Mastergrad ved Institutt for biologi ved NTNU

Oversikt over tilbud av masteroppgaver

HØSTEN 2016

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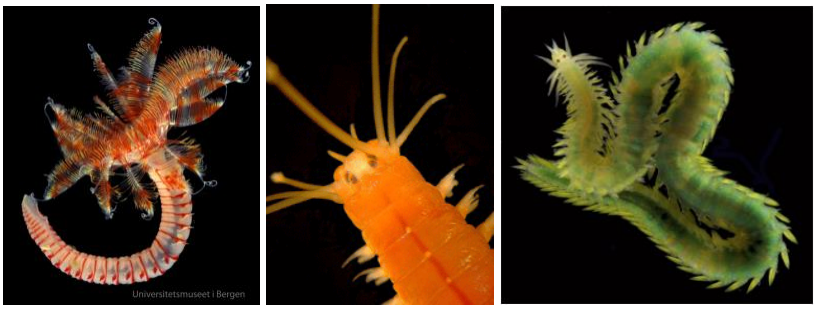
Hovedveileder:	Ole Kr. Berg / Sigurd Einum
Biveileder(e):	Odd Terje Sandlund, Tor F. Næsje, Antti Eloranta (NINA)
Arbeidstittel på oppgaven (max 20 ord):	**Sjøaure og innlandsaure i Storvatnet (Mølnbukt, Agdenes) (mulig to oppgaver)**
Kort beskrivelse av oppgaven (max 300 ord):	I forbindelse med et sjøaureprosjekt som NINA gjennomfører i Heggaelv/Nordgjerdselv-vassdraget i Agdenes tilbys en eller to MSc-oppgaver basert på prøvefiske og analyse av aurebestanden i Storvatnet med sikte på å fastslå i hvilken grad aurebestanden i vatnet består kun av stasjonær aure eller er en blanding av stasjonær og sjøvandrende aure. Feltarbeidet i oppgavene vil omfatte to runder prøvefiske med bunnsatte og pelagiske Nordiske oversiktsgarn eller garnlenker med tilsvarende maskevidder for å skaffe et analysemateriale av aure fra innsjøen. Felles feltarbeid for to studenter vil skaffe materiale til to MSc-oppgaver. Materialet av fisk skal prøvetas på vanlig måte: lengde, vekt, kjønn, modningsstadium, skjell og otolitter, samt mageprøver til analyse av fiskens diett. I tillegg tas vevsprøver til analyse av stabile nitrogen- og karbonisotoper. Supplerende undersøkelser kan eventuelt også gjennomføres i Litjvatnet (nedstrøms i samme vassdrag). Det må tas forbehold om tillatelse til prøvefiske her, da Litjvatnet er fuglereservat. **Oppgave 1:** Fokus på analyse av skjell fra auren for å detektere vekstmønster, da eventuelle sjøopphold vil kunne spores ved mønsteret i skjellene. Skjellanalysene samt data om størrelse, alder, kjønn og modning vil også danne grunnlag for analyse av bestandsdynamikk. Hvis det kan skaffes finansiering vil det også bli foretatt analyser av otolitter for innhold av strontium, som reflekterer at fisken eventuelt har hatt opphold i sjøen. **Oppgave 2:** Fokus på trofisk nettverk i innsjøen. Det tas vevsprøver til analyse av stabile nitrogen- og karbonisotoper av fisken som fanges ved prøvefisket. Dersom det forekommer fiskearter (f.eks. stingsild) som ikke fanges i prøvefisket bør det gjøres en innsats for å fange disse. I tillegg samles prøver av zooplankton og bunndyr til analyse av stabile nitrogen- og karbonisotoper i fiskens næringsdyr. I tillegg tas mageprøver av et utvalg fisk ved begge innsamlingsrunder for å fastslå hvilke taksonomiske grupper av næringsdyr fisken tar.
Oppgaven passer for (angi studieretning(er)):	Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	Jonathan Wright
Biveileder(e): Co supervisor	Henrik Jensen & Thor Harald Ringsby
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Personality and innovation in house sparrows: evolutionary and demographic consequences of individual phenotypic differences
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The house sparrow (*Passer domesticus*) is an excellent model species for studying evolutionary and demographic processes, such as gene flow, reproductive fitness and dispersal. It is also a classic example of an invasive bird species, which has spread worldwide due to its behavioural flexibility and innovation in artificial human environments (e.g. sparrows depend completely on farm buildings and agricultural food sources in many parts of Norway). However, little is known about individual variation in behaviour and innovation within and between populations, and to what extent this drives population growth, meta-population structuring and colonization of new habitats. This project will be part of an extensive study of house sparrows inhabiting farms on 18 islands on Helgeland by members of the Centre for Biodiversity Dynamics (CBD), involving over 20 years of field observations and genotyping. Different artificial bird-table feeders will be used to record which individuals are consistently the first to exploit novel food sources, and if their behaviour then provides information and access to this food for other individuals. Performance at these feeders will be compared to individual reproduction, survival and dispersal within and between breeding colonies on the different farms and islands. We predict that boldness in first exploring and innovation in successfully exploiting artificial feeders will be linked to greater dispersal distances and greater productivity in the early colonization of new habitats. Whereas more cautious, socially parasitic and competitive individuals might be expected to show great natal philopatry and gain higher fitness in established high density colonies and populations. This project would suit <u>one or more students</u> with research interests in the evolution of animal personalities and alternative social strategies. It also has wider links in population ecology and genetics, and important applications in conservation biology, such as in reintroductions and the population management of invasive species.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biologi; Økologi; Økologi, etologi og evolusjonsbiologi; og Natural Resource Management

Main supervisor:	Tor Jørgen Almaas
Co supervisor	
Preliminary title:	Electrophysiological characterization of receptor neurons on insects: taste receptors (feet, flagellum, mouth-parts), receptors for temperature, humidity and touch (antenna, feet), olfactory receptors (flagellum). (One student – one sensory modality)
Short description of the project:	By electrophysiological techniques the neurophysiological properties of sensory neurons will be described: sensitivity, specificity and temporal response pattern. Electrochemically sharpened tungsten electrodes or glass capillary electrodes are being positioned by micromanipulators in the extracelluar space close to the receptor cell in order to record actionpotentials as respons to the relevant stimulus. Special designed stimulation equipment are applied for the stimulation procedures. Please contact the supervisor for more information about the lab and how to design the individual project.
Suitable for (main profiles):	Physiology, ecology, cell biology

Hovedveileder: Main supervisor:	Torkild Bakken, NTNU Vitenskapsmuseet
Biveileder(e): Co supervisor	Dr Jussi Evertsen, Frøya videregående skole, Geir Johnsen, Department of Biology
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Biological diversity, environmental influence and management in marine environments**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Management authorities are in need of knowledge for a sustainable management of nature. What is the best advice? How does nature change from natural and human induced effects? We present different topics suitable for a master thesis, that will prepare students to work in environmental agencies, consultancies, research, and industry. 1) **Kelp forest**. Biological diversity and growth in *Laminaria hyperborea* in relation to locality and change in biological diversity. Do e.g. successional stages and age provide effect in the forest's biological diversity? 2) **Great scallop as environmental indicator**. Growth and age structure in populations of *Pecten maximus*. We want to study these parameters in populations with respect to localities, mobility, migration reproduction and season. This topic will be done in collaboration with the Institute of Marine Research (Havforskningsinstituttet) and industry at Frøya. 3) **Less utilised resources and management**. Biology and life history in marine benthic organisms that may be subject to commercial use. Knowledge in such species is needed, especially growth rates, reproduction and dispersal before commercial use may start. Species of snails, bivalves and also algae is of interest. These topics may be done in collaboration with other research institutions and local industry at Frøya.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine Coastal Development, Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	Torkild Bakken, NTNU Vitenskapsmuseet
Biveileder(e): Co supervisor	Dr Jussi Evertsen, Frøya videregående skole
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Sea slugs (Nudibranchia) – diversity, biogeography and taxonomy**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Knowledge of biological diversity in marine environments is important in order to understand the nature and how to manage it in a sustainable way. Which species do we have? How are they distributed? Do morphologically similar species with niche preferences represent cryptic species? Nudibranchs is a group of marine snails with relatively few species in northern latitudes. Norwegian waters hold about 90 species. But, the diversity is obviously larger as genetic differences demonstrate distinct species, not necessarily with morphological differences. There are several possibilities for different topics for a master's thesis. We collaborate with Bernard Picton at National Museum, Northern Ireland and Alexandre Martynov, Moscow State University. Possible topics: • Large genetic diversity. Several species being morphologically difficult to separate, or cryptic species? • Diversity in *Flabellina* species? Cryptic species? Are *Flabellina gracilis* just juvenile *Flabellina nobilis*? • Niche separation in *Doto* species? One, two or many species? What do they eat, is hydroids as food source delimitating species?
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine Coastal Development, Evolution and Biosystematics

Hovedveileder: Main supervisor:	Torkild Bakken, NTNU Vitenskapsmuseet
Biveileder(e): Co supervisor	Maria Capa, NTNU Vitenskapsmuseet
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Marine worms (Annelida) diversity in the Norwegian Sea**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Biodiversity is essential to the health of our planet's ecosystems. However, accurate taxonomic information does not currently exist for the vast majority of life on Earth, especially those species inhabiting in the marine realm. Taxonomy is a discipline that underpins a host of scientific knowledge but is currently considered in crisis. Knowledge of the community composition, abundance and distribution of species is fundamental to biodiversity conservation efforts, management and policy-making, and is of crucial importance in a changing world affected by climate change, habitat loss and invasive species. We are seeking for enthusiastic, hard working master students willing to learn the taxonomic skills and analytical methods to undertake contemporary biodiversity studies, from and evolutionary perspective, dealing with one of the most abundant and diverse groups of organisms inhabiting the seafloor, the polychaetes. The details of each individual project can be designed depending on preferences. Examples: a) Species delimitation of a particular species complex, b) Faunistic study of a scarcely known region c) Revision of a polychaete family/genus in Norway, 4) Temporal succession/colonisation in a given environment, 5) Assessment of invasive species in ports. Students will acquire: - Collecting and curatorial management skills - Classical taxonomic training (including morphological studies, use of Scanning Electron Microscope, photography, taxonomic databases, etc) - Traveling, to promote exposure with experts in the field - Training in molecular taxonomic techniques and analyses (i.e DNA barcoding and DNA taxonomy) - Phylogenetic analyses and others. 
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Systematic and evolution, Marine and coastal development.

Hovedveileder: Main supervisor:	Torbjørn Ekrem, Systematikk & evolusjonsgruppa, Vitenskapsmuseet
Biveileder(e): Co supervisor	Elisabeth Stur, Systematikk & evolusjonsgruppa, Vitenskapsmuseet
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Genetisk diversitet hos nærstående fjærmyggarter Genetic diversity in closely related non-biting midges
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	 Non-biting midges (Diptera: Chironomidae) is one of the most species rich insect families on earth and many species are difficult to separate. Thus, identification using standard genetic markers (so-called DNA barcoding) is particularly useful when studying diversity of non-biting midges. Recent studies have shown that midge species diversity is larger than originally thought based on morphological analyses. This cryptic diversity will be investigated through several student projects that are focused on species groups with northern distributions. The main goal will be to investigate if separate populations of selected midge species can be separated genetically and morphologically, and if they should be regarded as separate species. Some fieldwork in Norway or other Nordic countries will be an advantage, but not necessarily required due to our existing comprehensive collection at the NTNU University Museum. Practical work includes collection, sorting, slide mounting and identification of all life stages. The projects involve digital microscopy and molecular analyses in the laboratory facilities at the museum. Data will be analysed using available phylogenetic, bioinformatic and biogeographic tools. Students will be members of the Systematics and Evolution Group at the Department of Natural History.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	Gunnar Austrheim
Biveileder(e): Co supervisor	Kristian Hassel, James Speed
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Could functional plant traits be used to examine how bryophytes respond to changes in grazing and climate in alpine environments?
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Bryophytes are an important plant group with long-term dominance in alpine habitats. The alpine environment is however severe, and drivers such as grazing and climate may restrict variation in bryophyte life history. This project will focus on how bryophytes are affected by key drivers in alpine ecosystem such as grazing and climate. The student will use a functional traits approach to examine whether of bryophytes responses to the environment are dependent on traits such as growth form, longevity, sexuality etc. The student will use a long-term dataset on the bryophytes sampled from an experimental design with different grazing regimes in an alpine environment over 15 years (Hol, Southern Norway). Some field-work on bryophytes in alpine areas are needed, and the project will be an excellent introduction to bryophyte diversity and functional ecology in a changing alpine environment. **The project on bryophytes will be linked to other studies on alpine ecosystems through the project; MANaging ECOsystem services in low alpine cultural landscapes through livestock grazing (MANECO)** **http://www.ntnu.no/web/vitenskapsmuseet/maneco**
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Natural Resources management, Ecology, Conservation Biology

Hovedveileder: Main supervisor:	Anders G. Finstad, NTNU Vitenskapsmuseet https://www.ntnu.no/ansatte/anders.finstad (kontaktperson)
Biveileder(e): Co supervisor	Jan Grimsrud Davidsen, Karstein Hårsaker, m.fl.
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Biologisk mangfold, forvaltning og påvirkninger i ferskvannsmiljøer
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Hvilken kunnskap trenger miljøforvaltningen for en bærekraftig vannmiljøforvaltning? Hvordan påvirkes naturmiljøet av naturgitte og menneskelig påvirkning? Vi tilbyr ulike typer oppgaver som vil gi kompetanse og erfaring relevant for jobb i forvaltning, forskning, industri og undervisning. Fokus kan være både anvendt og grunnleggende forsking, formidling og forvaltning. Avhengig av oppgavefokus vil vi legge vekt på et veilederteam som reflekterer kompetanse innen både grunnforskning, anvendt økologi, formidling og forvaltning. Bruk av museale langtidsserier i kombinasjon med egen datainnsamling og lokale forvaltningsdata er aktuelle tilnærmingsmåter. Eksempler på tema: 1) Drikkevannskvalitet, trofiske interaksjoner og biologisk mangfold. Hvordan påvirker artssammensetning og introduksjon av fremmede arter struktur og funksjon i økosystemer og gjennom det essensielle økosystemtjenester, som for eksempel drikkevannskvalitet. 2) Biologisk mangfold og interaksjon mellom klimaendringer og fremmede arter. Hvordan påvirker klimaendringer effekten av fremmede arter på biologiske samfunn. Bruk av museale langtidstidsserier i kombinasjon med egen feltinnsamling. 3) Forvaltning og formidling av vannmiljøkunnskap. Hvordan forvalte / formidle kunnskap om vannmiljø og interaksjoner med naturlige og menneskeskapte påvirkningsfaktorer. Ta gjerne kontakt for en nærmere prat om akkurat dine muligheter.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Masterprogram Biologi: studieretning Økologi Masterprogram Naturressursforvaltning: studieretning biologi Lektorutdanning i realfag (LUR)

Hovedveileder: Main supervisor:	James Speed
Biveileder(e): Co supervisor	Gunnar Austrheim
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	The impact of ungulate herbivory and climate on shrub and treeline advance and forest succession
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	**Aim:** This project will address one of today's key environmental questions: How do climate and herbivory interact to determine ecosystem change? **Background:** The advance of trees and shrubs into tundra ecosystems is one of today's major ecological changes. The annual ring record in woody plants provides a window to the past, allowing us to infer previous environmental conditions. Using the annual ring record in trees and shrubs we can disentangle the impacts of climate and ungulate herbivores on the establishment and growth of trees and shrubs. Depending on the student's interest, this project can focus on forest ecosystems or alpine ecosystems Alpine tundra ecosystems: How does herbivory buffer the impact of climatic warming on treeline and shrub advance into tundra? Ungulates: sheep, reindeer, Plants: mountain birch, dwarf shrubs, tall shrubs. Forest ecosystems: How do large ungulates interact with climate and forest management to determine successional processes? Ungulates: moose, red deer, Plants: trees, dwarf shrubs. There are existing herbivore experiments that can be used in the boreal forests and mountains of Norway. Alternatively, the project can focus on regions with different historical densities of herbivores. **Methods:** The student will travel to the field sites to sample trees and shrubs, then prepare stem discs to measure ring widths using video-microscopy. Statistical modelling will be used to partition variance in tree/shrub growth and establishment between climate and herbivory. Further reading: Speed et al. 2011 Browsing interacts with climate to determine tree-ring increment. Functional Ecology. 25, 1018-1023 Myers-Smith et al. 2015 Climate sensitivity of shrub growth across the tundra biome. Nature Climate Change 5:887-891 Contact James Speed james.speed@ntnu.no Gunnar Austrheim: gunnar.austrheim@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Natural Resource Management

Hovedveileder: Main supervisor:	Gunnar Austrheim, Jan Davidsen, Anders Finstad, Dag-Inge Øien, James Speed
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Sustaining biodiversity and ecosystem services in Trondheim under changing climate and land use pressures**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project: 	Nature gives us basic ecosystem services and natural goods that are essential for quality of life and welfare. Urbanization and destruction of the natural and agricultural areas in urban and suburban areas is a daily challenge for policy makers. This project will do an ecosystem assessment for vulnerable habitats in Trondheim to examine the environmental/ecological sustainability in Trondheim, and to come up with alternative suggestions for an increase in sustainability. Some habitats are particularly vulnerable such as: (1) Sea shores incl. river mouths, (2) rivers, streams and freshwater. (3). Grasslands. Several questions are relevant: Which biodiversity and ecosystem services do these ecosystems provide? What are the status and trends in terms of biodiversity and ecosystem services? What are the key drivers of change? Which values are linked to ecosystem services? What can be done to restore natural qualities in the most vulnerable habitats? Actual supervisors will depend on the types of habitat and question selected. The project will take place in close cooperation with Trondheim municipality. The theme of the project is closely linked to the strategic research area NTNU Sustainability http://www.ntnu.edu/sustainability and the new Centre for Biodiversity and Ecosystem services (CeBES). http://cebes.no/
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Natural Resources Management, Ecology

Hovedveileder:	Jan Grimsrud Davidsen; jan.davidsen@ntnu.no
Biveileder(e):	Avhenger av type masteroppgave
Arbeidstittel på oppgaven (max 20 ord):	Sjøørretens marine vandringer, habitatbruk og interaksjoner med akvakultur.
Kort beskrivelse av oppgaven (max 300 ord): 	Sjøørret er en anadrom form av ørret (*Salmo trutta*) som gyter i ferskvann og vandrer mellom ferskvann og sjøvann for å oppnå de beste leveforholdene. Generelt har vi lite kjennskap til sjøørretens habitatbruk i havet og dens vandringer mellom sjø og ferskvann. NTNU Vitenskapsmuseet gjennomfører flere ulike forskningsprosjekter på marine vandringer og habitatbruk til sjøørret. Undersøkelsene foregår typisk i fjordsystemer og gjennomføres ved hjelp av elektronisk sporing av individuelt merket sjøørret (akustisk telemetri). Ved å følge enkeltfisk i inntil 2 år kan vi beskrive hvor sjøørreten oppholder seg, miljøet som påvirker den og hvordan dette varierer mellom de ulike årstidene. Videre kan vi studere hvordan ulikt omgivelsesmiljø påvirker sjøørretens atferd og vi får data på overlevelse og dødelighet i sjøen. Som en viktig del av våre prosjekter kartlegger vi mulige interaksjoner mellom vill sjøørret og oppdrettsfisk i fjordsystemene. En masteroppgave innen et av disse prosjektene vil bidra med ny og unik viten om sjøørretens liv under den marine næringsvandringen. Slik kunnskap er sterkt etterspurt og vil bidra til å utpeke de største trusselfarene som sjøørreten står overfor og dermed muliggjøre en mer effektiv forvaltningsstrategi. Innenfor prosjektene er det ulike muligheter for å skreddersy en masteroppgave. Interesserte studenter oppfordres derfor til å ta kontakt for en nærmere prat. Prosjektene skjer i samarbeid andre universiteter i Canada, Danmark og Norge Samt med Norsk Institutt for naturforskning (NINA). Det er dermed gode muligheter for å bygge nettverk under arbeidet med oppgaven For mer info se: www.ntnu.no/vitenskapsmuseet/sjoorretens-liv
Oppgaven passer for (angi studieretning(er)):	Masterprogram **Biologi**: studieretning *Økologi* Masterprogram **Marin kystutvikling**: studieretning *Marinbiologi* Masterprogram **Naturressursforvaltning**: studieretning *biologi*

Hovedveileder: Main supervisor:	Kristian Hassel (kristian.hassel@ntnu.no)
Biveileder(e): Co supervisor	Anders Lyngstad (anders.lyngstad@ntnu.no) James Speed (james.speed@ntnu.no)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Spatial distribution of typical raised bogs in Norway
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	 *Kaldvassmyra, a typical raised bog in Nord-Trøndelag* **Aim:** To identify the factors limiting establishment of typical raised bogs **Background** Raised bogs are mires where the peat forms a dome, and where the upper layer of peat is ombrogeneous, i.e. receiving its nutrient supply from precipitation only. Typical raised bogs dominate mire areas in lowland Østlandet and Trøndelag, but are threatened by draining for agriculture or forestry, peat extraction and various construction works. They are red listed as vulnerable (VU) in Norway. Drained mires release vast amounts of greenhouse gases through decomposition of peat, and because raised bogs contain particularly thick layers of peat, they are good candidates for restoration. Restoration of mires has recently gained interest in Norway, and Miljødirektoratet are currently establishing a restoration programme where raised bogs will be important.

	There is an ongoing survey with the aim of identifying all typical raised bog localities in Norway. The method applied is typification and classification using digitised aerial photographs in stereo model on screen. Typical raised bogs are, among other factors, climatically limited, but few studies have addressed the relationship between climatic factors and occurrence of typical raised bog. In this study, we will use a dataset from Østlandet to relate the distribution of typical raised bogs to climatic factors. **Methods** The student will apply distribution models to identify the primary factors affecting occurrence and distribution of typical raised bogs. The study will make use of data from a comprehensive survey of typical raised bogs where the location and extent of relevant mire massifs in Østlandet are recorded. Specifically, this study will complement the ongoing survey by identifying areas likely to contain typical raised bog, and reveal areas where typical raised bog localities may have been overlooked. The student will conduct field work to assess the results from the modelling approach. **Contact** Anders Lyngstad
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology: Ecology, Behaviour, Evolution and Biosystematics Natural Resources Management: Biology

Hovedveileder: Main supervisor:	Gaute Kjærstad, NTNU Vitenskapsmuseet
Biveileder(e): Co supervisor	Jo Vegar Arnekleiv, NTNU Vitenskapsmuseet
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Korttidseffekter av rotenonbehandling på bunndyr i rennende vann**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	I Bymarka i Trondheim planlegges rotenonbehandling av sju vann med tilliggende bekker. Dersom behandlingsplanene blir godkjent vil behandlinga bli gjennomført i september 2016. Det er gjort få studier på effekter av rotenon på bunndyr i mindre bekker. Aktuelle problemstillinger for en masteroppgave: - Er det forskjeller i bunndyrsamfunnet i bekker mht. tetthet, artsrikhet og artsdiversitet like før, sammenlignet med like etter rotenonbehandling? - Er det forskjeller mellom artene i toleranse overfor rotenon? Bunnfaunaen i tre bekker som rotenonbehandles sammenlignes med tre ubehandlete bekker. Prøvetaking gjennomføres i alle seks bekkene like før og like etter behandlinga. Det vil være aktuelt med et samarbeid med Veterinærinstituttet for å måle eksakte verdier av rotenon under og etter behandling.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology: Ecology, Behaviour, Evolution and Biosystematics Natural Resources Management

Hovedveileder: Main supervisor:	Gunnar Austrheim NTNU, James Speed NTNU,
Biveileder(e): Co supervisor	Erling Johan Solberg NINA, Anders Kolstad
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Effects of moose browsing on different ecosystem processes in boreal ecosystems**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project: 	Several Master-projects are possible: • Browsing, forest succession and nutrient dynamics/ecosystem productivity. • Browsing effects on plant quality (nutrients, secondary compounds) • Browsing, forest succession and carbon dynamic • Browsing, forest succession and plant biodiversity • Browsing, forest succession and ecosystem services • Browsing, forest succession and snow depth **Aim:** To determine short-term effects of moose browsing on boreal ecosystems The student will sample data from the experimental design during the summer. She/he will work within a multidisciplinary group including plant and animal ecologists, and ecosystem ecologists. The Master will be based on the project "Towards sustainable management of moose, red deer and their food resources" established by funding from the Norwegian Research Council: Miljø2015. ***Methods***: The data are collected from permanent vegetation plots every 2nd year: 300 plots in Trøndelag (start 2008), 320 plots in Telemark (start 2009), 320 plots in Akershus (start 2010). **Experimental design:** The permanent plots are placed in 16 experimental sites within each area. Each site consists of an exclosure (20x20 m) and a browsed control in recent clear-cuts. Sites are placed within pine or spruce forests with moose density varying between sites. James D. M. Speed, Gunnar Austrheim; Alison J Hester; Erling J Solberg; Jean-Pierre Tremblay. 2013. Regional-scale alteration of clear-cut forest regeneration caused by moose browsing. Forest Ecology and Management 289: 289-299. **Contact:** Gunnar Austrheim gunnar.austrheim@ntnu.no James Speed james.speed@vm.ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Natural Resources Management, Ecology

Hovedveileder:	Gunnar Austrheim (GA) NTNU, James Speed NTNU,
Biveileder(e):	Erling Johan Solberg NINA, Erling Meisingseth NIBIO
Arbeidstittel på oppgaven (max 20 ord):	**Effects of red deer browsing on different ecosystem processes in boreal ecosystems**
Kort beskrivelse av oppgaven (max 300 ord): 	Several Master-projects are possible: • Browsing, forest succession and nutrient dynamics/ecosystem productivity. • Browsing effects on plant quality (nutrients, secondary compounds) • Browsing, forest succession and carbon dynamic • Browsing, forest succession and plant biodiversity • Browsing, forest succession and ecosystem services • Browsing, forest succession and snow depth **Aim:** To determine short-term effects of red deer browsing on boreal ecosystems. The student will sample data from the experimental design during the summer. She/he will work within a multidisciplinary group including plant and animal and plant ecologists, and ecosystem ecologists. The Master will be based on the project "Towards sustainable management of moose, red deer and their food resources" established by funding from the Norwegian Research Council: Miljø2015. ***Methods***: The data are from permanent vegetation plots analysed every 2nd year: 200 plots in Tingvoll (start 2008) and Gloppen (start 2006). **Experimental design:** The permanent plots are randomly placed inside 10 experimental sites within each area. Each site consists of an exclosure (20*20 m) and a browsed control. Study sites are located in mixed pine and deciduous forests, with red deer density varying between sites. Speed, J.D.M., Meisingset, E., Austrheim, G., Hester, A.J.,Mysterud, A, Tremblay J.-P. & Solberg, E.J. (2013). Low intensities of red deer browsing constrain rowan growth in mature boreal forests of western Norway. *Ecoscience.**20**:3* 311-318 **Contact:** Gunnar Austrheim gunnar.austrheim@ntnu.no James Speed james.speed@vm.ntnu.no
Oppgaven passer for (angi studieretning(er)):	Natural Resources Management, Ecology

Hovedveileder: Main supervisor:	Lars Söderström
Biveileder(e): Co supervisor	Annika Hofgaard, Jørn-Olav Løkken
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Rate of species diversity change in the Norwegian **mountains**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	 The MSc project is part of ECOFUNC*, a newly funded large research project, focusing on ecosystem change rates and fragmentation of the alpine landscape. The successful candidate will be part of an enthusiastic group of graduate students and senior scientists. **Background:** Vegetation model predictions generally overestimate climate driven change rates of species distribution, and there is a serious need for empirical-based rate estimates. **Where:** Grødalen, Møre og Romsdal, Norway **When:** Field season is July-August 2016 **Who:** You have good knowledge of vascular alpine plant species and statistical analyses
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Økologi, Natural Resources Management

Hovedveileder: Main supervisor:	**Hans K. Stenøien** (Systematics & Evolution Group, NTNU University Museum), https://www.ntnu.no/ansatte/hans.stenoien
Biveileder(e): Co supervisor	Kristian Hassel (Systematikk & evolusjonsgruppa, NTNU Vitenskapsmuseet)
Arbeidstittel på oppgaven: Preliminary titel:	**Does moose contribute to plant dispersal?**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Peat and peat mosses are of extraordinary improtance for global carbon balance and hence climate change. Understanding the patterns of biodiversity in the *Sphagnum* genus is a prioritized area of research. Over the past few years we have learned a lot about peat mosses' abilities to disperse over long distances. Few other organisms are capable of migrating such vast distances, and this is due to their capacities of producing vast amounts of microscopic spores that are easily transferred worldwide by wind. We are all literally breathing air filled with *Sphagnum* spores. Some species, however, have not been observed producing spores under natural conditions. One such species is the endemic Central Norwegian *Sphagnum troendelagicum* ("trøndertorvmose"). Despite no capacity of spore dispersal we observe massive gene flow between regional populations. How can this be explained? How do peat mosses disperse when they do not produce spores? One hypothesis is that moose contribute to the spread of peat mosses between localities in Central Norway. We want to test this hypothesis by simulating trampling using real moose feet. Spres torvmose ved hjelp av elg? (YouTube: *https://www.youtube.com/watch?v=oIuW-vNQsQI*)
Suitable for (main profiles):	Biodiversity and Systematics/ Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	**Hans K. Stenøien** (Systematics & Evolution Group, NTNU University Museum), https://www.ntnu.no/ansatte/hans.stenoien
Biveileder(e): Co supervisor	Kristian Hassel (Systematikk & evolusjonsgruppa, NTNU Vitenskapsmuseet)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Why is Norway a «hot-spot» in global peat moss biodiversity, and what are the effects on global climate?**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Peat mosses constitute a major part of northern boreal and alpine biodiversity. This has to do with their extraordinary biology, their evolutionary history, genetics and ecology. We are offering several masters with the common aim of understanding various aspects of peat moss diversity, the evolutionary and ecological processes contributing to this, and the association of peat moss biodiversity and ecosystem services (not least global carbon sequestration. Since almost 1/3 of global carbon is stored in peatlands, these organisms are ideal for asking questions related to basic evolutionary processes, mechanisms behind speciation, and how this is linked to ecosystem services of global importance. Master students in biosystematics at NTNU may take high-quality master courses at other Nordic universities through the so-called NABiS network (http://www.nabismaster.org/). (*Foto: Kjell I. Flatberg*)
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biodiversity and Systematics/ Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	**Hans K. Stenøien**, (Systematics & Evolution Group, NTNU University Museum) https://www.ntnu.no/ansatte/hans.stenoien
Biveileder(e): Co supervisor	Mika Bendiksby (Systematics & Evolution Group, NTNU University Museum); Sverre Lundemo (WWF Norway)
Arbeidstittel på oppgaven (max 20 word):	**The genetics of black-listed *Picea* species**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Sitka spruce (*Picea sitchensis*) grows naturally on the North West coast of North America. It has been planted along the Oslo fjord and is categorized as an invasive species constituting high risk to native Norwegian Nature types (Norwegian List of Alien Species 2012). The species reduces the diversity of local vascular plants, mosses and lichens. Lutz spruce (*Picea × lutzii*) is a hybrid between sitka spruce and *Picea glauca* (the latter also categorized as a risk species on the Norwegian Alein List from 2012), and it is also naturally occurring in North-Western North America. It has been planted in Central Norway both because it is more tolerant to colder climate than sitka spruce, and also because it is categorized as a low risk alien species, as opposed to sitka spruce. However, the lower risk score might be due to lack of knowledge, and we hypothesize that the species is capable of higher dispersal and establishment in natural sites than previously thought. In this project we want to develop genetic markers enablimng us to separate sitka spruce from lutz spruce, to assess the distribution of the species in Norway, and analyse aspects of their demography. This knowledge will be used to better manage habitats that the species can become established. (*Foto: Wikipedia*)
Oppgaven passer for (angi studieretning(er)):	Biodiversity and Systematics/ Ecology, Behaviour, Evolution and Biosystematics

Hovedveileder: Main supervisor:	Dr Stuart Smith (NTNU)
Biveileder(e): Co supervisor	Prof Bente Graae (NTNU), Dr James Speed (VM) and Dr Frode Fossøy (NTNU/NINA)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Getting to the root of elephant and human tree damage in the Savannah ecosystems
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	**Background:** Savannahs cover one fifth of global land area and are dynamic ecosystems where trees and grasses coexist. The abundance of trees within savannahs depends upon many interacting factors such as climate, soil type and disturbance including fires, herbivores and human activities (i.e. logging). Changing tree abundance alters aboveground grassland productivity and nutrient cycling influence both wild herbivore and livestock grazing. However, little attention has been given to how this changing woody landscape influences belowground processes. Roots and soil microbes are important for regulating water, nutrient and carbon in savannah ecosystems. As part of the AfricanBioServices involving an international group of researchers, we are researching how wildlife and human managed savannahs influence belowground ecosystem functioning in and around Serengeti-Mara National Park in Tanzania and Kenya. The aim of this master project will be to **investigate the relationship between soil microbiota (archaea, bacteria and fungi), root decomposition and belowground nutrient cycling under elephant versus human damaged trees (Fig 1).** **Approach:** The master student will need to plan, conduct and analyse the results of an experiment exploring the impact of elephant and humans on micro-biota (archaea, bacteria, and fungi) and root decomposition across a gradient of tree damage in the Serengeti-Mara. The student will benefit from a pre-existing root decomposition study currently underway. As part of the project, the student will be able to utilize state-of-the-art eDNA techniques as well as microscopy and chemical nutrient analyses. For more information please contact: Stuart Smith stuart.smith@ntnu.no **Fig.1** Elephants shape woody cover inside protected areas, whilst humans alter woody cover outside protected areas in Serengeti-Mara ecosystem. Elephant photo by Craig Jackson. **Further reading:** (1) Scholes RJ, Archer S (1997) *Anu Rev Ecol Syst.* **28**: 517 -544 (2)Sankaran M *et al.* (2004) *Eco Let* **7**: 480-490 (3) Bond WJ *et al.* (2008) *Anu Rev Ecol Evol Syst* **39**: 641-659 (4) Morrison T *et al.* (2015). *J Ecol (in press)*
Oppgaven passer for (angi studieretning(er)):	Master in Ecology, Behavior and Evolution or Natural Resource Management

Hovedveileder: Main supervisor:	Dr Stuart Smith (NTNU)
Biveileder(e): Co supervisor	Prof Bente Graae (NTNU), Dr James Speed (NTNU University Museum) and Dr Vegard Martinsen (NMBU)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	(1) Appropriate land-use management for long-term carbon storage in Savannah ecosystems: protect, burn or graze? (2) What is the role of trees for carbon storage in savannah ecosystems?
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	**Background:** Appropriate land-use management of vegetation and soil is important to sequester and retain terrestrial carbon (C) and thereby offset human CO_2 emissions. Savannahs cover one fifth of global land area and are global C sinks, yet we currently have a limited understanding of the controls of C cycling and storage for this ecosystem. Globally savannah ecosystems are changing with an increase in woodiness across many continents, altering the distribution of C. Coexistence of grasses and trees is dependent on many factors, particularly disturbances such as fire, herbivory (wild and livestock) and human activities e.g. logging. Savannahs are increasingly under anthropogenic land-use pressure with unknown consequences for long-term C storage. As part of the AfricanBioServices involving an international group of researchers, we are researching how wildlife and human managed savannahs influence C storage in and around Serengeti-Mara National Park, Tanzania and Kenya. The aim of two master projects will be to **investigate the impact of different combinations of land-use management (fire, wild herbivore and livestock grazing) and the role of woody cover inside and outside the national park on ecosystem carbon stocks.** **Approach:** Two master students will plan, conduct and analyse the results of an experiment focused on the impact of land-use management and woody cover on plant and soil carbon storage in the Serengeti-Mara. These students will benefit from an established grassland productivity experiment. As part of the projects, the students will utilise geographic information system software, learn techniques to survey plant and soils in the field and undertake standard physical and chemical analyses of soil and plant material. For more information please contact: Stuart Smith stuart.smith@ntnu.no **Fig. 1**. Burned savannahs inside the Serengeti National Park and heavily livestock grazed savannahs outside the park, Tanzania. Photos by Bente Graae and Stuart Smith. **Further reading:** (1) Richie ME (2014) PeerJ 2.e233 (2) McSherry ME & Ritchie ME (2013). Glob Chan Biol 19:1347-1357 (3) Grace et al. 2006 J. Biogreogr. 33:387- 400 (4) Midgley GF & Bond WJ (2015) Nature Cli Chan 5:823-829
Oppgaven passer for (angi studieretning(er)):	Master in Ecology, Behavior and Evolution or Natural Resource Management

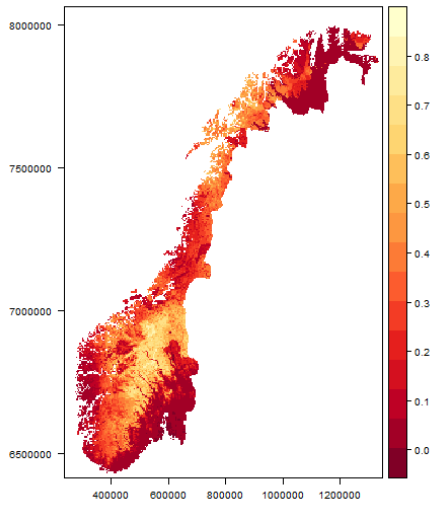
Hovedveileder: Main supervisor:	Gunilla Rosenqvist
Biveileder(e): Co supervisor	Anders Berglund (Uppsala University)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Environmental influence on mating system and sexual selection in sex-role reversed pipefish
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	**Purpose and aims** How environmental change affects sexual selection and ultimately individual and population viability. Pipefish constitute an excellent model for such a study: decades of work have established these species as a premier model for the study of sexual selection, and previous studies show that the intensity of sexual selection as well as environmental parameters can be manipulated in the laboratory. The goal of our research is to understand how ecological factors shape mate choice, mating systems and sexual selection. Our objective is to contribute to a resolution of how environmental change affect mating systems in nature. Sexually selected signals as well as mating systems can be affected by human induced environmental changes. Eutrophication, leads to extreme plant growth and phytoplankton blooms which makes the water turbid. The reduced visibility may cause changes in the mate choice and reproductive behaviour of fishes Our central hypothesis is that such change alters and typically reduces sexual selection, leading to changes in the mating system of natural populations. We want to investigate the mechanisms through which sexual selection affects changes in the mating system: how does, environmental change affect mate choice? This will allow new and deeper insights into how environmental change influences natural populations, into the capacity of such populations to adapt or acclimate to such changes, and will also further our understanding of the complicated relationship between sexual selection and population viability. The work will be conducted at Ar Research Station on Gotland, Sweden.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Behaviour, Evolution, Ecology

Hovedveileder: Main supervisor:	Christophe Pélabon (IBI)
Biveileder(e): Co supervisor	Geir H. Bolstad (NINA) og Kjetil Hindar (NINA)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Genetiske effekter av rømt oppdrettslaks
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	I Norge er det mer enn 400 lakseelver; samtidig har vi en stor akvakulturnæring og mer enn 1 million laks rømmer hvert år. Mange av de rømte oppdrettslaksene gyter sammen med villaksen, noe som fører til at det naturlige genetiske materialet til villaksen gradvis blir byttet ut med oppdrettslaksens genmateriale i mange elver. Å forstå de evolusjonære og økologiske konsekvensene av denne genetiske påvirkningen er et prioritert område i norsk forvaltning. Vi kan tilby flere typer masteroppgaver knyttet til denne problemstillingen. Vi kan også tilby evolusjonære masteroppgaver på laks som ikke går på rømtproblematikk. Alle disse oppgavene vil kreve bruk av relativt avanserte statistiske analyser. I utgangspunktet er ikke feltarbeid påkrevd, men kan være aktuelt dersom kandidaten har ønske om dette. Ved å velge denne masteroppgaven blir du en del av to aktive forskningsmiljø: Centre for Biodiversity Dynamics ved NTNU, og Akvatisk avdeling ved Norsk institutt for naturforskning (NINA). De to institusjonene ligger rett ved siden av hverandre på Gløshaugen og du vil få kontorplass på begge lokaliteter.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics Natural Resource Management Marine Coastal Development

Hovedveileder: Main supervisor:	Ole Kristian Berg
Biveileder(e): Co supervisor	Sigurd Einum
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Growth of a riverine, landlocked salmon "Småblank" from upper River Namsen, Norway
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The landlocked salmon, småblank, in upper river Namsen is held as (one of) the rarest Norwegian vertebrate subspecies. As such it currently receives quite a lot of scientific attention. This means that there may also be a good environment and resources for more than one master student: Based on scale samples of landlocked salmon, we want to make growth analyses (growth per summer) for individual fish. This will again be used to compare and analyze growth differences between different river- stretches and different years. The material is sampled or limited field effort is necessary, but the scale analyses is quite laborious lab.-work. Take contact : O.K. Berg Realfagbygget EU2 -159- Tel 918 97 518
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Master in biology; Ecology or Nat Res. Mgt

Main supervisor:	Prof. Sigurd Einum, CBD, IBI
Co supervisor	Prof. Christophe Pelabon, CBD, IBI
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Is canalization of quantitative genetic variance highest at home?**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Theory suggests that the amount of within-population genetic variance in fitness-related traits should be canalized under the environmental conditions that the population usually experience. In other words, one should genetic variance to increase under novel environmental conditions. Knowledge about this is crucial to predict evolutionary responses to environmental change, but empirical studies are few and results are mixed. Thus, the current project aims to increase the empirical understanding of this issue. The project will consist of laboratory studies of the crustacean *Daphnia* at Realfagsbygget. *Daphnia* have many biological characteristics that make them highly suitable as a model organism while at the same time being representative for a broad range of species of great ecological importance (i.e. planktonic crustaceans play a major role in freshwater and marine food webs). One of the major goals of our lab is to understand short- and long-term effects of temperature change on individuals and populations, including levels of genetic variance of thermal reaction norms. In a recent study we quantified the genetic variation in a range of life history traits at various temperatures, and were able to identify an intermediate temperature where genetic variance was smallest. This was done on a population from the Værøy Island (Lofoten), and the temperature of least genetic variance appears to be consistent with the summer temperatures likely to be experienced by that population. The natural next step with regar ds to this would be to do a similar study for 1-2 southern populations that are adapted to a more continental/Mediterranean climate, to test whether the temperature minimizing genetic variance would be higher for these. https://www.ntnu.edu/biology/research/ecology/einum-lab https://www.facebook.com/pages/Climate-Daphnia/265765213575339
Suitable for (main profiles):	Biology (Ecology/Evolution)

Hovedveileder: Main supervisor:	Fredrik Jutfelt, Associate professor
Biveileder(e): Co supervisor	Rachael Morgan, PhD student
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Thermal biology in zebrafish – individual thermal dispositions
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	 As climate change is making aquatic habitats warmer, fish can respond by migration, acclimatization or adaptation, but most often combinations of these strategies. This project will focus on individual variation in thermal performance, the idea that some individuals in a population have higher fitness than others at higher temperatures. This concept can be thought of as different individuals having differing thermal dispositions. The main questions that will be addressed are: • Are different measures of thermal tolerance, performance and personality correlated? • Are individuals in a population distributed along a "warm performer – cold performer" axis? • Is thermal behavioural preference linked to thermal physiology? • Are there sex-specific differences in thermal tolerance, performance and behaviour? • Could we predict which individuals are most likely to succeed in a warmer climate? • Are these individual differences in thermal performance heritable, and may form the basis for evolution of more thermally tolerant populations? To answer these questions, the students will use various physiological and behavioural measurements on zebrafish. The techniques will likely include in-vivo animal experiments, thermal exposures, growth rate and metabolic rate measurements, automated behavioural analysis and more. The experiments will be performed at NTNU gløshaugen. Please contact Fredrik Jutfelt or Rachael Morgan for more information.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology, with focus on physiology or behaviour. One to two students.

Hovedveileder: Main supervisor:	James D. M. Speed
Biveileder(e): Co supervisor	Anders G. Finstad
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Species distribution modelling: The role of data quality
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Background Species distribution modelling (SDM) has proved to be a popular tool for investigating species' ecology, for planning conservation measures for rare species and assessing invasiveness of exotic species. However, SDM has been criticized both for lacking a biotic component to the niche concept, and for being dependent on aggregated species occurrence data that usually lacks real absence data (i.e. presence only data) and is of variable and often poorly controlled quality. Approach In this project the student will use species occurrence data indexed in the Global Biodiversity Information Facility (GBIF) to (1) investigate how our understanding of species ecology varies depending on the quality of the data used (source, quality control procedure, inclusion of absence data) or (2) investigate including biotic interactions in SDM. The project is not limited by geographical region or taxonomic group, and can be moulded to the student's region/taxa of interest. The student will gain valuable experience in GIS, spatial analysis and processing of large data sets.  *Figure 1 Example SDM for Primula scandinavica in Norway* Further reading: Araújo MB & Luoto M. 2007. Glob. Ecol. Biogeogr. 16: 743-753. García-Roselló E et al. 2014. Methods in Ecology and Evolution 5: 708-713. Mesibov R. 2013. ZooKeys 293: 1. Contact James.Speed@ntnu.no Anders.Finstad@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology Natural Resource Management LUR in Biology

Hovedveileder: Main supervisor:	Vidar Grøtan (CBD, NTNU)
Biveileder(e): Co supervisor	Erlend B. Nilsen (terrestrisk avdeling, NINA) og Geir H. Bolstad (akvatisk avdeling, NINA)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Statistical modelling of environmental effects in Norwegian game and fish species
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	A better understanding of how the population dynamics is affected by environmental variation is important for sustainable management for important Norwegian game and fish species. Various data (such as count data/population estimates, recruitment data, weigh data and harvest data) for such species are often easily available, but the different data have often been analyzed separately instead of jointly. In recent years there has been rapid development in methods which allow for combining different data sources into a joint statistical model allowing for a more effective use of data and a better understanding of the different factors affecting the population dynamics. In addition to being important tools for understanding complex ecological processes, such models are likely to become increasingly important for management of several species. In particular, there is an urgent need for predicting how climate change will change the distribution, abundance and population dynamics of various species. Because of the increased interest and demand for such joint models NINA has recently funded a strategic program entitled INTEGRATE (https://osf.io/cd2xy) which aims meet the increasing demand for biostatistics. In cooperation with Centre for Biodiversity Dynamics (an interdisciplinary Centre of Excellence working at the interface between ecology and statistics) we offer several master projects. Master projects may be of variable scope and difficulty, but will most often aim to help answering an applied question. Projects will primarily be given on salmon/sea trout or Willow grouse, but other species may also be considered.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology

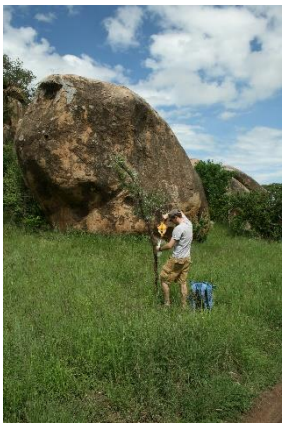
Hovedveileder: Main supervisor:	Vidar Grøtan (CBD, NTNU)
Biveileder(e): Co supervisor	Ola Håvard Diserud (NINA, NTNU)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Effects of variation in detectability and sampling effort on diversity indices
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Estimates of many important parameters and diversity indices in community ecology are based on counts of the number of individuals of the different species in the community. Most indices implicitly assume that all species have equal detectability (probability of being seen or included in the sample if the species is present) and that the sampling effort (e.g. time/effort spent on for individuals) is equal among individuals. The proposed project will as a first step use simulations to study how differences in detectability / sampling effort may bias estimates of community indices. Using newly developed methods, the second step will be to use an improved estimation procedure which accounts for differences in detectability / sampling effort when estimating diversity indices. Potential data for the study are from bird, beetle and zooplankton communities.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology

Main supervisor:	Prof. Sigurd Einum, CBD, IBI
Co supervisor	Prof. Veerle Jaspers, IBI
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Ecotoxicology expanded: individual and population responses to combined effects of temperature and toxic compounds using *Daphnia* as a model organism**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Effects of temperature change cannot be expected to be independent of other sources of anthropogenic disturbance. In particular, there is an increasing realization that effects of toxic compounds may depend on temperature regimes. In the current project we will study how temperature interacts with the highly relevant toxic compound mercury (Hg). Hg, and in particular methylmercury (MeHg), is of high international concern. We propose to use highly controlled lab experiments with *Daphnia* (water fleas) to study such interactions, an approach that provides us with many advantages. First, for *Daphnia* it is feasible to provide lab environments that resemble those in the wild across all life stages, and to perform studies spanning many generations (i.e. short generation time). Second, they reproduce clonally, enabling quantification of true environmental responses for single genotypes. Third, methods for quantifying individual variation in key phenotypic traits and demographic rates of *Daphnia* are well established. Finally, due to the extensive use of *Daphnia* in ecotoxicology, background information on toxicity testing is extensive. As such, using *Daphnia* provides advantages that are unparalleled in other macro-organisms, while at the same time being representative for a broad range of species of great ecological importance. In our lab at Realfagbygget we have a set of clones from a wild population that we know from ongoing studies are genetically variable in their response to temperature, and these will also be used in this project. Another novel aspect of this project is that working with *Daphnia* provides the opportunity to study effects of combined stressors (pollution and climate change) on population dynamics (effects on *r* and *K*) through multigenerational time series experiments. The work can be conducted throughout the year, and may start during June 2015 if this is desired. https://www.ntnu.edu/biology/research/ecology/einum-lab http://www.ntnu.edu/biology/research/environmental-toxicology/jaspers-lab https://www.facebook.com/pages/Climate-Daphnia/265765213575339
Suitable for (main profiles):	Biology & Envitox

Hovedveileder: Main supervisor:	Assoc. Prof. Veerle Jaspers
Biveileder(e): Co supervisor	Nathalie Briels (PhD student) Mari Løseth (PhD student)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Exposure assessment of Portuguese and Norwegian birds of prey to metal pollution.**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	This master project will investigate the levels of metals in feathers of Bonelli's eagles from the South of Portugal and in feathers and blood of white-tailed eagles from Norway. The feathers of the Bonelli's eagles are already available for analysis, but fieldwork in Norway within the NewRaptor project may be possible for the white-tailed eagle (on Smøla and Steigen). The aim is to look at differences in exposure among species and within species. Exposure to pollution is not only dependent on the habitat, but is also related to specific dietary habits and the trophic position, which can be investigated by stable isotope analysis. 1 student can work on this project. http://www.ntnu.edu/biology/research/environmental-toxicology/jaspers-lab https://www.ntnu.edu/biology/research/environmental-toxicology/jaspers-lab/the-new-raptor-project
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, Ecology

Hovedveileder: Main supervisor:	Assoc. Prof. Veerle Jaspers
Biveileder(e): Co supervisor	Nathalie Briels (PhD student) Mari Løseth (PhD student)
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Legacy and emerging organic pollutants in terrestrial birds of prey**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	It has previously been shown that the accumulation of legacy persistent organic pollutants is very different in aquatic and terrestrial environments. We hypothesize that several emerging flame retardants will bioaccumulate in birds of prey and we aim to study their accumulation from the diet in both the marine and the terrestrial ecosystems. Also more information on the bioaccumulation of perfluorinated chemicals (PFCs) in the terrestrial environment is needed, as for some PFCs differences have been noted in terrestrial compared to aquatic species and time trends have shown that PFC levels increase for some compounds in the terrestrial Norwegian habitat. Exposure to pollution is not only dependent on the habitat, but is also related to specific dietary habits and the trophic position. Therefore, the exposure to emerging pollutants will be assessed in the light of the specific ecology, including diet, trophic position and habitat (using stable isotopes analyses). 1 student can work on this project. http://www.ntnu.edu/biology/research/environmental-toxicology/jaspers-lab https://www.ntnu.edu/biology/research/environmental-toxicology/jaspers-lab/the-new-raptor-project
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, Ecology

Hovedveileder: Main supervisor:	Bente Graae
Biveileder(e): Co supervisor	Kenny Helsen
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Understanding invasive plant species impact: a case study of Impatiens glandulifera across Norway and Sweden
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The plant Impatiens glandulifera is included in the Norwegian black list of problematic invasive species. This large herb strongly competes with native plants and has been shown to increase erosion levels in riparian zones in certain areas. Although it has been suggested that invasive species effects might strongly depend on the species richness and composition of the plant communities they are interacting with, at present, we do not know if this is the case for I. glandulifera. For this reason, we want to explore how I. glandulifera interacts with the native plant communities, and how this is affecting erosion susceptibility. This master project will be part of a larger study that will evaluate these interactions across five European countries on a latitudinal gradient. However, the master student will focus on two sites within this larger gradient. More specifically, the student will compare I. glandulifera effects in populations around Trondheim with those of a second site of his/her choice across the gradient (Amiens, Gent, Bremen, Lund or Stockholm). At both sites, the student will assist the sampling of 25 vegetation plots (relevees) across an I. glandulifera abundance gradient. At each site, we will collect data on vegetation composition, measure a proxy for soil erosion susceptibility, and look at several plant traits for the present species, among these, leaf area, plant height and stem specific density. This setup will allow us to understand how and when the presence of I. glandulifera strongly shapes plant community composition and furthermore evaluate how this is affecting soil erosion. The insights gained from this study will be, in turn, useful for invasive species management, by allowing more targeted prioritization for eradication or control programs.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	LUR student with specialisation in Ecology

Hovedveileder: Main supervisor:	James D. M. Speed
Biveileder(e): Co supervisor	Bente J. Graae
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Carbon stocks in woody vegetation subjected to fire in Mole National Park, Ghana**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Background: Savanna ecosystems consist of a mixture of trees and grasslands. The occurrence of trees in savannas is limited by rainfall when the mean annual precipitation is less than 650mm. When MAP is greater than 650mm the occurrence of trees depends on herbivory and fire frequency. Fire is therefore one of the major drivers of woody plant occurrence in wet (MAP>650mm) savanna ecosystems. Fire is used as a management tool in many African savannas to enhance ecosystem productivity. Burning affects the vegetation composition in savanna ecosystems. Woody plants store the main pool of aboveground C stocks in savanna ecosystems. Fire will therefore affect the quantity of carbon stored in savanna vegetation. This master project will quantify C storage in aboveground vegetation in relation to burning frequency in a West African national park (Mole NP, Ghana).  *Figure 2 Assessing tree size and density in an African savanna ecosystem* Approach: Within Mole National Park, sites with varying intervals since the last fire will be selected based on satellite imagery (MODIS), National Park records and communication with National Park staff. Several fire-interval classes will be selected (e.g. <1 year, 2-5 years, 5-10 years, >10 years). Replicate sites will be selected for each interval class. Within each site, the density, height, stem diameter and species composition of woody plants will be determined during fieldwork in June/July 2016. This data will be converted to biomass and carbon density using biomass expansion factors for the given species. Regression analysis will be used to relate vegetation C stocks to fire interval. Contact James.Speed@ntnu.no Bente.j.Graae@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	30ECTS project in Biology for LUR students

Hovedveileder: Main supervisor:	Nicole Aberle-Malzahn
Biveileder(e): Co supervisor	Fredrik Jutfelt
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	***PROTOZOOPLANKTON AS FOOD SOURCE FOR LARVAL FISH***
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Protozooplankton functions as a trophic link between microbial and traditional food webs as it serves as an ideal food source for larger zooplankton and larval fish thus providing energy for higher trophic levels. Although the relevance of protozooplankton as food source for ichthyoplankton and its crucial role for larval fish recruitment has been stressed by the ‚Stable Ocean Hypothesis' (Lasker, 1981) more than 3 decades ago and, more recently, by Montagnes and co-workers (Montagnes et al., 2010), the transfer of energy from PZP to fish has been scarcely investigated so far. The first days of external feeding of larvae are considered as the critical days following Hjorts' (1914) critical period hypothesis, highlightening the importance of PZP as food for larval fish. The present project focusses on the role of protozooplankton as diets for larval fish (e.g. herring, cod) and the selective feeding potential of first-feeding larvae preying upon natural plankton communities will be assed experimentally. The aim is to relate changes in protozooplankton biomass, community composition and diversity to the survival and fitness of larval fish.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Masters students with a main emphasis on Biological Oceanography/Marine Ecology/Fish Ecology. Special interests in plankton ecology, food web interactions in the plankton, food quality, experimental marine ecology

Hovedveileder: Main supervisor:	Nicole Aberle-Malzahn
Biveileder(e): Co supervisor	Yngvar Olsen
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	***THE PHYTOPLANKTON-PROTOZOOPLANKTON LINK IN A WARMING OCEAN: THE ROLE OF MICROGRAZERS AS BLOOM MODELLERS AND CONTROLLERS.***
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Phytoplankton blooms are major, recurrent phenomena in temperate and cold planktonic systems which fuel secondary production (Sommer and Lewandowska, 2011). Warming is known to result in phenology shifts e.g. advancement of the phytoplankton spring bloom (Sommer et al., 2012; Winder et al., 2012). Bloom formation occurs only if the growth rate of primary producers exceeds the grazing losses of zooplankton (Rose and Caron, 2007) thus opening a 'loophole' for the phytoplankton to form a bloom (Irigoien et al., 2005). This is related to the different temperature dependencies of photoautotrophic and heterotrophic processes. While light-limited photosynthesis is only weakly responsive to warming, the physiology and metabolism of heterotrophs is considered as highly temperature-dependent *sensu* the 'Metabolic Theory of Ecology' (MTE) (Brown et al., 2004). The present project will focus on the feeding behaviour of protozooplankton (mainly ciliates and heterotrophic dinoflagellates) and its ability to control and modulate phytoplankton blooms in the Trondheimfjord with regard to ambient and elevated temperature conditions. The aim is to investigate changes in phytoplankton community composition and relate this to the occurrence and selective feeding of protozoa as well as to present temperature and future warming conditions.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Masters students with a main emphasis on Biological Oceanography/Marine Ecology. Special interests in plankton ecology, food web interactions in the plankton, climate change impacts, identification of phyto- amd protozooplankton, experimental marine biology

Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Arild Husby, Thor Harald Ringsby, Bernt-Erik Sæther, and/or Jonathan Wright may be co-supervisor(s)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Spatio-temporal dynamics of genes for ecologically important traits in house sparrows**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Knowing the genetic architecture of ecologically important traits is fundamental to our understanding of many ecological and evolutionary processes in natural populations. I can offer a number of exciting MSc-projects which focus on identifying the genetic architecture of such traits, and the causes and consequences of the traits' genetic architectures. The MSc-projects will use state-of-the-art genomic and eco-evolutionary data from a unique long-term study of a house sparrow (*Passer domesticus*) model system. Ecologically important traits are traits related to fitness (survival and reproduction) and they will therefore be important for both ecological and evolutionary dynamics in natural populations. Examples of such types of traits are morphological traits behavioural traits, physiological traits, parasite load, and life-history traits. A trait's genetic architecture consists of information on which genes affect the trait, locations of these genes in the genome, and how the genes affect the phenotype. Eco-evolutionary data have been collected on an individual based level from natural and experimental insular house sparrow populations in northern Norway since 1993. More than 27,000 individuals are included in our data base. The genomic data consists of a reference house sparrow genome, SNP-genotype data on 6500 SNPs for ca. 2300 individuals and 185,000 SNPs for ca. 4000 individuals, and information on polymorphisms within ca. 140 candidate genes for various ecologically important traits. The eco-evolutionary and genomic data will be used in statistical analyses to determine genetic architecture by mapping genes for various ecologically important traits using QTL-mapping (linkage mapping/GWAS) and/or study effects of candidate genes directly. Further statistical analyses will then be carried out to examine causes and consequences for spatio-temporal eco-evolutionary dynamics in the model system. Students choosing one of these MSc-projects will have the opportunity to get experience from fieldwork, molecular genetic laboratory work and cutting edge statistical analyses of eco-evolutionary and genomic data.
Oppgaven passer for (angi studieretning(er)):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management, Biotechnology

Suitable for (main profiles):	
Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Postdoc Alina Niskanen
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**The genetic basis for inbreeding depression in house sparrows**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Anthropogenic changes of the environment, such as habitat destruction, are the major causes of high rates of population declines and extinctions. As population sizes decline they become vulnerable to inbreeding, which is expected to decrease individual fitness (called inbreeding depression) and population growth rates. As a consequence, inbreeding depression is one of the most important genetic processes affecting the persistence of small and threatened populations. Despite its importance, the genetic mechanisms underlying inbreeding depression are not well known. For example, it is unclear whether inbreeding depression is mainly caused by small genome-wide effects or single genes with large effects. We can offer MSc-projects that will focus on I) investigating the genome-wide architecture of inbreeding depression, identify specific loci important for inbreeding depression, and identify the functional genetic variation within these loci, and II) examining the interaction between environmental conditions and inbreeding depression. To achieve these goals, the projects will use state-of-the-art genomic tools, long-term individual-based data on fitness and environmental records from a unique study system of pedigreed wild house sparrow (*Passer domesticus*) populations. Data on approximately 4,000 adult house sparrows from 11 Norwegian experimental and non-experimental island populations will be used. The birds have been genotyped for 185,000 genome-wide single nucleotide polymorphisms. Students choosing one of these MSc-projects will have the opportunity to get experience from fieldwork, molecular genetic laboratory work and cutting edge statistical analyses of eco-evolutionary and genomic data.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management, Biotechnology

Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Thor Harald Ringsby, Bernt-Erik Sæther, and/or PhD-stipendiat Dilan Saatoglu may be co-supervisor(s)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**The genetics of dispersal in house sparrows**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Dispersal (migration) of individuals between populations may affect both ecological and evolutionary dynamics and is consequently a very important process in natural populations. For example, immigration will increase population size, reduce inbreeding and introduce genetic variation. Furthermore, dispersal reduces genetic differentiation between populations. Accurate knowledge about the number of immigrants and where they dispersed from is crucial to understand both causes and consequences of dispersal. I can offer exciting MSc-projects where the goal is to combine ecological data with genetic analyses to identify the number and origin of immigrants to natural island-populations of house sparrows (*Passer domesticus*) at the Helgeland coast in northern Norway. This information will then be used to identify population and landscape characteristics that explain variation in dispersal in space and time, and to examine the consequences of dispersal for both ecological, population genetic and evolutionary processes. Eco-evolutionary data on e.g. dispersal has been collected on an individual based level from 18 natural house sparrow populations in an island metapopulation at Helgeland since 1993. In total more than 17,500 individuals are included in this data base. The genetic data consists of genotypes on 14 microsatellites for >12000 individuals, SNP-genotype data on 6500 variable SNPs distributed across the genome for ca. 1100 individuals, and SNP-genotype data on 185,000 SNPs for ca. 3300 individuals. Students choosing one of these MSc-projects will have the opportunity to get experience from fieldwork, molecular genetic laboratory work and cutting edge statistical analyses of eco-evolutionary and genomic data.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management, Biotechnology

Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Thor Harald Ringsby and postdoc Thomas Kvalnes
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Heritability and fitness effects of egg colour in house sparrows**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Egg colour and egg colour pattern has been shown to affect fitness in a number of bird species. This may be because colour and pattern influence the level of camouflage against predation or because colour and pattern may affect the probability of egg parasitism, either intra-specificially (e.g. by cockoo) or intra-specificially («egg dumping»). The goal of the MSc-project is to estimate the heritability (additive genetic variance) of egg colour and egg pattern, as well as genetic correlations between these traits and other fitness-related traits in house sparrows (*Passer domesticus*). Such estimates are very rare because few data sets exist where such analyses are possible. The project will then examine the effect of egg colour and pattern on individual fitness (measured by survival and reproductive output). Data on egg colour and egg pattern has been collected in up to five insular house sparrow populations at Helgeland between 2003 and 2009. Digital photographs that can be used to determine egg colour and egg pattern have been taken of more than 400 clutches. Clutches were assigned to individual females by genetic parentage analyses. Large and genetically determined pedigrees (containing almost 10,000 individuals) will be used with the data on egg colour and pattern to estimate quantitative genetic parameters using “animal models”. Students choosing this MSc-project will have the opportunity to get experience from fieldwork, molecular genetic laboratory work, quantitative genetic analyses, and statistical analyses of eco-evolutionary data.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management, Biotechnology

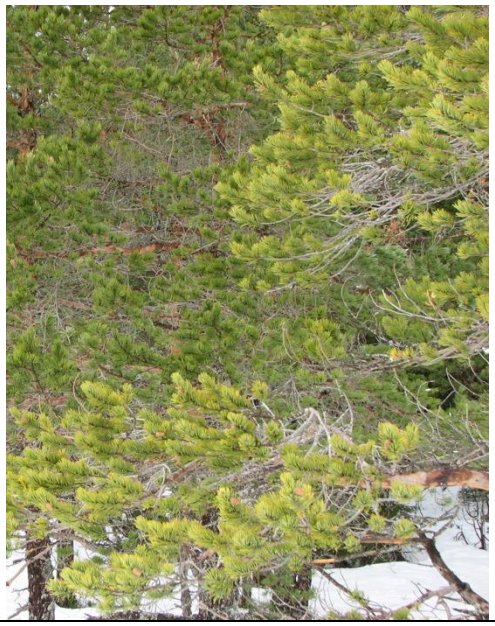
Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Bernt-Erik Sæther, Thor Harald Ringsby, Henrik Pärn, and/or PhD-student Sindre Sommerli may be co-supervisor(s)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Population genetics of water voles**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	To understand populations' ability to evolve in response to environmental change and persist in the face of habitat fragmentation and spatio-temporal fluctuations in demography due to e.g. anthropogenic effects, it is important to understand the causes and consequences of temporal changes in genetic variation within and between populations. In 2015 we started a large-scale field study on water voles (*Arvicola amphibius*) on islands at the coast of Helgeland. Our aim is that this will be a model system we can use to examine questions related to population dynamics and population genetics processes in such a fragmented system, which has large spatio-temporal fluctuations in population size. I can offer exciting MSc-projects with focus on important population genetics processes in water voles; inbreeding, genetic drift, genetic bottlenecks, founder events, and genetic population structure. Methods for genotyping individual voles on 13 microsatellites are already established. In addition, we will in collaboration with a research group at the University of Aberdeen develop high-throughput genomic resources for water voles that we aim to use in the proposed MSc-projects. Students choosing these MSc-projects will gain skills in carrying out high-quality fieldwork on the beautiful Helgeland coast, experience with molecular genetic laboratory work, and good knowledge about statistical analyses of population genetic data.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management, Biotechnology

Hovedveileder: Main supervisor:	Henrik Jensen, Associate Professor, Centre for Biodiversity Dynamics, Department of Biology (https://www.ntnu.edu/biology/jensen-lab)
Biveileder(e): Co supervisor	Researchers Ingerid Hagen, Øystein Flagstad (NINA) and Nina E. Eide (NINA)
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Landscape genomics and conservation of the arctic foxes living in a fragmented population under increasing competition pressure from red foxes**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The critically endangered *arctic fox* has failed to recover in Fennoscandia despite 80 years of protection. The main threats are 1) extremely small and fragmented population, 2) change in rodent cyclicity, and 3) increased competition from the red fox. Linked to ECOFUNC, a research project at NINA, we will explore several genetic issues related to interactions and dynamics between the two competing species; red fox an indicator of boreal invasion species and arctic fox an indicator of alpine species in retreat. Understanding patterns and processes of migration and gene flow (establishment and reproduction) requires detailed knowledge of how landscape characteristics structure populations. Using a landscape genomics approach, we aim to disentangle factors responsible for successful invasion of red fox into alpine habitats, and effects of fragmented landscapes on arctic fox migration, establishment and reproduction. Several questions and hypotheses will be tested: **1)** When is migration promoted? **2)** How does patch size and distance to the nearest fragment of suitable habitat affect migration rates? **3)** Do population sizes in donor and recipient populations affect migration rates? **4)** What is the importance of stepping stones of suitable habitat between core populations? **5)** Are there geographic- and/or environment-related patterns in genetic variation across the genome which is likely to be adaptive? **6)** Do migrants contribute with genetic variation evenly distributed across the genome, or only at particular (adaptive) genomic regions? **7)** How has the release of foxes from the captive breeding program affected migration patterns and genetic structure across the fox genome? **8)** How does the presence and density of competing species such as the red fox affect the gene flow to potential recipient populations? We can offer several MSc projects under this work package. Most samples are already collected, and SNP-arrays with 200,000 SNPs to be used in the projects are currently being developed for the two fox species. The students will learn laboratory skills and how to statistically analyse genomic data.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, Evolution and Biosystematics, Natural Resources Management

Hovedveileder: Main supervisor:	Prof. Bente Graae or Richard Strimbeck
Biveileder(e): Co supervisor	Dr. Benjamin Blonder
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Projects on alpine plant ecology in the Colorado Rocky Mountains (North America)
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	In this Master project you will join University of Oxford researcher Dr. Benjamin Blonder and the field assistant Rozalia Kapas in the Rocky Mountains in Colorado during July or August to record plant performance in plots with nutrient manipulations. There will be study sites both in alpine tundra and in subalpine meadows, with opportunities for several projects that all aim at increasing our understanding of plant fitness and plant communities in relation to rapid climate change. The alpine tundra encompasses fifty permanent plots in which all individuals from seedlings to adults are annually mapped and censused. In the subalpine meadows there are opportunities for more ecophysiological investigations – for instance measuring relationships between plant traits, photosynthetic capacities and thermal microclimate. Modeling projects with the above mentioned data are also possible within this project. Benjamin's project deals with determining when plant communities are in equilibrium in nature. The concept of equilibrium (optimal matching between a property of a species and the environment) underlies many contemporary research areas including niche distribution modeling and forecasting. Field data can be used via species distribution modeling and biophysical modeling to understand how species interactions, microclimate variation, life stage sensitivity, and temporal lags can prevent optimal matching of traits to environment. The Master student(s), Ben and Rozi will be based at the Rocky Mountain Biological Laboratory (Gothic, Colorado) at 3000 m elevation within the Gunnison National Forest, with convenient access to a nearby town (10 km) and to countless miles of alpine wilderness. The student will either work at the alpine site (access via a 1-2 hour uphill hike) or in a subalpine meadow (10-20 minute hike) and some time spent in a lab preparing plant samples. This study will need fieldwork in summer 2016 and/or 2017. The Norwegian research council will cover travel and accommodation. Contact Bente Graae or Richard Strimbeck if interested. bente.graae@bio.ntnu.no or richard.strimbeck@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Ecology, Behaviour, ~~evolution~~ Evolution and Biosystematics for Master students doing a 60 or a 30 ECTS point project.

Hovedveileder: Main supervisor:	Associate professor Richard Strimbeck
Biveileder(e): Co supervisor	Post doctoral fellow Kenny Helsen
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Get Fallopia: ecology and ecophysiology of an aggressive invader
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Knotweeds (Fallopia spp., Polygonaceae) are a group of aggressive invasive species and hybrids that continue to spread across Europe and North America. They are bamboo-like giant herbs that grow in dense, monospecific stands to as much as four meters height. They spread locally by deep underground rhizomes and more broadly by stem and rhizome fragments, often with the help of humans. Once established, they spread aggressively and displace local species, with little or no value to native wildlife. They are a particular problem along rivers and streams. Escapes and naturalized colonies of three Fallopia taxa can be found throughout western Norway as far north as Tromsø. The hybrid knotweed Fallopia x bohemica has spread widely in the Trondheim area and has the potential to invade along streams and forest edges. An understanding of the ecology and ecophysiology of these species may help in developing novel control methods. There is potential for two closely coordinated Master's projects that could include any of the following: • Mapping Fallopia populations around Trondheim and/or elsewhere in Norway • Temperature, light, soil moisture and chemistry in and adjacent to colonies • Leaf traits, stem growth and rhizome spread rates, annual biomass production rhizome and root depth in local soils • Photosynthesis and respiration in developing, mature, and sun and shade leaves, soil and root respiration • Similar measurements of co-occurring species to examine competitive potential and community level effects • Frost and salt tolerance of rhizome and stem fragments • Stem, root, and leaf biochemistry via GC-MS, phenol and antioxidant assays • Allelopathy assays The student(s) will gain experience with the measurement methods applied in the project and knowledge of invasive plant biology.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	MBI in Ecology, Evolution, and Behavior Physiology; Natural Resource Management

Hovedveileder: Main supervisor:	Gunnar Austrheim, Jan Davidsen, Anders Finstad, Dag-Inge Øien, James Speed
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Hvor bærekraftig er vår bruk av natur i Trondheim?**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project: 	Naturen gir oss grunnleggende naturgoder som er en forutsetning for livskvalitet og velferd. Urbanisering og ødeleggelse av natur- og landbruksområder i bynære områder er en daglig utfordring for beslutningstakere. Dette prosjektet vil lage et «miljøregnskap» (ecosystem assessment) for spesielt utsatte naturtyper i Trondheim og se på hvor bærekraftig vår bruk av naturen i Trondheim er, og hva som kan gjøres for å øke bærekraften. I bynære strøk er flere blå og grønne naturtyper spesielt utsatt: (1) Strandsone inkl. elveoser, (2) Elver, bekker & ferskvann. (3). Grasmarker. Aktuelle spørsmål er flere: Hvilke miljøverdier representerer disse som «intakte» økosystem: hva får vi av biomangfold og økosystemtjenester? Hva er status: hvor store arealer, hvor mye er i god tilstand? Hva er de viktigste drivkreftene som skaper endringer? Hvilken betydning har disse økosystemene og endringene i disse for menneskelig velferd? Hvilke verdier er knyttet til økosystemtjenestene? Hva kan gjøres for gjenskape naturkvaliteter i spesielt utsatte naturtyper? Aktuelle hoved- og biveiledere vil være avhengig av hvilke naturtyper som velges. Arbeidet vil foregå i nært samarbeid med Trondheim kommune som vil bidra med data. I tillegg må studenten samle inn egne data. Temaet for prosjektet er sentralt for NTNU sitt nye satsningsområde: Bærekraftig samfunnsutvikling http://www.ntnu.edu/sustainability og for Centre for Biodiversity and Ecosystem services (CeBES). http://cebes.no/
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Natural Resources Management, Ecology

Hovedveileder: Main supervisor:	Associate professor Richard Strimbeck
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Winter chlorosis and gas exchange in Scots pine and Norway spruce
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Evergreen conifers exposed to bright light in the winter and spring months often develop chlorosis, a distinctive yellowing of the needles. Preliminary data shows that this may be a result of some combination of long-term low temperature, light, and freezing stress. Although needles may recover during the spring and summer months, winter chlorosis may result in reduced productivity, and a better understanding of its causes and consequences may inform forest management. This project will include: • Field measurement of respiration and photosynthesis in healthy and chlorotic conifer shoots in autumn, winter, and spring • Experiments to determine the effects of low-temperature, light, and freezing stress on chlorosis development • Quantification of chlorosis by image analysis • Measurement of pigment concentrations by HPLC • Detection of key photosynthetic proteins by Western blotting The student will gain experience in using a state-of-the-art gas exchange system for measurement of photosynthesis and respiration, image analysis, HPLC, Western blotting, experimental design, and statistical analysis. 
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology, plant ecophysiology, plant ecology

Hovedveileder: Main supervisor:	Associate professor Richard Strimbeck
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Tree ring studies of alpine willows and dwarf birch
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	In the ECOSHRUB project, we are studying the causes and consequences of shrub encroachment in arctic-alpine ecosystems. Invasion of heath and meadow systems by willow and dwarf can potentially alter carbon storage and energy balance in these systems, with feedbacks on global climate. At present we have little information about the age and growth dynamics of the shrub species in our study sites on Dovrefjell. Tree-ring analysis can help fill in this gap. Using well-established methods for larger trees, the student will collect cross-sections of mature shrubs in the vicinity of our study plots, determine age distribution, and develop climate response functions. These methods are already being applied successfully to much smaller creeping shrub species in arctic regions. The student will gain experience in methods of tree ring analysis that are widely applied in the study of climate history and global climate change.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology, plant ecophysiology, plant ecology

Hovedveileder: Main supervisor:	Bernt-Erik Sæther
Biveileder(e): Co supervisor	Thor-Harald Ringsby, Henrik Jensen, Henrik Pärn
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Demografiske og genetiske effekter av spredning**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Spredning av individer og deres gener påvirker mange viktige økologiske og evolusjonære prosesser, f.eks populasjons- og samfunnsdynamikk, genflyt, genetisk struktur i populasjoner og lokale tilpassninger. I takt med at kritiske habitattyper går tapt og fragmenteres, så øker også antalet populasjoner med en metapopulasjonsstruktur, dvs lokale populasjoner som er knyttet sammen av individer som sprer seg. Å forstå effekterne av spredning kan derfor ha stor betyding for forvalting av trua populasjoner. Å studere evolusjon av spredning og dess evolusjonære konsekvenser i naturlige populasjoner krever store studieområder og gode data på individers overlevelse. Denne typen data kan samles in fra våndpopulasjonerne på øyerne i Helgelands flotte skjærgård. Målet med denne oppgaven er å bruke data fra vånd før å forstå demografiske og genetiske effekter av spredning i lokale populasjoner.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Økologi, atferd, evolusjon og biosystematikk

Navn på hovedveileder:	Thor Harald Ringsby
Navn på biveiledere etc.	Thomas Kvalnes, Henrik Jensen, Henrik Pärn, Jonathan Wright, Bernt Erik Sæther
Kort "arbeidstittel" på oppgaven (Opptil 20 ord)	**Temperature and humidity as measures of nest quality: How does nest quality influence parental fitness, and how does nest quality influence the fitness of offspring? (Two projects)**
Kort beskrivelse av oppgaven (opptil 60 ord)	Many factors influence the variation that we observe in fitness in wild species. One factor that rarely has been investigated is the quality of the nest site. Among house sparrows these vary considerably; some nests are warm and dry, others are cold and wet. We have collected data on temperature and humidity for a large number of nests (using small data loggers).
Grundig beskrivelse (opptil 300 ord)	Project 1) Is there a relationship between nest quality and morphology of the parents? For instance, does the most aggressive males acquire the best nest sites? In this project you will investigate whether parental quality (measured as morphology, age) is related to the quality of the nests that parents acquire, and whether nest quality is related to the fitness outcome (reproductive success) of the parents Project 2) In this project you will investigate whether the fitness of offspring (measured as morphology e.g. body size at 11 days age) is related to the quality of the nests they where raised in, accounting for parental qualities etc. You will be a part of the House sparrow project's stimulating working environment which consists of 4 professors/associated profs. as well as several researchers, Phd students and MSc students. The House sparrow project is hosted at the Center for Biodiversity Dynamics. Here you will and learn basic methods and routines for how data are collected during the fieldwork period in house sparrow populations at remote islands along the coast of Helgeland in northern Norway. You will also acquire experience on running advanced statistical analyses in order to test hypotheses using R .
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi

Navn på hovedveileder:	Thor Harald Ringsby
Navn på biveiledere etc.	Thomas Kvalnes, Henrik Jensen, Jonathan Wright, Henrik Parn, Håkon Holand, Bernt Erik Sæther
Kort "arbeidstittel" på oppgaven (Opptil 20 ord)	**Parent–offspring conflict and selection on egg size in House sparrows**
Kort beskrivelse av oppgaven (opptil 60 ord)	A mother has to decide whether she lays many small or few large eggs. This trade off may cause a conflict between mother and offspring, because the optimal egg size for offspring fitness may not necessarily be equivalent to the optimal eggsize for mothers
Grundig beskrivelse (opptil 300 ord)	We have recorded egg sizes in ca 500 house sparrow nests through several years. For the same nest we know the number of fledglings and their morphology as well as the parents identity, age, morphology etc. This dataset provides a unique possibility to study whether the optimal eggvoulme for offspring (measured as the eggvolume with the highest probability for survival) resemble the mother's optimum (measured as the eggvolume with the highest production of recruits). In this project you will obtain a unique insight into how natural selection (potentially) may act in favor of parental fitness, on the cost of offspring survival. You will be a part of the House sparrow project's stimulating working environment which consists of 4 professors/associated profs. as well as several researchers, Phd students and MSc students. The House sparrow project is hosted at the Center for Biodiversity Dynamics. Here you will and learn basic methods and routines for how data are collected during the fieldwork period in house sparrow populations at remote islands along the coast of Helgeland in northern Norway. You will also acquire experience on running advanced statistical analyses in order to test hypotheses using R .
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi

Navn på hovedveileder:	Thor Harald Ringsby and Håkon Holand
Navn på biveiledere etc.	Henrik Jensen, Henrik Pärn, Bernt-Erik Sæther
Kort "arbeidstittel" på oppgaven (Opptil 20 ord)	**The effect of Coccidae (parasite) on fitness in house sparrows**
Kort beskrivelse av oppgaven (opptil 60 ord)	During many years we have collected data one several parasites (, e.g. the nematode Syngamus trachea, and Coccidiae) in several populations of house sparrows at the coast of Helgeland in northern Norway. We know that parasites may have significant influence on the hosts's fitness, and it is important to investigate the dynamics of host-parasits and how they interact in nature. This is also a very relevant within the field of conservation biology.
Grundig beskrivelse (opptil 300 ord)	A common micro parasite in house sparrows (and many other bird species) is species belonging to the genus Isospora in the Coccidia subclass. Still, there exists very few studies on how this parasite affects the fitness of it hosts. In this project you will investigate the spatial and the temporal distribution of the Isospora sp , measured as prevalences in several house sparrow populations, over several years. Also, you will investigate how individual fitness (survival, and/or fecundity) of house sparrows are affected by being infected by the parasite You will be a part of the House sparrow project's stimulating working environment which consists of 4 professors/associated profs. as well as several researchers, Phd students and MSc students. The House sparrow project is hosted at the Center for Biodiversity Dynamics. Here you will and learn basic methods and routines for how data are collected during the fieldwork period in house sparrow populations at remote islands along the coast of Helgeland in northern Norway. You will include a period on the lab analyzing feces samples in order to count parasites. You will also acquire experience on running advanced statistical analyses in order to test hypotheses using R .
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi

Navn på hovedveileder:	Thor Harald Ringsby and Thomas Kvalnes
Navn på biveiledere etc.	Henrik Jensen, Bernt-Erik Sæther
Kort "arbeidstittel" på oppgaven (Opptil 20 ord)	**The significance of population density on fecundity and survival in House sparrows**
Kort beskrivelse av oppgaven (opptil 60 ord)	Local population density may strongly affect the competition over local resources (e.g. food) in populations and limit the resources available to successfully raise offspring. This project aims to estimate the effect of density dependence on female fecundity and how this varies among populations and years in a metapopulation of house sparrows at Helgeland in Nordland.
Grundig beskrivelse (opptil 300 ord)	In this project you will explore the effect of population density on the fitness performance of females (fecundity) and analyse whether this vary spatially and temporally. You will also analyse to what extent the local phenology measured as the onset of spring and local length of growth season (based on ndvi data generated from satellite images that measurers how green the habitat is) influence the fecundity of females. At Helgeland several house sparrow population live closely attached to farms. Now and then farms are being closed down which results in less food and nest sites available for the sparrows. Thus, this corresponds to a reduction in local carrying capacity. Accordingly, by applying this semi-experimental approach (i.e. the effect of farm closure) you will test how the effect of reducing K affects the fecundity. You will be a part of the House sparrow project's working environment which consists of 4 professors/associated profs. as well as several researchers, Phd students and MSc students. The House sparrow project is hosted at the Center for Biodiversity Dynamics. Here you will and learn basic methods and routines for how data are collected during the fieldwork period in house sparrow populations at remote islands along the coast of Helgeland in northern Norway. You will also acquire experience on running advanced statistical analyses in order to test hypotheses using R .
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi

Navn på hovedveileder:	Thor Harald Ringsby and Thomas Kvalnes
Navn på biveiledere etc.	Henrik Jensen, Håkon Holand, Bernt-Erik Sæther
Kort ”arbeidstittel” på oppgaven (Opptil 20 ord)	**How does cold and warm breeding seasons influence fitness in House sparrows;**
Kort beskrivelse av oppgaven (opptil 60 ord)	This project aims to estimate the effect of variation in local phenology (NDVI) on the seasonal reproductive success of females. The project will also investigate whether the reproductive success of females depend on certain morphological characteristics (e.g. bill length) and whether this is related to warm or cold breeding seasons
Grundig beskrivelse (opptil 300 ord)	This project will analyse whthere the annual variation in fitness of females, measured as number of offspring produced during a breeding season can be explained by the length of the local growth season and the temperature during the season. The length of the local growth season will be measured as NDVI which is an index that is generated based on remote sensing (satellite photos) that estimates the onset of spring, as well as the length of the growth season. In the literature we find examples that certain morphological characteristics are advantageous in cold seasons and others in warm, such as the bill size in Galapagos finches. In the present project we will analyse whether a corresponding mechanism is present among the island populations of house sparrows in northern Norway You will be a part of the House sparrow project’s working environment which consists of 4 professors/associated profs. as well as several researchers, Phd students and MSc students. The House sparrow project is hosted at the Center for Biodiversity Dynamics. Here you will and learn basic methods and routines for how data are collected during the fieldwork period in house sparrow populations at remote islands along the coast of Helgeland in northern Norway. You will also acquire experience on running advanced statistical analyses in order to test hypotheses using R .
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi

Navn på hovedveileder:	Svein Håkon Lorentsen (NINA)
Navn på biveiledere etc.	Thor Harald Ringsby (ansvarlig veileder, IBI)
Kort ”arbeidstittel” på oppgaven (Opptil 20 ord)	**Biology and management of seabirds**
Kort beskrivelse av oppgaven (opptil 60 ord)	
Grundig beskrivelse (opptil 300 ord)	Master projects are available related to a long term study of breeding biology of seabirds (e.g. European shag) at Sklinna in Nord-Trøndelag county, as well as a study on urban gulls The project will include fieldwork Contact us for further information.
Oppgaven passer for (angi studieretning(er)):	Økologi, Evolusjonsbiologi, Natural Resources Management

Navn på hovedveileder:	Erling Johan Solberg (NINA), Christer Rolandsen (NINA)
Navn på biveiledere etc.	T. H. Ringsby (Ansvarlig veileder IBI)
Kort ”arbeidstittel” på oppgaven (Opptil 20 ord)	**A project related to Management of moose**
Kort beskrivelse av oppgaven (opptil 60 ord)	Currently there is no concrete project formulated. However, if you are interested in a project related to management of moose, for instance regarding traffic accidents please take contact for further information.
Grundig beskrivelse (opptil 300 ord)	Contact us for information on specific projects/research questions
Oppgaven passer for (angi studieretning(er)):	Natural Resources Management, Økologi

Hovedveileder: Main supervisor:	Bente Graae
Biveileder(e): Co supervisor	Kenny Helsen
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Population genetic structure of the invasive *Impatiens glandulifera* through time: patterns across a European gradient.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The plant *Impatiens glandulifera* is included in the Norwegian black list of problematic invasive species, since this large herb strongly competes with native plants. However, this species is mainly annual; suggesting that long term population persistence is largely dependent on consecutive successful seed establishment each year. For this reasons it has been suggested that population size and persistence will most likely be strongly dynamic, with many populations disappearing or migrating through time. In this project, we are interested in how these potential population dynamics affect the genetic diversity of these populations. In this project, the student will compare the population genetic diversity and structure of 10 invasive populations of *I. glandulifera* that were collected 5 years ago, with the genetic diversity and structure of these same populations in 2016. These populations are located across a European latitudinal gradient ranging from France (Amiens) to Norway (Trondheim), and new leaf material will have to be collected in the summer of 2016, allowing the master student to join for (part of) this fieldwork along the gradient. Genetic analyses will be performed in the lab at NTNU using previously developed microsatellite (SSR) markers. Depending on the interests of the student, additional data can be collected that can be linked to the genetic make-up of the populations (e.g. functional traits, environmental data, population connectivity, reproductive output,…).
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Master of Science in Ecology, Behaviour, Evolution and Biosystematics (60 ECTS or 30 ECTS)

Hovedveileder: Main supervisor:	Jens Rohloff
Biveileder(e): Co supervisor	Richard Strimbeck
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	**Ecological Urban Production of Vegetables**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The master project(s) is/are integrated as part of a regional research project aiming at the utilisation of compost derived from manure and food waste for the ecological production of vegetables. Major active partners involve Skjetlein vgs (*Naturbrukslinje*) and the company Global Green Energy (GGE). Sub-goals include (a) Development and optimisation of compost products (mixtures) to be used as growth substrate (b) Increase knowledge about innovative soil substrate(s) by the use of a compost bioreactor (c) Improve recruitment to education and research within urban farming and ecological food production Possible master projects: 1. Investigation of effects of compost products in vegetable production (e.g. tomato, salad, herbs) on crop growth, yield and quality. Focus areas: plant physiology, phytochemistry, food chemistry 2. Investigation of effects of manure/food waste ratio and bioreactor conditions on composting process and composition with regard to soil substrate quality and commercial value. Focus areas: microbiology, biochemistry, agriculture
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology, Biotechnology, LUR

Hovedveileder: Main supervisor:	Thorsten Hamann
Biveileder(e): Co supervisor	Timo Engelsdorf
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Functional analysis of candidate genes mediating plant cell wall integrity maintenance
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The plant cell wall is the first line of defense of all plants against stress. It is a highly dynamic structure, which also provides different materials relevant for society. Plant cell wall signaling processes are essential during defense and are also intricately involved in maintaining functional integrity of the cell wall during growth and response to biotic stress. Recently the host lab has performed extensive transcriptomics and phospho-proteomics experiments to identify genes maintaining plant cell wall integrity during development and defense in *Arabidopsis thaliana*. The aim of the project is to functionally characterize several of these candidate genes in order to dissect the molecular mechanism underlying plant cell wall integrity maintenance. The project will initially involve sterile tissue culture work to generate biological material, qRT-PCR-based confirmation of transcriptomics results, LC-MS-based measurements of phytohormones in gene knockout plants, cloning of reporter-protein fusion and promoter reporter constructs, which will be followed by generation of transgenic plants to perform cellbiological and expression studies using advanced microscopy (confocal microscopy in combination with image analysis). Generating the data on gene function is the prerequisite to achieve the long-term of this project, which is to use the genes identified in Arabidopsis as leads to improve performance of food crops and facilitate bioenergy production from ligno-cellulosic biomass.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biologi, bioteknologi

Hovedveileder: Main supervisor:	Thorsten Hamann
Biveileder(e): Co supervisor	Timo Engelsdorf
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Development of novel analytical tools to analyze plant cell wall signaling
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Plant cell wall signaling processes are essential during interaction between the plant and the environment as well as during development. They are also intricately involved in maintaining functional integrity of the cell wall during growth and response to biotic stress. Currently there are no suitable tools available to study early, fast cell biological processes during cell wall integrity maintenance. The host lab has performed recently extensive transcriptomics experiments and identified genes, which are responding to cell wall integrity impairment. The aim of the project is to use the candidate genes as starting place to develop novel markers. The project will initially involve tissue culture work to generate biological material, qRT-PCR-based confirmation of transcriptomics results and cloning of reporter-protein fusion constructs, which will be followed by generation of transgenic plants to perform cellbiological studies of the reporter fusion constructs using advanced microscopy (confocal microscopy in combination with image analysis).
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biologi, bioteknologi

Hovedveileder: Main supervisor:	Rolf Erik Olsen
Biveileder(e): Co supervisor	Bjørg Egelandsdal, Erik Slinde, NMBU
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Krebs cycle in fish performance and quality
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The Krebs cycle is running in cell mitochondria and is the main provider of NADH for the synthesis of ATP which is the energy all living organisms need for growth and survival. Limitations in intermediates in the cycle will limit available energy for the animal. In a growing animal increasing the Krebs cycle output can increase energy availability and therefore growth performance over time. In pigs being slaughtered, boosting the Krebs cycle has been shown to increase product quality. The cause is unknown, but it is probably linked to a faster depletion of tissue oxygen and thereby lower lipid peroxidation. It is currently unknown if these mechanisms are valid in fish. But salmon in particular is a fatty species with high potential for rancidity. **The project will include feeding studies, quality assessment and cell tissue cultures.**
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Nutrient chemistry, chemistry, aquaculture, cell biology

Hovedveileder: Main supervisor:	Professor Berit Johansen
Biveileder(e): Co supervisor	Dr. Astrid Feuerherm, Dr Thuy Nguyen, Dr. Linn-Karina Selvik
Arbeidstittel på oppgaven (max 20 word): Preliminary tittel:	Lipid signaling mechanisms in inflammation.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Obesity is a major risk factor for lifestyle diseases. Lifestyle is affecting severity of chronic diseases, including cardiovascular diseases and rheumatism. Common symptom between obesity, lifestyle and chronic disease is inflammation (1,2). Investigations regarding molecular mechanisms of inflammation will give insights on how different aspects of lifestyle, hormonal responses, e.g. insulin, will affect disease progression and severity (3,4). Hormones under study include cytokines, insulin, chemokines, eicosanoids and adipokines. Model systems: Synoviocytes, cellular model for rheumatoid arthritis; Monocytes, cellular model for white blood cells. **Possible master theses:** 1) Characterization of insulin signaling in synoviocytes 2) Characterization of adipokin signaling in synoviocytes 3) Characterization of microRNA as a regulatory mechanism of synoviocyte biology 4) Characterisation of TLR2/4-induced responses, and possible involvement of cPLA2 in an osteoclast cell model 5) Metabolomics detection human samples (collaboration with Dr Jens Rohloff) 6) Systems biology of human intervention samples (collaboration with Prof. Martin Kuiper.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	MBIOT5, MBI-celle/molekylærbiologi, MSc Biotechnology (2yr)

1. WHO, *Global status report on noncommunicable diseases 2010. Description of the global burden of NCDs, their risk factors and determinants.*, WHO, Editor. 2011. p. 1-176.

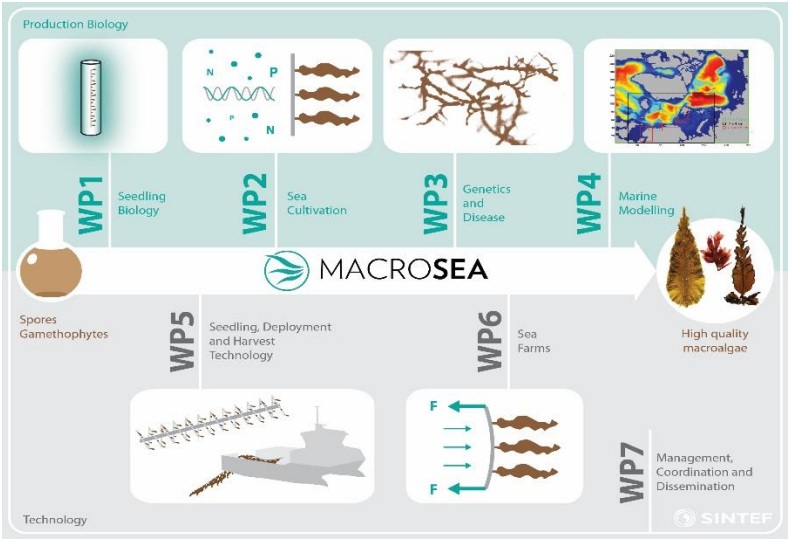
2. Kelly, T., et al., *Global burden of obesity in 2005 and projections to 2030.* International Journal of Obesity, 2008. **32**(9): p. 1431-1437.

3. Ouchi, N., et al., *Adipokines in inflammation and metabolic disease.* Nat Rev Immunol. **11**(2): p. 85-97.

4. Gregor, M.F. and G.S. Hotamisligil, *Inflammatory mechanisms in obesity.* Annu Rev Immunol, 2011. **29**: p. 415-45.

Hovedveileder: Main supervisor:	Martin Kuiper - kuiper@ntnu.no – 73550348 – DU1-111 IBI
Biveileder(e): Co supervisor	Astrid Lagreid, IKM-DMF; several other co-supervisors (IBI, IBT) are possible, depending on the design of the master proposal.
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Implementation of Boolean models for cell perturbation analysis and drug development
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The use of network and model based approaches to describe, explain and understand biological processes is an essential approach in Systems Biology. Tools that enable this approach range from Cytoscape (network based) to CellDesigner (pathway-based) to full-fledged mathematical modeling platforms. One of the more basic modeling paradigms is based on Boolean logics, where interactions between model components (proteins, genes) only need to be described in terms of activation and inhibition, and the regulatory rules are described using AND, OR, and NOT logics. We are developing user-friendly, semi-automated software tools (see Flobak et al 2015), in the new initiative DrugLogics (www.DrugLogics-NTNU.org), part of the NTNU Digital Life theme. DrugLogics aims to develop Boolean model based approaches to help develop Personalized Medicine approaches to treat cancer. This initiative offers possibilities for a variety of Master projects: - The assembly of a 'causal statement' knowledge base that integrates information from resources like Reactome and SIGNOR that can be used to build Boolean models - The use of our curation tool SciCura to convert information from literature in the form of causal statements to the knowledge base - The building of Boolean models to simulate the effect of experimental perturbations on the behavior of specific cells (plant, animal, microorganism) - The simulation of these Boolean models to predict the effects of mutations or other perturbations and the subsequent experimental validation - and many more …
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology / Biotechnology
Reference:	Flobak Å et al. Discovery of drug synergies in gastric cancer cells predicted by logical modelling. PloS Comp. Biol. 2015 DOI: 10.1371/journal.pcbi.1004426. www.druglogics-ntnu.org www.colosys.org https://www.ntnu.edu/crossover-research https://www.ntnu.edu/health/druglogics www.reactome.org, http://signor.uniroma2.it/

Hovedveileder: Main supervisor:	Augustine Arukwe
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	**Identification of key cellular targets of toxicants as potential *xenosensor* biomolecules in fish**
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Our group is part of a big NFR funded biotechnology "Digital life" project entitled "dCod 1.0: decoding systems toxicology of Atlantic cod (*Gadus morhua*) – environmental genomics for ecosystem quality monitoring and risk assessment" in collaboration with several national (UiB, UiO, NMBU) and international partners The project will pursue a research line in environmental omics that identifies key cellular targets of toxicants as potential *xenosensor* biomolecules. An illustrating example is the use of transcription factors such as the peroxisome proliferator-activated receptors (PPARs), aryl hydrocarbon receptor (AhR) and estrogen receptor (ER) in multiple assays for toxicants and endocrine disruptors in fish systems. We are looking for 4-5 master students to work together with a PhD fellow in delivering our part of the project. We will develop and structure out a candidate-specific *in vivo* or *in vitro* research plan that fits with the overall aims of dCod. Otherwise, the overall objective of our research is to develop diagnostic gene, enzyme and protein response tools in the study of the molecular and physiological mechanisms of the effects of xenoestrogens and xenobiotic, and their interactions in wildlife species. In our laboratory, these studies are performed in both *in vitro* and *in vivo* systems.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Environmental Toxicology and Chemistry; cell and molecular biology

Main supervisors:	Kjell Inge Reitan, Geir Johnsen, Atle Bones, Yngvar Olsen (one)
Co supervisors:	Jorunn Skjermo, Silje Forbord, Aleksander Handå (one or two)
Preliminary title:	**MACROSEA - A knowledge platform for industrial macroalgae cultivation in Norway (2016-2019)**
Short description of the project: MACROSEA	You will take part in the enthusiastic MACROSEA project team at SINTEF and NTNU and contribute to successful and predictable production of high quality biomass making significant steps towards industrial macroalgae cultivation in Norway.  The primary objective is to establish an interdisciplinary knowledge platform on fundamental production biology and technology for macroalgae cultivation over a wide range of climatic, ecological and physical conditions. Secondary objectives are: **(i)** to increase the principal knowledge on biological performance and environmental requirements for optimized chemical composition and biomass production, and **(ii)** to obtain technological specifications and develop generic model and simulation tools for farm systems and biomass production. The brown kelps *Saccharina latissima* and *Alaria esculenta* (large volumes, low value), and the red alga *Palmaria palmata* (small volumes, high value) will be studied as promising species for industrial cultivation in Norway. **<u>Topics for 5-7 master thesis in MACROSEA:</u>** • Develop cultivation and quality parameters • Develop quality indicators (genetic markers) • Characterize importance of light • Characterize N metabolism and photosynthetic capabilities • Characterize NH4 uptake (IMTA) • Measure quality parameters for seedlings with different latitudinal origin (Western, Mid and Northern Norway) • Perform a regional study of growth and quality together in Western, Mid and Northern Norway Contact: Project leader Aleksander Handå. <u>Aleksander.handa@sintef.no</u> - mob. 91577232
Suitable for:	Marine Biology, Aquaculture, Photobiology,Cell biology,Genetics

Main supervisor:	Professor Kjell Inge Reitan (NTNU) Kjell.i.reitan@ntnu.no
Co supervisors	Seniorforsker Aleksander Handå (SINTEF) Forsker Kari Attramadal (SINTEF)
Preliminary title (max 20 word):	Cultivation of Polychaeta for waste treatment, improved resource utilisation and production of raw material for feed in aquaculture: **Thesis I: Growth and reproduction of polychaetes under intensive culture conditions** **Thesis II: Metabolism and nutritional value of polychaetes under intensive culture conditions**
Short description of the project (max 300 word):	**Motivation:** The Norwegian salmon production is estimated to increase from 1.2 to 3 million tons, with a use of 3.6 million tons feed per year in 2030. To realize this growth, there are at least two major challenges that must be solved; *environmental impact and feed supply*. There is accordingly a need to develop strategies to a) decrease waste effluents and bio-deposit impacts from aquaculture and b) replace feed ingredients with proteins and lipids from new resources outside the human food chain. Polychaetes of the *Nereis* family seem promising for both. **Polychaeta** are filter- and detritus feeding marine worms that have several industrial applications. Polychaete biomass is rich in marine fatty acids and a valuable raw material for feed. In addition, the polychaetes grow fast at optimal conditions. The ability to convert organic waste to high quality biomass is useful in a range of issues related to aquaculture. E.g. polychaete cultivation combines waste treatment with improved resource utilisation and production of raw materials that are in high demand. **Master thesis** This will be the first studies of intensive polychaete production as a method to treat fish farm wastes in Norway. The main focus will be on production biology of polychaetes under intensive culture conditions to increase our understanding of: • Growth and reproduction (Thesis I) • Metabolism and biochemical composition (Thesis I and II) • Nutrient budgets (C,N,P) (Thesis II) • The potential of polychaetes to recycle wastes from aquaculture (Thesis I and II) ***Research team:*** *You will be part of a new enthusiastic research team on polychaetes. The team consists of researchers and engineers at NTNU Biology and SINTEF Fisheries and Aquaculture. You will contribute to the establishment of a knowledge platform for decision support to stakeholders considering using polychaete cultures to recycle waste effluents from various types of aquaculture systems.*
Suitable for (main profiles):	Biology/aquaculture

Hovedveileder: Main supervisor:	Professor Kjell Inge Reitan, NTNU Kjell.i.reitan@ntnu.no
Biveileder(e): Co supervisor	Research Scientist Matilde S. Chauton, SINTEF Research Scientist Kari J. K. Attramadal, SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Nitrogen-rich waste water from fish farming as a resource in cultivation of microalgae
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The outlet water from the fish farming tanks contains a lot of nitrogen, in some cases at levels that are relevant as growth fertilizer for successful cultivation of microalgae. This nitrogen concentration of the outlet water may give a microalgae biomass of 10^6 -10^7 cells/ml (depending on the algae species). Most of the nitrogen originate from the excretion of the fish and microbial degradation of fish feed. The nitrogen in the water is available as ammonia, nitrite and nitrate. Ammonia (NH_3) is toxic to fish, and must therefore be removed from the fish tank systems, and is a waste product in the fish farming units. The microalgae need nitrogen, mainly in the form of nitrate, nitrite or ammonium (NH_4^+). The reuse of the N-rich water from the fish tanks is interesting as a resource in the microalgae production, but we need to have more knowledge about the amount of N that are in water system and what forms it exists in. In this task, we will pick up the water with a fish breeder, and analyze and analyze the main nutrient nitrogen compounds as well as phosphorous, and use the water in cultivation trials with 2-3 different algae. The algaewill be selected among candidates with interesting chemical profile and uses for biomass production. Timescale: Spring 2016-Autumn 2017
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Biology, Biotechnology, Marine Coastal Development

Hovedveileder: Main supervisor:	Prof. Kjell Inge Reitan
Biveileder(e): Co supervisor	Forskere Andreas Hagemann og Matilde S. Chauton, SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Rhodomonas sp. og N-omsetning: Optimalisering av dyrkingsmedium i produksjonssammenheng
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Mikroalgen Rhodomonas sp. er interessant som fôr i produksjon av hoppekreps, bl.a fordi den har en god fettsyreprofil og balansert proteininnhold. Rhodomonas og andre svelgflagellater har dessuten spesielle pigmenter, fykobiliner, som er rike på N. Den kjemiske profilen varierer imidlertid med dyrkingsbetingelser og varighet på produksjonsperioden, og dette er en utfordring for å etablere stabil produksjon av algebiomasse med forutsigbar kjemisk profil. Et annet viktig element i storskalaproduksjon av mikroalger er kostnadene ved tilførsel av makronæringsstoffer (N, P el silikat) eller mikronæringsstoffer (spormetaller, vitaminer) og det er veldig relevant å vite mer om hvordan man kan utnytte disse komponentene bedre i dyrkingen. I denne oppgaven vil det derfor være fokus på å dyrke Rhodomonas under ulike vekstbetingelser med fokus på N-omsetningen og biomasseutbytte. Det vil også bli lagt vekt på å se hvor effektivt komponentene i næringsmediet utnyttes, for å foreta en optimalisering av næringsmedium for produksjon av Rhodomonas sp. Denne oppgaven vil knyttes til arbeidet som foregår hos C-feed, et nyetablert firma som produserer og selger copepode-egg.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	

Hovedveileder: Main supervisor:	Prof. Kjell Inge Reitan
Biveileder(e): Co supervisor	Forskere Matilde S. Chauton og Kari J. K. Attramadal, SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Bruk av nitrogenrikt vann fra fiskeoppdrett til produksjon av mikroalger
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Vann fra fiskeoppdrettskar inneholder mye nitrogen, i noen tilfeller så mye at det er på nivå med det som tilsettes i standard algedyrkingsmedium og nok til å produsere 10^6-10^7 celler/ml (avhengig av hvilken alge). Mye av nitrogenet stammer fra ekskresjon og urea-produksjon hos fisken og foreligger som ammoniakk, nitritt og nitrat i vannet. Ammoniakk (NH3) er giftig for fisken og man må derfor fjerne det. Mikroalger trenger N, hovedsakelig i form av nitritt eller ammonium (NH4+). Gjenbruk av N-rikt vann fra fiskeanlegg er interessant i mikroalgeproduksjon, men vi må ha mer kunnskap om hvor mye N som er i omløp i vannet og hvilke former det foreligger i. I denne oppgaven vil vi hente vann hos en fiskeoppdretter og analysere og analysere hovednæringsstoffene N og P, og så bruke det i dyrkingsforsøk med 2-3 forskjellige alger. Algene velges ut fra sin kjemiske profil og anvendelsesområder for biomassen.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	

Hovedveileder: Main supervisor:	Ann- Kristin Tveten
Biveileder(e): Co supervisor	Helene Fjørtoft, Anne Stene
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Sea lice (L. salmonis) microbiota and their role in dispersal of pathogens
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The coastal region of north west Norway have high densities of farmed fish, in addition to several different stocks of wild salmonid species. Increased production have the potential risk of increasing the number and dispersal of pathogenic like virus, parasites and bacteria. Interactions of pathogens between farmed and wild salmonids have been identified. Sea lice is a major problem in both wild and farmed salmonids in areas of high aquaculture activity. Sea lice can potentially delay the national goals of increased growth in the fish farming industry. The microbiota may vary geographically and may play a role in dispersal of the multiple pathogens. Known diseases caused by pathogens are; viruses: ILA, IPN, PD, VHS, HSMB, CMS, bacteria; vibriose, BKD, Furunkulose, and Yersiniose- and parasites; Paramoeba perurans (AGD) and Parvicapsul. In this project we would like to: • Map the microflora of sea lice to determine the sea lice role as a vector for the pathogen. • Establish methods for detection of a selection of the pathogens and determine their prevalence in sea lice. • If possible, study geographical variations We would like to focus on the interactions between farmed and wild salmon fish. We would like to focus on the intersection between the environment, the salmonid fish and pathogen in defined areas. The fish will be grouped in farmed salmon, rainbow trout, escaped farmed salmon (time in the sea after the escapes are determined by external confirmation), wild salmon. Collection of wild salmonid fish are in cooperation with the Institute of marine research and NINA and the local fishermen with wedge-net license. The project is a part of the PhD for Helene Fjørtoft, and financed through RFF and Miljøskapings fondet
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine biology - biotechnology - molecular biology - microbiology

Hovedveileder: Main supervisor:	Prof. Kjell Inge Reitan
Biveileder(e): Co supervisor	Forskere Matilde S. Chauton, SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Upscaling microalgae biomass production and post-harvesting processing to extract high-value compounds
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	We are looking for new resources to meet the demands for protein and essential lipids in the near future. Microalgae are a promising resource for applications such as feed production or extraction of high-value compounds such as lipids. Upscaled biomass production is a focus area, and we must solve challenges both upstream in the production end and downstream on the harvest and processing end. This work will focus on the production of microalgae biomass in a pilot system, a 250 L photobioreactor, and harvesting e.g. by centrifugation. After harvesting the biomass must be stabilized e.g. by lyophilization before it is ready for processing. Here the focus will be on obtaining protein-rich bulk material and high-value lipids such as EPA/DHA, and analysis of the fractions.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	

Hovedveileder: Main supervisor:	Prof. Kjell Inge Reitan
Biveileder(e): Co supervisor	Forsker Matilde S. Chauton, SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Høyverdi-komponenter fra marine mikroalger: Protein-og lipidinnhold utvalgte mikroalger under varierende dyrkingsbetingelser.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Mikroalger er en fremtidig kilde til proteiner og fett, inkludert høyverdi-komponenter EPA/DHA som brukes i helsekost og fôr. Mikroalger har et gunstig proteininnhold, og mange har også et høyt innhold av essensielle fettsyrer. Innholdet varierer imidlertid fra art til art, og med dyrkingsbetingelser. Vi trenger mer kunnskap om proteininnhold og hvilke alger som inneholder mest EPA/DHA, og under hvilke betingelser man får størst utbytte av disse komponentene. Oppgaven består i å dyrke 3-4 ulike mikroalger under forskjellige betingelser og analysere biomasseutbytte, protein- og lipidinnhold og aminosyre/fettsyreprofiler. Relevante dyrkingsbetingelser kan være variasjoner i lyskvalitet (LED vs konvensjonelt lys), temperatur og variasjoner i næringstilgang som f.eks nitrogenbegrensning.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	

Molecular and physiological investigation of plant response to external sugars

Production of organic compounds from inorganic through photosynthesis is essential for maintenance of life on Earth. Photosynthesis is a highly efficient and regulated metabolic process to maximize the use of available light, water, CO_2 and minerals to produce sugars and minimize damaging effects of by-products. The stored energy in sugars can be used to fuel cellular metabolic processes. In addition, sugars are known as strong signalling molecule which regulates different aspects of growth and development. Sugar production, transportation and consumption are tightly regulated processes. Molecular components and pathways involved in sugar and metabolite status sensing and signaling inside the plant cell have been studied comprehensively. In contrast, very little is known about how plants sense and respond to extracellular sugars. We have identified a Leucine Rich Repeat Receptor Like Kinase (LRR-RLK) with a possible function in sensing of extracellular sugars and connecting sugar availability to the regulation of gene expression and growth in model plant *Arabidopsis thaliana*.

During this project, the candidate will join us in performing a set of laboratory and greenhouse level experiments to evaluate physiological and molecular impacts of loss of function (knock-out) and over-expression plants for this gene.

Interested?

Contact us

Prof. Atle Bones: atle.bones@bio.ntnu.no

Tore Brembu: tore.brembu@bio.ntnu.no

Javad Najafi: javad.najafi@bio.ntnu.no

Hovedveileder: Main supervisor:	Rolf Erik Olsen
Biveileder(e): Co supervisor	Dag Altin Anders Johny Olsen
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Energy allocation and use in *Calanus finmarchicus*: The effect of food availability and temperature.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Like many other copepod species the life cycle of *C. finmarchicus* is strongly coupled to seasonal cycles in the algal productivity. To survive periods with low production of algae, *C. finmarchicus* may undertake a facultative diapause to conserve energy. This typically takes place during the last juvenile stage (C5) when the energy reserves of the organism are at its highest and aids in conserving energy for subsequent maturation of gonads and reproduction the coming season. Diapause is initiated after an vertical migration from surface waters to depth (~500 m in oceanic waters) and may last for many months. Little is known about the factors - both biological and physical - involved in the process. The project will be linked to ongoing activities at NTNU SeaLab with emphasis on elucidating the major components of the basal physiological mechanisms of *C. finmarchicus* regarding energy allocation and use. The project will involve experimental studies and chemical analysis at NTNU SeaLab. The project will provide competence in marine biology, which is a relevant background for positions within the management, marine and maritime industry and research.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	MACODEV, Fysiologi

Hovedveileder: Main supervisor:	Bjørn Munro Jenssen
Biveileder(e): Co supervisor	Tomasz M. Ciesielski Anders J. Olsen, Dag Altin
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Blue mussels as bioindicators for marine oil pollution: Biomarker responses and adverse outcome links.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Marine oil pollution is still a major environmental issue, and effective oil spill response actions are needed. The needs for environmentally safe and effective response actions were particularly demonstrated following the Deepwater Horizon oil spill in the Gulf of Mexico. The cold climate of the North Atlantic and Baltic Sea requires evaluation and biomonitoring of the effectiveness of oil spill actions in such environments. The project is linked to the EU project GRACE, and will focus on natural seasonal variations in biomarker variables in free-living blue mussels, and on biomarker responses in relation to exposure to petroleum oil pollution (laboratory experiments). The project will involve sampling in the field, experimental studies at NTNU SeaLab and analyses of biomarkers at SeaLab and Realfabygget. The project will provide competence in biological monitoring of marine pollution, which is a relevant background for positions within the management, marine and maritime industry and research.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, MACODEV

Hovedveileder: Main supervisor:	Bjørn Munro Jenssen
Biveileder(e): Co supervisor	Tomasz M. Ciesielski Anders J. Olsen, Dag Altin
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Calanus finmarchicus as bioindicators for marine oil pollution: Biomarker responses and adverse outcome links.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Marine oil pollution is still a major environmental issue, and effective oil spill response actions are needed. The needs for environmentally safe and effective response actions were particularly demonstrated following the Deepwater Horizon oil spill in the Gulf of Mexico. The cold climate of the North Atlantic and Baltic Sea requires evaluation and biomonitoring of the effectiveness of oil spill actions in such environments. The project is linked to the EU project GRACE, and will focus on on biomarker responses in Calanus finmarchicus relation to exposure to petroleum oil pollution and oil spill treatment. The project will involve experimental studies at NTNU SeaLab and analyses of biomarkers at SeaLab and Realfabygget. The project will provide competence in biological monitoring of marine pollution, which is a relevant background for positions within the management, marine and maritime industry and research.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, MACODEV

Hovedveileder: Main supervisor:	Bjørn Munro Jenssen
Biveileder(e): Co supervisor	Tomasz M. Ciesielski Anders J. Olsen, Dag Altin
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Behavioural variables as biomarkers for adverse effects of oil pollution in Calanus finmarchicus.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Marine oil pollution is still a major environmental issue, and effective oil spill response actions are needed. The needs for environmentally safe and effective response actions were particularly demonstrated following the Deepwater Horizon oil spill in the Gulf of Mexico. The cold climate of the North Atlantic and Baltic Sea requires evaluation and biomonitoring of the effectiveness of oil spill actions in such environments. The project is linked to the EU project GRACE, and will focus on on biomarker responses in Calanus finmarchicus in relation to exposure to petroleum oil pollution and oil spill treatment. The project will involve experimental studies on the in-house Calanus finmarchicus population at NTNU SeaLab and analyses of behavioral biomarkers at SeaLab or Realfagbygget. The project will provide competence in biological monitoring of marine pollution, which is a relevant background for positions within the management, marine and maritime industry and research.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, MACODEV

Hovedveileder: Main supervisor:	Bjørn Munro Jenssen
Biveileder(e): Co supervisor	Tomasz M. Ciesielski Anders J. Olsen, Dag Altin
Arbeidstittel på oppgaven (max 20 word): Preliminary title:	Adverse effect of oil and oil dispersant in three-spined sticklebacks (*Gasterosteus aculeatus*) as a model species.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	Marine oil pollution is still a major environmental issue, and effective oil spill response actions are needed. The needs for environmentally safe and effective response actions were particularly demonstrated following the Deepwater Horizon oil spill in the Gulf of Mexico. The cold climate of the North Atlantic and Baltic Sea requires evaluation and biomonitoring of the effectiveness of oil spill actions in such environments. The project is linked to the EU project GRACE, and will focus on on biomarker responses in Gasterosteus aculeatus relation to exposure to petroleum oil pollution and oil spill treatment (application of dispersants). The project will involve experimental studies at NTNU SeaLab and analyses of biomarkers at SeaLab and Realfabygget. The project will provide competence in biological monitoring of marine pollution, which is a relevant background for positions within the management, marine and maritime industry and research.
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	ENVITOX, MACODEV

Hovedveileder: Main supervisor:	Rolf Erik Olsen/Anders Olsen
Biveileder(e): Co supervisor	
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Life cycle in Calanus *finmarchicus*
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The global climate is now changing at an increasing pace. The consequences and conditions for life may thus change dramatically. One of the main sources of food in the oceans are the copepods like *Calanus finmarchicus* and *Calanus helgolandicus*. These animals have a complicated life cycle that is dependent on stable environmental factors. If temperature or feed sources change, then their life strategies can be compromised. For example, Calanus is dependent on entering diapause as an overwintering strategy with large lipid depots that are used for sexual maturation the following spring. If climate changes, it is possible that lipid buildup may not support gonad development in the spring. Or alternatively, it is possible that they will start the maturation process prematurely with consequent loss of progeny and recruitment. The current project will study the life cycle in Calanus finmarchicus (and possibly Calanus helgolandicus) and identify conditions that induces changes in life strategies. These conditions are then intended to use in input models for assessing the effects of climate change. The project may accommodate 2 master students. Contact: rolf.e.olsen@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Aquaculture, climate change, ealy life stages

Hovedveileder: Main supervisor:	Professor Olav Vadstein, Department of Biotechnology (Olav.vadstein@ntnu.no)
Biveileder(e): Co supervisor	Torunn Forberg and Ingrid Bakke, Department of Biotechnology, Rolf Erik Olsen, Department of Biology
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Gnotobiotic Salmon: Development of a Method to Establish Bacteria Free Salmon Larvae
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	The relationship between hosts and their microbes is an example of coevolution where the normal situation is that the relationship is mutually beneficial. So far focus has been on negative disease causing microbes both for humans and for fish. However, during recent years the beneficial host-microbe interactions have received more attention, and there is a rapid growth in new knowledge within this area. This is particularly the case for studies of mammals, but our research group has been instrumental for such studies of young stages of fish. Model systems were it is possible to establish microbe free individuals have served an important research tool to study the importance of microbes for a host, as they serve as a negative reference. As examples such studies have shown that a microbe free individual needs to eat 40% more to have the same weight gain as a conventional animal, and that a large number of host genes are regulated by the microbiota. We have already developed a method for obtaining microbe free Atlantic cod larvae (Forberg et al. 2011), and have had success using this as a model system. Now we want to establish a protocol for microbe free Atlantic salmon. The main goal of the thesis is to develop a disinfection and antibiotic protocol that results in microbe free yolk-sac larvae without harm to the larvae. We will aim at establishing a protocol that does not require antibiotic treatment after hatching. The student will do does-response experiments with 2-3 different disinfectants with and without addition of an antibiotics mixture. Presence of microbes will be quantified by both culture dependent and independent methods (including flow-cytometry), and effects on the salmon eggs and yolk sac larvae will be evaluated by registration of survival during both the egg and the yolk sac stage, hatching success, egg yolk conversion efficiency and possibly quantification of expression of a stress related gene by qPCR. Details in the goals/sub-goals and in the experimental setup will be planned together with the student. Forberg, T, Arukwe, A and Vadstein, O. 2011. A protocol and cultivation system for gnotobiotic Atlantic cod larvae (Gadus morhua L.) as a tool to study host microbe interactions. Aquaculture 315: 222–227. DOI: 10.1016/j.aquaculture.2011.02.047
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine Coastal Developement

Hovedveileder: Main supervisor:	Ingrid Bakke, Olav Vadstein, Rolf Erik Olsen
Biveileder(e):Co supervisor	Ingrid Bakke, Olav Vadstein, Rolf Erik Olsen
Arbeidstittel på oppgaven : Preliminary title:	Colonization of salmon fry in two aquaculture systems representing distinct microbial environments
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	**Goal** The overall aim is to assess the influence of the bacterial communities in the rearing water on the colonization of newly hatched salmon fry. More specifically, the objectives will be to examine - Whether distinct water microbiota will result in distinct microbiota on eggs, and on skin, gills, and in the intestinal system of fry at different developmental stages - Whether the egg microbiota influences on the fry microbiota - The ontogeny of the fry microbiota; i.e. the temporal development of microbial communities associated with the fry - Isolate bacterial strains from the gut at different developmental stages - Morphometric and development of the gastrointestinal tract **Background** In all vertebrates the gut microbiota is essential to health, for example through increased energy harvest from the diet and by protection against pathogenic infections. Moreover, the colonization of the intestines after birth/hatching is required for normal development of the immune and digestive systems. Fish embryos develops in bacteria-free environments inside the egg, but as soon as the fish larvae is hatched, it is colonized (skin, gills, and intestinal system). Fishes are sharing their living environment with high loads of bacteria. In aquaculture systems, the reared animals are exposed to high and unstable loads of bacteria compared to the natural environments. The consequences of these unnatural microbial environments are poorly understood, but in previous research projects, we have demonstrated that microbial stability in the rearing water is improving the growth and survival for marine fish larvae. Although Atlantic salmon is by far the most important species in Norwegian aquaculture, the interactions between bacteria in the water and salmon fry has not been investigated. In this project, we will create two rearing systems with different water microbiota. This can be obtained by applying distinct water treatment (e.g. a flow-through system and a recirculating system). The influence of the water microbiota on the colonization process for salmon eggs and fry will be investigated. It is also known that the development of the gastrointestinal tract is influenced by the intestinal microbial community. Consequently, the functional and morphological development of the gastrointestinal tract will be studied.

	Work description We plan that the two master students should work together to perform the rearing of salmon fry at NTNU sealab. One candidate will perform sampling of water, egg, and fry throughout the experiment. The other candidate will perform sampling of fish intestines for characterization of intestinal development. Methodology includes histology and, possibly molecular biology. Flow cytometry will be used for quantifying number of bacteria in the water samples. To investigate microbial communities, the bacterial 16S rRNA gene will be used as a marker for microbial diversity. A region of the gene will be amplified from samples by using so-called universal bacterial PCR primers. The resulting PCR products will be analysed by denaturing gradient gel electrophoresis (DGGE) and possibly by Illumina MiSeq amplicon sequencing. Statistical analyses of the sequencing/DGGE data will include multivariate statistics. Finally, this project will include cultivation and isolation of pure strains from the gut of salmon fry at different developmental stages, for generating a small strain library representing the salmon fry microbiota. Contact: Ingrid.bakke@ntnu.no, olav.vadstein@ntnu.no, rolf.e.olsen@ntnu.no
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine Coastal Development

Hovedveileder: Main supervisor:	Professor Kjell Inge Reitan Kjell.i.reitan@ntnu.no
Biveileder(e): Co supervisor	Research Scientist Kari Attramadal, NTNU and SINTEF
Arbeidstittel på oppgaven (max 20 word): Preliminary titel:	Mapping of microalgae growth in large scale salmon juvenile production farms.
Kort beskrivelse av oppgaven (max 300 word): Short description of the project:	It is observed that some large scale production tanks in salmon juvenile production farms get growth of microalgae within the tanks. This is an uncontrolled situation. The environmental conditions with high light intensity and secretion of inorganic nitrogen and CO_2 from the fish will stimulate growth of microalgae. It is observed a significant reduction in dissolved NO_3 in the fish tanks, and this can be a result of uncontrolled growth of microalgae The aim of this thesis is to describe the growth of microalgae in fish tanks in commercial juvenile production farms. The microalgae species composition will be characterized together with the growth dynamics. Nitrogen and phosphorous will be analyzed in order to make a full budget in the tanks. It will both be focused on flow through and recycling systems. This thesis will be performed in cooperation with "Brohode Frøya" together with commercial fish farm companies. Time schedule: Experiments in spring 2016-autumn 2017
Oppgaven passer for (angi studieretning(er)): Suitable for (main profiles):	Marine Coastal Development