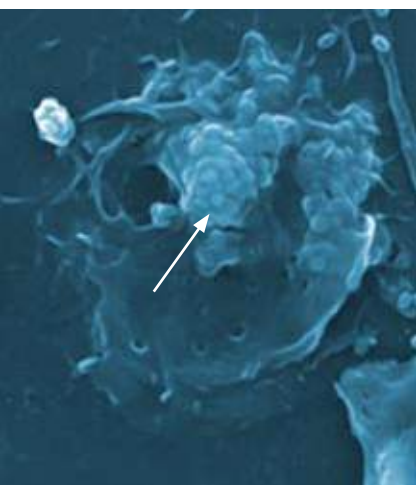


SpareBank 1 Nord-Norge Invest AS

www.snninvest.no



Infrastructure



Development of vaccines

Efficient vaccines are paramount for the further development of Norwegian fish farming. New vaccines and strategies are required to combat current diseases. An electron-microscopic image illustrates a white blood cell from a salmon which has absorbed tiny nano-particles containing a vaccine. The arrow points to a "lump" of nano-particles inside the cell.



RUDY CHAMERS

Research vessels

The research communities make use of three research vessels for a multiple range of activities related to marine research and education. «Hyas» (12 m) is used in near coastal waters and mostly for daytrips. «Johan Ruud» (31 m) is utilised for sailings in the fjords and coastal areas from Lofoten to the Varangerfjord. «Jan Mayen» (64 m) has been specially designed for sailings in the North Sea and Barents Sea, Svalbard and other areas covered in ice.

Tromsø Aquaculture Research Station

Tromsø Aquaculture Research Station consists of a land facility for experimental studies of fish and shellfish, and a fish health laboratory for the study of fish diseases, and also a new full-scale sea hatchery for studies of fish and shellfish under natural conditions.

www.havbruksstasjonen.no

BioLab Prosess

Modern pilot plants for developing and testing of processes and equipment for industrial production. This plant includes the latest technology for the production of marine ingredients.

www.prosesslab.no

Barents BioCentre

Barents BioCentre is a co-development between regional public institutions, the University of Tromsø, Northern Research Institute and local businesses in biotechnology. The paramount goal is to establish a common infrastructure for research and to develop biotechnology as a business. Barents BioCentre shall be a meeting place for industry and academia giving unique opportunities for developing new innovative products and new companies.

www.norut.no

Marbank

Marbank is a national marine biobank located in Tromsø. The marine biobank is established in close cooperation with the Ministry of Fisheries and Coastal Affairs. Marbank is responsible for collecting, preserving and cataloguing marine organisms from Norwegian waters (and especially from Arctic areas) for research and commercial exploitation purposes. The mission of Marbank is to provide an easy accessible repository of frozen marine biological samples for R&D institutions and industries that search for novel compounds in marine organisms. The material archived and stored in the repository includes taxonomy samples, frozen biomass samples and genetic and biochemical extracts from marine microorganisms, plankton, algae, invertebrates and vertebrates.

www.marbank.no



© Robert A. Johansen, MARBANK

Marbio

Marbio is a medium/high-throughput platform for purification/isolation, screening and identification of bioactive compounds from Arctic/sub-Arctic marine organisms. Marbio screens for compounds with activities within several areas:

- Antibacterial activities
- Anticancer activities
- Immunostimulants
- Anti-inflammatory activities
- Antioxidants
- Antiviral activities
- Enzymes and inhibitors



MARBIO

www.uit.no



The biotechnology business

The Tromsø region is one of the leading research areas within biomarine sciences, with interplay between business, the University of Tromsø and research institutions. The result is a dynamic environment incorporating innovation and knowledge sharing.

This interplay is reflected within the knowledge-based biomarine industry. The different companies cooperate with regional, national and international R&D institutions to develop their business. Several affiliated industries cooperate with the biomarine industry in the region.

This brochure mainly describes companies with a core business within biotechnology. Most of the companies base their activities on available marine raw materials in the region. Nevertheless, several of them have developed and are no longer dependent on the raw materials as such today.

Some companies have specialised in products to be used within the growing aquaculture industry. The brochure also describes companies that are not necessarily categorised as “biomarine”. These companies operate mainly within the areas of industrial and medical biotechnology.

The companies are divided into four categories:

- Use of waste products from fisheries and aquaculture
- Bioactive compounds
- Products for aquaculture and fish health
- Associated activities

List of other associated companies within the biomarine area can be found at www.mabit.no.



Cod enzyme improves HIV tests

Marine Biochemicals AS has developed an enzyme from Cod (*Uracil-N-glycosylase*) that is used in commercial HIV-tests. The use of the Cod enzyme increases the specificity and sensitivity of the tests.

1. Use of waste products from fisheries and aquaculture

Cognis Scandinavia

Estb: 1998
www.cognis.com

Cognis Scandinavia AS is a wholly-owned subsidiary of Cognis B.V. Cognis is a globally leading supplier of innovative, environmentally sound products and formulations. Cognis offers winning solutions and ready-to-market concepts for cosmetics, toiletries, detergents and household cleaners.

Core competence: industrial processes, chemicals and nutritional ingredients.



ConTra

Estb: 1999



ConTra develops and manufactures biotechnological products used as processing aids in the fish feed industry. The core business is manufacture of marine enzymes which are used in the manufacture of different fish products (i.e. processing salmon caviar).

Core competence: downstream technology, development of processing systems.



Maritex

Estb: 1993
www.tine.no

Maritex AS is located in Sortland, Vesterålen, and has been a subsidiary of the TINE Group since October 2003. The company specialises in the production, marketing and sales of refined cod-liver oil.



SigMarine

Estb: 2009

SigMarine AS is a company producing and selling marine products made from various parts of fish by using marine biotechnological processing methods.

Core competence: Marine biotechnology, fish by-products, value-added products.

2. Bioactive compounds / pharmaceuticals / lipids / natural products / nutraceuticals

Arctic Biolab

Arctic Biolabs Company AS (ABC) works with the identification and development of new, active substances to combat cardiovascular diseases. Central to this research is the detection and utilisation of new marine antioxidants. ABC is a partner in MabCent-SFI.

Estb: 2009

Core competence: Marine bioprospecting, use of antioxidants

Biotec Pharmacon



Biotec Pharmacon ASA develops new pharmaceutical products for treatment of immune related diseases. The company's bioactive compound SBG (SBG, soluble-1,3/1,6-glucan) is in clinical phase III development within two therapeutic indications; treatment of diabetic ulcers and prevention and treatment of oral mucositis. The company's clinical development program also includes immunotherapy of cancer where a combination treatment of SBG and

Estb: 1990

www.biotec.no

monoclonal antibodies currently is in clinical phase I/II. Through the subsidiaries Immunocorp Consumer Health AS and Immunocorp US, the company also markets immune stimulating health products for the consumer market. Biotec Pharmacon is a partner in MabCent-SFI. **Core competence:** carbohydrate chemistry, drug manufacturing, immunomodulation



Calanus



Calanus AS is a Norwegian biomarine company founded on competence related to ecologically sustainable harvesting of the zooplankton *Calanus finmarchicus* and on scientific and technological expertise related to development, manufacture and use of health- and nutrition products based on this abundant resource in the North Atlantic ocean. *Calanus*

Estb: 2005

www.calanus.no

finmarchicus has a unique biochemical composition and will therefore become the source of a whole range of novel products such as dietary supplements, ingredients, and bioactive compounds for pharmaceutical use.

Core competence: Health and nutrition, bio-medicine, industrial processing, resource ecology

CALANUS

Chitonor

Chitonor AS is a subsidiary of Seagarden ASA. Chitonor AS produces high quality chitin for use in the medical and cosmetic industries from the cold water shrimp *Pandalus borealis*.

Estb: 2005

www.seagarden.no

Core competence: production and marketing of marine protein powder and peptide extracts

CLAR

Estb: 2008

CLAR (Centre for Lipid and Antioxidant Research) generates business/IPR related to commercial exploitation of marine resources.

Core competence: Lipids, antioxidants, pharmacy, nutraceuticals, commercialisation



Lytix Biopharma

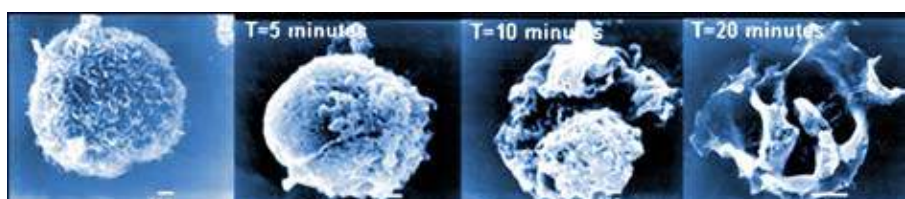
Estb: 2003

www.lytixbiopharma.no

Research and Development of new drugs for anti-infection and anti-cancer use. Discovery research on novel drug candidates based on marine bioprospecting.

Lytix Biopharma AS develops new innovative drugs based on their proprietary technology. LTX-109 is developed for the treatment of infections caused by multiresistant microorganisms, while LTX-315 is developed for the treatment of several types of cancer. Lytix Biopharma AS is also a partner in the MabCent-SFI consortium and has as a strategic goal to develop the next generation of drugs based on marine natural products.

Core competence: Drug discovery, medicinal chemistry, drug development, infectious diseases, tumorology



Marealis

Estb: 2008

www.marealis.no

Development and production of ingredients and bioactive peptides from the coldwater prawn *Pandalus borealis*.

Core competence: Nutraceuticals of marine origin.



MINORIX / REBO

Marimol

Estb: 2009

Marimol is a biomolecule research and development company. The primary involvement is identification, development and production of biomolecules from marine microbiota based on its technological platforms. Usage towards gene technology, medical diagnostics and diagnostics related to food safety.



Marine Biochemicals

Estb: 2009

www.marinebiochem.com

Marine Biochemicals AS, a subsidiary of Biotec Pharmacon AS, develops and manufactures unique DNA/RNA-modifying marine enzymes for use in genetic research and molecular diagnostics. Marine Biochemicals is a partner in MabCent-SFI.

Core competence: Enzymology, protein expression, protein engineering



Olivita



OliVita AS has a special combination of omega 3 fatty acids and antioxidants from minimal processed olive oil which can reduce the risk of developing atherosclerosis and strokes. There is over 20 years of medical research behind the product OliVita, including clinical research trials that confirm the healthy benefits of OliVita.

Core competence: Dietary and nutritional supplements, health food



Estb: 2002
www.olivita.no

ProBio Group

ProBio is a leading player within the production of high-quality Omega-3 and pharmaceutical products. Consolidated turnover in 2008 was NOK 239 million. The company's client portfolio includes more than 200 major brand owners worldwide. The companies within the field of operation are gathered under the name of Ayanda. Ayanda operates within production, sales and marketing of pharmaceuticals and nutraceuticals. The business segment, Arctic Nutrients, produces ingredients based on Arctic raw materials, in particular focusing on specialty lipids. The companies within this area are NorOmega AS and BioSea Management AS.

Core competence: Omega-3, innovative product development, nutraceutical, pharmaceutical



Estb: 2000
www.ayanda.com



Promar Aqua

Promar Aqua AS utilises biological production processes to produce high value compounds, like natural Astaxanthin to the Salmon feed market. We have also developed new photo bioreactor technology competitive with synthetic production.

Core competence: Industrial scale Biotech production company.



Estb: 2001
www.intravision.no

Propylux Pharma

Propylux Pharma is dedicated to developing a new prophylactic treatment against Neonatal Alloimmune Thrombocytopenia (NAIT), a serious condition which affects the newborn.

Core competence: Immunological mechanism leading to NAIT

Propylux Pharma AS

Estb: 2008
www.propyluxpharma.com

Scandinavian Dermal Innovations

Scandinavian Dermal Innovations AS identifies, develops and commercialises innovative cosmoceutical ingredients based on unique marine and plant biotechnology with an Arctic origin.

Estb: 2009
www.skincare.no

3. Products for aquaculture and fish health

BioMar

Estb: 1962
www.biomar.com

The BioMar group is one of the leading suppliers of high performance fish feed to the aquaculture industry. Our main business areas are feed for salmon and trout in Norway, the United Kingdom and Chile, and feed for trout, eel, sea bass and sea bream in Continental Europe.



EWOS

Estb: 1947
www.ewos.com

EWOS is a leading and trusted supplier of aquafeed for the international aquaculture industry. We produce fish feed in all four of the world's major salmon farming regions: Norway, Chile, Canada and Scotland.



Eximo / Trofi

Estb: 2000 (Trofi 1964)
www.trofico.com
www.oddberg.no

Trofi is a business segment within the Odd Berg Group which consists of the companies KS Tromsø Fiskeindustri AS & Co and Eximo AS. Production of marine phospholipids, marine raw materials, start feed marine juveniles.
Core competence: Process and product development



PharmaQ

Estb: 2005
www.pharmaq.com



Pharmaq is the world's leading pharmaceutical company supplying the global aquaculture industry. PHARMAQ is a knowledge-driven company and consequently more than 20 different unique fish vaccines are currently supplied in a worldwide distribution. In addition to a global network of distributors, Pharmaq operates through its subsidiaries in Chile, the UK and its representation office in Vietnam. The foundations for Pharmaq's success were built in the Tromsø research environment in the mid-eighties, where the company's first fish vaccine production facility was established. Pharmaq has sustained its

close cooperation within specific R&D projects in Tromsø.

Core competence: bacteriology, virology, formulation technology, clinical research, regulatory affairs.



Skretting

Estb: 1899
www.skretting.com

Skretting is the world leader in the production and supply of feed for farmed fish. Total annual production is 1.3 million tonnes. Skretting has operating companies on five continents to produce and deliver feed for more than 50 species of farmed fish.

Core competence: Fish nutrition and health, feed raw materials, feed manufacturing



4. Other associated companies

Northern Biolabs

Northern Biolabs' main focus area is to explore de novo hardware and software design for molecular diagnostics and deep-sequence-analyses for human medicine, aquaculture and marine bioprospecting.

Estb: 2007
www.northernbiolabs.no

Core competence: Next Generation sequence analysis and mining, Bioinformatics, biological database design, hardware design for Next Generation Diagnostics.



Orthogenics

Orthogenics is a biotechnology company focusing on research and product development within cartilage-related diseases, primarily osteoarthritis (OA). The company aims at providing easy-to-use diagnostics for early detection of OA and develops effective therapy against OA.



Estb: 1999
www.orthogenics.no



Core competence: Molecular Diagnostics

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Epimeria loricata

Tromsø region facts

- Population of approx. 70,000
- The University of Tromsø is the northernmost university in the world with a total of 9,000 students and 2,700 employees
- Approx. 500 researchers are engaged in biomarine science at the University and 8 other R&D institutions
- The University Hospital of North Norway has 6,000 employees
- There are approx. 25 biotech companies in the Tromsø region with approx. 400 employees.
In this brochure, the biotech companies are divided into four sectors:
 - Use of waste products from fisheries and aquaculture
 - Bioactive compounds, pharmaceuticals, lipids, natural products, nutraceuticals
 - Products for aquaculture and fish health
 - Other associated companies
- The national marine biobank – Marbank – is located in Tromsø
- The Process Lab offers a modern pilot plant for developing and testing processes and equipment for industrial production
- Barents BioCentre hosts common infrastructure and modern high-tech laboratories for rental
- Innovation actors focus on life science, offering services and support such as incubators and business development
- Tromsø Science Park has a significant focus on life science
- The International Conference on Marine Biotechnology - BIOPROSP - is arranged every second year in Tromsø



Tromsø kommune

www.tromso.kommune.no

MABIT

www.mabit.no