DET MATEMATISK-NATURVITENSKAPLIGE FAKULTET

Søknad om oppretting av

Integrert masterprogram i havbruk og sjømat – HAVSJØ (sivilingeniør)

30.10.2015

1. Generelt om studiet

Hver boks kan ha flere kryss:

Typer laveregradsstudium (kryss av)	
	Bachelorgradsstudium
	Kortere studium på lavere grad som ikke fører til en grad (grunnutdanning), årsstudium
	Studieretning innenfor en bachelorgrad
	Fellesgrad
	Videreutdanning
Type mastergradsstudium (kryss av)	
	Mastergradsstudium 120 studiepoeng – § 3
	Erfaringsbasert mastergradsstudium 90 studiepoeng – § 5
	Erfaringsbasert mastergradsstudium 120 studiepoeng - § 5
X	Mastergradsstudium 300 studiepoeng
	Fellesgrad
	Videreutdanning

Hvorvidt studiet skal tilbys som (kryss av)	
X	Heltidsstudium
	Deltidsstudium
	Campus-/stedbasert studium
	Samlingsbasert studium
	Nettstudium
	Nettstudium med samlinger

Oppbygning - Integrert masterprogram i havbruk og sjømat – HAVSJØ (sivilingeniør)

V	10. sem.	Masteroppgave (60 stp.) Evt. Masteroppgave (30 stp.) og utplassering (6 mnd., tilsv. 30 stp.)		
H	9. sem.	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS
V	8. sem.	BFH300/301 Forsknings- og profesjonsutøvelse 10 sp, nytt emne)	NHH/HiB: Økonomi, verdikjede havbruk, marked (foretak, produksjon, prosess, markedskunnskap/analyse) (10 sp, nytt emne)	HiB/UiO/Gründerskolen: Innovasjon og entreprenørskap (10 sp)/GRU401 Grunderskolen (10 sp)
H	7. sem.	BIO 382 Akvatisk matproduksjon	Valg: BIO206 Ernæring hos fisk/BIO207 Næringsmiddelmikrobiologi	NHH/HiB: Ledelse, beslutningsteori og – prosesser, styring, strategi, kommunikasjon (nytt emne)
V	6. sem.	BIO 208 Miljøvirkninger av oppdrett (10 sp)	BIO 204a Etikk og velferd hos akvatiske organismer i oppdrett (2 sp)+LAS201/203 Forsøksdyrkurs, fisk (2+6sp)	BIO205 (tilpasset): Rammebetingelser (lovverk, forvaltning), krav, kvalitets- og styringssystemer (10 sp)
H	5. sem.	BIO280 Fiskebiologi I - Systematikk og anatomi (10 sp)	BIO291 Fiskebiologi II – fysiologi (10 sp)	Stat110 Grunnkurs statistikk (10 sp)
V	4. sem.	BIOxxx Havbruksteknologi (10 sp, nytt emne)	BIO103 Cellebiologi og genetikk (10 sp)	Ex.phil. (10 sp)
H	3. sem.	BIO213 Marin økologi (10 sp)	PHYS101 Grunnkurs i mekanikk og varmelære (10 sp)	INF100 Grunnkurs i programmering (10 sp)
V	2. sem.	BIF101 Organismebiologi (10 sp, nytt emne)	Kjem110 Kjemi og energi (10 sp)	Mat102 Brukerkurs II (10 sp)/MAT121 Lineær algebra (10 sp)
H	1. sem.	BIF100 Innføring i fiskehelse og havbruk (10sp, nytt emne)	BIO100 Økologi og evolusjon (10 sp)	MAT101 Brukerkurs I/MAT111 Grunnkurs i matematikk (10 sp)

Overordnet beskrivelse av studiet

Forankring

Studiet tilhører Institutt for biologi, Det matematisk-naturvitenskaplige fakuletet, UiB, og er utviklet i samarbeid med nærings- og kompetanseaktørene i Sjømatklyngen (Seafood Innovation Cluster).

Innledning

Institutt for biologi (BIO) er Norges største akademiske fagmiljø innen marinbiologi og har lang tradisjon for å utdanne kandidater innen havbruk, fiskeri, sjømat og marinbiologi.

Sjømatnæringen har uttrykt ønske om en ny type kandidat – sjømatkandidaten, som har en breiere utdanningsbakgrunn enn den tradisjonelle biologen med fag som teknologi, ledelse, økonomi og innovasjon i tillegg til en solid bakgrunn i biologi og naturvitenskaplige fag.

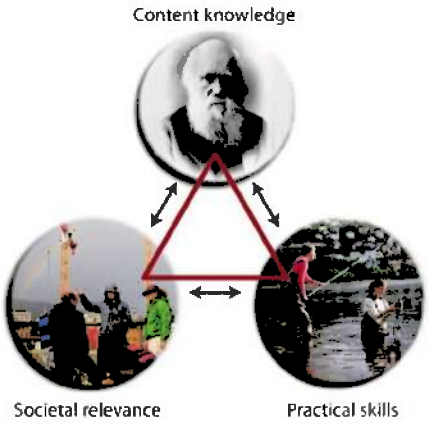
MN-fakultetet ønsker å styrke den teknologiske profilen i enkelte utdanningsløp, og har signert avtale med HIB og NHH som skal sikre studentene et bredere tilbud innen sivilingeniørutdanning.

Marin forskning er ett av UiBs satsningsområder.

BIO er partner og vertskap for UiBs eneste Senter for fremragende utdanning – bioCEED. bioCEEDs visjon er å utvikle fremragende utdanning som kobler teori, praktiske ferdigheter og samfunnsrelevans og utdanne kandiater som møter samfunnets behov og framtidas utfordringer. Det integrerte masterprogrammet i havbruk og sjømat er designet med bioCEEDs visjon som grunnleggende forutsetning.

Det nye studieprogrammet er en 5-årig integrert masterutdanning i havbruk og sjømat (HAVSJØ) med oppbygning som en sivilingeniørutdanning, og vil erstatte dagens Bachelorprogram i bærekraftig havbruk som har vært tilbudt ved BIO i litt ulike versjoner siden 1985. Kjerneemner innen biologi, havbruk og naturvitenskap fra dette programmet videreføres i HAVSJØ, men bli supplert med emner innen teknologi, ledelse, økonomi og innovasjon. HAVSJØ har i tillegg sterkere innslag av matematiske og tekniske basisfag.

Faglig profil og fagområde



bioCEED-triangelet. SFU bioCEEDs visjon er å utvikle en utdanning som kobler teori, praktiske ferdigheter og samfunnsrelevans for å skape framtidens biologer.

Studieprogrammet skal gi studentene bred kompetanse innen sentrale tema for havbruks- og sjømatnæringen. Programmet er bygd opp slik at kandidatene skal utvikle evnen til å tenke hele verdikjeden i sammenheng og kunne ta fornuftige beslutninger ut fra en helhetsvurdering. Innovasjon, nytenkning og entrepernørskap vil vektlegges.

Sentralt i studieprogrammet står biologien til artene i havbruk, herunder kunnskap om ernæring, reproduksjon, tidlig utvikling, vekst og kjønnsmodning. Videre skal kandidaten få innsikt i avlsarbeid, fiskehelse, havbruksteknologi og produksjon, optimalisering av produksjonsprosessen, kvaliteten på produktet, foredling og mikrobiologi. I forhold til utøvelsen av virksomhet i havbruks/sjømatnæringen skal kandidaten ha kunnskaper om økonomi, ledelse, salg, marked, markedsføring, ulike kulturer og kommunikasjon.

Gjennom masteroppgaven (fortrinnsvis 60 stp, men også 30 stp + 30 stp kurs er mulig) skal kandidaten bl.a. utvikle spesialisert innsikt i et tema av vesentlig betydning for havbruks- og sjømatnæringen. Masteroppgaver kan gis f.eks. i samspillet mellom biologi og teknologi, innenfor optimalisering av prosesser, kvalitet på produktet, og marked. Gjennom arbeidet med masteroppgaven, samt kurs og praksis i masterstudiet, vil kandidaten få dyp innsikt i fagområdets vitenskapelige teori og metode, denne erfaringen og kunnskapen vil gjøre kandidaten i stand til i neste omgang å anvende kunnskapen og analysere problemstillinger på nye områder innenfor havbruks- og sjømatnæringen.

Programmet skal utvikle studentenes evne til å tenke hele havbruks- og sjømatverdikjeden i sammenheng, og med bakgrunn i vitenskapelige teorier, metoder og fortolkninger utvikle evnen til å løse relevante utfordringer for næringen. I en kunnskapsbasert og innovativ næring som havbruks- og sjømatnæringen vil studiet vektlegge evne til innovasjon, nytenkning og entreprenørskap. Studiet vil videre gi kandidaten ferdigheter i selvstendig arbeid. Dette sikres bl.a. gjennom arbeidet med masteroppgaven og gjennom utplassering og praksis i havbruks- og sjømatbedrifter. Integrert i masterutdanningen ligger også utvikling av en kritisk holdning til informasjon, og evnen til å trenge dypere ned i forskningen bak informasjonen. Selvstendighet og evne til kritisk tenkning er to av hovedpilarene i en mastergradsutdanning, og studiet vil utvikle kandidatens ferdigheter på disse områdene som en basis for å forholde seg til og strukturere informasjonen i et faglig resonnement. Mastergradsutdanningen har som hovedsiktemål å gi kandidaten den nødvendige kunnskap og ferdigheter til å arbeide selvstendig med et forskningsprosjekt under veiledning, og etter hvert ut fra egne kunnskaper og erfaringer.

Et siving.-studium innen havbruk og sjømat gir kandidaten viktige generelle ferdigheter og kompetanse. Det vektlegges i egne kurs i studieløpet både fag-, yrkes- og forskningsetiske problemstillinger som gjør kandidaten rustet til å møte denne type problemstillinger i arbeidslivet. Studiet vektlegger innovasjon og entreprenørskap, bl.a. gjennom egne kurs på disse områdene, med

siktemål å gi kandidaten bakgrunn og verktøy for nytenkning og utvikling på området. Et integrert masterstudium representerer også en trening i formidling, både skriftlig (oppgaven) og muntlig (bl.a. presentasjon av arbeidet), som gjør kandidaten trygg på egne ferdigheter og som sikrer at kandidaten behersker fagområdets uttrykksformer, som regel både på engelsk og norsk. Evnen til kommunikasjon, både innenfor det fagspesifikke, det allmennyttige, og i forhold til publikum med ulik kulturell bakgrunn er viktige ferdigheter for en sjømatkandidat.

Sentrale tema:

- Verdikjede havbruk
- Innovasjon og entreprenørskap
- Økonomi/marked: bl.a. anvendt foretaksøkonomi, produksjonsøkonomi, prosessøkonomi, markedskunnskap, markedsanalyse
- Ledelse, beslutningsteori/prosesser, personalansvar, styring, strategi, kommunikasjon, arbeidsmiljø
- Teknologi: bl.a. anleggsutforming, fabrikkutforming, effektive prosesseringslinjer, tekniske løsninger, vannforsyning, produksjonsenheter, transport, maskinlære, IT systemer
- Akvakultur: Biologi, bl.a. fysiologi, ernæring, produksjonssyklus, produksjonsplanlegging, helse, velferd, råvareforsyning og fôr, produksjonsteknikk, distribusjonssystemer, ressurstilgang (regulering av villfiskarter og bruk av vegetabilske råvarer)
- Kvalitets– og styringssystemer, standarder relevante for bransjen
- Ytre miljø – forurensing til sjø og land, økosystem, livet i havet, kjemikalie og medikamentbruk
- Myndighetspålagte krav og rammebetingelser, forvaltning, reguleringer

Læringsutbytte

Kandidaten skal ved avslutta program ha følgende læringsutbytte definert i kunnskaper, ferdigheter og generell kompetanse:

Kunnskaper

Kandidaten

- har oversikt over sentrale utfordringer og muligheter innenfor havbruks- og sjømatnæringen
- har inngående kunnskap om biologisk teori og metode, inkludert biologi, fysiologi, anatomi og økologi til artene i havbruk
- skal kunne oppsummere og forklare hvordan oppdrettsaktivitet er knyttet til marin- og kystøkologi og bærekraftig utvikling
- skal kunne forklare relevansen av generell teori om økonomi, marked og ledelse for aktiviteter i næringen

- kan beskrive teknologi av vesentlig betydning for havbruks- og sjømatnæringen
- kan bedømme hvordan næringen opererer og blir oppfattet i samfunnet og av forbrukere

Ferdigheter

Kandidaten kan

- bidra til å løse problemer og finne løsninger for havbruks- og sjømatnæringen
- bruke relevante metoder for forskning og faglig utviklingsarbeid på en selvstendig måte
- gjøre kvantitative beregninger og analyser av økonomiske, biologiske og tekniske forhold med relevans for sjømatnæringen
- kommunisere med næringsaktører og har hatt en praksisperiode i næringen

Generell kompetanse

Kandidaten kan

- analysere relevante fag-, yrkes- og forskningsetiske problemstillinger
- anvende sine kunnskaper og ferdigheter på nye områder for å gjennomføre avanserte arbeidsoppgaver og prosjekter
- gjennomføre vitenskapelige forsøk og analyser og behersker vitenskapelig metode
- kommunisere faglige problemstillinger, analyser og konklusjoner med spesialister og til allmennheten
- bidra til nytenkning og innovasjon i produksjon av sjømat

2. Grunnleggende forutsetninger for godkjenning

2.1 Krav i aktuelle forskrifter og rammeplaner skal være oppfylt. For studier som ikke er omfattet av opptaksforskriften, skal det også redegjøres for opptak.

Opptakskrav til studiet

Opptakskravet til utdanningen er høyeste nivå i matematikk fra videregående opplæring og nest høyeste nivå i fysikk samt kravet til generell studiekompetanse jmf. Forskrift om opptak til Høyere utdanning (eventuelt tilsvarende kvalifikasjoner eller andre opptaksgrunnlag som fremgår av opptaksforskriften fastsatt av departementet § 3-4 i Opptaksforskriften[1]).

Begrunnelse for opptakskrav

Dette er det nasjonale kravet for opptak til studier som skal føre til en sivilingeniørgrad[2]

Tidspunkt for opptak og tidspunkt for studiestart.

Tidspunkt for opptak og studiestart vil være høst. Søknad gjennom Samordna opptak til ordinære frister. Første utlysning V-16 med opptak H-16.

Rammeplaner & redegjørelse

Studiet er en 5-årig integrert masterutdanning med oppbygning som en sivilingeniørutdanning[3]. Utdanningen er forskningsbasert og følger kravet om gode basiskunnskaper i matematikk, statistikk, fysikk, kjemi, informatikk og teknologi, samt spissede kvalifikasjoner i spesialområdet havbruk og sjømat (biologisk spesialsiering) og trening i tverrfaglige emner som økonomi, ledelse, innovasjon med mer. Læringsutbyttet er beskrevet på nivå 7 i henhold til NKR.

[1] Det gjøres unntak fra kravet om generell studiekompetanse for følgende studier:
Integrert masterstudium i teknologiske fag, 3-årig ingeniørutdanning og maritime fag : Unntak fra kravet om generell studiekompetanse gjelder for søkere som har bestått 1-årig forkurs for ingeniør- og maritim høyskoleutdanning, nyere godkjent 2-årig fagskoleutdanning i tekniske fag eller 2-årig fagskoleutdanning etter studieordninger før rammeplan fastsatt av departementet 1998/99.

[2] http://www.uhr.no/documents/Hva_karakteriserer_en_sivilingeni_rutdanning___vedtatt.pdf

[3] http://www.uhr.no/documents/Hva_karakteriserer_en_sivilingeni_rutdanning___vedtatt.pdf

Oversikt over faglig fordeling i en sivilingeniørutdanning, og hvordan dette er oppfylt i graden det søkes om:

Utdanningen har en faglig fordeling som er slik:		
	MINIMUMSOMFANG	Siving. havbruk og sjømat
Realfaglig basis	45 stp.	50 stp.
Matematiske basisfag (matematikk og statistikk)	minst30 stp. minst 25 stp. i matematikk minst 5 stp. i statistikk	MAT101/MAT111 (10 stp) MAT102 (10 stp) STAT110 (10 sp)
Naturfaglige basisfag (fysikk, kjemi)	minst 10 stp. i fysikk kjemi bør inngå	KJEM110 (10 sp) PHYS101 (10 sp)
Ikke-MNT-fag (språk, økonomi, etikk etc.)	15 stp	Ledelse m.m. (10 sp) Økonomi m.m. (10 sp) Ex.phil (10 sp)
Tekniske fag	150 stp* Veiledende fordeling	
Basisfag (IT, mekanikk etc)	20-30 stp	INF100 (10 stp) Havbruksteknologi (10 sp)
Ingeniørfag (studieretning)	60-90 stp	110 stp. BIO/BIF-emner innen biologi/havbruk/sjømat Praksis (min. 10 sp) Forskning- og profesjonsutøvelse (10 sp)
Ingeniørfag (hovedprofil)	30-130 stp	
Fag på tvers av retning	5-15 stp	Innovasjon/GRU401 (10 sp)
Masteroppgave	30 stp	60 stp masteroppgave alt. 30 stp praksis+30 sp masteroppgåve
Totalt omfang på utdanningen	300 stp	300 stp

Beskrivelse og begrunnelse for omfang av selvstendig arbeid:
Utdanningen avsluttes med en 60 stp masteroppgave (alt. 30 stp oppgave og 30 stp emner/utplasseing i bedrifter/institusjoner), som utføres som et selvstendig forskningsprosjekt under veiledning. Fagmiljøet ønsker å beholde en ettårig (60 stp) masteroppgave for å gi kandidatene omfattende og konkret erfaring med forskning og anvendelse av kunnskap og ferdigheter de har opparbeidet seg gjennom studiet.

Enkeltemner gjennom studiet legger også opp til selvstendig arbeid gjennom oppgaver, lab-rapporter og feltrapporter som totalt overstiger 10 stp.

2.2 Rekrutteringen av studenter til studiet skal være stor nok til at institusjonen kan etablere og opprettholde et tilfredsstillende læringsmiljø og et stabilt studium.

Rekruttering

Opptaksrammen for studiet er satt til 15 plasser, overført fra Bachelorprogram i bærekraftig havbruk (BA HAV) (som blir lagt ned som følge av opprettelse av havbruk/sjømat).

Fakultetet ønsker å omdisponere 25 bachelorplasser (15 plasser fra Bachelorprogram i bærekraftig havbruk og 10 plasser fra Bachelorprogrammene i biologi og/eller miljø og ressursfag MN) til integrerte femårige masterplasser i havbruk og sjømat fra og med opptaket 2016/2017. Studieprogrammene har ulike finansieringskategorier (C og E) og ulik studielengde. Fra og med 2019/2020 må også 15 to-årige masterplasser trinnvis omgjøres til integrerte masterplasser i havbruk og sjømat.

Bachelorprogrammet i berekraftig havbruk har hatt rimelig stabil rekruttering siden oppstarten[4]. Et nyopprettet studium i havbruk/sjømat vil ha overlappende målgruppe med BA-HAV, men vil ha en bredere målgruppe siden studiet ikke bare er et integrert masterstudium innen havbruk, men også sjømat. Studiet favner hele næringen/produksjonsprosessen. Potensialet for økt verdiskaping i norsk biomarin industri er stort. I en analyse sier en arbeidsgruppe oppnevnt av de to vitenskapsakademiene NTVA[5] og DKNVS[6] at det er mulig med en omsetning på 550 milliarder i 2050, en seksdobling fra i dag. Evnen til å tiltrekke seg talenter og et behovsrettet utdanningssystem er spesielt nevnt i rapporten, bl.a. oppsummeres følgende :
For å kunne realisere det store verdiskapingspotensialet, som er pekt på i rapporten, må næringen i større grad fremstå som attraktiv for talenter. En utvikling mot større forretningsenheter vil bidra i riktig retning da større bedrifter oftere etterspør mer personell med høyere utdanning og skaper reelle karrierestiger for de ansatte.
Utdanningssystemet rettet mot marin sektor må gjennomgås kontinuerlig og tilpasses behovene i sektoren. Utdanningsstrukturen må bli evaluert med tanke på å utvikle verdens beste marine utdanningssystem.

I dagens situasjonen med lav oljepris i overskuelig framtid og oppbremsing av aktiviteten i oljenæringen tror vi det er mange dyktige og ambisiøse studenter som ser etter alternativ innen en næringsretta utdanning der utsiktene for et sterkt arbeidsmarked er gode. Havbruks- og sjømatnæringen representerer nettopp et slikt alternativ og tidspunktet for å starte opp et slikt studium er derfor gunstig.

Antall studenter ved det omsøkte studiet	**Studenter totalt første studieår**	**Studenter totalt ved full drift**
Antall fulltidsstudenter	15	75
Antall deltidsstudenter	0	0
Antall nettstudenter	0	0

[4] http://dbh.nsd.uib.no/statistikk/rapport.action?visningId=156&visKode=false&columns=arstall&index=5&formel=422!8!423!8!424&hier=insttype!9!instkode!9!fakkode!9!ufakkode!9!progkode&sti=Universiteter!9!Universitetet%20i%20Bergen!9!Det%20matematisk-naturvitenskapelige%20fakultet!9!Institutt%20for%20biologi&param=arstall%3D2015!8!2014!8!2013!8!2012!8!2011!9!dep_id%3D1!9!insttype%3D11!9!instkode%3D1120!9!fakkode%3D260!9!ufakkode%3D600

[5] Norges Tekniske Vitenskapsakademi

[6] Det Kongelige Norske Videnskabers Selskab

Læringsmiljø
15 studieplasser er i utgangspunktet et lavt tall, men læringsmiljøet vil favne om betydelig flere studenter. HAVSJØ vil inngå i et stort og godt etablert læringsmiljø ved Institutt for biologi. Studieplanen følger langt på vei den reviderte planen til Profesjonsstudium i fiskehelse (25 studieplasser), og disse programmene danner til sammen et større faglig læringsmiljø. Studentene innen disse fagområdene har en felles studentorganiasjon (Linjeforeningen for fiskehelse og havbruk).

Studiet vil bli en del av BIOs studietilbud og læringsmiljø, som i tillegg til Profesjonsstudium i fiskehelse (25 studieplasser) omfatter Bachelorprogram i biologi (85 studieplasser per år), Bachelorprogram i miljø-og ressursfag (24 studieplasser per år) og Masterprogram i biologi (55 studieplasser per år). Instituttet har gjennom flere år jobbet målrettet med kvalitetsutvikling og læringsmiljø, og er vert for et Senter for fremragende utdanning i biologi – bioCEED.

Frafallet fra bachelorutdanningene (HAV, BIO og MIRE) er betydelig større enn frafallet fra Profesjonsstudium i fiskehelse (5-årig integrert studium). Det er vår vurdering at HAVSJØ som et 5-årig integrert studium med tette koblinger til Sjømatklyngen og en ingeniør-faglig profil vil gi lavere frafall og høyere kandidatproduksjon enn det vi i dag kan vise til for BA HAV.

Stabilt studium

BIO har tradisjon tilbake til oppstarten av norsk havbruksnæring tidlig på 80-tallet for å tilby utdanninger innen havbruk og sjømat i tett dialog med aktuelle nærings- og forvaltningsaktører. Vi ser på oppretting av HAVSJØ som en naturlig utvikling av dette studietilbudet, der samarbeid med samfunn og næring får et enda sterkere fokus samtidig som utdanningen utvikles for å gi studentene den solide faglige dybde og bredde som arbeidsmarkedet krever.

2.3 For studier med praksis skal det foreligge tilfredsstillende avtaler som regulerer vesentlige forhold av betydning for studentene.

Innsikt i, og erfaring fra, ulike deler av havbruks- og sjømatnæringen er helt sentralt for å gi studentene den nødvendige kunnskap og kompetanse som en kandidat med denne utdanningen skal ha.

BIO har godt etablerte samarbeid og avtaler for praksis i BA HAV og Profesjonsstudium i fiskehelse. HAVSJØ vil videreføre eksisterende samarbeid med Sjømatklyngen for å tilby studentene variert og relevant praksis gjennom studiet[7].

Beskrivelse av hvordan det legges til rette for og gjennomføres praksis*:

- Kortere praksiserfaring/møter med næringen i grunnemner (BIF100)
- BIO205 Praksisperiode, lovverk og forvaltning (3 uker praksis inngår i emnet).
- Praksis er inkludert i det nye emnet Forsknings-og profesjonsutvøvelse
- Masteroppgave: forskningspraksis internt eller eksternt avhengig av masterprosjekt

[7] Jf. Letter of commitment fra Seafood Innovation cluster

- Ved 30 sp masteroppgave skal studentene ha 30 sp (1 sem) praksis innen økonomi, biologi og produksjon, produktutvikling, forvaltning og økologi og/eller velferd og etikk)

*med begrepet praksis menes her deler av studiet som foregår utenfor institusjonen

Dersom en bruker begrepet praksis i en bredere betydning til å inkludere undervisning og læring av praktiske ferdigheter med relevans for yrkesutøvelsen kan omfattande laboratorie- og feltundervisning inkluderes i studentens praktiske opplæring gjennom studiet.

2.4 Vedleggsliste:

Vedlegg til Grunnleggende forutsetninger for oppretting	**Vedlegg nr.**
Oversikt over behandlingsorganer, samt tidspunkt for og innhold i vedtak	Vedlegg 1
Organisasjonskart over fakultetets styringsstruktur	Vedlegg 2
Mandat for relevante styrer, råd og utvalg	Vedlegg 1
Mal for utdanningsplan	Vedlegg 3
Tekst til vitnemål og Diploma Supplement	Mål & innhald+ LU blir brukt. Andre punkter fylles i (ettersendes til fakultetet for godkjenning).
Forslag til praksisavtaler	Eksempel på praksisavtale (BIO376) som i dag er i bruk på Profesjonsstudium i fiskehelse (vedlegg 4)

3. Plan for studiet

(studietilsynsforskriften § 7-2)

3.1 Studiet skal ha et dekkende navn.

Norsk navn (bokmål og nynorsk): Integrert masterstudium i havbruk og sjømat (sivilingeniør)
Engelsk navn: Integrated master in Aqauculture and Sea Food


Nå kommer sjømatingeniøren

Et nytt, skreddersydd studie skal bane vei for en helt ny yrkestittel: Sjømatingeniør. Bak initiativet står Universitetet i Bergen i samarbeid med Norges Handelshøyskole og Høgskolen i Bergen.

Begrepet *Sjømatkandidat* ble lansert tidlig i diskusjonen om opprettelsen av en sivilingeniørutdanning ved BIO. Etter grundige diskusjoner med samarbeidspartnere og internt på instituttet ble det besluttet å også inkludere havbruk i tittelen, sammen med sjømat. Begrepet sjømat omfatter større deler av næring- og fagområdet enn havbruk, men kan også lett forbindes med sluttproduktet sjømat og næringsmiddel/matlaging. Ved å inkludere *havbruk* vil tittelen omfatte hele verdikjeden og produksjonsprosessen.

3.2 Studiet skal beskrives gjennom krav til læringsutbytte jamfør Nasjonalt kvalifikasjonsrammeverk for livslang læring. Det formuleres ett læringsutbytte for hvert studium.

Læringsutbyttebeskrivelsen for studiet har tatt utgangspunkt i Nasjonalt kvalifikasjonsrammeverk for livslang læring (nivå 7).

Kandidaten skal ved avslutta program ha følgende læringsutbytte definert i kunnskaper, ferdigheter og generell kompetanse:

<u>Kunnskaper</u>

Kandidaten

- har oversikt over sentrale utfordringer og muligheter innenfor havbruks- og sjømatnæringen
- har inngående kunnskap om biologisk teori og metode, inkludert biologi, fysiologi, anatomi og økologi til artene i havbruk
- skal kunne oppsummere og forklare hvordan oppdrettsaktivitet er knyttet til marin- og kystøkologi og bærekraftig utvikling
- skal kunne forklare relevansen av generell teori om økonomi, marked og ledelse for aktiviteter i næringen
- kan beskrive teknologi av vesentlig betydning for havbruks- og sjømatnæringen
- kan bedømme hvordan næringen opererer og blir oppfattet i samfunnet og av forbrukere

<u>Ferdigheter</u>

Kandidaten kan

- bidra til å løse problemer og finne løsninger for havbruks- og sjømatnæringen
- bruke relevante metoder for forskning og faglig utviklingsarbeid på en selvstendig måte
- gjøre kvantitative beregninger og analyser av økonomiske, biologiske og tekniske forhold med relevans for sjømatnæringen
- kommunisere med næringsaktører og har hatt en praksisperiode i næringen

Generell kompetanse

Kandidaten kan

- analysere relevante fag-, yrkes- og forskningsetiske problemstillinger
- anvende sine kunnskaper og ferdigheter på nye områder for å gjennomføre avanserte arbeidsoppgaver og prosjekter
- gjennomføre vitenskapelige forsøk og analyser og behersker vitenskapelig metode
- kommunisere faglige problemstillinger, analyser og konklusjoner med spesialister og til allmennheten
- bidra til nytenkning og innovasjon i produksjon av sjømat

3.3 Studiets innhold og oppbygning skal samsvare med og være tilpasset læringsutbyttebeskrivelsen slik at læringsutbyttet oppnås.

Se studieplan for oppbygning av studiet. Studieplanen lenker til emnebeskrivelser for emner som eksisterer per i dag. For nye emner som er ferdig beskrevet er emnebeskrivelser vedlagt.

Alle emner i studieplanen er obligatoriske (med unntak av et valg mellom to emner).

Studieplanen er lagt opp med 10 sp moduler (3 emner per semester fram til oppstart på masteroppgaven. Studentene skal møte sitt spesialiseringsområde i første semester gjennom emnet BIF100 Innføring i fiskehelse og havbruk, og vil i videre semester ha en stamme av biologiske/havbruksemner som bygger på generell biologisk kunnskap i første og andre semester mot mer spesifikk kunnskap innen spesifikke emner knyttet til havbruk og sjømat. Parallellt med spesialiseringsemner i faget skal studentene få de nødvendige basiskunnskaper i matematikk, statistikk, fysikk, kjemi og informatikk. Et eget emne 'Havbruksteknologi' gir det teknologiske perspektivet som er nødvendig for å bidra til utvikling og omstilling av næringene.

Praksis inngår som et eget emne i 6. semester og vil også være en del av emnet Forsknings-og profesjonsutøvelse i 8. semester. 4. året vil studentene få kunnskap,ferdigheter og kompetanse innen bl.a. ledelse, økonomi og innovasjon, samt forsknings- og profesjonsutøvelse. Sjømatklyngen har forpliktet (se vedlegg 5) seg til å samarbeide med BIO om å gi studentene et relevant og kvalitetssikret praksistilbud.

Studiet avsluttes med en masteroppgave (60 sp) som er et selvstendig vitenskaplig forskningsprojekt under veiledning. Masteroppgaven skal gjennomføres i en av de aktuelle forskningsgruppene ved Institutt for biologi, eller en av instituttets samarbeidspartenere. Instituttet har ansvar for kvalitetssikring av både interne og eksterne prosjekt.

Studieplanen følger i store trekk planen til Profesjonsstudium i fiskehelse de første 4 semesterne, noe som sikrer en god ressursutnyttelse, effektiv undervisning, og et spennende og utviklende læringsmiljø for studentene.

Det tverrfaglige innholdet (ikke MNT-fag) dekkes av emner i ledelse, økonomi og innovasjon. Her vil vi samarbeide med andre aktulle utdanningsinstitusjoner (NHH, HIB) og koordinere tilbudet med

MNs andre sivilingeniørgrader (planlagt søknader for disse neste år). UiBs arbeid med utdanningstilbud innen innovasjon vil også inluderes der det er relevant.

3.4 Arbeids- og undervisningsformer skal samsvare med og være tilpasset læringsutbyttebeskrivelsen slik at læringsutbyttet for studiet oppnås.

Det overordna læringsutbyttet for sjømatkandidater er at de skal bli problemløsere og innovasjonsdrivere i sjømatnæringen. De skal også ha gode biologi-kunnskaper, med mye fysiologi og havbruksrelatert biologi og økologi, og de skal være i stand til å gjøre kvantitative og statistiske analyser av data med tanke på å forbedre prosesser og produksjon av sjømat. Store deler av disse læringsutbyttene blir oppnådd ved å ta utgangspunkt i eksisterende biologiemner og emner som inngår i dagens havbruksstudie. Men for å utvikle et blikk for innovasjon, teknikk og økonomi har vi etablert et samarbeid med aktører i næringen (Klyngen) og andre utdanningsinstitusjoner (NHH, HiB) som har mer erfaring med disse sidene av læringsutbyttet i HAVSJØ. Studiet starter med en pillar av biologi/havbrukfag og av kvantitative fag som matematikk/statistikk/programmering, og bygger slik opp en basis av kjernefag som ivaretar kunnskap om sjømat og analytiske og kvantitative ferdigheter. Senere i studiet utvikles forståelsen for økonomi/ledelse/teknologi og de kommer ut i praksis. Samlet sett danner dette et studium meg godt samsvar mellom læringsutbyttebeskrivelse, den undervisning som blir gitt og det vil også bli lagt vekt på at vurderingen retter seg mot å sikre at læringsutbyttet til studenten blir oppnådd ('constructive alignment', se Biggs & Tang 2013).

Ulike arbeids- og undervisningsformer er beskrevet i emnebeskrivelsene til hver enkelt emne. Se også oversiktstabell over emner i graden med undervisingsformer og vurderingsformer (vedlegg 6).

3.5 Eksamensordninger og andre vurderingsformer skal samsvare med og være tilpasset læringsutbyttebeskrivelsen slik at læringsutbyttet for studiet oppnås.

Ulike vurderingsformer er beskrevet i emnebeskrivelsene til hver enkelt emne.

Se også oversiktstabell over emner i graden med undervisingsformer og vurderingsformer (vedlegg 6).

Vurderingsformene i eksisterende emner som inngår i graden er varierte og tilpassa det læringsutbyttet hvert emne skal gi. Programmet som helhet er satt sammen av emner som gir det beskrevne læringsutbyttet.

-Det er et rikt innhold av laboratoriebasert undervisning med blant annet rapportskriving som vurderingsgrunnlag i biologi- og kjemiemnene. For å oppnå de ønskede kommunikasjonevnene blir det lagt opp til betydelige innslag av muntlige presentasjoner og skriftlige øvelser i mange emner, for eksempel kan bloggskriving bli et naturlig element i forbindelse med praksisperioden slik det er i eksisterende praksisemner på BIO.

-Emnene med innslag av økonomi, ledelse, utplassering og teknologi har et mål om å utvikle gründerånd og innovative evner hos studentene. Dette kan oppnås med varierte vurderingsformer og et stort innslag av vurdering av evne til å løse praktiske problemer. Vurdering vil derfor innbefatte

praktisk retta oppgaver der studentene skal løse tenkte eller reelle utfordringer for bedrifter og forvaltning i næringen.

-Praksis og førstehånds kjennskap til næringsaktører er i seg selv et viktig læringsmål, og her vil vurderingen basere seg på deltakelse, refleksjon og formidling av erfaringene til andre.

-Et kjerneelement i universitetsutdanning er å gi kandidatene forståelse for og ferdighet til å lese og bruke vitenskaplige arbeid og metoder. Det inngår i læringsmålet i dette programmet, og er et innslag som inngår i de fleste emner gjennom studiet. Det viktigste her er likevel masteroppgaven, som er et selvstendig forskningsarbeid utført i nært samarbeid med en av våre mange forskergrupper.

3.6 Studiet skal ha en tydelig faglig relevans for arbeidsliv og/eller videre studier.

Planene for studiet har på mange måter sitt utspring i Seafood Innovation Cluster i Bergen, der sentrale næringsaktører i klyngen kom med følgende bestilling (se nedenfor) våren 2015. UiB ved rektor dag Rune Olsen tok invitasjonen, og fakultetet spilte ballen videre til BIO.

> Innspill til videre arbeid:
>
> - Ewos og Grieg savner en bredere kompetanse av de som utdannes, høyskole utdanning med bredde innenfor - biologi, teknologi og økonomi. Generaliseringsevnen, evnen til å tenke bredt i hele verdikjeden er avgjørende for kunne fungere godt nok i en kompleks forretningshverdag. Utdanningsinstitusjonene blir i høy grad målt på antall mastergrader, doktorgrader og publikasjoner, - noe som lett fører til spissing av kompetanseområdet og spesialisering. En ny utdanning ala fiskerikandidat, bør etableres for sjømatsnæringen

Vestlandet/Vestlandskysten har stor og bred aktivitet innen havbruk som vil ha behov for ulik kompetanse på mange nivå. En utdanning innen havbruk og sjømat er etterspurt fra næringen, og kandidater fra studiet vil kunne gå inn i en rekke ulike jobber som for eksempel innenfor oppdrettsselskap, forselskaper, forskning, finansiering, forsikring, utstyrsleverandører, mm.

Sjømatklyngen (NCE Seafood Innovation Cluster) har vært en sentral samarbeidspartner for insituttet i utviklingen av studieprogrammet HAVSJØ. Klyngen er en av verdens største sjømatklynger og representerer 70 industriaktører i hele sjømatverdikjeden. Klyngens mål er å videre fremme bærekraftig vekst i norsk sjømat ved å styrke samarbeidet mellom bedrifter, FoU og utdanning gjennom strategiske samarbeidsprosjekt mellom klyngen og eksterne partnere.

Se også rapporten *Verdiskaping basert på produktive hav i 2050* som trekker opp perspektiver og muligheter Norge,som en av verdens største havnasjoner, har innen høsting og dyrking av havets biologiske ressurser.

3.7 Studiet skal ha tilfredsstillende kopling til forskning, faglig og/eller kunstnerisk utviklingsarbeid, som er tilpasset studiets nivå, omfang og egenart.

Institutt for biologi har forskningsbasert undervisning, og undervisere på emnene er aktive forskere innen instituttets fagområder. Studentene vil gjennom ulike emner gjennom studiet få innsikt i, og kunnskap om, forskningsfronten innen fagområdet. Gjennom masterstudiet vil studentene gjennomføre et selvstendig forskningsarbeid. Se vedlegg X for oversikt over instituttets faglige aktivitet innen det marine området.

3.8 Studiet skal ha ordninger for studentutveksling og internasjonalisering, som skal være tilpasset studiets nivå, omfang og egenart.

Det er ikke direkte tilrettelagt for delstudium i utlandet med et anbefalt semester, men det vil vere mulig gjennom BIOs utvekslingsavtaler å tilbringe 3. eller 5. semester i utlandet med forhåndsgodkjente emner som erstatter obligatoriske emner i studiet.

Praksis og masteroppgave kan gjennomføres i utlandet gjennom etablert forskningssamarbeid eller gjennom avtaler med samarbeidspartnere av Sjømatklyngen.

3.9 Studiet skal ha lokaler, bibliotektjenester, administrative og tekniske tjenester, IKT-ressurser og arbeidsforhold for studentene, som er tilpasset studiet.

Studentene/studiet vil benytte UiBs lokaler, tjenester og ressurser.

Infrastruktur:

- undervisningslokaler MN-fakultetet
- undervisningslaboratorier BIO
- Studentarealer MN-fak (nye studentarealer på Marineholmen f.o.m. 1.1.2016))

Støttefunksjoner:

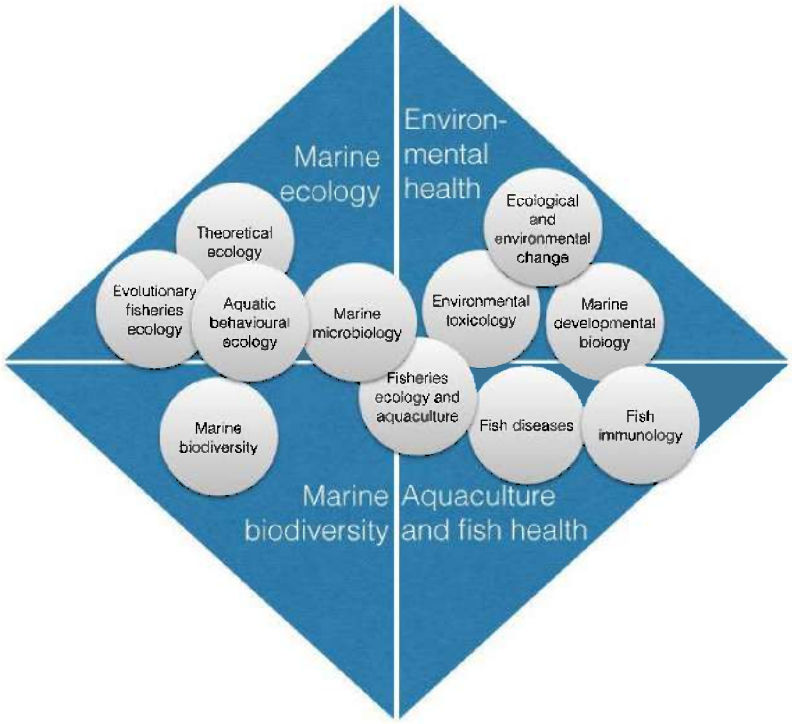
- Studieadministrasjon ved BIOs studieseksjon og MN-fak Infosenter
- Teknisk (undervisningstekniker og forskningstekniker) ved BIO

3.10 Vedleggsliste:

Vedlegg til Plan for studiet: Marker med «Ikke relevant» dersom et vedlegg ikke er aktuelt for studiet	**Vedlegg nr.**
Studieplan	Vedlegg 3
Oversikt over muligheter for studentutveksling og internasjonalisering	http://www.uib.no/utvekslingsavtale

4. Fagmiljø tilknyttet studiet

(studietilsynsforskriften § 7-3)



Skjematisk framstilling av BIOs forskningsgrupper involvert i marin forskning

Her legger vi ved en omfattende egenevaluering av marin FoU gjennomført i 2015 (vedlegg 7). Evalueringen dekker perioden 2004-2013 og beskriver mange av punktene under.

Andre samarbeidspartnere:
NCE Seafood Innvation Cluster (inkl. Havforskningsinstituttet, NIFES, NHH, HIB m.fl.)
CtrlAQUA

Andre mulige samarbeidspartnere:
Blått kompetansesenter

Instituttets vitenskaplig stab (forskning og undervisning) innen marine fag (2004-2013)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total number of staff involved	101	104	105	119	130	131	131	124	117	123
Number of staff involved in the field more than 50% of their time	98	101	102	115	125	127	128	120	113	120
Full time equivalents (FTEs) in the field:										
• Professors (*professor/førsteamanuensis/andre førstestillinger*)	37,1	39,5	40,1	42,3	39,6	40,9	40,1	39,5	39,1	40,4
• Other permanent academic staff	0	0	0	0	0	0	1	1	1	1
• Postdoc fellows	11	15	13	10	13	11	9,5	11,5	10,5	9
• PhD fellows	27,3	27,5	27	30	35	38	36	28,75	31,75	34,75
• Researchers	16,1	12	11,8	18,9	19,75	18,55	23,7	21,1	14,7	17,5

Gjennom de siste ti årene har den marine aktiviteten ved instituttet økt og mellom 75% og 85% av instituttets faste vitenskaplige stab er involvert i marin forskning og utdanning.

4.1 Fagmiljøets sammensetning, størrelse og samlede kompetanse skal være tilpasset studiet slik det er beskrevet i plan for studiet og samtidig tilstrekkelig for å ivareta den forskning og det faglige og kunstneriske utviklingsarbeidet som utføres.

4.2 Fagmiljøet skal delta aktivt i nasjonale og internasjonale samarbeid og nettverk relevante for studiet.

4.3 Minst 50 prosent av årsverkene knyttet til studiet skal utgjøres av tilsatte i hovedstilling ved institusjonen. Av disse skal det være personer med minst førstestillingskompetanse i de sentrale delene av studiet.

4.4 Fagmiljøet skal drive aktiv forsking, faglig og/eller kunstnerisk utviklingsarbeid.

4.5 For studier med praksis skal fagmiljøet og eksterne praksisveiledere ha hensiktsmessig erfaring fra praksisfeltet.

4.6 Vedleggsliste:

Vedlegg til Fagmiljø tilknyttet studiet: Marker med «Ikke relevant» dersom et vedlegg ikke er aktuelt for studiet	**Vedlegg nr.**
CV for alle som inngår i studiets fagmiljø	Ettersendes ved forespørsel.
Publikasjonslister for de siste fem årene (før gjeldende søknadsfrist)	Vedlegg 7
Dokumentasjon på nasjonale og internasjonale samarbeid og nettverk som fagmiljøet deltar aktivt i	Vedlegg 7

Emnebeskrivelser og skisser for nye emner

Emnekode	**BIF100**
Namn, nynorsk	**Innføring i fiskehelse og havbruk**

Namn, bokmål	Innføring i fiskehelse og havbruk
Namn, engelsk	
Studiepoeng	10
Undervisningssemester	Haust
Undervisningsspråk	Norsk
Studienivå	*Bachelor*
Institutt	*Institutt for biologi*
Krav til studierett	For oppstart på emnet er det krav om ein studierett knytt til profesjonsstudium i fiskehelse, bachelorprogram i havbruk/siving havbruk og sjømat.
Innhald	Emnet er et innføringsemne til profesjonsstudiet i fiskehelse og til sivilingeniørstudiet i havbruk og sjømat. Emnet tar opp utviklingen av norsk akvakultur og havbruk med fokus på artenes biologi, helse i oppdrett og teknologi. Videre introduseres studentene til dagens situasjon og fremtidige perspektiver nasjonalt og internasjonalt. Miljøproblem knyttet til oppdrett blir presentert og diskutert. Emnet har et laboratoriekurs der studentene skal bli kjent med utvalgte oppdrettsorganismer og bli introdusert til et utvalg av metoder og til arbeid og sikkerhet i laboratoriet. Emnet introduserer forskerne og forskningen som blir gitt innenfor området ved UiB, hva den har betydd og betyr for næringen, pågående forskingsprosjekter og fremtidige perspektiv. Deler av undervisningen blir gitt av studentassistenter. Studentene blir også introdusert til aktørene i næringen på seminarer og deltar i ekskursjoner til utvalgte bedrifter. Et viktig formål med emnet er å gi en ganske variert studentgruppe et felles utgangspunkt før videre studier.
Læringsutbytte	Etter å ha tatt emnet skal studentene kunne/ha 1) en oversikt over helseaspektet innenfor oppdrettsnæringen både i historisk, samtidig og framtidig perspektiv. 2) enhetlig faggrunnlag for de fagområdene som undervises senere i profesjonsstudiet og siv. ing. studiet 3) forståelse av at dagens oppdrettsnæring er forskningsbasert og høyteknologisk 4) beskrive utvalgte oppdrettsteknologier og metoder 5) gjøre rede for dynamikken helse, sykdom, oppdrettsteknologi og biologisk produksjon 6) erfaring i å møte og kommunisere med aktørene i næringen 7) erfaringer med skriftlig rapportering av egne aktiviteter og samarbeid
Krav til forkunnskapar	Ingen
Fagleg overlapp	Ingen
Undervisning og omfang	
Obligatoriske arbeidskrav	Obligatorisk oppmøte første undervisningsdag. All undervisning er obligatorisk. Studentene skal føre personlig studiejournal som blir lagt fram for og godkjent av faglærer. Undervisningen blir gitt som forelesninger, seminarer, laboratorie- og feltkurs/ekskursjoner. Obligatoriske aktiviteter gyldig i 3 semester.
Vurderingsform	Muntlig eksamen. Obligatorisk undervisningsaktivitet må være godkjent for å melde seg til eksamen.
Vurderingssemester	Det er eksamen hvert semester. Obligatoriske aktiviteter må være godkjent for å avlegge eksamen.

Karakterskala	Ved sensur av emnet vert karakterskalaen A-F nytta
Undervisningsstad**	Bergen
Emneevaluering**	Studentane skal evaluere undervisninga i tråd med UiB og instituttet sitt kvalitetssikringssystem.
Kontaktinformasjon	Forelesar og Administrativ kontaktperson finn du på Mi side, kontakt ev studiekonsulenten på instituttet.

Emnekode	**BIF101**
Namn, nynorsk	**Organismebiologi for fiskehelse og havbruk**

Namn, bokmål	Organismebiologi for fiskehelse og havbruk
Namn, engelsk	
Studiepoeng	10
Undervisningssemester	Vår. Emne har eit avgrensa tall på plassar og inngår i undervisningsopptaket
Undervisningsspråk	Norsk
Studienivå	Bachelor
Institutt	Institutt for biologi
Krav til studierett	For oppstart på emnet er det krav om ein studierett knytt til profesjonsstudium i fiskehelse, bachelorprogram i havbruk/siving havbruk og sjømat, samt at du oppfyller ev. opptakskrav.
Innhald	Mål for emne er å gi en oversikt over livets opprinnelse, systematikk og evolusjon. Studenten vil bli presenteret for generelle bygningstrekk hos sentrale organismegrupper via forelesninger og laboratorium øvelser. Klassiske dissekerings- og mikroskoperingsteknikker vil bli brukt til å demonstrere morfologiske strukturer og biosystematiske detaljer hos utvalgte dyr. Mikrobielle detekteringsmetoder vil bli brukt til å karakterisere og identifisere utvalgte prokaryote organismer. Emnet inkluderer et omfattende laboratoriekurs og et feltkurs.
Læringsutbytte	Etter fullført emne skal studenten: 1. ha en grunnleggende forståelse av hvordan organismene har utviklet seg over tid gjennom jordens historie. 2. kunne rekonstruere hvordan enklere livsformer har utviklet seg til mer komplekse og flercellede livsformer 3. ha en oversikt på inndelingen av hovedgrupper i livets tre (somener, rekker og fyla). 4. ha kjennskap til diversitet i de ulike hovedgruppers morfologi og kjennetegn 5. emnet skal gi kunnskap om hovedgruppers unike kjennetegn 6. anvende denne kunnskapen til å forstå de enkelte gruppers biosystematiske plassering, evolusjonsforløp og slektskap 7. ha kjennskap til enkelte basale metoder som brukes for å identifisere og klassifisere sentrale organismegrupper. 8. Gjennom feltkurset ha kjenneskap til viktige oppdrettsarter, deres biologi, oppdrettsmetoder og helse
Tilrådde forkunnskapar	BIF100, BIO100
Krav til forkunnskapar	Ingen
Fagleg overlapp	BIO101 6 sp.
Undervisning og omfang	
Obligatoriske arbeidskrav	Deltakelse på laboratoriekurs, feltkurs og godkjent lab- og feltjournal. Obligatorisk aktivitet er gyldig i seks semester.
Vurderingsform	Skriftlig avsluttende eksamen 4 timer, lab- og feltjournal må være godkjent for å få gå opp til avsluttende eksamen
Vurderingssemester	Det er ordinær eksamen hvert semester. Obligatoriske aktiviteter må være godkjent for å avlegge eksamen.
Karakterskala	Ved sensur av emnet vert karakterskalaen A-F nytta.
Undervisningsstad**	Bergen

Emneevaluering**	Studentane skal evaluere undervisninga i tråd med UiB og instituttet sitt kvalitetssikringssystem.
Kontaktinformasjon	Emneansvarleg og Administrativ kontaktperson finn du på Mi side, kontakt ev studiekonsulenten på instituttet.

Emnekode	BIFXXX
Namn, nynorsk	Havbruksteknologi

Namn, bokmål	Havbruksteknologi
Namn, engelsk	
Studiepoeng	10
Undervisningssemester	Vår
Undervisningsspråk	Norsk
Studienivå	Bacehlor/Master
Institutt	Institutt for biologi
Krav til studierett	*For oppstart på emnet er det krav om ein studierett knytt til profesjonsstudium i fiskehelse, bachelorprogram i havbruk/siving havbruk og sjømat, samt at du oppfyller ev. opptakskrav.*
Innhald	Emnet vil dekke ulike tema innan havbruksteknologi knytt opp mot fisken sin biologi, velferd og helse. Fokus er på samspelet mellom fisken sine krav til miljø for normal vekst og utvikling og korleis ein legg til rette for eit optimalt oppdrettsmiljø gjennom teknologiske løysingar. Aktuelle tema er m.a. tettheit og straum i oppdrettseininga, det fysisk-kjemiske grunnlaget for vasskvalitet (gassar, metall, pH), betring av råvasskvalitet, transport av fisk, stress, opne og lukka system i sjø, fôr og fôring. Emnet vil innehalde ein gjennomgang av praktiske aspekt og teknologiske løysingar som kan gi betre oppdrettsmiljø og vasskvalitet, og korleis dette påverkar fisken si velferd og helse.
	Etter å ha fullført emnet BIO xxx ´Havbruksteknologi´ skal studentane 1. ha ei grundig forståing av kritiske faktorar i høve til teknologiske løysingar i oppdrett, og korleis desse verkar inn på utvikling, vekst, helse og velferd hos oppdrettsfisk. 2. kjenne til kva faktorar som avgrensar produksjonen av fisk i eit system, og skal ha innsikt i praktiske og teknologiske løysingar for å sikre vasskvaliteten (både ferskvatn og sjøvatn), kva avgrensingar som ligg i tettheit og vasstilførsel, risiko og tekniske løysingar ved transport, og teknologi for produksjon av settefisk og matfisk. 3. Integrert i forståinga av miljøfaktorane skal studentane ha innsikt i dei fysiologiske reaksjonane i fisken på sub-optimale miljøtilhøve (patofysiologi). 4. Gjennom å skrive og presentere ei semesteroppgåve skal studentane skaffe seg djupare innsikt i utvalde tema, og skaffe seg erfaring i ferdigheiter i å presentere eit vitskapeleg spørsmål til medstudentane.
Tilrådde forkunnskapar	BIF 100, 101, BIO 213, Phys101
Krav til forkunnskapar	Ingen

Fagleg overlapp	Ingen
Undervisning og omfang	
Obligatoriske arbeidskrav	Semesteroppgåve
Vurderingsform	Munnleg eksamen (50%) og semesteroppgåve (50%)
Vurderingssemester	Vår
Karakterskala	Ved sensur av emnet vert karakterskalaen A-F nytta
Undervisningsstad**	Bergen
Emneevaluering**	Studentane skal evaluere undervisninga i tråd med UiB og instituttet sitt kvalitetssikringssystem.
Kontaktinformasjon	Emneansvarleg og Administrativ kontaktperson finn du på Mi side, kontakt ev studiekonsulenten på instituttet.

BIO/HiB/NHH xxx Økonomi i havbruks- og sjømatnæringen (nytt emne)

Mål, innhald og læringsutbytte (kort)

Emnet vil dekke ulike tema innan økonomi i havbruks- og sjømatnæringen. Sentralt i emnet vil vere verdikjede havbruk, der studentane skal forstå samspelet mellom dei ulike ledda i kjeda, korleis ein set verdi på dei ulike innsatsfaktorane i produksjonen, m.a. i høve til dei ramane styresmaktane set, og som samla skal munne ut i ei forståing av korleis ein etablerar og driv ei lønsam havbruksverksemd. Vidare skal emnet skape ei forståing for marknaden for sjømat, og gjere studentane i stand til å analysere viktige sider ved denne marknaden, for slik å foreslå og setje i verk tiltak i verksemder innan m.a. produksjon og prosess.

BIO/NHH/HiB xxx Leiing i havbruks- og sjømatnæringen (nytt emne)

Mål, innhald og læringsutbytte (kort)

Emnet vil dekke ulike tema innan leiing og teorien bak avgjerder i havbruks- og sjømatnæringen. Eit sentralt tema i emnet vil vere å forstå korleis havbruks- og sjømatverksemder vert leia, kva prosessar som er kritiske for å ta dei rette avgjerdene, og korleis ramane som styresmaktane set og forholdet til samfunnet ikring påverkar kva avgjerd som er rett. Vidare skal emnet gjere studentane rusta til å setje seg inn i viktige forhold knytt til styring og strategi for ei havbruksverksemd, der dei biologiske, økologiske, økonomiske og marknadsmessige føresetnadene for vekst i verksemda vert vurderte og balansert i høve til ei rett avgjerd. Eit sentralt element i alt leiarskap er kommunikasjon med medarbeidarar og i høve til styresmaktar, og kurset vil førebu studentane til å sikre at alle viktige synspunkt kjem fram i høve til å treffe den rette avgjerda, både i verksemda, og vis a vis styresmaktane.

BFH 300/301 (Forskings- og) profesjonsutøving

Mål, innhald og læringsutbytte (kort)

Målet med emnet er å gje studentane praktisk innsyn i korleis ei havbruksverksemd vert drive, kva prosessar som til ein kvar tid krev tid, innsats og avgjerder. Emnetvert organisert som ein utplassering i ei havbruks- eller sjømatverksemd, der studenten skal ta del i viktige sider ved arbeidet i verksemda, og skaffe seg praktisk erfaring frå slikt arbeid. Ein vil leggje vekt på at studentane tek del i både det praktiske arbeidet knytt til sjølve produksjonen, på eit havbruksanlegg eller i ei sjømatverksemd på land, og likeeins at studentane får ta del i oppgåver i verksemda i høve til strategi, leiing, avgjerder, økonomi, marknad og kommunikasjon. Utplasseringa skal godkjennast på førehand, og studenten skal skrive ei rapport frå opphaldet, og leggje denne fram for medstudentane som ein obligatorisk del av emnet.

Vedlegg 1 Oversikt over behandlingsorganer, samt tidspunkt for og innhold i vedtak & mandat for relevante styrer, råd og utvalg

Programstyret ved Institutt for biologi	Saksliste: 24.09.2015
Instituttrådet ved Institutt for biologi	Saksliste: 29.09.2015[1]
Studiestyret ved Det matematisk- naturvitenskaplige fakultet	Saksliste: 28.10.2015
Fakultetsstyret ved Det matematisk-naturvitenskaplige fakultet	05.11.2015

Mandat for relevante styrer, råd og utvalg

Mandat for Programstyret ved BIO:

Sammensetning
Programstyret består av faglige representanter som dekker bredden i studieprogrammene, samt to studentrepresentanter. De faglige representantene er ledere for undervisningsgruppene ved instituttet, og Programstyret ledes av instituttets undervisningsleder. Undervisningsleder er faglig koordinator og leder for undervisning og studietilbud ved instituttet, delegert fra instituttstyrer. Undervisningsleder representerer instituttet i fakultetets studiestyre.

Administrativ studieleder er programstyret sekretær, og har sammen med studieseksjonen administrativ ansvar for instituttets undervisning og studietilbud.

Mandat
Programstyret har ansvar for driften av instituttets undervisning og utdanning. Dette innebærer:

- Ansvar for instituttets totale emne- og programportefølje
- Ansvar for kontakt/kommunikasjon med andre programmer instituttet deltar i
- Gi råd til instituttleder i saker som angår emnetilbudet og studieprogrammene
- Studieplanfastsettelse (hvilke emner inngår i programmene) og studieplanendringer.
- Ansvar for faglig helhet og samordning innad i programmet. Herunder planlegging av timeplaner/koordinering av arbeidsbyrdene i parallelle emner gjennom semesteret for studenter og ansatte.
- Ansvar for disponering av ressurser i form av midler over undervisningsbudsjettet og undervisningskrefter , i samråd med instituttleder
- Kontinuerlig evaluering og utvikling av instituttets studietilbud
- Ansvar for oppfølging av arbeidet til undervisningsgruppene
- Samarbeid med involverte institutter og enheter

Drift av studieprogram og emner:

- Faglig ansvar for overgangsordninger fra andre studier etc., herunder å vurdere opptaksgrunnlag og innpassing
- Internasjonalisering/utvekslingsavtaler for studentene på instituttets program
- Opptak: foreslå og begrunne opptaksrammer, foreslå kvantitative og kvalitative opptakskrav, foreslå rangeringsregler og gjennomføre opptaket (mastergrad).
- Utarbeide og administrere rutiner for semesterrapportering
- Administrer regler for innlevering og vurdering av masteroppgaver
- Kvalitetssikring og utvikling av undervisnings- og vurderingsformer i studietilbudet som helhet i tråd med UiBs retningslinjer fastlagt i kvalitetshåndboken
- Sørge for evaluering av studietilbudet
- Miljøskapende tiltak. Ansvar for mottak av nye studenter og at studentene til en hver tid er ivaretatt.
- Rekruttering og profileringsarbeid

Mandat for Instituttrådet ved BIO:
http://biologi.uib.no/Sakslister/Instituttraadet/2009/Instituttraadsmandat.pdf

Mandat for studiestyret ved MN-fakultetet:
http://www.uib.no/sites/w3.uib.no/files/attachments/mandat_studiestyre_2014.pdf

[1] Også behandlet på sirkulasjon i etterkant av møtene.

Fakultetsstyret ved MN-fakultetet – regler for fakultetsorganene

Vedlegg 2 Organisasjonskart over fakultetets styringsstruktur

Vi viser til fakultetets nettsider: http://www.uib.no/matnat/52902/organisasjon-og-ledelse

Studieplan for Integrert masterprogram i havbruk og sjømat – HAVSJØ (sivilingeniør)

Godkjenning:

Studieplanen er godkjend av:

Universitetsstyret: ……(dd.mm.år)
Programstyret: ……24.09.2015……(dd.mm.år)
Det matematisk-naturvitskaplege fakultet: ……(dd.mm.år)

Studieplanen vart justert: ……(dd.mm.år)

Evaluering:

Studieprogrammet vart sist evaluert: ……(dd.mm.år)
Neste planlagde evaluering: ……(dd.mm.år)

FS-rader	Overskrift	Standardsetningar og rettleiing	
		Norsk	**English**
	Namn på studieprogrammet - bokmål - nynorsk Name of the programme of study	Integrert masterprogram i havbruk og sjømat (sivilingeniør)	Integrated master's programme in aquaculture and seafood
	Namn på studieretningar - bokmål - nynorsk Name of the specializations		
SP_GRADEN	**Namn på grad** Name of qualification	Master i havbruk og sjømat (sivilingeniør)	Master of Science in aquaculture and seafood
SP_OMFANG	**Omfang og studiepoeng** ECTS credits	Masterprogrammet i havbruk og sjømat har eit omfang på 300 studiepoeng og er normert til 5 år.	Five years of full-time study, where the normal workload for a full-time student is 60 credits for one academic year.
SP_FULLDEL	**Fulltid/deltid** Full-time/part-time	Fulltid	Full-time
SP_SPRAK	**Undervisningsspråk** Language of instruction	Norsk	Norwegian
SP_START	**Studiestart - semester** Semester	Haust	Autumn
SP_INNHOLD	**Mål og innhald** Objectives and content	Studieprogrammet skal gi studentene bred kompetanse innen sentrale tema for havbruks- og sjømatnæringen. Programmet er bygd opp slik at kandidatene skal utvikle evnen til å tenke hele verdikjeden i sammenheng og kunne ta fornuftige beslutninger ut fra en helhetsvurdering. Innovasjon, nytenkning og entrepernørskap vil vektlegges. Sentralt i studieprogrammet står biologien til artene i havbruk, herunder kunnskap om ernæring, reproduksjon, tidlig utvikling, vekst og kjønnsmodning. Videre skal kandidaten få innsikt i avlsarbeid, fiskehelse, havbruksteknologi og produksjon, optimalisering av produksjonsprosessen, kvaliteten på produktet, foredling og mikrobiologi. I forhold til utøvelsen av virksomhet i havbruks/sjømatnæringen skal kandidaten ha kunnskaper om økonomi, ledelse, salg, marked, markedsføring, ulike kulturer og kommunikasjon. Gjennom masteroppgaven (fortrinnsvis 60 stp, men også 30 stp + 30 stp kurs er mulig) skal kandidaten bl.a. utvikle spesialisert innsikt i et tema av vesentlig betydning for havbruks- og sjømatnæringen. Masteroppgaver kan gis f.eks. i samspillet mellom biologi og teknologi, innenfor optimalisering av prosesser, kvalitet på produktet, og marked. Gjennom	

		arbeidet med masteroppgaven, samt kurs og praksis i masterstudiet, vil kandidaten få dyp innsikt i fagområdets vitenskapelige teori og metode, denne erfaringen og kunnskapen vil gjøre kandidaten i stand til i neste omgang å anvende kunnskapen og analysere problemstillinger på nye områder innenfor havbruks- og sjømatnæringen. Programmet skal utvikle studentenes evne til å tenke hele havbruks- og sjømatverdikjeden i sammenheng, og med bakgrunn i vitenskapelige teorier, metoder og fortolkninger utvikle evnen til å løse relevante utfordringer for næringen. I en kunnskapsbasert og innovativ næring som havbruks- og sjømatnæringen vil studiet vektlegge evne til innovasjon, nytenkning og entreprenørskap. Studiet vil videre gi kandidaten ferdigheter i selvstendig arbeid. Dette sikres bl.a. gjennom arbeidet med masteroppgaven og gjennom utplassering og praksis i havbruks- og sjømatbedrifter. Integrert i masterutdanningen ligger også utvikling av en kritisk holdning til informasjon, og evnen til å trenge dypere ned i forskningen bak informasjonen. Selvstendighet og evne til kritisk tenkning er to av hovedpilarene i en mastergradsutdanning, og studiet vil utvikle kandidatens ferdigheter på disse områdene som en basis for å forholde seg til og strukturere informasjonen i et faglig resonnement. Mastergradsutdanningen har som hovedsiktemål å gi kandidaten den nødvendige kunnskap og ferdigheter til å arbeide selvstendig med et forskningsprosjekt under veiledning, og etter hvert ut fra egne kunnskaper og erfaringer. Et siving.-studium innen havbruk og sjømat gir kandidaten viktige generelle ferdigheter og kompetanse. Det vektlegges i egne kurs i studieløpet både fag-, yrkes- og forskningsetiske problemstillinger som gjør kandidaten rustet til å møte denne type problemstillinger i arbeidslivet. Studiet vektlegger innovasjon og entreprenørskap, bl.a. gjennom egne kurs på disse områdene, med siktemål å gi kandidaten bakgrunn og verktøy for nytenkning og utvikling på området. Et integrert masterstudium representerer også en trening i formidling, både skriftlig (oppgaven) og muntlig (bl.a. presentasjon av arbeidet), som gjør kandidaten trygg på egne ferdigheter og som sikrer at kandidaten behersker fagområdets uttrykksformer, som regel både på engelsk og norsk. Evnen til kommunikasjon, både innenfor det fagspesifikke, det allmennyttige, og i forhold til publikum med ulik kulturell bakgrunn er viktige ferdigheter for en sjømatkandidat.
SP_UTBYTTE	**Læringsutbyte** Required learning outcomes	Kandidaten skal ved avslutta program ha følgende læringsutbytte definert i kunnskaper, ferdigheter og generell kompetanse: Kunnskaper Kandidaten • har oversikt over sentrale utfordringer og muligheter innenfor havbruks- og sjømatnæringen • har inngående kunnskap om biologisk teori og metode, inkludert biologi, fysiologi, anatomi og økologi til artene i havbruk • skal kunne oppsummere og forklare hvordan oppdrettsaktivitet er knyttet til marin- og kystøkologi og bærekraftig utvikling

		• skal kunne forklare relevansen av generell teori om økonomi, marked og ledelse for aktiviteter i næringen • kan beskrive teknologi av vesentlig betydning for havbruks- og sjømatnæringen • kan bedømme hvordan næringen opererer og blir oppfattet i samfunnet og av forbrukere Ferdigheter Kandidaten kan • bidra til å løse problemer og finne løsninger for havbruks- og sjømatnæringen • bruke relevante metoder for forskning og faglig utviklingsarbeid på en selvstendig måte • gjøre kvantitative beregninger og analyser av økonomiske, biologiske og tekniske forhold med relevans for sjømatnæringen • kommunisere med næringsaktører og har hatt en praksisperiode i næringen Generell kompetanse Kandidaten kan • analysere relevante fag-, yrkes- og forskningsetiske problemstillinger • anvende sine kunnskaper og ferdigheter på nye områder for å gjennomføre avanserte arbeidsoppgaver og prosjekter • gjennomføre vitenskapelige forsøk og analyser og behersker vitenskapelig metode • kommunisere faglige problemstillinger, analyser og konklusjoner med spesialister og til allmennheten • bidra til nytenkning og innovasjon i produksjon av sjømat
SP_OPPTAK	**Opptakskrav** Admission requirements	Opptakskravet til utdanningen er høyeste nivå i matematikk fra videregående opplæring og nest høyeste nivå i fysikk samt kravet til generell studiekompetanse jmf. Forskrift om opptak til Høyere utdanning (eventuelt tilsvarende kvalifikasjoner eller andre opptaksgrunnlag som fremgår av opptaksforskriften fastsatt av departementet § 3-4 i

		Opptaksforskriften).
SP_ANBFORK	**Tilrådde forkunnskapar** Recommended previous knowledge[i]	
SP_OBLIGAT	**Obligatoriske emne** Compulsory units	

V	10. sem.	Masteroppgave (60 stp.) Evt. Masteroppgave (30 stp.) og utplassering (6 mnd., tilsv. 30 stp.)		
H	9. sem.	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS	Utplassering (velg fra Økonomi; Biologi og produksjon; Ingeniør; Produktutvikling; Forvaltning og Økologi; Velferd og etikk) 150 t og 10 ECTS
V	8. sem.	BFH300/301 Forsknings- og profesjonsutøvelse 10 sp, nytt emne)	NHH/HiB: Økonomi, verdikjede havbruk, marked (foretak, produksjon, prosess, markedskunnskap/analyse) (10 sp, nytt emne)	HiB/UiO/Gründerskolen: Innovasjon og entreprenørskap (10 sp)/GRU401 Grunderskolen (10 sp)
H	7. sem.	BIO 382 Akvatisk matproduksjon	Valg: BIO206 Ernæring hos fisk/BIO207 Næringsmiddelmikrobiologi	NHH/HiB: Ledelse, beslutningsteori og – prosesser, styring, strategi, kommunikasjon (nytt emne)
V	6. sem.	BIO 208 Miljøvirkninger av oppdrett (10 sp)	BIO 204a Etikk og velferd hos akvatiske organismer i oppdrett (2 sp)+LAS201/203 Forsøksdyrkurs, fisk (2+6sp)	BIO205 (tilpasset): Rammebetingelser (lovverk, forvaltning), krav, kvalitets- og styringssystemer (10 sp)
H	5. sem.	BIO280 Fiskebiologi I - Systematikk og anatomi (10 sp)	BIO291 Fiskebiologi II – fysiologi (10 sp)	Stat110 Grunnkurs statistikk (10 sp)
V	4. sem.	BIOxxx Havbruksteknologi (10 sp, nytt emne)	BIO103 Cellebiologi og genetikk (10 sp)	Ex.phil. (10 sp)
H	3. sem.	BIO213 Marin økologi (10 sp)	PHYS101 Grunnkurs i mekanikk og varmelære (10 sp)	INF100 Grunnkurs i programmering (10 sp)

		V 2. sem. BIF101 Organismebiologi (10 sp, nytt emne) | Kjem110 Kjemi og energi (10 sp) | Mat102 Brukerkurs II (10 sp) H 1. sem. BIF100 Innføring i fiskehelse og havbruk (10sp, nytt emne) | BIO100 Økologi og evolusjon (10 sp) | MAT101 Brukerkurs I/MAT111 Grunnkurs i matematikk (10 sp) **Tilrådd formulering**: Masteroppgåva: XXX399 Masteroppgåve i havbruk og sjømat er på 60 studiepoeng. Studenten kan i samråd med instituttet velje å skrive ei oppgåva på 30 studiepoeng og ha ein praksisperiode på eit semester (30 sp). Masteroppgåva skal leverast innan en fast frist i slutten av 10.semester, 20. november eller 1. juni.	
SP_VALGFRI	**Tilrådde valgemne** Recommended electives		
SP_REKKEFO	**Rekkefølje for emne i studiet** Sequential requirements, courses	Tilrådd rekkefølje for emna finn du under overskrifta «Obligatoriske emne».	The recommended sequence of the courses in the programme can be found under the heading "Compulsory units".
SP_DELSTUD	**Delstudium i utlandet** Study period abroad	Opphald ved lærestadar i utlandetgo slaø avtalast med rettleiar, og skal vere ein del av masteravtalen.	You can plan study periods abroad in consultation with your supervisor as a part of the master agreement.
SP_UNDMETO	**Undervisningsmetodar** Teaching methods	Sjå søknad	
SP_VURDRI	**Vurderingsformer** Assessment methods	Sjå søknd	
SP_K-SKALA	**Karakterskala** Grading scale	Ved UiB er det to typar karakterskalaer: «bestått/ikkje bestått» og bokstavkarakterar på skalaen A-F. For masteroppgåva nyttas bokstavkarakter. Karakterskala for kvart emne som inngår i masterprogrammet er omtalt i emnebeskrivinga.	At UiB the grades are given in one of two possible grading scales: passed/failed and A to F. The master's thesis will be graded A to F. The grading scale for each course is given in the course description.

SP_VITNEM	**Vitnemål og vitnemålstillegg** Diploma and Diploma Supplement	Vitnemål på norsk med vitnemålstillegg (Diploma supplement) på engelsk vert utstedt når krava til graden er oppfylte.	The Diploma, in Norwegian, and the Diploma Supplement, in English, will be issued when the degree is completed.
SP_VSTUDIE	**Grunnlag for vidare studium** Access to further studies	Masterstudiet gir grunnlag for opptak til forskarutdanninga (ph.d.-grad). For å vere kvalifisert for opptak til forskarutdanninga må gjennomsnittskarakterane på emna i spesialiseringa i bachelorgraden, emna i mastergraden samt masteroppgåva vere C eller betre. Ein må normalt vere tilsett i ei stilling som stipendiat for å få opptak.	To be eligible for admission to the Doctoral education (PhD) the candidate must have completed a master's degree. To qualify for the Doctoral education (PhD) at UiB the average grade for the master's thesis, the Master's degree and the bachelor's degree should be at least C. In order to get enrolled you have to be granted a fellowship for doctoral training.
SP_ARBLREL	**Relevans for arbeidsliv** Employability	*sjå søknd*	*Give examples of employability*
SP_EVALUER	**Evaluering** Evaluation	Masterprogrammet vert kontinuerlig evaluert i tråd med retningslinene for kvalitetssikring ved UiB. Emne- og programevalueringar finn ein på kvalitetsbasen.uib.no	The programme will be evaluated according to the quality assurance system of the University of Bergen.
SP_AUTORIS	**Skikkavurdering og autorisasjon** Suitability and authorization	*Fylles ut ved behov*	*To be filled in if necessary*
SP_FAGANSV	**Programansvarleg** Programme committe	Programstyret har ansvar for fagleg innhald og oppbygging av studiet og for kvaliteten på studieprogrammet.	The programme committee is responsible for the academic content, the structure and the quality of the program
SP_ADMANSV	**Administrativt ansvarleg** Administrative responsibility	Det matematisk-naturvitskaplege fakultet ved Institutt for biologi har det administrative ansvaret for studieprogrammet.	The Faculty of Mathematics and Natural Sciences by the Department of [..], holds the administrative responsibility for the programme.
SP_KONTAKT	**Kontaktinformasjon** Contact information	Ta gjerne kontakt med studierettleiar på programmet dersom du har spørsmål: Studie@bio.uib.no	Please contact the academic adviser for the program if you have any questions: Studie@bio.uib.no

Avtale om praksis i fiskehelse knyttet til emnet

BIO376 Innføringskurs i praktisk fiskehelsearbeid

1. Parter

Avtale om praksisopplæring i fiskehelse mellom:

i) Bedrift…… (heretter kalt bedriften)

Kontaktperson:……

ii) Institutt for biologi (BIO), Universitetet i Bergen

Kontaktpersoner: Ivar Hordvik, (ivar.hordvik@bio.uib.no) tlf. 55 58 45 38

Tommy Strand (tommy.strand@bio.uib.no) tlf. 55 58 44 09

iii) Kandidat:

2. Formål.

Kandidaten/studenten skal av bedriften gis praksis og veiledning innen et utvalg av følgende temaer:

Anleggsbesøk:
- Rutinebesøk evt. akuttbesøk på settefiskanlegg og matfiskanlegg med obduksjoner og andre relevante undersøkelser.
- Mikroskopi av ferske preparater fra hud og gjeller med tanke på parasitter.
- Lusetelling på matfiskanlegg.
- Vurdering av vaksinebivirkninger i forhold til Speilbergs skala.
- Vurdering av produksjonslidelser som katarakt, gjellelokksforkortning, korthaler etc.
- Skriving av besøksrapporter fra anleggsbesøk.
- Orientering om aktuelle smittsomme sykdommer og andre lidelser i det aktuelle området. Og gjennomgang av klinikk, obduksjonsfunn, diagnostisering og evt. profylakse/behandling av disse.
- Utstedelse av helseattest.
- Gjennomgang av praktiske smitteforebyggende tiltak, med eksempler fra en eller flere konkrete problemstillinger.

Legemidler:
- Gjennomgang av reseptskriving, bestilling av vaksiner og utfylling av skjema for spesielt godkjenningsfritak.
- Orientering om erfaringer ved bruk av ulike legemidler og vaksiner.

Prøvetaking:
- Uttak, dyrking og vurdering av bakteriologiske prøver.
- Uttak av histologiske prøver.
- Blodprøvetaking.
- Forsendelse av prøver.
- Vurdering av prøvesvar fra laboratorium.

Lovverk:

- Orientering om viktige lover og forskrifter som har betydning for den daglige driften.

Felter som kan behandles om mulig:
- Analyse av ferskvannsprøver i forhold til vannkjemi.
- Analyse av sjøvannsprøver i forhold til mikromaneter evt. alger.
- IPN-hurtigtest.
- Preparering og vurdering av histologiske snitt.
- Uttak av andre prøver for eksempel for virusdyrking, PCR-analyse etc.
- Uttak av hygieniske prøver på fiskeribedrift/slakteri, samt vurdering av forebyggende og forbedrende hygieniske tiltak i slike bedrifter.
- Miljøundersøkelser

3. Omfang og periode

Kandidatene skal gjennomføre praksis i totalt 10 dager i bedriften i følgende periode(r)/dager

Fra dato: Til dato:

4. Plikter

Kandidaten plikter:
- Overholde arbeidstid og inngåtte avtaler vedr. denne, samt utføre avtalte oppgaver etter beste evne
- På forhånd gjøre seg kjent med bedriften og arbeidsoppgaver knyttet til praksisen
- Følge og overholde instruksjoner vedrørende sikkerhetsregler på bedriften
- Overholde eventuell taushetsplikt knyttet til praksisen
- Kandidaten skal skrive en arbeidslogg som skal leveres til bedriften og til Institutt for biologi etter endt praksis
- Kandidaten skal gi en muntlig presentasjon av sin praksisopplæring i et felles seminar ved Institutt for biologi i midten av juni/desember(stryk det som ikke passer) 20……(sett inn årstall)

Bedriften plikter
- Å ta ansvar for kandidaten ved legge til rette for og involvere kandidaten i aktuelle arbeidsoppgaver knyttet til punkt 2 i avtalen.
- Opplyse om aktuelle sikkerhets- og arbeidsregler, samt avtale arbeidstidsbestemmelser for praksisen
- Gi nødvendig veiledning og tilbakemelding i forhold til de arbeidsoppgaver som skal gjennomføres.
- Signere og godkjenne arbeidsloggen som kandidaten utarbeider under praksisperioden.

5. Kompensasjon for praksisveiledning

Institutt for biologi vil kompensere bedriften med kr. 5000,- pr kandidat for praksisveiledning i 10 arbeidsdager.

Faktura må angi bestillerkode 126000 og merkes BIO 376 Fiskehelse - Praksisperiode.
Faktura sendes til:

Felles fakturamottak
Universitetet i Bergen
Postboks 7803

5020 Bergen

6. Reiseutgifter

BIO vil dekke kandidatens merutgifter til reise til og fra praksissted og gi støtte til opphold på kr. 150,- pr døgn for kandidater som må overnatte (i henhold til gjeldende regler for feltarbeid.) Eventuelle reiseutgifter i praksis vil også bli dekket.

7. Forsikring

Studenter har ingen forsikring gjennom studiestedet. Videre er studenter i praksis å anse som arbeidstakere i forhold til yrkesskadeforsikringsloven (LOV-1989-06-16-65). Praksisvirksomheten har derfor ansvar for at kandidaten har yrkesskadedekning mens praksisoppholdet varer. Nærmere informasjon om forsikring finnes her: http://www.uhr.no/documents/Rapport_forsikring.pdf

Dato:

Signatur:

For BIO For Bedriften Kandidat

Norwegian Centres of Expertise
NCE Seafood
Innovation Cluster

Letter of commitment

I hereby confirm that the Norwegian Center of Expertise, The Seafood Innovation Cluster supports the proposal of the new educational program, submitted by Professor Sigurd Steffansson, from the Institute of Biology.

NCE Seafood Innovation Cluster represents 70 industry players and world leading producers of Atlantic Salmon and Seafood, supplying healthy and sustainable seafood to the global community. In June 2015, due to its unique global position and its important contribution to Norwegian value creation, the cluster was granted the status of a Norwegian Centre of Expertise (NCE), by the Norwegian Government. The Seafood Innovation Cluster has already formalized a long-term collaboration commitment with the University of Bergen.

As a Norwegian Center of Expertise, knowledge collaboration is one of the main important strategic pillars to strengthen long-term knowledge capacity within the Center. Increased knowledge of the various business operations through the entire seafood value chain is of great interest. The main responsibility of the Seafood Innovation Cluster in the proposal has been to provide relevant industrial input during the development of the course, contribute with relevant internships and to support the definition of relevant business projects for the students.

Bergen, 10th of October, 2015

Sincerely,

Tanja Hoel

TANJA HOEL
Managing Director
Norwegian Center of Expertise,
The Seafood Innovation Cluster

Vedlegg 6

http://vedlegg.uib.no/?id=5786dcd13b34ccf5814a359f511f6abc

Evaluation of Marine Research at the University of Bergen (UiB)
Self-Assessment Report 2004-2013

Department/centre at UiB to be included in the evaluation:

The Department of Biology (BIO) is one of eight departments at UiB's Faculty of Mathematics and Natural Sciences (MN) at UiB. Marine Research represents one of two major focus areas of our university. While BIO is currently organised into 13 research groups, 12 of these perform marine-related research. One of the groups is the cross disciplinary group that constitutes the Centre of Geobiology (a Center of Excellence) which is defined to be a separate evaluation unit in this process. Hence 11 of the 12 research groups with marine activities have been included in BIO's self-assessment. The Sea Lice Research Centre, a Centre for Research-based Innovation is part of the Fish Disease Research group, but as SLRC is also a separate evaluation unit, the SLRC activities are not reported in BIO's self-assessment.

For the purpose of this report and ease of presentation, we have categorized the groups under 4 major research topics (Fig. 1). With the department's marine biological focus in mind, a wide breadth of expertise exists. While divergent, these also share commonalities, upon which a multitude of alternative categorizations are possible. The division presented here however was chosen to reflect the department's fundamental shift from traditional organism and biome-based studies towards more process and system-oriented disciplines such as developmental biology, evolutionary biology and ecology. This new, integrative biology approach encourages interdisciplinary collaboration with the natural sciences such as physics, chemistry, geology and medicine while emphasizing mathematics, computational biology and bioinformatics. More importantly, it generates fundamental new knowledge to help resolve today's major global challenges (i.e. marine health, climate change etc.). It should be noted this categorization in no way reflects a ranking or prioritization of the research groups, topics or individual researchers.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**
- **Marine Microbiology Research Group (MMRG)**
- **Theoretical Ecology Research Group (TERG)**
- **Aquatic Behavioral Ecology Research Group (ABERG)**

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**
- **Environmental Toxicology Research Group (ETRG)**
- **Ecological and Environmental Change Research Group (EECRG)**

AQUACULTURE AND FISH HEALTH

- **Fisheries Ecology and Aquaculture Research Group (FEARG)**
- **Fish Disease Research Group (FDRG)**
- **Fish Immunology Research Group (FIRG)**

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**

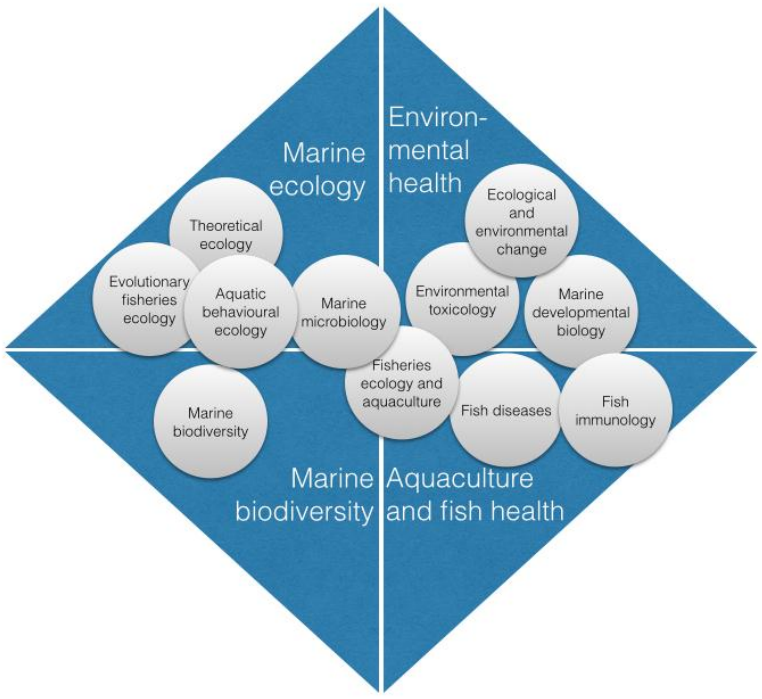


Figure 1. Schematic representation of BIO's research groups involved in Marine Research and where the groups belong in relation to the 4 main thematic areas presented in this self-assessment report. As illustrated, a large degree of overlap exists across the research groups as well as the thematic areas.

Introduction and general instructions

The present evaluation is initiated by the University of Bergen (UiB) in order to have a systematic review and assessment of the strategic priority area marine research at UiB. Whereas marine research has been a strategic priority at the university since the 1980s, the focus of the evaluation is on the last ten-year period (2004-2013).

The evaluation is conducted by an international evaluation panel, appointed by UiB, with secretarial help from NIFU. The panel is mandated to evaluate the quality and relevance of the scientific production and educational programmes (at master and doctoral level) within marine research at UiB, as well as the dissemination activities, cooperation with institutions in UiB's periphery (*randsoneinstitusjoner*) and international activities of the associated academic communities.

In order to do so, we need a wide set of information about the activities of the units conducting marine research at UiB. Against this background, we ask the departments/centres involved in marine research to fill in this self-assessment report template. The self-assessment template follows the Terms of Reference (ToR) for the evaluation. Each item in the template quotes the ToR-questions to be addressed, and asks for relevant information about the unit/its activities in the ten-year period to be evaluated, as well as the unit's experiences and assessments.

Your department/centre should return only one self-assessment report. However, if you have several major research topics/research groups within marine research, we ask you to provide information specified by research topic/research group where this is relevant.

To avoid double counting, please coordinate your reporting with other departments/centres involved in marine research at UiB. As a general rule, you should report the activities of researchers holding a main position at your unit.

The self-assessments will, together with other data sources, form the basis for a review and assessment of the strategic priority area marine research at UiB as a whole. There will not be separate evaluations of the research units.

Please send the completed self-assessment to NIFU by 11 August 2014 (siri.aanstad@nifu.no). The self-assessments will not be published or distributed to other parts of UiB.

1 Background information: thematic areas and resources

Please use the boxes in each section to specify your activities and views.

a) Thematic areas of marine research: In the table below, list your major research topics/research groups and projects (2004-2013).

Major research topics/Research groups (2004-2013)	**Major research projects (2004-2013)**
FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS	
Evolutionary Fisheries Ecology Research Group	**2006–2010**, Norwegian Research Council, "Sustainable harvesting of marine resources: interactions between demographic, ecological and evolutionary effects of fishing", NOK 6,458,000 (Heino) **2007–2011,** Bergen Research Foundation, "Evolutionary Fisheries Ecology", NOK 8,000,000 (Heino) **2008–2011,** Norwegian Research Council, "Socio-economic effects of fisheries-induced evolution", NOK 9,023,000 (Heino) **2012–2015**, Norwegian Research Council, "An experimental evaluation of fisheries induced evolution", NOK 11,386,000 (Heino) **2011-2012:** Life-history strategies in an extreme marine environment: behavioural and physiological adaptations. UiB FRIFORSK; 300.000 NOK (Salvanes) **2011-2012:** Behavioural and molecular mechanisms behind the Benguela goby's (*Sufflogobius bibarbatus)* adaptation to naturally occurring hypoxia. The Meltzer-foundation; 400.000 NOK (Salvanes) **2010-2011:** *Causes of the Benguela goby's success among jellyfish and toxic sediments in a heavily overfished ecosystem*; The Meltzer-foundation; 300.000 NOK (Salvanes) **2007-2010:** *Gobies and hake in the hypoxic waters of the Benguela up-welling current*; The Norwegian Research Council; 1.5 mill NOK (Utne-Palm, Salvanes, Gibbons, Kaartvedt, Nilsson, Currie) **2003-2005**: Ecology of the goby *Sufflogobius bibarbatus* in the Benguela upwelling ecosystem; Norway and South Africa Research Councils; NOK 1.0 mill. (Salvanes, Utne-Palm, Gibbons, Currie)

Marine Microbiology Research Group Main topic: • *Microbial Ecology*	BASICS: Bacterial single-cell approaches to the relationship between diversity and function in the Sea. EU 2002-2005. MIRACLE: Microbial Marine Community Diversity: from culture to function. EU 2002-2005. The Deep Biosphere of the Ocean Crust. RCN 2004-2006 *** Patterns in Biodiversity: Blooms versus stable coexistence in the lower part of marine food webs. (Strategic University Programme). RCN 2004-2007. Bioprospecting Huge Marine Algal Viruses. RCN 2004-2007. METAOCEANS: Meta-analysis of the ocean. EU 2005-2009. AEROBACTICS: Assessment of the quantity, identity, viability, origin and dispersion of airborne micro-organisms for application in crisis management tools. EU 2006-2009. MICROBAIR: Quantification and Characterization of Microbial Communities in Air. RCN 2007-2009. *** PAME Nor: DOC turnover in polar microbial food webs (IPY) RCN 2007-2010. NUTRITUNNEL: 'Nutrient tunnelling' and other alternative pathways for mineral nutrients through the microbial food web to copepods. RCN 2008-2010. INTERACT: Interactions between eutrophication, oil and contaminants in marine ecosystems. RCN 2008-2011. EPOCA: European Project of Ocean Acidification. EU 2008-2011. MERCLIM-BIO - Marine Ecosystem Response to a changing CLIMate. RCN 2008-2011. VIPMAP - Viral lysis and programmed cell death in marine phytoplankton. RCN 2008-2011. HAPTODIV: Diversity and Dynamics of Marine Haptophytes. RCN 2009-2012. *** MESOAQUA Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean. EU 2009-2012. *** MINOS: ERC Advanced Investigator Grant. MIcrobial Network OrganiSation. EU 2011-2016. BallastFlow: Real-time monitoring of ballast water by Flow Cytometry. RCN 2011-2014. PHAEONIGMA: A novel cross-disciplinary approach to solve an old enigma: the food-web transfer of the mass-blooming

	phytoplankter Phaeocystis. RCN 2011-2014. Arctic Microorganisms: Microorganisms in the arctic: major drivers of biogeochemical cycles and climate change. RCN 2013-2016. OceanCertain: Ocean Food web Patrol – Climate Effects: Reducing Targeted Uncertainties with an Integrated Network. EU 2013-2017. *** MicroPolar: Processes and Players in Arctic Marine Pelagic Food Webs - Biogeochemistry, Environment and Climate Change. RCN 2013-2017. MIRACLES: Multi-product Integrated bioRefinery of Algae: from Carbon dioxide and Light Energy to high-value Specialties. EU 2013-2017. *** *largest, most prestigious projects*

Theoretical Ecology Group Main topic: • *Marine ecosystem dynamics and modelling*	*ETHOFISH – The effect of turbidity and hypoxia on the behaviour coastal marine fishes.* 2002-2005. EU. Team leader of work package 6 Modelling. (2 post-docs, 2 technicians, 3400 KNOK). (Aksnes/Fiksen) *Models of optimal energy allocation, maturation strategies and skipped spawning in cod*. 2002-2005. NFR. 1452 KNOK (1 PhD). (Fiksen) *ADAPT – Adaptation to the ecosystem: Co-evolution of life histories of Calanus and herring in the Norwegian Sea*. 2003-2006. NFR. 1938 KNOK, of total project grant 6200 KNOK (1 PhD). (Giske/Fiksen) *ECOBE – Effects of North Atlantic climate variability on the Barents Sea ecosystem*. 2003-2006. NFR. 2920 KNOK, of total grant 22000 KNOK. Leader of Module 3: Larval and juvenile transport, growth and survival (1 PhD, 1 post-doc). (Fiksen) *CLIMAR – Climate and production of marine resources*. 2004-2006. In charge of the UoB contribution (1 post-doc, 1531 KNOK). (Giske/Fiksen) *EUROCEANS. The loophole hypothesis of anchovy recruitment in Bay of Biscay.* (1 PhD student, 1500 KNOK). (Fiksen) *Sustainable harvesting of renewable resources*. (2006-2010, NFR project, collaboration with IMR). In charge of about 3000 KNOK of total 6450 KNOK (1 PhD, 1 technician, the UoB contribution). (Heino/Jørgensen/Fiksen) FRIMEDBIO: *Trait-based ecosystem models: from individuals to biodiversity in aquatic communities.* (2009-2012). Project leader. 4550 KNOK. Two researchers. (Fiksen/Giske) NFR FRIMEDBIO: *Female infidelity promotes male cooperation in collective predator defense or sharing of resources*. (2009-2012). 7000 KNOK. (Eliassen) Havet og Kysten: *Coastal water darkening causes eutrophication symptoms*. (2009-2010). 2000 KNOK. (Aksnes) EGGVALUE. *Towards operational models of fish eggs and larvae along the Norwegian coast* (2011-2014). 6700 KNOK. (Jørgensen/Fiksen) Nordic Centre of Excellence (NCoE) 2011- 2016: *The Nordic Centre for Research on Marine Ecosystems and Resources under Climate Change* NorMer. Bergen node – 2 PhD students. 5000 KNOK. (Jørgensen/Fiksen) NFR FRIMEDBIO: Promiscuity and the Evolution of Cooperative Neighborhoods. 2013-2017. 8000 KNOK (Eliassen/Jørgensen)

Aquatic behavioral ecology Main topics: • *Fish population biology* • *Spatial dynamics* • *Schooling dynamics and collective behaviour* • *Aquaculture: Behaviour, cognition and welfare* • *Ontogeny and escapees* • *Fish behaviour in relation to fishing gear*	NFR-project "Interactions between wild and farmed Atlantic cod: non-lethal impacts of escapees on wild populations" 2006-2008. (Fernø) NFR-project "Vertical distribution: Hybridisation barrier between escapee and wild cod" 2006-2008. (Fernø) Partner: Strategic program NFR (SFI) "Centre for Research-based Innovation in Sustainable fish capture and Preprocessing technology (CRISP)" 2011-2018. (Fernø) Partner: NFR project "Salmon dynamics: Behaviour and coping of individual salmon in farm environments with fluctuating oxygen and hydrodynamics" 2011-2013. (Fernø) Partner: NFR-project "Exposed farming: Exposed salmon farming in high currents and waves" 2011-2013. (Fernø)
MARINE AND ENVIRONMENTAL HEALTH	
Marine Developmental Biology - Main Topics: • *Smoltification, osmoregulation* • *Early life stages, salmon and marine fish* • *Growth, sexual maturation* • *Digestive function and appetite in developing larval fish* • *Nutritional physiology and growth of teleosts* • *Chromatin and Cell Cycle Dynamics in Urochordates* • *Cellular templating of complex extracellular structures* • *Marine trophodynamics, climate change and environmental monitoring* • *Low trophic marine biomass for feed, biofuel and manufacturing applications* • *Development and function of the visual system in fish larvae.* • *Deep brain photoreception, development and function* • *Skeletal development salmon, skeletal deformities salmon* • *Notochord development, salmon*	NFR 165331 'Environmental impact and molecular regulation of the osmoregulatory gill during parr-smolt transformation in Atlantic salmon', 2005 – 2007 NFR 172504 'Nitric oxide regulation of development in fish: emphasis on the light-brain-pituitary axis and gill during salmon smoltification', 2006 – 2008 NFR 165239 'Sjøvannsinnblanding i intensiv smoltproduksjon: effekter på helse, velferd og risiko for vintersår', 2005 – 2007 NFR 172514 'Moderne settefiskproduksjon av laks - normal utvikling og velferd i intensive oppdrettssystemer', 2006 - 2009 NFR 184997 'Optimal smolt production and post smolt performance in the High North - Seawater intermixing, low temperatures and intensive rearing' (NORSMOLT), 2008 – 2011 NFR 199800 'The smolt probe - novel tools for assessment of smolt quality and marine performance in Atlantic salmon', 2010 – 2012 NFR 217502 'Optimalisert postsmolt: et paradigmeskifte for norsk lakseindustri', 2012 – 2014 NFR 199482 'Cod Development CODE', 2010 – 2014 (Task 4.10. Osmo and ions) NFR 1722630 'Progressive, modern production of juvenile Atlantic cod' (PROCOD), 2006 – 2009 NFR 190469 'Fish welfare assessment through brain function: Impacts of environmental stress on brain plasticity and behaviour', 2009 – 2011 NFR 222215 'The smolt brain model: Unravelling nature´s

	regulation of neural plasticity', 2013 - 2015 NFR 163429 'Optimisation of harvested halibut by lowering maturation, increasing growth and improving flesh quality' 2005 – 2007 NFR 199518 'Early puberty in salmon males in seawater - causes and consequences for hypo-osmoregulatory ability and welfare', 2010 – 2013 EU, FP7-KBBE-2007-2A, 222719, LIFECYCLE—Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture (01.03.2009 – 28.02.2013) NFR #174229 (2006-07): CodGut - Digestive function in Atlantic cod larvae- effects of intensive and extensive rearing systems and correlation with peaks in mortality NFR #187281 (2008-09): Distended gut syndrome (DGS) in larval Atlantic cod (Gadus morhua) - do the larvae suffer from diarrhea? NFR #190019 (2009-11): GutFeeling. New feeding strategies for Atlantic halibut and cod larvae to increase the output of high quality juveniles in production systems. EU- FP7-KBBE-2007-2A (2009-13): LIFECYCLE. Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture. NFR # 199482 (2010-2014): CODE- a knowledge platform for the early stages of Atlantic cod NFR #165203 (2005-08): Differential protein expression in relation to dietary AA composition: a proteomic approach towards understanding growth in fish Helse Vest & UoB (2005-09): NettMett. Bioactive peptides. NFR #172548 (2006-08): Leptin in fish – exploring the actions of a novel hormone and its role in control of appetite, growth and puberty in Atlantic salmon and cod NFR # 190043 (2009-12): BIOplus. Innovative use of bioactive marine ingredients as strategy to sustain growth in fish farming production and to improve fish flesh quality NFR # 208352 (2011-2014): Integrated amino acid requirement in Atlantic salmon 146653/431 NFR Biotech, 6.2M (2002-06) Developmental Genomics of Oikopleura, a marine architect at the invertebrate/vertebrate transition. (OIKOGEN) 183690/S10 NFR-FUGE, 5.3M (2007-10) Systems biology in the Marine Tunicate Oikopleura dioica 204891/F20 NFR-FRIBIO 4.1M (2011-14) Genome-wide

	chromatin regulatory signatures in an ultra-compact chordate genome 17541/S10 NFR-FUGE, 4.9M (2006-09) Cellular Mechanisms Templating Complex Extracellular Structures via Cellulose Scaffolds: the Oikopleura House 190265/S40 NFR-KMB, 10M (2010-14) Phylogenetic microarrays and high-throughput sequencing: A new tool for biodiversity assessment in Northern Norway 204040/E40 NFR-HK 4.9M (2011-15) Response of pelagic food webs to warmer, acidified oceans. 199624 NFR-FORNY, 1M (2010) Efficient 2nd generation marine feedstock for bio-fuel 209075/O30 NFR-FORNY 1.9M (2011-12) Tunicol: A New Environmentally Friendly Biofuel 217241/030 NFR-FORNY+ 5.8M (2012-14) Tunicol – Environmentally friendly biomass for biofuels and animal feed 226138/030 NFR-BIOTEK2021 3.3M (2013-14) Bioactive peptides in tunicate biomass 236517 NFR-FORNY+3.6M (2104-15) Tunikater, -utvikling av en effektiv høste- og prosessmetode NFR #190019 (2009-11): GutFeeling. New feeding strategies for Atlantic halibut and cod larvae to increase the output of high quality juveniles in production systems NFR # 199482 (2010-2014): CODE- a knowledge platform for the early stages of Atlantic cod Start-up grant University of Bergen Effects on extreme exercise on salmon vertebral column Functional genetics of vertebral organogenesis

Environmental toxicology Main topics: • *environmental pollutants and impacts on marine and Arctic organisms* • *environmental pollutants and human health* • *marine environmental pollutants and obesity-linked disorders* • *mechanisms of action of endocrine-disrupting chemicalsocean and human health*	at MBI 2004- 2009 Effects of produced water on Atlantic cod; Mechanistic studies and biomarker development with proteomics based methods (NFR-PROOF 2005-2007) NFR 164423 Effect of produced water... (gjennom Uni Research AS) 2005-2008 (Goksøyr) NFR 140293 Proteom- og ekspresjonsstudier av biomarkører 2002-2008 (Grøsvik) SFT/6006147 Opptak av kvikksølv og metylkvikksølv… 2006-2007 (Goksøyr) NIFES 159197/I20 Stress genes in the Atlantic cod 2005-2005 (Goksøyr) TotalFinaElf, contract no 2565.02 2003-2006 (Grøsvik) iCod: Integrative environmental genomics of cod (Gadus morhua) (NFR-SUP 2008-2012) EASYRING (ENVIRONMENTAL AGENTS SUSCEPTIBILITY ASSESSMENT UTILISING EXISTING AND NOVEL BIOMARKERS AS RAPID NONINVASIVE TESTING METHODS), EU/QLK-4-CT-202-02286 , 2003-2005 NFR 18188/S30 Nuclear receptor targets for endocrine. 2007-2011. (Goksøyr/Rusten) NFR 192441/I30 iCod:integrative environmental genomics of cod 2009-2012 (Goksøyr/Karlsen) At BIO 2010-2014 “POLARISATION: Polar cod metabolism and disruption by polycyclic aromatic hydrocarbons”. NFR, project no.: 214184 (coordinator: UiT) Do environmental pollutants interact with stress responses? " NFR, project no.: 213076 (coordinator: NVH) NFR 196239/S30 Forurens 3rd Norw.Environmental Tox. 2009-2011 (Goksøyr) NFR 196193 3rd Norwegian Toxicology Symp. 2010-2011 (Goksøyr) 2014-2018 Role of Xenobiotics in Metabolic Diseases: A Translational Approach. NFR FRIPRO Young Research Talents 7,000,000 NOK. 2013 Environmental pollutants and diabetes. Financed by Grieg Foundation. 200,000NOK

	2013-2016 Signaling Impairments GeNerated by Endocrine Disruptors. Environmental Exposures and Health Outcomes programme 6,000,000NOK. 2011-2013: Searching the origin of the insulin resistance syndrome. Environmental Exposures and Health Outcomes programme 2,000,000NOK.

Ecological and Environmental Change Research Group Main Topic: • *Marine Palaeoecology andpalaeoclimate*	PES: Palaeoecological reconstructions of marine soft bottom Ecologic Status and in situ references conditions. Led by Elisabeth Alve, University of Oslo Funded by NFR - 63,100 kr for 2009 and 64,700 kr for 2010 PalaeoDrivers: Quantifying the Drivers of Palaeoecological Change. Led by Richard Telford, University of Bergen. Funded by NFR - 2,781,000 kroner from 2012 to 2015 (877,000 in 2012; 903,000 in 2013; 930,000 in 2014; 959,000 in 2015)
AQUACULTURE AND FISH HEALTH	
Fisheries Ecology and Aquaculture Main Topics: • *Fish population biology* • *Fish nutrition and development* • *Shellfish production* • *Juvenile fish production* • *Animal health and water quality* • *Food quality and traceability* • *Trophic ecology and life history biology* • *Larval fish ecology* • *Climate and environmental impact* • *Otolith growth and composition studies* • *Fisheries ecology and management*	Mare Minimum (2005-) Funding by UiB (BIO, Meltzer foundation (2006 & 2010) and IMR. BioBullets for Enhanced Sustainable Shellfish Yield E!7995 (BESSY). NFR project 228019/O30. EUREKA High Level Group, EUROSTAR project (UK, Norway) 2013-2016 Partner; SEA-on-a-CHIP, Real-time monitoring of SEA contaminants by an autonomous Lab-on-a-chop biosensor. EU-project, Collaborative project FP7-OCEAN-2013 no 614168. 14 partners (RTD, SME), budget 5,7 mill euro. 2014-2017 Bioactive peptides in tunicate biomass (TUNIPEP). Project leader. BIOTEK21, project no 226138/O30 (UiB, IRIS, EWOS, BTO, Uni R), NFR 3 mill nok 2013-2014 New marine biomass, diverse TUNICOL prosjekter fra FORNY programmet med BTO, UIN R og BIO. Herunder to patenter og en anmeldt. 5-6 mill nok, 2011-2014 VAMP: Water quality for marine hatceries. (UiB and SMEs). Vestlandsrådet (1 mill nok). 2011-2012 Partner. REPROSEED: REsearch to improve PROduction of SEED of established and emerging bivalve species in European hatcheries. Proposal acronym: REPROSEED. Funding scheme: Small or medium-scale focused research project. Work programme topic: KBBE-2009-1-2-11: Improving mollusc seed production in hatcheries, 3 mill euro. UiB/BIO partner with 9 RTDs in Europa. High score 13/15. 2010-2014 Bivalve conditioning and settlement – keys to competitive hatchery production (SETTLE). EU-project. Type of funding scheme: Research for SMEs. Capacities - Research for the Benefit of Specific Groups (in particular SMEs). Call FP7-SME-2007-1. Partners 5 RTDs and 5 SMEs in Norway, Spain, France og Ireland. 1,4 mill euro. UiB coordinator. 2008-2010 EU Framework 5 Q5RS-2001-01697 "CODTRACE - Establishing traceability for cod (Gadus morhua): determining location of spawning and harvest" 2002 – 2004 €308,000 EU Framework 5 Q5RS-2002-01610 "IBACS - Integrated

	Approach to the Biological Basis of Age Estimation in Commercially Important Fish Species" 2002 – 2005 £97,525 EU Framework 5 Q5RS-2002-01056 "WESTHER - A multidisciplinary approach to the identification of herring (Clupea harengus L.) stock components west of the British Isles using biological tags and genetic markers" 2002 -2005 £158,306 EU Framework 5 Q5CA-2002-01891 "TACADAR - Towards accreditation and certification of age determination of aquatic resources" 2002 - 2005 EU Accompanying Measures Q5AM-2002-00527 "FIFS – International Symposium on the Role of Flatfishes in Benthic Ecosystems" 2002 – 2004 €92,452 NFR – PROOF programme – "Effects of Production Water on reproductive success of cod " 2004-2006 NFR – PROOF programme – "Study of long-term effect in Atlantic Herring (*Clupea harengus*) there have been eating oil polluted *Calanus finmarchius*. Effects of trophic transfer of hydrocarbons after oil spill on the reproduction and immune systems of herring " 2007-2009 EU Framework 6 SSP-022717 "UNCOVER - Understanding the Mechanisms of Stock Recovery" 2006 – 2010 Meltzer Fund – "JELLY STONES: statolith tools for jellyfish biogeography and population ecology" 2007-2008 EU - Framework 7 – "FishPopTrace" - The structure of fish populations and traceability of fish and fish products 2008 – 2011 EU - Framework 7 – "CalMarO" - Calcification of Marine Organisms - A Marie Curie ITN (Initial Training Network) concerned with understanding biomineralization and the effects of ocean acidification on calcifying organisms 2008 – 2011 NFR - HAVKYST - PRIBASE: Pollution Risk and Impact Analysis for the Barents Sea Ecosystem 2009-2011 EEA - Managing effects of global climate on estuarine biodiversity and productivity, network project PT0010, Norway-the Netherlands-Portugal 2008-2012 Participant "Herring genetics" project 2013-2014 (ref. L. Andersson Uppsala University), 0.57 mill. NOK) Participant "KILO" project 2012-1013 (ref. S. Sundby, IMR Bergen, 0.4 mill. NOK) Participant in NFR project "Progressive, modern production of juvenile Atlantic cod" (PROCOD), 2006-2008 (ref. A.K. Imsland, UiB) (UiB budget 2.2 mill. NOK).

	Participant in NFR project “The occurrence of skipped spawning and its importance for population dynamics in Northeast Arctic gadoids”, 2009-2011 (ref. R.D.M. Nash, IMR Bergen) Project leader of Meltzer project 2005-2006. “High latitude climate variability and its effect on human settlement and fishery resources as revealed by fossil otoliths (0.4 mill NOK) Participant in NFR project “Optimization of growth performance of juvenile cod by applying environmental regulation and water quality control”, 2003-2005 (ref. A.K. Imsland, UiB) (UiB budget 0.93 mill NOK). Partner in EU project “Association of Physical and Biological Processes acting on Recruitment and Post-Recruitment stages of Anchovy“ (ANREC), 2002-2005 (ref. Dr. A. Kallianiotis, Kavala, Greece) (UiB budget 0.14 mill EUR). Regional Research Fund "Lice Interventions and Mucosal Mapping on farmed Salmon (LIMM)" Project nr 236379 (start 2013) Innovation Norway "Establishment support" Project nr 2013/110399 (start 2014) Research Council of Norway "Alpha to Omega 3" Project nr 234057/E40 (start 2014) EU Cost Action "Larvanet" FA0801 2009-2012 Produs Aqua "Salsoy" and "Slime" (2010-2013) “Arrested development: the endocrine and molecular basis of flatfish metamorphosis” (ARRDE; Q5RS-2002-01192)) 2004-2006 EU project
Fish Disease Research Group	2002-2007 “Function of genes and gene products in the specific immune system of Atlantic salmon”. RCN-project (*FUGE)* (7.45 mill Nok) Collaborative project with other research groups in Norway – coordinated by Dr. Unni Grimholt, NVH. “Function and expression of disease related genes in Atlantic salmon” (SalEx) (Approx. 38 mill Nok) 2006 “Molecular characterization of T cell markers in salmonid fish”. RCN-project *(Aquaculture; Production of aquatic organisms/ FUGE),* International collaboration/travel grant (150.000 Nok) 2007-2009 Marie Curie Transfer of Knowledge (ToK) project at University of Valencia, Spain (3 x 2 months); Pathogen Research in Mediterranean Aquaculture (PATHMEDA) 2009 ”Antistoffrespons hos laks og ørret: Karakterisering av ulike isotyper og genene som koder for disse.” Meltzer, UoB; (100.000

	Nok) 2008-2011 “Genolice; Salmon louse genome sequencing and functional studies on host parasite interactions” Project leader: Prof. Frank Nilsen 2014 Study leave spring 2014; University of Tasmania (UTAS), Professor Barbara Nowak’s research group, AMC. RCN; Personal Overseas Grant *(Aquaculture – Production of aquatic organisms)*.
Fish Immunology Research Group	2000 2006 Strategic project, NFR.” Smolting in atlantic salmon: the interrelationship between physiological, endocrine and immunological changes, and their genetic regulation”. Collaboration between Sigurd Stefansson, Heidrun I. Wergeland both from Institute of Fisheries and Marine Biology and Daniel Chourrout, Sars Centre. (Total 9.3 mill NOK) NFR project no 136260. 2002-2005 ”Infeksiøs pankreas nekrose virus (IPNV) infeksjon – en immunologisk utfordring”. NFR/FHF (Total 1.75 mill NOK), NFR project no. 152051/120 2002-2006 “Impact of smoltification on salmon immune responses (Total 1.98 mill NOK), NFR oroject no. 146858/S40. 2003 “Etablering av real-time reverse transcription polymerase chain reaction (RT-PCR) for kvantifisering av ekspresjon av cytokiner I vev og celler fra laks” Meltzer Høyskolefond, (total 0.1 mill NOK), project no.480245. (Runnings costs) 2007-2010 Francisella sp. infection in Atlantic cod (*Gadus morhua*) – study of pathogen and host immune cells interactions, NFR. 2008-2011 Studies of salmon phagocytic cells- key cells in cellular immune responses, NFR 2008-2013 Fish patogens and vaccine development related projects, one NUFU and one NORAD funded (partner/fish health) 2013- 2014: Challenge models and immune responses – Lumpsucker , FHF funded 2013 - 2017 PROAQUA partner, funding Danish Council for Strategic Research 2014 – Vaccines to lumpsucker, funded by Pharmaq

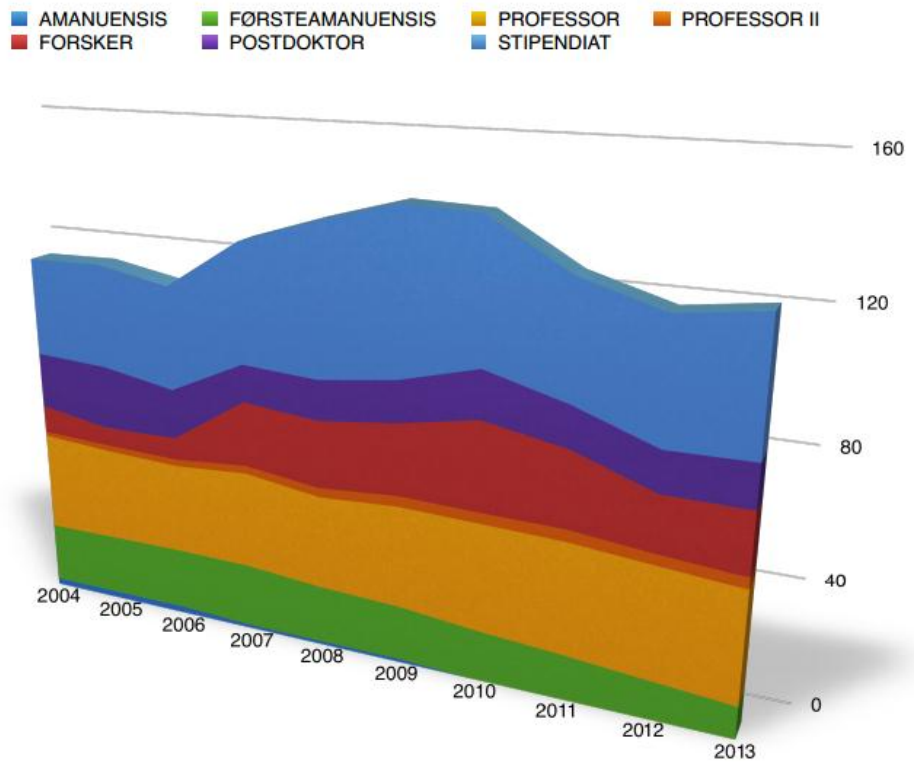
Marine Biodiversity Research Group Main Topics: • *The ecology of the shore crab, Carcinus maens* • *Norwegian cumaceans* • *Species inventory of the Sognefjord* • *Minor fondings:* • *"Effects of a newly introduced benthic red alga on biodiversity and community structure in the coastal zone of Norway"* • *Leader of WP3 Seaweeds of the Hardangerfjord, part of the EPIGRAPH project (Institute of Marine Research).* • *"Causes and consequences of a large-scale shift from sugar kelp (Saccharina latissima) to ephemeral algae and implications for management"*	2009 The Carlsberg Foundation (3.500.000 Dkr) 2010 The Norwegian Species Databank (2100.000 Nkr) 2013 The Norwegian Species Databank (3100.000 Nkr) 2014 Tilskudd til kvalitetssikring og tilrettelegging av stedfesta artsdata (artsdatabanken) (180.00 Nkr) 2010 The Norwegion Science Academy (80.000 Nkr) 2009 The Meltzer foundation (212.000 Nkr) 2009 The Norwegion Science Academy (100.000 Nrk) 2003–04: The Research Council of Norway, project no ' 154192/720 2008-2011: The EPIGRAPH project was funded by The Ministry of Fisheries and Coastal Affairs and The Research Council of Norway. 2013 – 2016: Coordinator of "Invasive seaweeds in rising temperatures: impacts and risk assessments (INVASIVES)" (Funded by Seas-Era, The Research Council of Norway) 2007-2010: The Research Council of Norway

b) The department/centre's academic personnel in marine studies (research and/or teaching)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total number of staff involved	**101**	**104**	**105**	**119**	**130**	**131**	**131**	**124**	**117**	**123**
Number of staff involved in the field more than 50% of their time	**98**	**101**	**102**	**115**	**125**	**127**	**128**	**120**	**113**	**120**
Full time equivalents (FTEs) in the field:										
• Professors (*professor/førsteamanuensis/andre førstestillinger*)	**37,1**	**39,5**	**40,1**	**42,3**	**39,6**	**40,9**	**40,1**	**39,5**	**39,1**	**40,4**
• Other permanent academic staff	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
• Postdoc fellows	**11**	**15**	**13**	**10**	**13**	**11**	**9,5**	**11,5**	**10,5**	**9**
• PhD fellows	**27,3**	**27,5**	**27**	**30**	**35**	**38**	**36**	**28,75**	**31,75**	**34,75**
• Researchers	**16,1**	**12**	**11,8**	**18,9**	**19,75**	**18,55**	**23,7**	**21,1**	**14,7**	**17,5**

If relevant, please specify the size of your major research topics/research groups within marine research relative to the size of the department/centre and describe the main developments in academic personnel (growth/reduction) for these topics/groups in the period 2004-2013.

During the last ten years the overall marine activity at the department reached its highest level in the period of 2007-2010 (measured in FTEs). Between 75 % and 85 % percent of BIO's permanent and non-permanent scientific staff have during the evaluation period been involved in marine research and education. The proportion of faculty involved has been relatively stable throughout the last ten years, but the proportion of prof. II and post docs engaged in marine activities have gradually increased. Even though the proportion has been relatively stable across the groups, within the groups there has been some variation in disciplines covered.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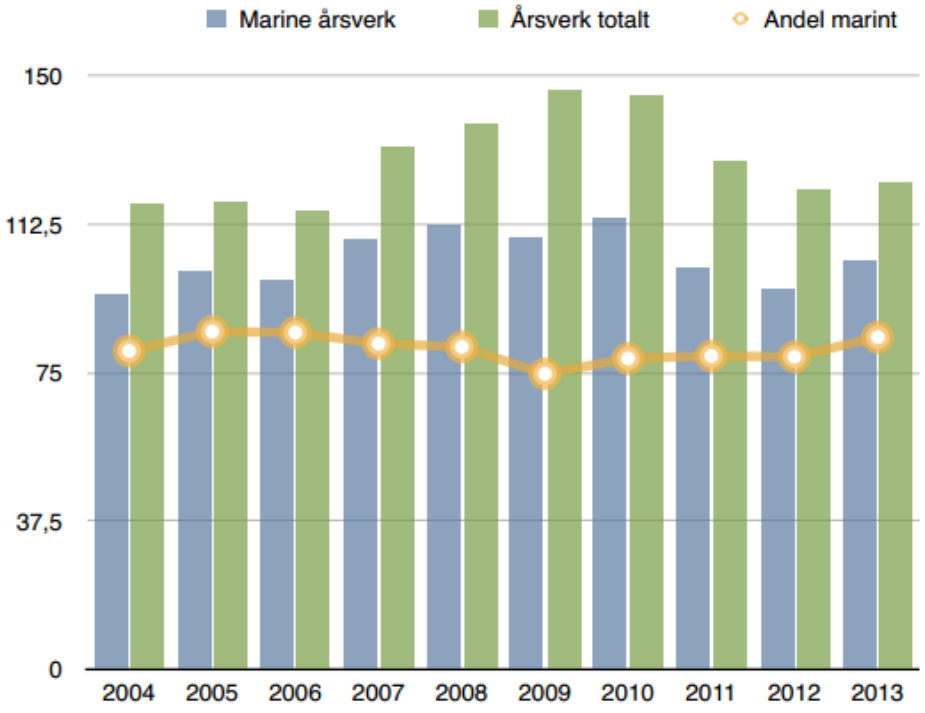
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c) Funding of research activities: Fill in the department/centre's total expenditure for marine research by funding source (in 100 000 NOK).

Source	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Institutional core funding (total)*	532	565	631	686	713	767	779	746	801	824
- funding received from UiB's strategic priority of marine research	28	28	28	43	55	31	26	20	31	40
Grants from the Research Council of Norway	215	194	203	252	246	253	303	297	240	347
Other Norwegian public funding (ministries, directorates/agencies, etc.)	143	169	173	156	150	76	134	63	50	37
Private domestic sources (industry or NGOs)	14	14	15	15	33	33	41	44	27	29
Funding from abroad	152	122	35	37	36	47	111	118	82	69
Sum**	1056	1064	1057	1146	1178	1176	1368	1268	1200	1306

*) Operating expenses for the use of research vessels are funded centrally from the MN Faculty and the costs are not split between the user departments. The total costs for each year 2004-2013 (in 100 000 NOK):
2004: 195; 2005: 200; 2006: 211; 2007: 204; 2008: 237; 2009: 214; 2010: 238; 2011: 253; 2012: 260; 2013: 270.
The Industrial and Aquatic Laboratory (www.ilab.uib.no) in the Marineholmen Science Park provides climate- and water-quality-controlled laboratory facilities for the scientific environment and the aquaculture industry, and a large proportion of the costs for the use by marine researchers and students at UiB are covered by UiB centrally.
The UiB has also funded the new BIO buildings at Marineholmen and renovated the research infrastructure on the 1st, 3rd and 4th floor in the High Technology Centre (Bioblokken), and a large proportion of this is used for marine research and education.
**) It should also be noted that these are historic numbers from BIO's accounts which therefore have not been adjusted for inflation.

If relevant, please describe the main developments in research funding (growth/reduction) per major research topic/research group in the period 2004-2013.

Marine research and training at Master and PhD level requires external funding. Although being competitive and attracting external funding a common trend across all the research groups constituting the department has been the increased challenge to secure dependable funding for core research activities. Lack of predictability to secure basic funding has hampered lab- as well as field-based research activity. Application success rates of EU and RCN funds have been limited, at least in part, by many programme-oriented calls focusing on problem-solving rather than integrative biology. Our dependence on the funding of positions (PhD, post-docs) rather than fractions of researcher positions also hampers our participation in EU-projects. The limited opportunities for blue sky research in many of the RCN research programmes has also been addressed in the national evaluation of biology and medicine in 2010 and by the committee appointed by RCN to suggest following up actions. While the department recognizes the importance of practicing proactive approach to apply for research funding, it has been particularly challenging to rhyme the challenges of narrow programme calls with the continuously increasing need to maintain up-to-date research facilities in addition to means and opportunities for

operating it. As a competing research department, we are dependent upon the infrastructure in order to be able to maintain high quality research output and remain competitive in the funding competition.
However, numerous examples exist to illustrate the impact that financial investment in UiB's strategic areas has had on its academic and research performance. The investments made in the state-of-the-art infrastructure of the marine biology station for instances have served as the basis for prestigious EU projects, an ERC Advanced Grant as well the Møbius prize from NFR. Furthermore, UiB, the faculty's and BIO's strategic focus and financial support regarding fish health research and other interdisciplinary marine activities have resulted in, among other things, one Centre for Research-based Innovation (SFI; the SLRC) and one Norwegian Centre of Excellence (SFF; the CGB). In addition, BIO has had one successful Bergen Forskingsstiftelse (BFS) candidate who is now a professor at BIO within the priority field of marine research.

2 Scientific production

ToR: "On the basis of international standards to assess the quality and relevance of the scientific production within marine research based on the combined production of publications and theses, with emphasis on the last 10 years."

The panel will assess UiB's overall scientific production within the field based on bibliometrics/publication lists extracted from Cristin and Web of Science. As additional information and background to interpret the bibliometric data we would like input on what you consider the department/centre's most significant publications within the field. Five to ten publications per major research topic/research group should be listed.

Please provide full references to each publication.

The most significant publications per major research topic/research group, 2004-2013:

With the department's primary focus on marine research over decades, its greatest expertise lies naturally in the research themes constituting the four greater research topics defined here. Consequently, this has resulted in numerous publications perceived by the research groups as among their most significant publications within the field. While some have selected more than the requested 5-10 publications, the reader is referred to Cristin or Web of Science for BIO's full list of publications.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

Evolutionary Fisheries Ecology Research Group

1. Dieckmann, U., and M. Heino. 2007. Probabilistic maturation reaction norms: their history, strengths, and limitations. *Marine Ecology Progress Series* 335:253–269. doi: 10.3354/meps335253.

2. Dunlop, E. S., M. Heino, and U. Dieckmann. 2009. Eco-genetic modelling of contemporary life-history evolution. *Ecological Applications* 19:1815–1834. doi: 10.1890/08-1404.1.

3. Enberg, K., C. Jørgensen, E. S. Dunlop, M. Heino, and U. Dieckmann. 2009. Implications of fisheries-induced evolution for stock rebuilding and recovery. *Evolutionary Applications* 2:394–414. doi: 10.1111/j.1752-4571.2009.00077.x.

4. Enberg, K., C. Jørgensen, E. S. Dunlop, Ø. Varpe, D. S. Boukal, L. Baulier, S. Eliassen, and M. Heino. 2012. Fishing-induced evolution of growth: concepts, mechanisms, and the empirical evidence. *Marine Ecology* 33:1–25. doi: 10.1111/j.1439-0485.2011.00460.x.

5. Heino, M., and U. Dieckmann. 2008. Detecting fisheries-induced life-history evolution: an overview of the reaction norm approach. *Bulletin of Marine Science* 83:69–93.

6. Jørgensen, C., E. S. Dunlop, A. F. Opdal, and Ø. Fiksen. 2008. The evolution of spawning migrations: state dependence and fishing-induced changes. *Ecology* 89:3436–3448.

7. Jørgensen, C., K. Enberg, E. S. Dunlop, R. Arlinghaus, D. S. Boukal, K. Brander, B. Ernande, A. Gårdmark, F. Johnston, S. Matsumura, H. Pardoe, K. Raab, A. Silva, A. Vainikka, U. Dieckmann, M. Heino, and A. D. Rijnsdorp. 2007. Managing evolving fish stocks. *Science* 318:1247–1248. doi: 10.1126/science.1148089.

8. Jørgensen, C., B. Ernande, and Ø. Fiksen. 2009. Size-selective fishing gear and life history evolution in the Northeast Arctic cod. *Evolutionary Applications* 2:356–370. doi: 10.1111/j.1752-4571.2009.00075.x.

9. Jørgensen, C., and Ø. Fiksen. 2010. Modelling fishing-induced adaptations and consequences for natural mortality. *Canadian Journal of Fisheries and Aquatic Sciences* 67:1086–1097. doi:10.1139/F10-049.

10. Laugen, A. T., G. H. Engelhard, R. Whitlock, R. Arlinghaus, D. J. Dankel, E. S. Dunlop, A. M. Eikeset, K. Enberg, C. Jørgensen, S. Matsumura, S. Nusslé, D. Urbach, L. Baulier, D. S. Boukal, B. Ernande, F. D. Johnston, F. Mollet, H. Pardoe, N. O. Therkildsen, S. Uusi-Heikkilä, A. Vainikka, M. Heino, A. D. Rijnsdorp, and U. Dieckmann. 2014. Evolutionary impact assessment: accounting for evolutionary consequences of fishing in an ecosystem approach to fisheries management. *Fish and Fisheries* 15:65–96. doi: 10.1111/faf.12007.

11. Salvanes, A.G.V., Bartholomae, C., Yemane, D., Gibbons, M.G., Kainge, P., Krakstad, J.-O., Rouault, M., Staby, A., Sundby, S. (in press) Spatial dynamics of the bearded goby and its key fish predators off Namibia varies with climate and oxygen availability. *Fisheries Oceanography*

12. Skrypzeck, H. Salvanes, A.G.V., Currie, B., Kotze, A. (2014) First records of reproductive behaviour and early development for the bearded goby Sufflogobius bibarbatus. *J Fish Biology* 84: 1256-1261

13. Gunawickrama K.B.S., Westgaard J.-I., Salvanes A.G.V., Johansen T. (2012) Characterization of polymorphic microsattelite markers for the bearded goby *Sufflogobius bibarbatus*. *Conservation Genetics Resources.* 4: 187-189; *DOI 10.1007/s12686-011-9505-5*

14. Cedras, R.B., Salvanes, A.G.V. and Gibbons, M.J. (2011) Investigations into the diet and feeding ecology of the bearded goby, *Sufflogobius bibarbatus*, off Namibia. *African Journal of Marine Science* 33: 313-320 http://dx.doi.org/10.2989/1814232X.2011.600431

15. Salvanes A.G.V., Utne-Palm A.C., Currie B., Braithwaite V.A. (2011). Behavioural and physiological adaptations of the bearded goby: a key fish species of the extreme environment of Benguela. *Marine Ecology Progress Series* 425: 193-202. http://www.int-res.com/abstracts/meps/v425/p193-202/

16. Utne-Palm AC, Salvanes AGV, Currie B, Kaartvedt S, Nilsson GE, Braithwaite V, Stecyk JAW, Hundt M, van der Bank M, Flynn B, Sandvik GK, Klevjer TA, Sweetman, AK, Brüchert,V, Pittman K, Peard KR, Lunde IG, Strandabø RAU, Gibbons MJ (2010) Trophic structure and community stability in an overfished ecosystem. *Science* 329: 333-336 http://www.sciencemag.org/content/329/5989/333.full?sid=3ecac9ca-691f-4d4e-9cf8-714309bf2935

17. Gunawickrama K.B.S., De Silva P.M.C.S., Johansen T., Salvanes A.G.V., Nævdal G. (2010) Preliminary evidence for genetic heterogeneity of the goby (*Sufflogobius bibarbatus*) in the Benguela ecosystem. *Journal of Applied Ichthyology* 26: 110-112 http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0426.2009.01370.x/abstract

18. Hundt, Matthias; Utne-Palm, Anne Christine; Gibbons, Mark J. Cross-shelf observations of diet and diel feeding behaviour of the bearded goby Sufflogobius bibarbatus off Namibia. *South African Journal of Marine Science* 2011 ;Volum 33.(1) s. 119-126

Marine Microbiology Research Group

- *Microbial Ecology*

1. Thingstad TF, Krom MD, Mantoura RF, Flaten GA, Groom S, Herut B, Kress N, Law CS, Pasternak A, Pitta P, Psarra S, Rassoulzadegan F, Tanaka T, Tselepides A, Wassmann P, Woodward EM, Riser CW, Zodiatis G, Zohary T (2005) Nature of phosphorus limitation in the ultraoligotrophic eastern Mediterranean. **Science**. Aug 12;309(5737):1068-71

2. Martiny JBH, Bohannan BJM, Brown JH, Colwell RK, Fuhrman JA, Green JL, Horner-Devine MC, Kane M, Krumins JA, Kuske CR, Morin P, Naeem S, Øvreås L, Reysenbach A-L, Smith VA, Staley J (2006). Microbial biogeography: putting microorganisms on the map. **Nature Reviews Microbiology** 4: 102-112.

3. Horner-Devine MC, Silver JM, Leibold MA, Bohannan BJM, Colwell RK, Fuhrman JA, Green JL, Kuske CR, Martiny JBH, Muyzer G, Øvreås l, Reysenbach A-L, Smith VH (2007). A comparison of taxon co-occurrence patterns for macro-and microorganisms. **Ecology** 88: 1345-1353.

4. Thingstad TF, Bellerby RGJ, Bratbak G, Borsheim KY, Egge JK, Heldal M, Larsen A, Neill C, Nejstgaard J, Norland S, Sandaa R-A, Skjoldal EF, Tanaka T, Thyrhaug R, Topper B (2008) Counterintuitive carbon-to-nutrient coupling in an Arctic pelagic ecosystem. **Nature** 455: 387-U337.

5. Rodriguez-Valera F, Martin-Cuadrado AB, Rodriguez-Brito B, Pasic L, Thingstad TF, Rohwer F, Mira A (2009) OPINION Explaining microbial population genomics through phage predation. **Nature Reviews Microbiology** 7: 828-836.

6. Sandaa R-A, Gomez-Consarnau L, Pinhassi J, Riemann L, Malits A, Weinbauer MG, Gasol JM, Thingstad TF (2009) Viral control of bacterial biodiversity - evidence from a nutrient-enriched marine mesocosm experiment. **Environ. Microbiol**. 11: 2585-2597.

7. Ogata H, Ray J, Toyoda K, Sandaa R-A, Nagasaki K, Bratbak G, Claverie J-M (2011). Girus-encoded MutS subfamilies abundant in the marine environment. **The ISME Journal** DOI:10.1038/ismej.2010.210

8. Jorgensen, SL, Hannisdal B, Lanzen A, Baumberger T, Flesland J, Fonseca R, Øvreås L, Steen IH, Thorseth IH, Pedersen RB, Schleper C (2012). Correlating microbial community profiles with geochemical data in highly stratified sediments from the Arctic Mid-Ocean Ridge. **PNAS USA** 109(42): E2846-E2855.

9. Bengtsson MM, Sjøtun K, Lanzén A, Øvreås L (2012). Bacterial diversity in relation to secondary production and succession on surfaces of the kelp Laminaria hyperborea. **The ISME Journal** doi: 10.1038/ismej.2012.67.

10. Vardi, A, Haramaty L, Van Mooy BAS, Fredricks HF, Kimmance SA, Larsen A, Bidle KD (2012). Host-virus dynamics and subcellular controls of cell fate in a natural coccolithophore population. **PNAS USA** 109(47): 19327-19332.

11. Moore, CM, Mills MM, Arrigo KR, Berman-Frank I, Bopp L, Boyd PW, Galbraith ED, Geider RJ, Guieu C, Jaccard SL, Jickells TD, La Roche J, Lenton TM, Mahowald NM, Marañón E, Marinov I, Moore JK, Nakatsuka T, Oschlies A, Saito MA, Thingstad TF, Tsuda A, Ulloa O (2013) Processes and patterns of oceanic nutrient limitation. **Nature Geoscience** 6:701-710 doi:10.1038/NGEO1765

12. Urich T, Lanzén A, Stokke R, Bayer C, Pedersen RB, Thorseth I, Schleper C, Steen IH, Øvreas L (2013) Microbial community structure and functioning in marine sediments associated with diffuse hydrothermal venting assessed by integrated meta-omics. **Environ Microbiol**. Sep 20. doi: 10.1111/1462-2920.12283.

13. Vaage S, Storesund JE, Thingstad TF (2013). "SAR11 viruses and defensive host strains." **Nature** 499 (7459): E3-E4.

14. Thingstad TF, Våge S, Storesund JE, Sandaa R-A, Giske J (2014) A theoretical analysis of how strain-specific viruses can control microbial species diversity. **PNAS USA**,111(21) 7813–7818, doi: 10.1073/pnas.1400909111

Theoretical Ecology Research Group

1. Jarl Giske, Sigrunn Eliassen, Øyvind Fiksen, Per J. Jakobsen, Dag L. Aksnes, Marc Mangel and Christian Jørgensen. (2014) The emotion system promotes diversity and evolvability. *Proceedings of the Royal Society B -Biological Sciences*. 281: 20141096. http://dx.doi.org/10.1098/rspb.2014.1096

2. Eliassen S, Jørgensen C. 2014. Extra-pair mating and evolution of cooperative neighbourhoods. *PLoS One*. 9: e99878. [doi:10.1371/journal.pone.0099878]

3. Jarl Giske, Sigrunn Eliassen, Øyvind Fiksen, Per J. Jakobsen, Dag L. Aksnes, Christian Jørgensen, and Marc Mangel. 2013. Effects of the Emotion System on Adaptive Behavior. *The American Naturalist* 182:689-703.

4. Aksnes DL, Cao FJ. 2011. Inherent and apparent traits in microbial nutrient uptake. Marine Ecology Progress Series. 440: 41-51. [doi:10.3354/meps09355]

5. Jørgensen C, Enberg K, Dunlop ES, Arlinghaus R, Boukal DS, Brander K, Ernande B, Gårdmark A, Johnston F, Matsumura S, Pardoe H, Raab K, Silva A, Vainikka A, Dieckmann U, Heino M, Rijnsdorp AD. 2007. Managing evolving fish stocks. Science. 318: 1247-1248.

6. Fiksen Ø, Jørgensen C, Kristiansen T, Vikebø F, Huse G (2007). Linking behavioural ecology and oceanography: how behaviour determines growth, mortality and dispersal. *Marine Ecology Progress Series* **347:** 195-205

7. Varpe Ø, Jørgensen C, Tarling GA, Fiksen Ø. 2007. Early is better: seasonal egg fitness and timing of reproduction in a zooplankton life-history model. Oikos. 116: 1331-1342. [doi:10.1111/j.2007.0030-1299.15893.x]

8. Jørgensen C, Ernande B, Fiksen Ø, Dieckmann U. 2006. The logic of skipped spawning in fish. Canadian Journal of Fisheries and Aquatic Sciences. 63: 200-211.

9. Grimm V, Berger U, Bastiansen F, Eliassen S, Ginot V, Giske J, Goss-Custard J, Grand T, Heinz SK, Huse G, Huth A, Jepsen JU, Jørgensen C, Mooij WM, Müller B, Pe'er G, Piou C, Railsback SF, Robbins AM, Robbins MM, Rossmanith E, Rüger N, Strand E, Souissi S, Stillman RA, Vabø R, Visser U, DeAngelis DL. 2006. A standard protocol for describing individual-based and agent-based models. Ecological

Modelling. 198: 115-156. [doi:10.1016/j.ecolmodel.2006.04.023] (This paper came out from a workshop held in Bergen, arranged by our research group.)

10. Aksnes DL, Nejstgaard J, Sædberg E, Sørnes T. 2004. Optical control of fish and zooplankton populations. Limnology and Oceanography. 49: 233-238.

Aquatic Behavioral Ecology Research Group

- *Fish population biology*

1. Johannessen, A., Skaret, G., Langård, L., Slotte, A., Husebø, Å. and Fernö, A. 2014. The Dynamics of a Metapopulation: Changes in Life-History Traits in Resident Herring that Co-Occur with Oceanic Herring during Spawning. *PLoS ONE* 9(7): e102462. doi:10.1371/journal.pone.0102462

- *Spatial dynamics*

2. Langøy, H., Nøttestad, L., Skaret, G. Broms, C. and Fernö, A. 2012. Overlap in distribution and diets of Atlantic mackerel (*Scomber scombrus*), Norwegian spring-spawning herring (*Clupea harengus*) and blue whiting (*Micromesistius poutassou*) in the Norwegian Sea during late summer. *Marine Biology Research* 8, 442-460.

3. Huse, G., Utne, K.R. and Fernö, A. 2012. Vertical distribution of herring and blue whiting in the Norwegi Sea. *Marine Biology Research* 8, 488-501.

- *Scooling dynamics and collective behavior*

4. Nøttestad, L. Fernö, A., Misund, O.A. and Vabø, R. 2004. Understanding herring behaviour:Linking individual decisions, school patterns and population distribution. In: Skjoldal, H.R., Sætre, R., Fernö, A., Misund, O.A. and Røttingen, I. (Editors). The Norwegian Sea Ecosystem. Tapir. Trondheim.

5. Huse, G., Fernö, A. and Holst, J. 2010. Establishment of novel wintering areas in herring co-occurs with peaks in the ´first time/repeat spawner` ratio. *Marine Ecology Progress Series* 409, 189-198.

- *Aquaculture: Behaviour, cognition and welfare*

6. Kristiansen, T., Fernö, A., Holm, J.C., Privitera, L., Bakke, S. and Fosseidengen, J.E. 2004. Swimming behaviour as an indicator of low growth rate and impaired welfare in Atlantic halibut (*Hippoglossus hippoglossus* L.) reared in three stocking densities. *Aquaculture* 230, 137-151.

7. Nilsson, J., Kristiansen, T.S., Fosseidengen, J.E., Fernö, A. and van den Bos, R. 2008. Learning in cod (*Gad morhua*): long trace interval retension. *Animal Cognition* 11, 215-222.

8. Nilsson, J., Kristiansen, T.S., Fosseidengen, J.E., Stien, L.H., Fernö, A. and van den Bos, R. 2010. Learni and anticipatory behaviour in a “sit-and-wait” predator: the Atlantic halibut. *Behavioural Processes* 8 257-266.

9. Fernö, A., Huse, G., Jakobsen, P.J., Kristiansen, T.S. and Nilsson, J. 2011. Fish Behaviour, Learni Aquaculture and Fisheries. In: *Fish Cognition and Behaviour.* Second edition (editors C. Brown, K Laland and J. Krause). Blackwell Publishing.

10. Meager, J.J., Fernö, A., Skaeraasen, J.E., Järvi, T., Rodewald, P., Sverdrup, G., Winberg, S. and Mayer 2012 Multidimensionality of behavioural phenotypes in Atlantic cod, *Gadus morhua*. *Physiology a Behaviour* 106, 462-470.

- *Ontogeny and escapees*

11. Meager, J.J., Skjæraasen, J.E., Fernö, A. Løkkeborg, S., Karlsen, Ø., Michalsen, K. and Utskot, S.O. 2009.Vertical dynamics and reproductive behaviour of farmed and wild Atlantic cod, *Gadus morhua*. *Marine Ecology Progress Series* 389, 233-243.

12. Skjæraasen, J.E., Meager, J.J., Karlsen, Ø., Hutchings, J.A., and Fernö, A. 2011. Extreme spawning-s fidelity in Atlantic cod. *ICES Journal of Marine Science*, 68, 1472-1477.

- *Fish behaviour in relation to fishing gear*

13. Løkkeborg, S., Fernö, A. and Humborstad, O.B. 2010. Fish Behaviour in Relation to Longlines. In *Behaviour of Marine Fishes: Capture Processes and Conservation* (editor P. Hi). Blackwell Publishing Ltd.

14. Rosen, A., Engås, A., Fernö, A. and Jørgensen, T. 2012. The reactions of shoaling cod to a pelagic tra implications for commercial trawling. *ICES Journal of Marine Science* 69, 303-312.

- *Other*

15. Braithwaite, V.A. & Salvanes, A.G.V. 2010. Aquaculture and restocking: implications for conservation and welfare. *Animal Welfare* 19: 139-149

16. Gunawickrama, K.B.S., De Silva, P.M.C.S., Johansen, T., Salvanes, A.G.V. & Nævdal, G. 2010. Preliminary evidence for genetic heterogeneity of the goby (*Sufflogobius bibarbatus*) in the Benguela ecosystem. *Journal of Applied Ichthyology* 26: 110-112

17. Strand, D.A., Utne-Palm, A.C., Jakobsen, P.J., Braithwaite, V.A. & Salvanes, A.G.V. 2010. Enrichment promotes learning in fish. *Marine Ecology Progress Series* 412: 273-282.

18. Utne-Palm A.C., Salvanes A.G.V., Currie, B., Kaartvedt, S., Nilsson, G.E., Braithwaite, V.A., Stecyk, J., Hundt, M., van der Bank, M., Flynn, B., Sandvik, G.K,, Klevjer, T.A., Sweetman, A.K., Brüchert, V., Pittman, K., Peard, K.R., Lunde, I.G., Strandabø, R.A.U., & Gibbons, M.J. 2010. Trophic Structure and Community Stability in an Overfished Ecosystem. *Science* 329: 333-336

19. Groison, A-L., Suquet, M., Cosson, J., Mayer I., Severe, A., Bouquet, J-M., Geffen, A.J. Utne-Palm, A.C., & Kjesbu, O.S. 2010. Sperm motility in European hake, *Merulicus merulicus*, and characterization of its spermatozoa concentration and volume, spermatocrit, osmolality and pH. *Aquaculture* 301: 31-36

20. Huse, G., Fernö, A. & Holst, J. 2010. Establishment of novel wintering areas in herring cooccurs with peaks in the ´first time/repeat spawner` ratio. *Marine Ecology Progress Series* 409: 189-198.

21. Kennedy, J., Skjæraasen, J.E., Nash, R.D.M., Thorsen, A., Slotte, A., Hansen, T. &Kjesbu, O.S. 2010. Do capital breeders like Atlantic herring (*Clupea harengus* L.) exhibit sensitive periods of nutritional control on ovary development and fecundity regulation *Canadian Journal of Fisheries and Aquatic Science* 67: 16-27

22. Korsøen, Ø.J, Dempster, T., Fosseidengen, J-E., Fernö, A., Heegaard, E. & Kristiansen, T.S. 2010 Behavioural responses to pressure changes in cultured Atlantic cod (*Gadus morhua*): defining practical limits for submerging and lifting sea-cages. *Aquaculture* 308: 106-115

23. Langård, L., Øvredal, J.T., Johannesen, A., Nøttestad, L., Skaret, G., Fernö, A. and Wahlberg, M. (2008) Sound production in pre-spawning herring, cod and haddock in a naturally enclosed ecosystem. *Bioacoustics* 17: 38-40.

24. Meager, J.J., Moberg, O., Strand, E. & Utne-Palm, A.C. 2010 Effects of light intensity on visual prey detection by juvenile Atlantic cod. *Marine and Freshwater Behaviour and Physiology*. 43(2): 99-108

25. Meager, J.J., Skjæraasen, J.E., Fernö, A. & Løkkeborg, S. 2010. Reproductive interactions between fugitive farmed cod and wild cod in the field. *Canadian Journal of Fisheries and Aquatic Sciences* 67: 1221-1231.

26. Nilsson, J., Kristiansen, T.S., Fosseidengen, J.E., Stien, L.H., Fernö, A. & van den Bos, R. 2010. Learning and anticipatory behaviour in a "sit-and-wait" predator: the Atlantic halibut. *Behavioural Processes* 83: 257-266

27. Skjæraasen, J.E. & Hutchings, J.A. 2010. Shifting reproductive success in a shoal of Atlantic cod, Gadus morhua L. Environmental Biology of Fishes 88:311-318

28. Skjæraasen, J.E., Kennedy, J., Thorsen, A., Nash, R.D.M., Nilsen, T. & Kjesbu, O.S. 2010 Liver energy, atresia and oocyte stage influence fecundity regulation in Northeast Arctic cod. Marine EcologyProgress Series 404:173-183

29. Skjæraasen, J.E., Meager, J.J., Karlsen, Ø., Mayer, I., Dahle, G., Rudolfsen, G.,Haugland, T. & Fernö, A. 2010. Mating competition between farmed and wild cod: wild females choose wild males. *Marine Ecology Progress Series* 412: 247-258.

30. Skjæraasen, J.E., Meager, J.J. & Hutchings, J.A. 2010. A cost of reproduction in male Atlantic cod *(Gadus morhua*). *Canadian Journal of Zoology* 88(6): 595-600.

31. Stiansen, S., Fernö, A., Jørgensen, T., Furevik D. & Løkkeborg, S. 2010. Horizontal and vertical odor plume trapping of red king crabs explains the different efficiency of top and side entrance pot designs. *Transactions of the American Fisheries Society* 139: 483-490.

32. Kristoffersen, J.B. & Salvanes, A.G.V. 2009. Distribution, growth, and population genetics of the glacier lanternfish (*Benthosema glaciale*) in Norwegian waters: contrasting patterns in fjords and the ocean. *Marine Biology Research* 5: 596-604

33. Johannesen, A., Nøttestad, L., Fernö, A., Langård, L. & Skaret, G.. 2009. Two components of Northeast Atlantic herring within the same school during spawning: support for the existence of a metapopulation? ICES Journal of Marine Science 66: 1740-1748.

34. Meager, J.J., Skjæraasen, J.E., Fernö, A., Karlsen, Ø., Løkkeborg, S., Michalsen, K. & Utskot, S.O. (2009) Vertical dynamics and reproductive behaviour of farmed and wild cod *(Gadus morhua). Marine Ecology Progress Series* 389: 233-243.

35. Skjæraasen, J.E., Kennedy, J., Thorsen, A., Fonn, M., Njøes-Strand, B., Mayer, I. & Kjesbu, O.S. 2009. Mechanisms regulating oocyte recruitment and skipped spawning in the Northeast Arctic cod (Gadus morhua L.). Canadian Journal of Fisheries and Aquatic Science 66:1582-1596

36. Skjæraasen, J.E. Mayer, I. Meager, J.J., Rudolfsen, G., Karlsen, Ø., Haugland, T., & Kleven, O. 2009. Sperm characteristics and competitive ability in farmed and wild cod. *Marine Ecology Progress Series* 375: 219-228.

37. Skjæraasen, J.E., Nilsen, T., Meager, J.J., Herbert, N.A., Moberg, O., Tronci. V., Johansen, T. & Salvanes, A.G.V. 2008. Hypoxic avoidance behaviour in cod *(Gadus morhua* L.): The effect of temperature and haemoglobin genotype. *Journal of Experimental Marine Biology and Ecology* 358: 70-77.

38. Kainge, P., Kjesbu, O.S., Thorsen, A. & Salvanes, A.G.V. 2007. *Merluccius capensis* spawn in Namibian waters, but do *M. paradoxus*? *African Journal of Marine Science* 29: 379-392

39. Mqoqi, M., Lipinski, M.R.& Salvanes, A.G.V. 2007. The ecology of *Sepia australis* (Cephalopoda : Sepiidae) along the south coast of South Africa *ICES Journal of Marine Science* 64: 945-955.

40. Salvanes, A.G.V., Moberg, O. & Braithwaite, V.A. 2007. Effects of eary experience on group behaviour in fish. *Animal Behaviour* 74: 805-811.

41. Doksaeter, L., Olsen, E., Nøttestad, L. & Fernö, A. 2008. Distribution and feeding ecology of dolphins along the Mid-Atlantic Ridge between Iceland and the Azores. *Deep-sea Research* 55: 243-253.

42. Hardie, D., Renaud, C., Ponomarenko, V.P.P., Mukhina, N.V., Yaragina, N.A., Skjæraasen, J.E. &

Hutchings, J.A. 2008. The Isolation of Atlantic cod, Gadus morhua (Gadiformes), populations in northern meromictic lakes - A recurrent arctic phenomenon. Journal of Ichthyology 48: 230-240.

43. Meager, J.J. & Utne-Palm, A.C. 2008. Effect of turbidity on habitat preference of juvenile Atlantic cod, *Gadus morhua* and turbidity. *Environmental Biology of Fishes* 81: 149-155.

44. Nilsson, J., Kristiansen, T.S., Fosseidengen, J.E., Fernö, A. & van den Bos, R. 2008. Learning in cod (*Gadus morhua*): long trace interval retension. *Animal Cognition* 11: 215-222.

45. Nilsson, J., Kristiansen, T.S., Fosseidengen, J.E., Fernö, A. & van den Bos, R. 2008. Signand goal-tracking in Atlantic cod (*Gadus morhua*). *Animal Cognition* 11: 651-659.

46. Rowe, S., Hutchings, J.A., Skjæraasen, J.E., de Mestral Bezanson, L. 2008. Phenotypic and behavioural correlates of individual variation in male Atlantic cod reproductive success. Marine Ecology Progress Series 354: 267-276.

47. Skjærrasen, J.E., Meager, J.J. & Karlsen, Ø. 2008. Expression of secondary sexual characteristics in recruit and repeat spawning farmed and wild cod. *ICES Journal of Marine Science* 65: 1710-1716.

48. Stiansen, S., Fernö, A., Furevik, D., Jørgensen, T. & Løkkeborg, S. 2008. Efficiency and catch dynamics of collapsible square and conical crab pots used in the red king crab (*Paralithodes camtschaticus*) fishery. *Fishery Bullentin* 106: 40-46.

49. Jørgensen, T., Løkkebørg, S., Fernö, A. & Hufthammer, M. 2007. Walking speed and area utilization of red king crab (*Paralithodes camtschaticus*) introduced to the Barents Sea coastal ecosystem. *Hydrobiologica* 582: 17-24.

50. Kristiansen, T. and Fernö, A. (2007) Individual behaviour and growth of halibut (*Hippoglossus hippoglossus* L.) fed sinking and floating food: evidence of different coping styles. *Applied Animal Behaviour Science* 104, 236-250.

51. Meager, J.J. & Batty, R.S. 2007. Effects of turbidity on the spontaneous and prey searching activity of juvenile Atlantic cod (*Gadus morhua*). *Philosophical Transactions of the Royal Society of London Series B* 362: 2123-2130.

52. Rowe, S., Hutchings, J.A. & Skjæraasen, J.E. 2007. Non-random mating in a broadcast spawner: mate size influences reproductive success in Atlantic cod (Gadus morhua). Canadian Journal of Fisheries and Aquatic Sciences 64: 219-226.

53. Salvanes, A.G.V. & Braithwaite, V.A. 2006. The need to understand the behaviour of fish we rear for mariculture or for restocking. *ICES Journal of Marine Science.* 63: 346-354

54. Meager, J.J., Domenici, P., Shingles, A.& Utne-Palm, A.C. 2006. Escape responses in juvenile Atlantic Cod (*Gadus morhua* L.): the effects of turbidity and predator speed. *Journal of Experimental Biology* 209: 4174-4184.

55. Michalsen, K., Fernö, A. & Nilsson, J. 2006. Synchronous vertical dynamics of individual cod (*Gadus morhua* L.) at the spawning ground. *Journal of Fish Biology* 69, 59*.*

56. Skjæraasen, J.E., Nilsen, T. & Kjesbu, O.S. 2006. Timing and determination of potential fecundity in Atlantic cod (Gadus morhua). Canadian Journal of Fisheries and Aquatic Sciences 63: 310-320.

57. Skjæraasen, J.E., Rowe, S. & Hutchings, J.A. 2006. Sexual dimorphism in pelvic fin length of Atlantic cod. Canadian Journal of Zoology 84: 865–870.

58. Utne-Palm, A.C & Bowmaker, J.K. 2006. Spectral sensitivity of the two-spotted goby (*Gobiusculus flavescens*): a physiological and behavioural study. *Journal of Experimental Biology* 209: 2034-2041.

59. Braithwaite, V.A. & Salvanes, A.G.V. 2005. Environmental variability in the early rearing environment generates behaviourally flexible cod: implications for rehabilitating wild populations. *Proceedings of the Royal Society, London Series B*. 272: 1107-1113.

60. Salvanes, A.G.V. & Braithwaite, V.A. 2005. Exposure to variable spatial information in the early rearing environment generates asymmetries in social interactions in coastal cod. *Behavioral Ecology and Sociobiology* 59: 250-257.

61. Artigas, M.L., Skjæraasen, J.E., Utne-Palm A.C. & Nilsen, T. 2005. Recovery from handling stress in cod (*Gadus morhua* L.). *Journal of Fish Biology* 67: 384-391.

62. Meager, J.J., Solbakken, T., Utne-Palm, A.C. & Oen, T. 2005. Effects of turbidity on the reactive distance, search time and foraging success of juvenile Atlantic cod (*Gadus morhua*). *Canadian Journal of Fisheries and Aquatic Sciences* 62: 1978-1984.

MARINE AND ENVIRONMENTAL HEALTH

Marine Developmental Biology Research Group

- *Smoltification, osmoregulation*

1. Nilsen, T. O., Ebbesson, L. O. E., Madsen, S. S., McCormick, S. D., Andersson, E., Björnsson, B. Th., Prunet, P. and Stefansson, S. O., 2007. Differential expression of gill Na^+,K^+-ATPase α- and β-subunits, Na^+,K^+,$2Cl^-$-cotransporter and CFTR anion channel in juvenile anadromous and landlocked Atlantic salmon *Salmo salar*. *J. Exp. Biol.*, 210, 2885-2896.

2. Stefansson, S.O., Haugland, M., Björnsson, B.Th., McCormick, S.D., Holm, M., Ebbesson, L.O.E., Holst, J.C., Nilsen, T.O., 2012. Growth, osmoregulation and endocrine changes in wild Atlantic salmon post-smolts during marine migration. *Aquaculture*, 362-363, 127-136. doi:10.1016/j.aquaculture.2011.07.002

- *Early life stages, salmon and marine fish*

3. Angotzi, A. R., Ersland, K. M., Mungpakdee S., Stefansson, S. and Chourrout, D., 2008. Independent and dynamic reallocation of pitx gene expression during vertebrate evolution, with emphasis on fish pituitary development. *Gene*, 417, 19-26.

4. Angotzi, A. R., S. Mungpakdee, S. Stefansson, R. Male, D. Chourrout, 2011. Involvement of Prop1 homeobox gene in fish pituitary early development. *Gen. Comp. Endocrinol*., 171, 332–340. doi:10.1016/j.ygcen.2011.02.026

- *Growth, sexual maturation*

5. Kling, P., Jönsson, E., Nilsen, T. O., Einarsdottir, I. E., Rønnestad, I., Stefansson, S. O. and Björnsson, B. Th., 2012. The role of growth hormone in growth, lipid homeostasis, energy utilization and partitioning in rainbow trout: interactions with leptin, ghrelin and insulin-like growth factor I. *Gen. Comp. Endocrinol*., 175, 153-162 (doi.org/10.1016/j.ygcen.2011.10.014).

6. Koedijk R. M., Le Francois N. R., Blier P. U., Foss, A., Folkvord, A., Ditlecadet, D., Lamarre, S. G., Stefansson, S. O. and Imsland, A. K., 2010. Ontogenetic effects of diet during early development on growth performance, myosin mRNA expression and metabolic enzyme activity in Atlantic cod juveniles reared at different salinities. *Comp. Biochem. Physiol.*, 156, 102-109.

- *Development and function of the visual system in fish larvae*

7. Valen, R., R.B. Edvardsen, A.M. Søviknes, Ø. Drivenes and J.V. Helvik. (2014). Molecular evidence that only two opsin families, the blue light- (SWS2) and green light-sensitive (RH2), drive color vision in Atlantic cod (*Gadus morhua*). *PLOS ONE* (in revision)

8. Helvik JV, Drivenes Ø, Næss TH, Fjose, A and Seo, HC (2001). Molecular cloning and characterisation of five opsin genes from the marine flatfish Atlantic halibut *(Hippoglossus hippoglossus) Visual Neuroscience* 18 767-780

- *Deep brain photoreception, development and function*

9. Eilertsen,M., Ø. Drivenes, R. B. Edvardsen, C. A. Bradley, L. O.E. Ebbesson and J.V. Helvik. (2014). Melanopsin and exorhodopsin in the pineal complex of Atlantic halibut (*Hippoglossus hippoglossus*). *J. Comp. Neurol*., 2014 (In Press)

10. Sandbakken, M., L. Ebbesson,S.O. Stefansson and J. V. Helvik (2012). Isolation and characterization of melanopsin photoreceptors of Atlantic salmon (*Salmo salar*). *J. Comp. Neurol.*, 520:3727-44.

- *Digestive function and appetite in developing larval fish*

11. Gomes, A.S., Y Kamisaka, T. Harboe, D. Power, I. Rønnestad. 2014. Functional modifications associated with gastrointestinal tract organogenesis during metamorphosis in Atlantic halibut (*Hippoglossus hippoglossus*) - *BMC Developmental Biology*. 14: 11.

- *Nutritional physiology and growth of teleosts*

12. Rønnestad, I., K. Murashita, G. Kottra, A-E. Olderbakk Jordal, C Jolly, S. Narawane, H. Daniel, T. Verri. 2010. Molecular cloning and functional expression of Atlantic salmon Peptide Transporter 1 in Xenopus oocytes reveals efficient intestinal uptake of lysine-containing and other bioactive di- and tripeptides in teleost fish. *J. Nutrition*. 140: 893-900.

13. Rønnestad, I., T.O. Nilsen, K. Murashita, A.R. Angotzi, A-G. Gamst-Moen, S.O. Stefansson, P. Kling, T.B. Björnsson and T. Kurokawa. 2010. Leptin and leptin receptor genes in Atlantic salmon: cloning, phylogeny, tissue distribution and expression correlated to long-term feeding status. *Gen. Comp. Endocrinol.,* 168: 55-70

- *Chromatin and Cell Cycle Dynamics in Urochordates*

14. Campsteijn C, Øvrebø JI, Karlsen BO and EM Thompson (2012). Expansion of cyclin D and CDK1 paralogs in *Oikopleura dioica*, a chordate employing diverse cell cycle variants. *Mol. Biol. Evol.* 29: 487-502.

15. Denoeud F, Henriet S, Mungpakdee S, Aury JM, Da Silva C, Brinkmann H, Mikhaleva J, Olsen LC, Jubin C, Cañestro C, Bouquet JM, Danks G, Poulain J, Campsteijn C, Adamski M, Cross I, Yadetie F, Muffato M, Louis A, Butcher S, Tsagkogeorga G, Singh S, Jensen MF, Cong EH, Eikeseth-Otteraa H, Anthouard V, Kachouri-Lafond R, Nishino A, Ugolini M, Chourrout P, Nishida H, Aasland R, Huzurbazar S, Westhof E, Delsuc F, Lehrach H, Reinhardt R, Weissenbach J, Roy SW, Artiguenave F, Postlethwait JH, Manak JR, Thompson EM, Jaillon O, Du Pasquier L, Boudinot P, Liberles DA, Volff JN, Philippe H, Lenhard B, Crollius HR, Wincker P and D Chourrout (2010). Plasticity of animal genome architecture unmasked by rapid evolution of a pelagic tunicate. *Science* 330, 1381-1385.

- *Cellular templating of complex extracellular structures*

16. Sagane Y, Hosp J, Zech K and EM Thompson (2011). Cytoskeleton-mediated templating of complex cellulose-scaffolded extracellular structure in the urochordate *Oikopleura*. *Cell. Molec. Life Sci.* 68, 1611-1622.

17. Sagane Y, Zech K, Bouquet JM, Schmid M, Bal U and EM Thompson (2010). Functional specialization of cellulose synthase genes of prokaryotic origin in chordate larvaceans. *Development* 137, 1483-1492.

- *Marine trophodynamics, climate change and environmental monitoring*

18. Hadziavdic K, Lekang, K, Lanzen, A; Jonassen, I, Thompson, EM and C Troedsson (2014). Characterization of the 18S rRNA Gene for Designing Universal Eukaryote Specific Primers. *PLoS ONE*, 9: e87624.

19. Troedsson C, Bouquet JM, Lobon CM, Novac A, Nejstgaard JC, Dupont S, Bosak S, Jakobsen HH, Romanova N, Pankoke LM, Isla A, Dutz J, Sazhin AF and EM Thompson (2012). Effects of ocean acidification, temperature and nutrient regimes on the appendicularian Oikopleura dioica: A mesocosm study. *Mar. Biol.* [special issue on ocean acidification], 160: 2175-2187.

- *Skeletal development salmon, skeletal deformities salmon*

20. Norvik, K., Kryvi, H., Totland, G. K., Grotmol, S. 2005. The salmon vertebral body develops through mineralization of the preformed tissues that are encompassed by two layers of bone. *J. Anat.* 206, 103-114.

21. Grotmol, S., Kryvi, H., Totland, G. K. 2005. Deformation of the notochord by pressure from the swim bladder may cause malformation of the vertebral column in cultured Atlantic cod *Gadus morhua*: a case study. *Diseas. Aquat. Org.* 65, 121-128.

- *Notochord development, salmon*

22. Wang, S., Furmanek, T., Kryvi, H., Krossøy, C., Totland, G. K., Grotmopl, S., Wargelius, A. 2014. Transcriptome sequencing of Atlantic salmon (*Salmo salar* L.) notochord prior to development of the vertebrae provides clues to regulation of positional fate, chordoblast lineage and mineralization. *BMC genomics* 15, 141-155.

23. Sagstad, A., Grotmol,.S., Kryvi,. H., Krossøy, C., Totland, G.K., Malde,. K., Wang, S., Hansen, T. Wargelius, A. 2013. Identification of *vimentin-* and *elastin*-like transcripts specifically expressed in developing nototochord of Atlantic salmon (*Salmo salar* L). *Cell Tissue Res.*, 346, 191-202.

Environmental Toxicology Research Group

1. Nilsen BM, Berg K, Eidem JK, Kristiansen SI, Brion F, Porcher JM, Goksøyr A. Development of quantitative vitellogenin-ELISAs for fish test species used in endocrine disruptor screening. Anal Bioanal Chem. 378:621-33 (2004).

2. Bemanian, V; Male, R. & Goksøyr, A. The Aryl hydrocarbon receptor-mediated disruption of vitellogenin synthesis in the fish liver: Cross-talk between AHR- and ERα-signaling pathways. Comparative Hepatology 3:2 (2004), http://www.comparative-hepatology.com.

3. Hasselberg L., Goksøyr A., Grøsvik B.E. Celander M Interactions between xenoestrogens and ketoconazole on CYP1A and CYP3A in juvenile Atlantic cod (Gadus morhua). Comparative Hepatology, 4:2 (2005).

4. Goksøyr A. Endocrine disruptors in the marine environment: mechanisms of toxicity and their influence on reproductive processes in fish. J. Toxicol. Environ. Health part A, 69:175-184 (2006).

5. Eidem, JK, Kleivdal H, Kroll K, Denslow N, van Aerle R, Tyler C, Panter G, Hutchinson T, Goksøyr A. Development and validation of a direct homologous quantitative sandwich ELISA for fathead minnow (Pimephales promelas) vitellogenin. Aquat. Toxicol. 78:202-206 (2006).

6. Luigi Viganò, Emilio Benfenati, Anne van Cauwenberge, Janne K. Eidem, Claudio Erratico, Anders Goksøyr, Werner Kloas, Silvia Maggioni, Alberta Mandich, Ralph Urbatzka. Estrogenicity profile and estrogenic compounds determined in river sediments by chemical analysis, ELISA and yeast assays. Chemosphere 73:1078-1089 (2008).

7. Jasmine Nahrgang, Lionel Camus, Patrice Gonzalez, Anders Goksøyr, Jørgen Schou Christiansen & Haakon Hop. PAH biomarker responses in polar cod (Boreogadus saida) exposed to benzo(a)pyrene. Aquatic Toxicology, 94:309-319 (2009).

8. Anneli Bohne Kjersem, Arnfinn Skadsheim, Anders Goksøyr & Bjørn Einar Grøsvik. Candidate biomarker discovery in plasma of juvenile cod (Gadus morhua) exposed to crude North Sea oil, alkyl

phenols and polycyclic aromatic hydrocarbons. Marine Environ. Res. 68:268-277 (2009).

9. Berntssen, M.H.G., Olsvik, P.A., Torstensen, B.E., Julshamn, K., Midtun, T., Goksøyr, A., Johansen, J., Sygholt, T., Joerum, N., Jakobsen, J.-V., Lundebye, A.-K., Lock, E.-J. Reducing persistent organic pollutants while maintaining long chain omega-3 fatty acid in farmed Atlantic salmon by use of decontaminated fish oils during a full cycle production. Chemosphere, 81:242-252 (2010).

10. Berg, K., Puntervoll, P., Valdersnes, S. and Goksøyr, A. Responses in the brain proteome of Atlantic cod (Gadus morhua) exposed to methylmercury. Aquat. Toxicol., 100:51-65 (2010).

11. Meier, S., H.C. Morton, G. Nyhammer, B.E. Grøsvik, V. Makhotin, A. Geffen, S. Boitsov, K.A. Kvestad, A. Bohne-Kjersem, A. Goksøyr, A. Folkvord, J. Klungsøyr and A. Svardal, Development of Atlantic cod (Gadus morhua) exposed to produced water during early life stages: Effects on embryos, larvae, and juvenile fish. Mar. Environ. Res., 70:383-394 (2010).

12. Schwesig, David; Borchers, Ulrich; Chancerelle, Laure; Dulio, Valeria; Eriksson, Ulla; Farre, Marinella; Goksoyr, Anders; Lamoree, Marja; Leonards, Pim; Lepom, Peter; Leverett, Dean; O'Neill, Anne; Robinson, Rod; Silharova, Katarina; Slobodnik, Jaroslav; Tolgyessy, Peter; Tutundjian, Renaud; Wegener, Jan-Willem; Westwood, David. A harmonized European framework for method validation to support research on emerging pollutants. Trends Anal. Chem. 30:1233-1242 (2011).

13. Olsvik, Pål A., Brattås, Marianne, Lie, Kai K., and Goksøyr, Anders. Transcriptional responses in juvenile Atlantic cod (Gadus morhua) after exposure to mercury-contaminated sediments obtained near the wreck of the German WW2 submarine U-864, and from Bergen Harbor, Western Norway. Chemosphere, 83:552-563 (2011).

14. Yadetie F, Butcher S, Førde HE, Campsteijn C, Bouquet JM, Karlsen OA, Denoeud F, Metpally R, Thompson EM, Manak JR, Goksøyr A, Chourrout D. Conservation and divergence of chemical defense system in the tunicate Oikopleura dioica revealed by genome wide response to two xenobiotics. BMC Genomics. 2012 Feb 2;13:55.

15. Karlsen OA, Puntervoll P and Goksøyr A. Mass spectrometric analyses of microsomal cytochrome P450 isozymes isolated from β-naphtoflavone-treated Atlantic cod (Gadus morhua) liver reveal insights into the cod CYPome. Aquatic Toxicology, 2012. Feb;108:2-10.

16. Fekadu Yadetie, Odd Andre Karlsen, Anders Lanzén, Karin Berg, Pål Olsvik, Pål Puntervoll, Christer Hogstrand, Anders Goksøyr. Global transcriptome analysis of Atlantic cod (Gadus morhua) liver after in vivo methylmercury exposure suggests effects on energy metabolism pathways. Aquat Toxicol. 2013 Jan 15;126:314-25

17. Karlsen OA, Sheehan D, Goksøyr A. Alterations in the Atlantic cod (Gadus morhua) hepatic thiol-proteome after methylmercury exposure. Journal of Toxicology and Environmental Health, part A. 2014. 77(9-11):650-62.

18. Fekadu Yadetie, Odd Andre Karlsen, Marta Eide, Karin Berg, Christer Hogstrand, Anders Goksøyr.
19. Liver transcriptome analysis of Atlantic cod (Gadus morhua) exposed to PCB 153 indicates effects on cell cycle and lipid metabolism. BMC Genomics, 2014 Jun 17. 15(1):481.

20. Eide M, Karlsen OA, Kryvi H, Olsvik PA, Goksøyr, A. Precision-cut liver slices of Atlantic cod (Gadus morhua): an in vitro system to study effects of environmental contaminants. Aquatic Toxicology 153: 110–115 (2014).

21. Bainy A, Kubota A, Goldstone JV, Lille-Langøy R, Karchner SI, Hahn ME, Goksøyr A, and Stegeman JJ. Functional Characterization of a Full Length Pregnane X Receptor, Expression in vivo, and Identification of PXR Alleles in Zebrafish (Danio rerio). Aquatic Toxicology 142-143:447-457 (2013).

22. Castelli MG, Rusten M, Goksøyr A, Routti H. mRNA expression of genes regulating lipid metabolism in

ringed seals (Pusa hispida) from differently polluted areas. Aquat. Toxicol. 146:239-246 (2014).

23. Eide M, Rusten M, Jensen KH, Male R, Goksøyr A. The ZFL cell line is non-responsive to environmental estrogens – a characterization of in vitro liver cell models for the zebrafish (Danio rerio). Aquat. Toxicol. 147:7-17 (2014).

24. MM Ibrahim, E Fjære, EJ Lock, D Naville, H Amlund, E Meugnier, B Le Magueresse Battistoni, L Frøyland, L Madsen, N Jessen, S Lund, H Vidal, and J Ruzzin. 2011. Chronic consumption of diet with farmed salmon containing persistent organic pollutants causes insulin resistance and obesity in mice. PLoS ONE, 6: e25170 (IF:4.53)

25. J Ruzzin. 2012. Public health concern behind the exposure to persistent organic pollutants and the risk of metabolic diseases. BMC Public Health, 12:298-302 (IF:2.36)

26. J Ruzzin, DH Lee, DO Carpenter, D Jacobs Jr. 2012. Reconsidering metabolic diseases: the impacts of persistent organic pollutants. Atherosclerosis, 224:1-3 (IF:4.15)

27. J Ruzzin and DR Jacobs Jr. 2012. The secret story of fish: decreasing nutritional value due to pollution? British Journal of Nutrition, 108:397–99 (IF:3.40)

28. MM Ibrahim, E Fjære, EJ Lock, H Amlund, L Frøyland, N Jessen, S Lund, H Vidal, and J Ruzzin. 2012. Metabolic impacts of high dietary exposure to persistent organic pollutants in mice. Toxicology Letters, 215:8-15 (IF:3.60)

29. DR Jacobs Jr, J Ruzzin, and DH Lee. 2014. Environmental pollutants: downgrading the fish food stock affects chronic disease risk. Journal of Internal Medicine (IF:6.55).

30. M-S Gauthier, R Rabasa-Lhoret, D Prud'homme, A Karelis, D Geng, B van Bavel, and J Ruzzin. 2014. The metabolically healthy but obese phenotype is associated with lower plasma levels of persistent organic pollutants as compared to the metabolically abnormal obese phenotype. The Journal of Clinical Endocrinology and Metabolism, 99(6):E1061-6 (IF:6.43).

Ecological and Environmental Change Research Group

1. Kemp, AC, **Telford, RJ**, Horton, BP, Anisfeld, SC, Sommerfield, CK. 2013. Reconstructing Holocene sea level using salt-marsh foraminifera and transfer functions: lessons from New Jersey, USA. *Journal of Quaternary Science*, 28, 617-629

2. **Telford RJ**, Li C, Kucera M. 2013. Mismatch between the depth habitat of planktonic foraminifera and the calibration depth of SST transfer functions may bias reconstructions. *Climate of the Past*, 9, 859-870

3. Bouchet VMP, Alve E, Rygg B, **Telford RJ.** 2012. Benthic foraminifera provide a promising tool for ecological quality assessment of marine waters. *Ecological Indicators*, 23: 66-75

4. Austin WEN, **Telford RJ**, Ninnemann US, Brown L, Wilson, LJ, Small DP, Bryant CL. 2011. North Atlantic reservoir ages linked to high Younger Dryas atmospheric radiocarbon concentrations. *Global and Planetary Change*, 79: 226-233

5. Lloyd J, Moros M, Perner K, **Telford RJ**, Kuijpers A, Jansen E, McCarthy D. 2011. A 100 yr record of ocean temperature control on the stability of Jakobshavn Isbrae, West Greenland. *Geology* 39: 867-870

6. Andersson C, Pausata FSR, Jansen E, Risebrobakken B, **Telford RJ**. 2010. Holocene trends in the foraminifer record from the Norwegian Sea and the North Atlantic Ocean. *Climate of the Past* 6, 179–193

AQUACULTURE AND FISH HEALTH

Fisheries Ecology and Aquaculture Research Group

- *Fish population biology*

1. Geffen AJ (2009) Advances in herring biology: from simple to complex, coping with plasticity and adaptability. ICES Journal of Marine Science 66: 1688–1695

2. Geffen AJ, Nash RDM, Dau K, Harwood AJP (2011) Sub-cohort dynamics of O-group plaice, *Pleuronectes platessa* L., in the Northern Irish Sea: settlement, growth and mortality. Journal of Experimental Marine Biology and Ecology. 400 (1-2):108-119. DOI:10.1016/j.jembe.2011.02.030

3. Geffen AJ, Nash RDM, Dau K, Harwood AJP (2011) Sub-cohort dynamics of O-group plaice, *Pleuronectes platessa* L., in the Northern Irish Sea: settlement, growth and mortality. Journal of Experimental Marine Biology and Ecology. 400 (1-2):108-119. DOI:10.1016/j.jembe.2011.02.030

4. Johannessen A, Skaret G, Langård L, Slotte A, Husebø Å, Fernø A (2014) The Dynamics of a Metapopulation: Changes in Life-History Traits in Resident Herring that Co-Occur with Oceanic Herring during Spawning. PLoS ONE 9(7): e102462. doi:10.1371/journal.pone.0102462

5. Johannessen, A., Nøttestad, L., Fernö, A., Langård, L. and Skaret G. 2009. Two components of Northeast Atlantic herring within the same school during spawning: support for the existence of a metapopulation? – ICES Journal of Marine Science, 66 (8): 1740–1748

6. Langård, L., A. Johannessen, , A. Fernö, L. Nøttestad, G. Skaret, A. Slotte, J. Røttingen and J. T. Øvredal 2012. Acoustic tagging: A suitable method for the study of natural herring behaviour around spawning? In A.N. Popper and A. Hawkins (eds.), The effects of noise on aquatic life, Advances in Experimental Medicine and Biology 730, DOI 10.1007/978-1-4419-7311-5_87. Springer Science+Business Media, LLC

7. Silva, F., A. Slotte, A. Johannessen, J. Kennedy, OS. Kjesbu 2012. Strategies for partition between body growth and reproductive investment in migratory and stationary populations of spring spawning Atlantic herring (*Clupea harengus* L.). Fisheries Research 138: 71– 79

- *Fish nutrition and development*

8. Hamre K, M Moren, J Solbakken, I Opstad, K Pittman, 2005. The impact of nutrition on metamorphosis in Atlantic halibut (Hippoglossus hippoglossus L.). Aquaculture. 250, 555-565.

9. Kjørsvik E, K Pittman, D Pavlov, 2004. From fertilisation to the end of metamorphosis - functional development.

10. Pittman K, M Yúfera, M Pavlidis, AJ Geffen, W Koven, L Ribeiro, JL Zambonino Infante, A Tandler, 2013. Fantastically plastic: fish larvae equipped for a new world. Reviews in Aquaculture. 5, S224-S267.

11. Power DM, IE Einarsdottir, K Pittman, GE Sweeney, J Hildahl, MA Campinho, N Silva, Ø Sæle, M Galay-Burgos, H Smaradottir, BT Björnsson, 2008. The Molecular and Endocrine Basis of Flatfish Metamorphosis. Reviews in Fisheries Science. 16, 95-111.

12. Sæle Ø, JS Solbakken, K Watanabe, K Hamre, K Pittman, 2003. The effect of diet on ossification and eye migration in Atlantic halibut larvae (*Hippoglossus hippoglossus*). Aquaculture. 220, 683-696.

13. Sæle Ø, KA Pittman, 2010. Looking closer at the determining of a phenotype? Compare by stages or size, not age. Journal of Applied Ichthyology. 26, 294-297.

- *Shellfish production*

14. Andersen, S, G. Christophersen, T. Magnesen. 2013. Implications of larval diet concentration on post-larval yield in a production scale flow through system for scallops (*Pecten maximus* Lamarck) in Norway." Aquaculture International 21 (2), 435-452.

15. Andersen, S., G. Christophersen, T. Magnesen. 2011. Great scallop (*Pecten maximus* L.) spat production; a rollercoaster. A review. Canadian Journal of Zoology 89:585-604.

16. Andersen, Ø., Torgersen, J.S., Pagander, H.H., Magnesen, T. Johnston, I.A. 2009. Gene expression analyses of essential catch factors in the smooth and striated adductor muscles of postlarval and adult great scallop (*Pecten maximus*). Journal of Muscle Research and Cell Motililty 30:233-242.

17. Jacobsen, A. Otto Grahl-Nielsen, Thorolf Magnesen. 2012. Effects of reduced diameter of bag cultures on content of essential fatty acids and cell density in a continuous algal production system? Journal of Applied Phycology: 24 (1):109-116.

18. Jacobsen, Anita, Otto Grahl-Nielsen, Thorolf Magnesen. 2010. Does large scale continuous algal production system provide a stable supply of fatty acids to bivalve hatcheries? Journal of Applied Phycology 22 (6):769-777

19. Magnesen, T and G. Christophersen. 2008. Reproductive cycle and conditioning of translocated scallops (*Pecten maximus*) from five broodstock populations in Norway. Aquaculture 285, 109-116.

- *Juvenile fish production*

20. Imsland AK, A Foss, R Koedijk, A Folkvord, SO Stefansson, TM Jonassen, 2006. Short- and long-term differences in growth, feed conversion efficiency and deformities in juvenile Atlantic cod (*Gadus morhua*) startfed on rotifers and zooplankton. Aquaculture Research. 37, 1015-1027.

21. Larsen SV, AK Imsland, P Lohne, K Pittman, A Foss, 2011. Stepwise temperature regulation and its effect on growth, feeding and muscle growth patterns of juvenile Atlantic halibut (Hippoglossus hippoglossus L.). Aquaculture International. 19, 825-837.

22. Lohne P, AK Imsland, S Larsen, A Foss, K Pittman, 2012. Interactive effect of photoperiod and temperature on the growth rates, muscle growth and feed intake in juvenile Atlantic halibut. Aquaculture Research. 43, 187-197.

- *Animal health and water quality*

23. Magnesen T., Erga S.R, Christophersen G,. 2010. Growth of scallop spat in raceway nursery during autumn conditions in western Norwegian coastal waters. Journal of Shellfish research 29 (1): 1-10

24. Magnesen, T. and A. Jacobsen 2011. 2012. Effect of water recirculation on seawater quality and production of scallop (*Pecten maximus*) larvae. Aquacultural Engineering 47:1-6

25. Pittman K, A Pittman, S Karlson, T Cieplinska, P Sourd, K Redmond, B Ravnoy, E Sweetman, 2013. Body site matters: an evaluation and application of a novel histological methodology on the quantification of mucous cells in the skin of Atlantic salmon, Salmo salar L. Journal of Fish Diseases. 36, 115-127.

26. Sandaa, R.-A., Brunvold, L., Magnesen, T. and Bergh, Ø. 2008. Monitoring the opportunistic bacteria *Pseudoalteromonas* LT-13 in a great scallop, *Pecten maximus* hatchery. Aquaculture 276:14-21.

- *Food quality and traceability*

27. Grahl-Nielsen, Otto, Anita Jacobsen, Gyda Christophersen, Thorolf Magnesen. 2010. Fatty acid composition in spat adductor muscle from five Norwegian king scallop (*Pecten maximus*) populations reared in the same environment. Biochemical Systematics and Ecology 38 (4):478-488

28. Higgins RM, Danilowicz BS, Balbuena JA, Daníelsdóttir AK, Geffen AJ, Meijer WG, Modin J, Montero F,

Pampoulie C, Perdiguero D, Schreiber A, Stefánsson MO, Wilson B. (2010) Multi-disciplinary Fingerprints Reveal the Harvest Location of Cod (*Gadus morhua*) in the Northeast Atlantic. Marine Ecology Progress Series 404: 197–206 DOI: 10.3354/meps08492

29. Redmond, K., Magnesen, T, Hansen, P.K., Strand, Ø 2010. Stable isotopes and fatty acids as tracers of the assimilation of salmon fish feed in blue mussels *(Mytilus edulis*). Aquaculture 298:202-210.

- *Trophic ecology and life history biology*

30. Folkvord A, C Jørgensen, K Korsbrekke, RDM Nash, T Nilsen, JE Skjæraasen, 2014. Trade-offs between growth and reproduction in wild Atlantic cod. Canadian Journal of Fisheries and Aquatic Sciences. 71, 1106-1112.

31. Gibbons, 2011. Dietary success of a 'new' key fish in an overfished ecosystem: evidence from fatty acid and stable isotope signatures. Marine Ecology Progress Series. 428, 219-233.

32. Magnesen, Thorolf; Redmond, Kirsten Jayne. 2012.Potential predation rates by the sea stars *Asterias rubens* and *Marthasterias glacialis*, on juvenile scallops, *Pecten maximus*, ready for sea ranching. *Aquaculture International* 20 (1):189-199.

33. Utne-Palm AC, AGV Salvanes, B Currie, S Kaartvedt, GE Nilsson, VA Braithwaite, JAW Stecyk, M Hundt, M van der Bank, B Flynn, GK Sandvik, TA Klevjer, AK Sweetman, V Bruchert, K Pittman, KR Peard, IG Lunde, RAU Strandabo, MJ Gibbons, 2010. Trophic Structure and Community Stability in an Overfished Ecosystem. Science. 329, 333-336.

- *Larval fish ecology*

34. Folkvord A, 2005. Comparison of size-at-age of larval Atlantic cod (*Gadus morhua*) from different populations based on size- and temperature-dependent growth models. Canadian Journal of Fisheries and Aquatic Sciences. 62, 1037-1052.

35. Folkvord A, Ø Fiksen, H Høie, A Johannessen, E Otterlei, KW Vollset, 2009. What can size distributions within cohorts tell us about ecological processes in fish larvae? Scientia Marina. 74, 119-130.

36. Kristiansen T, Ø Fiksen, A Folkvord, 2007. Modelling feeding, growth, and habitat selection in larval Atlantic cod (*Gadus morhua*): observations and model predictions in a macrocosm environment. Canadian Journal of Fisheries and Aquatic Sciences. 64, 136-151.

37. Vollset KW, A Folkvord, HI Browman, 2011. Foraging behaviour of larval cod (Gadus morhua) at low light intensities. Marine Biology. 158, 1125-1133.

38. Vollset KW, IA Catalán, Ø Fiksen, A Folkvord, 2013. Effect of food deprivation on distribution of larval and early juvenile cod in experimental vertical temperature and light gradients. Marine Ecology Progress Series. 475,

- *Climate and environmental impact*

39. Frommel AY, RH Maneja, DM Lowe, A Malzahn, A Geffen, A Folkvord, U Piatkowski, T Reusch, C Clemmesen, 2012. Ocean acidification effects on larvae of a commercially important fish species, Atlantic cod (*Gadus morhua*). Nature Climate Change. 2, 42-46.

40. Geffen AJ, Høie H, Folkvord A, Hufthammer, AK, Andersson, C, Ninemann U, Pedersen, RB, Nedreaas K (2011) High latitude climate variability and its effect on fishery resources as revealed by fossil otoliths. ICES Journal of Marine Science. 68: 1081-1089. DOI:10.1093/icesjms/FSR017

41. Hufthammer AK, H Høie, A Folkvord, AJ Geffen, CA Andersson, US Ninnemann, 2010. Seasonality of human site occupation based on stable oxygen isotope ratios of cod otoliths. Journal of Archaeological Science. 37, 78-83.

- *Otolith growth and composition studies*

42. Chang M-Y, Geffen AJ. (2013) Taxonomic and environmental influences on fish otolith microchemistry. Fish and Fisheries. 14: 458-492. DOI: 10.1111/j.1467-2979.2012.00482.x

43. Folkvord A, A Johannessen, E Moksness, 2004. Temperature dependent otolith growth in Norwegian spring spawning herring (*Clupea harengus*) larvae. Sarsia. 89, 297-310.

44. Høie H, E Otterlei, A Folkvord, 2004. Temperature-dependent fractionation of stable oxygen isotopes in otoliths of juvenile cod (*Gadus morhua* L). ICES Journal of Marine Science. 61, 243-251.

45. Tomas, J., Geffen, A.J., Allen, I.S., & Berges, J. (2004) Analysis of the soluble matrix of vaterite otoliths of juvenile herring (Clupea harengus): do crystalline otoliths have less protein? *Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology*, 139, 301-308

- *Fisheries ecology and management*

46. Garcia, S. E., Kolding, J., Rice, J., Rochet, M.-J., Zhou, S., Arimoto, T., Beyer, J. E., Borges, L., Bundy, A., Dunn, D., Fulton, E. A., Hall, M., Heino, M., Law, R., Makino, M., Rijnsdorp, A., Simard, F., and Smith, A. 2012.Reconsidering the consequences of selective fisheries. *Science* 335:1045-1047.

47. Kolding, J. and van Zwieten, P.A.M. 2011. The tragedy of our legacy: how do global management discourses affect small-scale fisheries in the South? *Forum for Development Studies* 38(3): 267-297.

48. Law, R., Kolding, J. and Plank, M.J. 2013. Squaring the circle: Reconciling fishing and conservation of aquatic ecosystems. *Fish and Fisheries*, online 7 September. Doi: 10.1111/faf.12056

49. Law, R., Plank, M.J and Kolding, J. 2012. On balanced exploitation of marine ecosystems: results from dynamic size spectra. *ICES Journal Marine Sciences* 69:602-614. doi: 10.1093/icesjms/fss031.

Fish Disease Research Group

1. KOPPANG EO, HAUGARVOLL E, HORDVIK I, POPPE TT, BJERKÅS I. Granulomatous uveitis associated with vaccination in the Atlantic salmon. *Veterinary Pathology* 41: 122-130, 2004

2. HORDVIK I, TORVUND J, MOORE L, ENDRESEN C. Structure and organization of the T cell receptor alpha chain genes in Atlantic salmon. *Molecular Immunology* 41: 553-559, 2004

3. FISCHER U, DIJKSTRA JM, KÖLLNER B, KIRYU I, KOPPANG EO, HORDVIK I, SAWAMOTO Y, OTOTAKE M. The ontogeny of MHC class I expression in rainbow trout (Oncorhynchus mykiss). *Fish & Shellfish Immunology* 18: 49-60, 2005

4. VAN DÒ T, HORDVIK I, ENDRESEN C, ELSAYED S. Characterization of parvalbumin, the major allergen in Alaska Pollack, and comparison with codfish Allergen M. *Molecular Immunology* 42: 345-353, 2005

5. KOPPANG EO, HORDVIK I, AUNE L, POPPE TT. Vaccine-associated granulomatous inflammation and melanin accumulation in Atlantic salmon, Salmo salar L., white muscle. *Journal of Fish Diseases* 28: 13-22, 2005

6. MOORE LJ, SOMAMOTO T, LIE KK, DIJKSTRA JM, HORDVIK I. Characterisation of salmon and trout CD8 alpha and CD8 beta. *Molecular Immunology* 42: 1225-1234, 2005

7. VAN DÒ T, ELSAYED S, FLORVAAG E, HORDVIK I, ENDRESEN C. Allergy to fish parvalbumins: Studies on the cross-reactivity of allergens from 9 commonly consumed fish. J*ournal of Allergy and Clinical Immunology* 116: 1314-1320, 2005

8. OLSVIK PA, JORDAL AEO, LIE KK, NILSEN TO, HORDVIK I. Evaluation of potential reference genes in real time RT-PCR studies of Atlantic salmon. *BMC Molecular Biology* (online journal) 6:21, 2005

9. HEVRØY EM, JORDAL A-E, HORDVIK I, ESPE M, HEMRE G-I, OLSVIK PA. Myosin heavy chain mRNA expression correlates higher with muscle protein accretion than growth in Atlantic salmon, Salmo salar. *Aquaculture* 252: 453-461, 2006

10. MORRISON RN, KOPPANG EO, HORDVIK I, NOWAK BF. MHC class II+ cells in the gills of salmon experimentally infected with amoebic gill disease. *Veterinary Immunology and Immunopathology* 109: 297-303, 2006

11. DIJKSTRA JM, SOMAMOTO T, MOORE LJ, HORDVIK I, OTOTAKE M, FISCHER U. Identification and characterization of a second CD4-like gene in teleost fish. *Molecular Immunology* 43: 410-419, 2006

12. JORDAL A-E, HORDVIK I, PELSERS M, BERNLOHR D, TORSTENSEN BE. FABP3 and FABP10 in Atlantic salmon (Salmo salar L.)–General effects of diatary fatty acid composition and life cycle variations. *Comparative Biochemistry and Physiology B, Biochemistry & Molecular Biology* 145: 147-158 , 2006

13. LIU Y, MOORE L, KOPPANG EO, HORDVIK I. Characterization of the CD3□, CD3□□and CD3□□subunits of the T cell receptor complex in Atlantic salmon. *Developmental and Comparative Immunology* 32: 26-35, 2008

14. HAUGARVOLL E, BJERKÅS I, NOWAK BF, HORDVIK I, KOPPANG EO. Identification and characterization of a novel intraepithelial lymphoid tissue in the gills of Atlantic salmon. *Journal of Anatomy* 213: 202-209, 2008

15. MOORE L, DIJKSTRA JM, KOPPANG EO, HORDVIK I. CD4 homologous in Atlantic salmon. *Fish & Shellfish Immunology* 26: 10-18, 2009

16. ØVERGÅRD AC, HORDVIK I, NERLAND AH, EIKELAND G, PATEL S. Cloning and expression analysis of Atlantic halibut (Hippoglossus Hippoglossus) CD3 genes. *Fish & Shellfish Immunology* 27: 707-13, 2009

17. KOPPANG EO, FISCHER U, MOORE L, TRANULIS MA, DIJKSTRA H, KÖLLNER B, AUNE L, JIRILLO E, HORDVIK I. Salmonid T cells assemble in the thymus, spleen and in novel interbranchial lymphoid tissue (ILT). *Journal of Anatomy* 217: 728-739, 2010

18. TADISO TM, LIE KK, HORDVIK I. Molecular cloning of IgT from Atlantic salmon, and analysis of the relative expression of □, □ and □ in different tissues. *Veterinary immunology and immunopathology* 139: 17-26, 2011

19. TADISO TM, KRASNOV A, SKUGOR S, AFANASYEV S, HORDVIK I, NILSEN F. Gene expression analyses of immune responses in Atlantic salmon during early stages of infection by salmon louse (Lepeophtheirus salmonis) revealed bi-phasic responses coinciding with the copepod-chalimus transition. *BMC Genomics* 12: 141, 2011

20. KAMIL A, FALK K, SHARMA A, RAAE A, BERVEN F, KOPPANG EO, HORDVIK I. A monoclonal antibody distinguishes between two IgM heavy chain isotypes in Atlantic salmon and brown trout: Protein characterization, 3D modeling and epitope mapping. *Molecular Immunology* 48: 1859-1867, 2011

21. TADISO TM, SHARMA A, HORDVIK I. Analysis of polymeric immunoglobulin receptor- and CD300-like molecules from Atlantic salmon. *Molecular Immunology* 49: 462-473, 2011

22. YOUSAF MN, KOPPANG EO, SKJØDT K, KÖLLNER B, HORDVIK I, ZOU J, SECOMBES C, POWELL MD. Cardiac pathological changes of Atlantic salmon (Salmo salar L.) affected with heart and skeletal muscle inflammation (HSMI). *Fish Shellfish Immunol.* 33: 305-15, 2012

23. LARSEN HA, AUSTBØ L, MØRKØRE T, THORSEN J, HORDVIK I, FISCHER U, JIRILLO E, RIMSTAD E, KOPPANG EO. Pigment-producing granulomatous myopathy in Atlantic salmon: A novel inflammatory response. *Fish Shellfish Immunol.* 33: 277-85, 2012

24. WIIK-NIELSEN J, LØVOLL M, FRITSVOLD C, KRISTOFFERSEN AB, HAUGLAND Ø, HORDVIK I, AAMELFOT M, JIRILLO E, KOPPANG EO, GROVE S. Characterization of myocardial lesions associated with cardiomyopathy syndrome in Atlantic salmon, Salmo salar L., using laser capture microdissection. *Journal of Fish Diseases*, 35: 907-916, 2012

25. YOUSAF MN, KOPPANG EO, SKJØDT K, HORDVIK I, ZOU J, SECOMBES C, POWEL MD. Comparative cardiac pathological changes of Atlantic salmon (Salmo salar L.) affected with hearth and skeletal muscle inflammation (HSMI), cardiomyopathy syndrome (CMS) and pancreas disease (PD). *Vet Immunol Immunopathol.* 151: 49-62, 2013.

26. KAMIL A, RAAE A, FJELLDAL PG, KOPPANG EO, FLADMARK KE, HORDVIK I. Comparative analysis of IgM sub-variants in salmonid fish and identification of a residue in m3 which is essential for MAb4C10 reactivity. *Fish Shellfish Immunol.* 34: 667-672, 2013.

27. KAMIL A, FJELLDAL PG, HANSEN T, RAAE A, KOPPANG EO, HORDVIK I. Vaccination of Atlantic salmon leads to long-lasting higher levels of serum immunoglobulin and possible skewed ratios of two distinct IgM isotypes. *ABB Special issue on Antibodies* 4: 85-90, 2013

Fish Immunology Research Group

1. Rønneseth, A., Pettersen, E.F. & Wergeland, H.I. 2005. Leucocytes of anadromous and landlocked strains of Atlantic salmon (Salmo salar L.) in the smolting period. Fish & Shellfish Immunology. 19: 229-239.

2. Pettersen, E.F., Bjørløw, I., Hagland, T.J. & Wergeland, H.I. 2005Effect of seawater temperature on leucocyte populations in Atlantic salmon post-smolts. Veterinary Immunology and Immunopathology.106: 65-76.

3. Rønneseth,A., Pettersen, E.F. & Wergeland, H.I .2006 Neutrophils and B-cells in blood and head kidney of Atlantic salmon (Salmo salar L.) challenged with infectious pancreatic necrosis virus (IPNV). 20:610-620.

4. Ingersle, H-C., Cunningham, C & Wergeland, H.I. 2006. Cloning and expression of TNF-α, IL-1 and COX-2 in an anadromous and landlocked strain of Atlantic salmon (Salmo salar L.) during the smolting period. Fish and Shellfish Immunology 20: 450-461.

5. Ingerslev, H-C, Pettersen, E.F., Jakobsen, R.A, Bie, P.C. & Wergeland, H.I.2006. Expresion profiling and validation of reference gene candidates in immune relevant tissues and cells from Atlantic salmon (Salmo salar L.) Molecular Immunology 43:1194-1201.

6. Rønneseth,A., Wergeland,HI& Pettersen, EF. 2007 Neutrophils and B-cells in Atlantic cod (Gadus morhua L.). Fish & Shellfish Immunology , 23: 493-503.

7. Rønneseth, A, Wergeland.HI ,Devik , M, Evensen, Ø & Pettersen, EF. 2007 Mortality after IPNV challenge of Atlantic salmon (Salmo salar L.) differs based on developmental stage of fish or challenge route. Aquaculture 271 :100–111.

8. Nguyen T.T.T., Nguyen H.D. & H.I.Wergeland 2009. Characterization of Vibrio parahaemolyticus causing the ulcerative disease in oranged-spotted grouper (Epinephelus coioides) cultured in Viet nam. A Scientific Collection of Research Insititutes for Aquaculture No. III between 2004-2009. Agriculture Publishing house. 863 pp. (In Vietnames with English abstract).

9. Pettersen,EF, Ingerslev, H-C, Stavang, V, Egenberg, M & Wergeland, HI .2008 A highly phagocytic cell line TO from Atlantic salmon is CD83 positive and M-CSFR negative, indicating a dendritic-like cell type. Fish and Shellfish Immunology 25: 809–819.

10. Ingerslev H-C., Rønneseth ,A., Pettersen E F.& Wergeland,H.I.2009 Differential expression of immune genes in Atlantic salmon (Salmo salar L.) infected intraperitoneally or by cohabitation with IPNV.: Scandinavian Journal of Immunology. 69:90-98.

11. Øverland, S.H., Pettersen, E.F. ,Rønneseth, A. & Wergeland, H.I. 2010. Phagocytosis by B-cells and neutrophilic granulocytes in Atlantic salmon (Salmo salar L.) and Atlantic cod (Gadus morhua L). Fish & Shellfish Immunology, 28: 193-204

12. Haugland,GT., Pettersen, FE, Sviland,C., Rønneseth, A. & Wergeland, H.I. 2010 Immunostaining of Atlantic salmon (Salmo salar L.) leucocytes. Journal of Immunological Methods 362:10-21

13. Furevik, A., Pettersen, E.F., Colquhoun,D. & Wergeland, H.I. 2011 The intracellular lifestyle of Francisella noatunensis in Atlantic cod (Gadus morhua L.) leucocytes. Fish & Shellfish Immunology 30: 488-494

14. Kalgraff, C.A.K., Wergeland, H.I.& Pettersen, E.F. 2011 Flow cytometry assays of respiratory burst in Atlantic salmon (Salmo salar L.) and in Atlantic cod (Gadus morhua L.) leucocytes. Fish & Shellfish Immunology 31: 381-388.

15. Nguyen Thi Thanh Thuy, Nguyen Huu Dung, H.I. Wergeland 2011. The immune response of orange spotted grouper (Epinephelus coioides) to pathogen bacteria Vibrio parahaemolyticus. Journal of biotechnology 10/2011 (In Vietnamese with English abstract).

16. Martens, L.G., Fjelldal, P.G., Lock, E.J., Wargelius, A., Wergeland, H., Witten, P.E., Hansen, T., Waagbo, R., & Ornsrud, R. 2012. Dietary phosphorus does not reduce the risk for spinal deformities in a model of adjuvant-induced inflammation in Atlantic salmon (Salmo salar) postsmolts. Aquac. Nutr. 18: 12-20.

17. Fraser, T.W.K., Rønneseth, A., Haugland, G.T., Fjelldal, P.G., Mayer, I.& Wergeland H.I.. 2012 The effect of triploidy and vaccination on neutrophils and B-cells in the peripheral

18. blood and head kidney of 0+ and 1+ Atlantic salmon (Salmo salar L.) post-smolts. Fish & Shellfish Immunology, 33:60-66..

19. D'Alvise, P.W., Lillebø, S.,. Prol-Garci, M.J. Wergeland , H.I., Nielsen, K. F.,Bergh Ø & Gram, L. 2012 Phaeobacter gallaeciensis eliminates Vibrio anguillarum in cultures of microalgae and rotifers, and prevents vibriosis in cod larvae. PLOS ONE, 8:e43996.

20. Haugland, G.T., Jakobsen, R.AA., Vestvik, N., Ulven, K., Stokka, L &. Wergeland,H.I. 2012 Phagocytosis and respiratory burst activity in lumpsucker (Cyclopterus lumpus L.) leucocytes analysed by flow cytometry. PLOS ONE, Volume 7| Issue 10 e47909

21. Haugland GT, Jordal AE and Wergeland HI. 2012 Characterization of small, mononuclear blood cells from salmon having high phagocytic capacity and ability to differentiate into dendritic like cells. PLOS ONE. Volume 7 Issue 11 e49260

22. Rønneseth, A, Pettersen, EF, Wergeland, HI, 2012. Flow cytometry assay for intracellular detection of Infectious Pancreatic Necrosis virus (IPNV) in Atlantic salmon (Salmo salar L.) leucocytes. Fish &Shellfish Immunology 33:1292.1302.

23. D'Alvise, PW, Lillebø, S, Wergeland, HI, Gram, L, Bergh, Ø 2013 Protection of cod larvae from vibriosis by Phaeobacter spp.: A comparison of strains and introduction times 2013 Aquaculture 384-387: 73-82

24. Hich TV, Quyen VDH, Dung NH & HI Wergeland, 2013. Experimental Streptococcus iniae infection in barramundi (Lates calcarifer) cultured in Vietnam. International Journal of Aquatic Science: 4, 3-12

25. Nguyen TTT , Dung HN & HI. Wergeland 2013 Specific humoral immune response and protection against Vibrio parahaemolyticus in orange-spotted grouper Epinephelus coioides. International Journal of Aquatic Science: 4, 24-35

26. Rønneseth A, Haugland, G.T. & Wergeland H.I. 2013 Flow cytometry detection of Infectious Pancreatic Necrosis Virus (IPNV) within subpopulations of Atlantic salmon (Salmo salar L.) leucocytes after vaccination and during the time course of experimental infection. Fish Shellfish Immunol. 34(5):1294-305

27. Vestvik N, Rønneseth A, Kalgraff CAK, Winther-Larsen HC, Wergeland HI & Haugland GT Francisella noatunensis subsp. noatunensis replicates within Atlantic cod (Gadus morhua L.) leucocytes and inhibit respiratory burst activity. Fish Shellfish Immunol 35 (3): 725-33

28. Kaldestad M, Haugland GT, Rønneseth A, Wergeland HI & Samuelsen OB (2014) Antibiotic uptake by cultured Atlantic cod leucocytes and effect on intracellular Francisella noatunensis subsp. noatunensis replication. Dis Aquat Organ 108: 11-21

29. Haugland GT, Rønneseth A &Wergeland HI (2014). Flow cytometry analyses of phagocytic and respiratory burst activities and cytochemical characterization of leucocytes isolated from wrasse (Labrus bergylta A.). Fish and shellfish Immunol. 39;51-60.

MARINE BIODIVERSITY

1. Glenner H; Winther M; Hansen A; Huelsenbeck JP; Ronquist F; Willerslev; E (2005). Bayesian inference of the Metazoan evolution based on combined morphological and molecular data. Curr. Biol. 14, 1644-1649.

2. Glenner H; Winther M; Hansen A; Huelsenbeck JP; Ronquist F; Willerslev E (2005). Bayesian inference of the metazoan phylogeny: A combined molecular and morphological approach (vol 12, pg 1828, 2004). Curr. Biol. 15: 392-393.

3. Glenner H; Hebsgaard MB (2006). Phylogeny and Evolution of Life History Strategies of the Parasitic Barnacles (Crustacea, Cirripedia, Rhizocephala). Mol. Phyl. Evol. 41, 528-538.

4. Glenner H; Thomsen PF; Hebsgaard MB; Sørensen MV; Willerslev E (2006). Origin of Insects. Science. 314: 1883 – 1884.

5. Glenner H; Grygier MJ; Fujita Y; Høeg JT. (2008). Induced metamorphosis in the crustacean y-larvae. BMC Biology. 6:21.

6. Glenner, H., J.T. Hoeg, A.V. Rybakov, Thomsen P.,F., and B. Galil. (2008). The phylogenetic position of the parasitic barnacle Heterosaccus dollfusi; a Lessepsian migrant species now spreading in eastern Mediterranean waters (Cirripedia: Rhizocephala; Sacculinidae). Israel Journal of Zoology. 54 (2), 223-238.

7. Høeg, JT; M pérez-losada; H Glenner; GA Kolbasov and KA Crandall. (2009). Evolution of morphology, ontogeny and life cycles within the Crustacea Thecostraca. - Arthropod Systematics & Phylogeny, 67 (2): 199-217.

8. Steeman EM; MB Hebsgaard; RE fordyce; SYW Ho; DLL Rabosky; R Nielsen; C Rahbek; H Glenner; MV Sørensen and E Willerslev. (2009). Radiation of Extant Cetaceans Driven by Restructuring of the Oceans. Syst. Biol. 58(6): 573–585.

9. Kristensen T, Nielsen AI, Jørgensen AI, Mouritsen KN, Glenner H, Christensen JT, Lützen J, Høeg JT. (2012) The selective advantage of host feminization: a case study of the green crab Carcinus maenas and the parasitic barnacle Sacculina carcini. Marine Biology Volume: 159 Issue: 9 Pages: 2015-2023 DOI: 10.1007/s00227-012-1988-4 Published: SEP 2012.

10. Rees DJ, Noever C, Høeg JT, Ommundsen A, Glenner H (2014) On the Origin of a Novel Parasitic-Feeding Mode within Suspension-Feeding Barnacles. CURBIO, 24, 1429–1434.

11. Bengtsson MM, Sjøtun K & Øvreås L (2010). Seasonal dynamics of bacterial biofilms on the kelp Laminaria hyperborea. Aquatic Microbial Ecology 60: 71-83

12. Coyer J, Hoarau G, Sjøtun K, Olsen JL (2008). Being abundant is not enough: a decrease in effective population size over eight generations in a Norwegian population of the seaweed, Fucus serratus. Biology Letters 4: 755-757

13. Eilertsen M, Norderhaug KM & Sjøtun K (2011). Does the amphipod fauna associated to epiphytes on kelp (Laminaria hyperborea) change with depth? Marine Biology Research 7: 224-234

14. Heldal HE & Sjøtun K (2010). Technetium-99 (99Tc) in annual growth segments of knotted wrack (Ascophyllum nodosum). Science of the Total Environment 408: 5575-5582

15. 5. Husa V & Sjøtun K (2006). Vegetative reproduction in "Heterosiphonia japonica" (Dasyaceae, Ceramiales), an introduced red alga on European coasts. Botanica Marina 49: 191-199

16. Husa V, Sjøtun K, Brattenborg N & Lein TE (2008). Changes of macroalgal biodiversity in sublittoral sites in southwest Norway: impact of an introduced species or higher temperature? Marine Biology Research 4: 414-428

17. Husa V, Steen H, Sjøtun K (2014). Historical changes in macroalgal communities in Hardangerfjord (Norway). Marine Biology Research 10: 226-240

18. Husa V, Kutti T, Ervik A, Sjøtun K, Kupka Hansen P, Aure J (2014). Regional impact from fin-fish farming in an intensive production area (Hardangerfjord, Norway). Marine Biology Research 10: 241-252

19. Sjøtun K, Christie H & Fosså JH (2006). The combined effect of canopy shading and sea urchin grazing on recruitment in kelp forest (Laminaria hyperborea). Marine Biology Research 2: 24-32.

20. Sjøtun K, Eggereide SF & Høisæter T (2007). Grazer-controlled recruitment of the introduced Sargassum muticum (Phaeophyceae, Fucales) in northern Europe. Marine Ecology Progress Series 342: 127-138.

3 Education at master and doctoral level

ToR: “Evaluate the quality and relevance, including the development of expertise and level of execution, of the area's combined educational programs at the master and doctorate level with emphasis on the last 10 years.”

Please list the names of the educational programmes in marine studies (at master and doctoral level) your department/centre has been involved in in the period 2004-2013.

Educational programmes in marine studies, 2004-2013:

Master programmes:	**Ph.D. programmes/research schools:**
Master’s Programme in Fisheries Biology and Management*	Ph.D. Programme
Master’s Programme in Marine Biology	MCB – Molecular and Computational Biology Research School - http://www.uib.no/en/rs/mcb
Master’s Programme in Aquaculture	Bergen Summer Research School - http://www.uib.no/fs/bsrs
Master’s Programme in Biology**	Nordic Marine Academy (2005-2010) http://armauer.uib.no/nma/
Master’s Programme in Nutrition - Marine	
Integrated Master’s Programme in Aquamedicine	
Master’s Programme in Water and Coastal Management (2003-2007)***	

*) Also offered as a NORAD Programme until 2008
**) Includes several specializations, including microbiology, environmental toxicology, geobiology, cell biology etc.
***) Water and Coastal Management was also offered as a Joint Degree with European partners.

Describe and comment on how these educational programmes have developed in the period 2004-2013 (scope of programmes, recruitment of students, completion and other relevant issues).

On average the Master’s Programmes within Marine Sciences at BIO have recruited approximately 40-45 students per year. Approximately the same number of students have graduated with MSc each year. The recruitment of students to these programmes has been quite stable over the period 2004-2013, but varied some between the different specializations.
Although the organization of the programme offered has changed over the last 10 years, the most important topics are still; aquaculture, fisheries biology and management, aquamedicine, marine biology (ecology and biodiversity), microbiology, cell biology and physiology. On average, a little over 80% of MSc graduated from BIO are within the Marine Sciences.

Please indicate the proportions of Ph.D.-candidates from these programmes employed by higher education institutions/research institutes and industry respectively, and provide examples of typical career trajectories of the candidates.

At the Department of Biology, 190 Ph.D. candidates successfully obtained their degree during the assessed period (2004-2013) and of these, approx. 80% were in the fields of marine science. While BIO has not kept a complete record of their further employment or career development, below are some examples of current positions held by former BIO PhD candidates to illustrate their typical career trajectories:

- Paco Cardenas, Postdoctoral researcher at Department of Medicinal Chemistry, Division of Pharmacognosy, University of Uppsala, Stockholm (research)
- Mia M Bengtsson, Postdoc at Department of Limnology and Oceanography, University of Vienna (research)
- Sophia Fortunato, Post doc researcher at the Sars Center at the University of Bergen, Norway, (research)
- Vivian Husa. Researcher, Institute of Marine Research. Bergen, Norway (research)
- Ainao Laila Hosia, researcher, University Museum in Bergen, Norway (administration/research)
- Binh Dang Thuy, Vice Director, Institute for Biotechnology and Environment Nha Trang University, Vietnam, (research/management)
- Fabian Zimmermann, postdoc at UiB (research)
- Olav Moberg: PhD 2010, then short-term contracts with various research projects at UiB, Senior Advisor, Directorate of Fisheries (management)
- Arved Staby, short-term contracts with various research projects at UiB, , Researcher Institute of Marine Research (research)
- Vidar Aspehaug, Business Director PatoGen Analyse AS (industry)
- Aril Slotte, Researcher, Institute of Marine Research. Bergen, Norway (research)
- Christofer Troedsson, Researcher, UNI research. Bergen, Norway (research)
- Geir Olav Melingen, Business Manager Aqua in MSD Animal Health, Norway. Bergen, Norway
- Knut Wiik Vollset, Researcher, UNI Environment (research)
- Kari Nordvik, Senior Research Advisor, The Faculty of Mathematics and Natural Sciences, UiB (administration).
- Anita Sagstad, Senior Advisor, The Directorates of Fisheries (administration)
- Anne Christine Knag, Environmental Coordinator - Statoil?

Master Degrees within Marine research - Department of Biology										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Master's Programme in Fisheries Biology and Management	12	5	17	3	10	2	6	7	3	3
Integrated Master's Programme in Aquamedicine	3	8	1	4	7	11	6	12	8	7
Master's Programme in Aquaculture	6	4	9	5	4	4	6	7	6	7
Master's Programme in Marine Biology	8	6	10	11	12	16	5	7	8	13
Water and Coastal Management/Water studies	NA	9	9	14	5	3	NA	NA	NA	NA
Master's Programme in Nutrition - Marine	1	2	9	3	3	7	5	1	3	4
Master's Programme in Biology	5	12	10	9	7	6	6	9	4	4
	35	46	65	49	48	49	34	43	32	38

4 The significance of UiB's strategic priority of marine research

ToR: "With the additional resources that accompany being a main focus area in mind, give a combined assessment of the strategic added value/utility this has provided."

Please describe the types of added resources your department/centre has received through UiB's strategic priority of marine research in the period 2004-2013 (e.g. Ph.D.-positions, infrastructures). Refer to amounts reported in section 1 c) where relevant, and comment on the added value of these resources for your research and education activities; that is, what results you would not have achieved without the additional resources.

Due to UiB's strategic priority of marine research in the period 2004-2013, the department has received added resources of various types. These include, but are not limited to:

- Recruitment of staff/personnel (PhD scholarships, postdoctoral fellowships within research projects, permanent scientific positions)
- New BIO buildings and renovation of existing facilities at Marineholmen, incl. funds for some scientific equipment
- Accompanying new research facilities (e.g. boats, vessels, wet labs and associated UiB funding)
- Annual UiB financial contributions to maintain or upgrade existing facilities such as ILAB, which in turn has enabled their continual use for educational and research purposes
- Annual UiB financial contributions for scientific equipment

BIO is dependent on investments from UiB in order to maintain and continuously develop scientific quality and maintain state-of-the-art facilities so that our researchers are attractive as research partners and continues to be competitive and attract external funding.

5 Cooperation with academic communities in UiB's periphery (*randsonen*)

ToR: “Evaluate the associated academic communities' cooperation with relevant academic communities in UiB's periphery, including organization, participation in projects, ability to generate resources and networking.”

If relevant, please report separately for your major research topics/research groups in this section.

Describe how your cooperation with relevant academic communities in UiB’s periphery (*randsoneinstitusjoner*) has developed in the period 2004-2013, and comment on how such cooperation has affected your ability to generate resources and build networks.

In the fields of marine science, cooperation with UiB’s periphery is of vital importance to BIO’s marine research and education activities. In the period of 2004-2013, the Department of Biology’s cooperation with relevant academic communities in UiB’s periphery (randsoneinstitusjoner) has continued to develop. Each in turn has affected the department’s ability to generate resources and build networks at the groups’ as well as the departmental level. The most prominent peripheral academic communities with which the research groups collaborate are described below. As the descriptions show, cooperation with the below-named academic communities, has contributed towards increased accessibility to expertise, resources, facilities and funding opportunities. In addition, it has been paramount to successful development and support of academic network and centers, of which the two recent initiatives towards Centre of Research-driven Innovation (SFI) “Centre for Research-based Innovations in Controlled-environment Aquaculture (CtrlAQUA)” (BIO, Nofima and Uni Research) and “Centre for Innovation and Research in Ocean Health (CIROH)” (BIO, Uni, IMR, IRIS etc.) are prime examples, illustrating collaborative efforts between BIO and institutions in the UiB periphery.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**

The EFERG collaborates with **Uni Research**, **Institute of Marine Research (IMR)**, and the **Norwegian School of Economics (NHH)**/ **Samfunns- og næringslivsforskning (SNF)**. Many projects have been carried out in partnership with IMR and this has seen some cross-employment through adjunct positions (i.e. J Devine at BIO and M Heino at IMR). EFERG had one joint project with NHH/SNF and many joint applications.

- **Marine Microbiology Research Group (MMRG)**

The MMRG collaborates and shares members with **Uni Research**. These cooperations are regarded in a positive light given increased access to projects, laboratory facilities, instrumentation and skilled and experienced researchers. In contrast to UiB practice, the latter attests to Uni’s regular employment of permanent scientific staff and is greatly appreciated. Despite complications arising from dealings between two different entities, the close collaboration between UiB and Uni Research links academic and applied research and gives the group a larger circle of acquaintances and broader access to different stakeholders and possible funding sources.

- **Theoretical Ecology Research Group (TEG)**

TEG collaborates with **Uni Research**, **Hjort Centre for Marine Ecosystem Dynamics**, **Institute of Marine Research (IMR)**, **Norwegian School of Economics and Business Administration** and several local collaborators

within the UiB (e.g. Geophysical Institute and Dept. of Mathematics). TEG's successful establishment of the **Bergen Marine Research Cluster** entails close collaborations with its affiliated members (UiB, IMR, **NERSC, NIFES, CMR, Uni Research and NOFIMA**).

TEG enjoys a successful collaboration with the **Computation Ecology Group at Uni Research**, optimizing reciprocal use of strength between these essentially twin-groups. **The Hjort Centre for Marine Ecosystem Dynamics**, set up in Bergen in 2014, is a collaboration between IMR, UiB, Uni Research, and the Nansen Environmental and Remote Sensing Center. Opened by Prime Minister Erna Solberg, TEG has been central in developing its concept and drafting its Science Plan. Nationally, the group has strongest links to researchers at the **Institute of Marine Research (IMR),** but also enjoys active links with the **Norwegian School of Economics and Business Administration** (i.e. one joint CoE application and one joint RCN-funded project), Bodø **University College**, **Statoil**, and **Norwegian Polar Institute** and recently **CEES, UiO** (in a successful joint Nordic Center of Excellence application). Within UiB, TEG has collaborated with numerous research groups within BIO, the Department of Mathematics and the Geophysical Institute. Finally, TEG has been deeply involved in establishing and running **Bergen Marine Research Cluster (UiB, IMR, NERSC, NIFES, CMR, Uni Research and NOFIM**A), **Bergen International Research School in Marine Biology, Bergen Advanced Training Site in Marine Ecology** (an EC Marie Curie Training Site 2001-2005), and **MENTOR** (a planned Marine European Network for Training of Researchers involving Bergen, Brest, Bremen, Bremerhaven, Kiel, and Southampton).

- **Aquatic Behavioral Ecology Research Group**

Relevant academic communities in UiB's periphery (randsoneinstitusjoner) with which ABERG has cooperated in the period 2004-2013, include among others the Institution of Marine Research.

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**

MDBRG collaborates with **Uni research, IMR, NIFES, Nofima** on early all projects regarding "Smoltification and osmoregulation" and "Growth and maturation". **The recent initiative "Centre for Research-based Innovations in Controlled-environment Aquaculture (CtrlAQUA)" towards Centre of Research-driven Innovation (SFI)** is a collaborative effort between **Nofima, Uni and BIO**. Collaborations with **EWOS innovation, NOFIMA, Uni Research and BTO** have helped secure funding from NFR and Regional Forskningsfond to strengthen/develop networks with local, national and international industrial partners. Since 1996, in collaboration with **NIFES**, MDBRG has had multiple joint NFR projects, COST programme, NORAD project and shared PhD students. Since 1982, it has had joint NFR projects with **IMR** and shared supervision of Master and PhD students. Within UiB, it collaborated with the Department of Medicine (2005-09) until funding was discontinued. Other MDBRG collaborators have included Department of Ophthalmology, **Haukeland** University Hospital and **Phillips** BV, the Netherlands.

- **Environmental Toxicology Research Group (ETRG)**

Cooperation between ETRG and **IMR** has been strong throughout the period 2004-2013 and cooperation with **NIFES** and Uni has developed positively during the latter part of the period. Several major projects and publications have been dependent on these collaborations. The SFI CIROH initiative is a follow-up of these collaborations.

- **Ecological and Environmental Change Research Group**

EECRG has also benefited from a strong collaborations during this period with **Bjerknes Centre for Climate Research**

AQUACULTURE AND FISH HEALTH

- **Fisheries Ecology and Aquaculture Research Group (FEARG)**

FEARG collaborates with **IMR** and within BIO on projects relating to fish population biology, reproduction and behavior. It has carried out the sclerochronology projects, including EU FP7 project CalMarO, and Meltzer project in collaboration with colleagues at **UNI, Bjerknes**. Research on New marine biomass for biofuel and animal feed has led to two patents: (1) 2011 WO2011/158215.2011; (2) 2011 UK *Patent Application No. 1121722.1*.) Research on skin mucus cells have led to BTO funded projects

- **Fish Disease Research Group**

During the evaluation period, the FDRG has considerable cooperation with numerous relevant academic communities in UiB's periphery. This has greatly affected their ability to generate resources and build networks. A prime example is the Sea Lice Research Centre (SLRC), a Centre for Research-based Innovation (SFI), appointed by the Research Council of Norway in 2011. While the University of Bergen is the host of the SLRC SFI, the basis for the center lies with three departments at the UIB Faculty of Mathematics and Natural Sciences, including the Department of Biology where it originated from a fruitful collaboration between researchers at the **Institute of Marine Research** and the **Salmon Louse Research Center**. Other members of the center and include the Norwegian University of Life Sciences, and various industrial partners (i.e. **EWOS Innovation AS, Lerøy Seafood Group ASA, Marine Harvest ASA, Novartis International, Animal Health AG,** and **PatoGen Analyse AS**).

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**

The MBRG includes members from **NIVA**, **IMR** and the **BioGeo Center** in Bergen in an integrated research environment sharing projects, laboratory facilities and instrumentation. They collectively strive to operate as one research group with joint responsibility for teaching, labs, equipment and administration. Physical proximity to the large marine research institutions in the vicinity have enable cooperation and collaborations in ways otherwise deemed impossible due to distance.

6 Dissemination activities and international cooperation

ToR: “Evaluate the associated academic communities' dissemination and promotion of their research results domestically and internationally.”

ToR: “Evaluate the associated academic communities' international activities, including project cooperation, participation in conferences, presentations, marketing and networking.”

If relevant, please report separately for your major research topics/research groups in this section.

a. Describe the major target groups of your research and the major channels for disseminating and promoting your research results domestically and internationally. Please comment on the relative importance of academic/popular and of domestic/international dissemination.

In the marine biological sciences the research communities are international, and the major channels for dissemination of research results are through international journals. We focus on publication as an integral part of the research process, and we encourage targeting of the highest-impact journals. Incentives include featuring new publications in BIO’s weekly newsletter and linking part of the research groups’ funding to publications. Our researchers and students also participate in international conferences and symposia to disseminate their research findings and seek international collaborators in their research projects. A large part of marine research also holds relevance for industry and government/management, as well as the general audience. Therefore, we also emphasize the necessity to communicate widely towards user groups at local and national seminars, as well as by regional and national media channels, through interviews, commentaries and newspaper articles. While the latter holds true across all of BIO’s research groups, examples provided below describe any additional target groups and dissemination channels specific for the individual groups.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**

Target groups are fellow marine and evolutionary scientists as well as resource managers. The first group is reached by being active in conferences and publishing in respected journals. The second group through EFERG presence at the Institute of Marine Research (the biggest Norwegian provider of advice on marine environment) and their contacts, as well as active participation (including a co-chair) in the Working Group on Fisheries-Induced Evolution (WGEVO), an international working group under the auspices of the International Council for the Exploration of the Sea (ICES) headquartered in Copenhagen and main provider of advice on marine environment and resources for the Northeast Atlantic ocean.

- **Marine Microbiology Research Group (MMRG)**

The main target group of one’s research is the scientific community and the main channel for dissemination the international peer reviewed journals.
Dissemination to reach the general public (mainly domestic) has been through project webpages, radio interviews (NRK, “Verdt å vite”), popular presentations, “Forskning.no”, “Forskningsdagene” and via the visual artist Ellen Karin Mæhlum (http://www.ellenkarin.no/). More recently the has
been using social media such as Facebook and blogs:

- https://www.facebook.com/themicropolarproject,
- http://micropolar.blogspot.no/,
- https://www.facebook.com/oceancertain

- **Theoretical Ecology Research Group (TERG)**

TERG has a long standing collaboration including numerous long-term visits to Prof. Marc Mangel's lab in Santa Cruz, Center for Stock Assessment Research, University of California. Prof. Mangel has been in Bergen approximately every second year during the last decade and now holds a Prof. II position at UiB, with TERG. TERG also has collaborations with researchers at Scripps Institution of Oceanography, Massachusetts Institute for Technology and Technical University of Denmark. A recent collaboration is now established at University of eastern Australia in Perth, with Leigh Simmons.

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**

Dissemination of results is continuously achieved through publication in peer-reviewed scientific journals, presentations at international meetings, and technical reports submitted to the Research Council of Norway. Focus is on high dissemination activity of group results and endeavours to publish in high impact journals. Several projects generate data of high impact for the commercial producers, particularly for salmon, but also marine fish. For these datasets this audience is specifically targeted in technical reports, popular scientific papers and seminars for commercial producers, meetings with industry representatives, and close collaboration in research projects with user contribution (KMB) or user-led (BIP)

- **Environmental Toxicology Research Group (ETRG)**

The major target groups have been the scientific community, environmental management / government, and industry, in that order of priority. Attempts have been made to disseminate through a number of channels, including national and international scientific meetings and symposia (>100 poster and platform presentations during the period), user oriented meetings with environmental management and industry, as well as popular dissemination to the general public through opinions and interviews in newspapers, books and other media (radio, TV, documentaries, websites).

AQUACULTURE AND FISH HEALTH

- **Fisheries Ecology and Aquaculture Research Group (FEARG)**

The group aims to make active use of the internet. Group member participate in Christie conference. Promotion of the group occurs through teaching, provision of presentation material ("Lindåsdagane") and guide for local events (Trip for "Selskapet for Norske Vitenskapers Fremme" 2014). International cooperation takes place through participation in:

  - ICES research working groups
  - EU and other funded projects
  - Serving on review panels (Portugal, Belgium)
  - Members of international groups (ELHS, AquaTT)
  - EU COST Training School (*Methodological advancements in applied fish reproductive biology)*
  - Leadership of Nordic Marine Academy (2005-2010)
  - Scientific Board member: International Pectinid Workshop, Physiomar

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**

The main MBRG target group is the scientific community and their main channels for dissemination are international peer reviewed journals. Dissemination to reach the general public has been through project webpages, newspaper articles and interviews, (most recently upon request from "*National Geographic*") presentations, "Forskning.no" etc.

b. Describe and comment on how the dissemination and promotion of your marine research has developed (e.g. increase/decrease in activity level, new dissemination and promotion channels) in the period 2004-2013.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

Dissemination and promotion of marine research in groups driving investigation of Fisheries Ecology and Marine Ecosystem Dynamics has remained largely constant in the period 2004-2013. With the main channel for dissemination of scientific results being international peer reviewed journals, groups' joint publication rates have averaged approximately 20-30 publications per year (e.g. MMRG). Increased activity level through social media channels has however taken place through the establishment of Twitter accounts (in 2011 "@EvoFish_UiB") or launch of Facebook promotional pages (in 2013, "evofishgroup"). Past dissemination to the general public was targeted largely towards a general domestic public, but the rise of recent social media channels has broadened these audiences to include the international public. Furthermore noteworthy of mention is a collaborative effort initiated in 2007 by MMRG with visual artist, Ellen Karin Mæhlum (http://www.ellenkarin.no/), which has led to a series of plankton organism SEM images-based silkscreen prints named "Plankton Portraits". These have been promoted through exhibition in numerous national and international galleries. To a similar end, SALT, a communication and outreach company specialising on marine issues has been included in the project consortium of a recent Arctic project involving field work and cruise campaigns for public dissemination of the project through primarily Facebook, blogs, YouTube and radio presentations.

MARINE AND ENVIRONMENTAL HEALTH

Dissemination and promotion of marine research in groups driving investigation of Marine and Environmental Health in the period 2004-2013 has been integral to most of the projects. Consequently, involvement of users in projects (MDRG) has increased during the reporting period. Dissemination and promotional activities have been subject to continuous efforts to achieve maximum propagation and efforts have focused on increased dissemination to direct contacts through national and international media channels and address presentations to industrial stakeholders for whom group results are of greatest impact and relevance for their activities. Use of recent social media channels such as Twitter and internet blogs (e.g. palaeoclimatic studies blog by EECRG) have also seen a rise in these groups, although traditional channels such as peer-reviewed publications and conference presentations are still highly valued and employed.

MARINE BIODIVERSITY

Due to unstable number of group members over the years the dissemination activity of our results has been inhomogeneous. With its current stable member status, the group anticipates increased dissemination activity in the years to come.

c. Please provide a list your most significant *domestic* dissemination activities (apart from scientific publications) in the period 2004-2013 (extracted from Cristin where possible). Categories to be included:
- contribution at conferences
- popular/user-oriented talks:
- popular articles
- media contributions (newspapers, TV, radio, film, blogs, etc.):

Not all groups' members have kept a detailed account of their dissemination activities. Briefly however, all groups partake regularly in domestic conferences, workshops and seminar series through oral and/or poster presentations and contribute to domestic dissemination of scientific activities through popular articles and media appearances (e.g. newspapers, radio, internet, etc.). Listed below are some recent examples from research groups that have recorded their activities.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**

Popular articles and Media contributions:
- Heino, M., T. Svåsand, and O. R. Godø. 2011. Gode gener ut. *Dagens Næringsliv* 5.12.2011: 26–27.
- Andreassen, K.E., 2011. Fiskeri påvirker fiskens gener. *På Høyden*. Available at: http://nyheter.uib.no/?modus=vis_nyhet&id=48924
- Anon, 2011. - Fiskeri påvirker fiskens gener. *Fish.no*. Available at: http://www.fish.no/fiskeri/4580--fiskeri-pavirker-fiskens-gener.html
- Anon, 2009. Overfiske fører til turboevolusjon. *Fiskersidens Forum*. Available at: http://www.fiskersiden.no/forum/index.php?showtopic=49876&st=0&p=542119&hl=turboevolusjon&fromsearch=1&#entry542119
- Bergstrøm, I.W., 2013. De søte fiskenes undergang. *På Høyden*. Available at: http://pahoyden.no/2013/10/de-sote-fiskenes-undergang
- Bråthen, K., 2007a. Fiske fører til evolusjon. *På Høyden*. Available at: http://nyheter.uib.no/?id=38434&modus=vis_nyhet
- Bråthen, K., 2007b. Fiske gjør at fisken endrer seg. *forskning.no*. Available at: http://www.forskning.no/artikler/2007/november/fiske_foerer_til_evolusjon
- Senneset, E., 2009a. Turboevolusjon på norskekysten. *Hubro*, 16(3). Available at: http://hubro.uib.no/hubro3-2009/turboevolusjon.html
- Senneset, E., 2009b. Turboevolusjon på norskekysten. *forskning.no*. Available at: http://www.forskning.no/artikler/2009/oktober/231308

- **Marine Microbiology Research Group (MMRG)**

popular/user-oriented talks:
- Several contributions at "Forskningsdagane" on plankton, marine organisms and viruses.
- Several popular presentations on microorganisms in the sea (eg. at Tysnes sogelag, Osterøy Senioruniversitet, Kvinnherad Senioruniversitet, Landslaget for offentlige pensjonister, Bergen.)
- 100-years Anniversary for Armauer Hansen. 2012 - Public seminar on Armauer Hansen and Lepra. The seminar and Armauer Hansen was covered in a wide range of newspapers and in a NRK TV interview.
- Christikonferansen 2013. Stand and oral presentation: "Marine Microbes - Why care?

media contributions (newspapers, TV, radio, film, blogs, etc.):
- Several radio interviews (NRK «Verdt å Vite») about algal blooms and *Emiliania huxleyi*, microbial diversity, marine plastics and mesocosm experiments.
- Contribution of microscope images of marine microorganisms to / for various uses (eg. the film «Fjordens liv» (Manus and regi: Randi Storaas), decoration of the Goliat platform and Eni Norge's operational office in Hammerfest, book on Plankton organisms in Norwegian fjords, Per Flood 2014, UiB Division of Communication)
- Plankton portraits by Ellen Karin Mæhlum (http://www.ellenkarin.no/).
- Facebook and blogs from MicroPolar fieldwork (https://www.facebook.com/themicropolarproject,

http://micropolar.blogspot.no/)

- **Theoretical Ecology Research Group (TERG)**

popular/user-oriented talks:

- Yearly organization of the annual Darwin-Day lecture since 2007
- Organization of a series of public lectures in 2009 in connection to the 200 years celebration of Darwin (150 years since The Origin of Species). Invited speakers included Daniel Dennett, Kevin Padian, Peter Hammerstein and Geoffrey Miller.
- Establishment of the Horizons lectures at UiB, which typically attract >100 attendants.

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**

Conference contributions:

- Oral and poster presentations at the bi-annual NFR HAVBRUK conference
- Rønnestad, I., A. Gomes, Y. Kamisaka, K. Olsen, R. Tillner, I. Lukram, A-E. Jordal, L.E.C. Conceição, T. Harboe. 2012. Fôropptak, appetitt og fordøyelse hos kveite- fra startfôring til yngel. Programkonferansen HAVBRUK 2012, Stavanger. Apr 16-18, 2012
- Bouquet JM, Troedsson C, Parida M, Reeve M, Dupont S, Novac A, Skaar KS, Massart W, Manak JR and EM Thompson (2014) Response of the pelagic, gelatinous appendicularian Oikopleura dioica to ocean warming and acidification. IMBER Open Science Conference - Future Oceans, Bergen, Norway
- Lekang K, Hadziavdic K, Thompson EM, Skaar KS and C Troedsson (2014) High throughput molecular methods in environmental monitoring: sample preparation and analytical pipelines IMBER Open Science Conference - Future Oceans, Bergen, Norway
- Bouquet JM, Troedsson C and EM Thompson (2013) Response of pelagic food webs to warmer, acidified oceans: Response of the appendicularian Oikopleura dioica to ocean acidification. Havet og Kysten Meeting, Trondheim, Norway
- Thompson EM (2011). Managing a rapid chordate life cycle through manipulation of cell cycle variants. EvoNet Meeting, Os, Norway.

popular/user-oriented talks:

- Contributions to seminar series arranged by the major aquaculture producers, feed companies etc.,
- Dissemination of novel research findings at aquacultur industry workshops
- Rønnestad, I., Understanding the early stages of marine fish. Sats Marint. Bergen, Norway. 7 Feb, 2013. (Invited lecture)
- Thompson EM (2013) A new marine biomass source. Presentation to Miriade group for Innovation and Economic Development from Basse-Normandie, France, Bergen, Norway
- Thompson EM (2011). Biomass from the Ocean. Norwegian Technology Transfer Meeting, Bergen, Norway

popular articles and media contributions (newspapers, TV, radio, film, blogs, etc.):

- "Fisk med pubertetsproblemer". På Høyden. August 2007 http://nyheter.uib.no/?modus=vis_nyhet&id=37276
- "Fisk med pubertetsproblemer". Fiskaren August. 2007
  - http://www.fiskaren.no/incoming/article141925.ece
- "Fisk med pubertetsproblemer". Forskning.no August. 2007
  - http://www.forskning.no/Artikler/2007/august/fisk_med_pubertetsproblemer
- "Fet fisk, fete mennesker". På Høyden. February 2009
  - http://nyheter.uib.no/?modus=vis_nyhet&id=42704
- "EU satser på fiskeoppdrett". På Høyden. February 2009
  - http://nyheter.uib.no/?modus=vis_nyhet&id=42820
- "Holder seg i likevekt". På Høyden. August 2009
  - http://nyheter.uib.no/?modus=vis_nyhet&id=44275
- "Sym like godt uansett" Bergens Tidende-Magasinet, 29 August 2009
- "Kan ha funnet årsak til DGS hos torsk" Fish.no
  - http://www.fish.no/oppdrett/2428-kan-ha-funnet-arsak-til-dgs-hos-torsk.html

- "Flaskehals trolig funnet". Nytt fra havbruk / NR 1 / Mars 2010, NFR.
- "Torskelarven under lupen". På Høyden. November 2010
  - http://nyheter.uib.no/?modus=vis_nyhet&id=47537
- "Forskar på torskens barndom"
  - http://www.nifes.no/index.php?page_id=&article_id=3955&lang_id=1
- "Viktig å forske på torsk nå" Nytt fra HAVBRUK Nr. 3-4, 2012
  - http://www.forskningsradet.no/prognett-havbruk/Trykte_nyhetsbrev/1228296458151
- Various articles concerning our research have also appeared in local and national newspapers (e.g. BA, BT) and magazines.

- **Environmental Toxicology Research Group (ETRG)**

Conference contributions:

- Regular contributions at the Norwegian Society for Pharmacology and Toxicology Annual Winter Meetings
- Regular contributions at the Norwegian Environmental Toxicology Symposium Series.
- Grøsvik B.E. and A. Goksøyr. Vintermøtet på Beito. Norsk selskap for farmakologi og toksikologi, Beitostølen, 29/1-1/2 2004. Platform.
- Sandnes K.V. C.C. Tolfsen, A. Goksøyr and B.E. Grøsvik. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, 29/1-1/2 2004. Poster.
- Tolfsen, C.C. L.V. Sundbäck, A. Goksøyr and B.E. Grøsvik. Vintermøtet på Beito. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, 29/1-1/2 2004. Platform.
- Bohne A. B.E. Grøsvik and A. Goksøyr. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, 29/1-1/2 2004. Platform.
- Grøsvik B.E., C.C. Tolfsen, M. Caspersen and A. Goksøyr. Symposium on toxicological research in Norway. Adamstuen, Oslo, 19-20 October 2004. Platform.
- Grøsvik B. E., A. B. Kjersem and A. Goksøyr. PROOF Annual meeting 2004, Orkanger 12-14 October. Platform.
- Goksøyr A. BIOPROSP 2004 Symposium on Marine Bioprosepcting. Tromsø Oct. 13-14, 2004. Invited speaker.
- Goksøyr A. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, Jan. 27-29, 2005. Invited speaker.
- Sundbäck L., Tolfsen C.C., Vigano L., Goksøyr A., & Grøsvik B.E. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, Jan. 27-29, 2005. Poster.
- Eidem J.K., Saramäki M. & Goksøyr A. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, Jan. 27-29, 2005. Poster.
- Søfteland T., Tolfsen C.C., Vigano L., Goksøyr A. & Grøsvik B.E. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, Jan. 27-29, 2005. Poster.
- Urbatzka R., Kloas W., Benfenati E., Bertolotti R., Bottero S., van Cauwenberge A., Goksøyr A., Grøsvik B.E., Martinez M.P., Porazzzi E., Tolfsen C., Vigano L., & Mandich A. Annual Meeting of the Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, Jan. 27-29, 2005. Poster.
- Tolfsen C.C., L.V. Sundback, T. Søfteland, R. Urbatzka, L. Viganó, W. Kloas, E. Benfenati, A. Goksøyr and B. E. Grøsvik. Norsk selskap for farmakologi og toksikologi, Beitostølen, 27/1-29/1 2005. Platform. Abstr. no. T5.
- Grøsvik B.E., C. C. Tolfsen, L. V. Sundbäck, T. Søfteland, M. Blø, A. Bohne Kjersem and A. Goksøyr. National Proteomics Conference, Bergen, 18-19/5-2005. Platform.
- Grøsvik, Bjørn Einar; Kjersem, Anneli Bohne; Meier, Sonnich; Sundt, Rolf Christian; Skadsheim, Arnfinn; Sanni, Steinar; Goksøyr, Anders. [Vitenskapelig foredrag]. Langtidsvirkninger av utslipp til sjø fra petroleumsvirksomheten (PROOF) årsmøte 2005 ; 27.09.2005 - 29.09.2005.
- TOLFSEN CC, SUNDBÄCK LV, SØFTELAND T, URBATZKA R, MAGGIONI S, VIGANÓ L, MANDICH A, KLOAS W, BENFENATI E, GOKSØYR A AND GRØSVIK BE. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 27-29 January 2006. Platform.
- Kjersem AB, M Blø, KA Aa, T Søfteland, S Meier, A Skadsheim, A Goksøy, BE Grøsvik. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 27-29 January 2006. Platform.
- Aa KA, A Bohne Kjersem, S Meier, A Goksøyr, BE Grøsvik. Norsk selskap for farmakologi og toksikologi, Beitostølen, 27-29/1 2006. Poster.
- Tolfsen, C.C. T. Søfteland, R. Urbatzka, S. Maggioni, S. Schiarea, W. Kloas, E. Benfenati, A. Goksøyr and B.E. Grøsvik. National Proteomics Meeting. 7-8 August 2006.

- Kjersem AB, Olsvik P, Lanzen A, Puntervoll P, Goksøyr A, Grøsvik BE. 2nd Norwegian Proteomics Meeting. Bergen, August 7-8, 2006. Platform.
- M. Brattås, S. _Tingstad & A. Goksøyr. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 25-27 January 2007. Poster.
- Kjersem AB, Grøsvik BE, Olsvik P, Nilsen F, Lanzen A, Puntervoll P, Goksøyr A. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 25-27 January 2007. Platform.
- Anders Goksøyr, Christina Tolfsen, Tina Søfteland, Lilian Sundbäck, Janne K. Eidem, Luigi Viganò, Alessandra Massari, Alberta Mandich & Bjørn Einar Grøsvik. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 24-26 January 2008. Platform.
- ANDERS GOKSØYR, Christina Charlotte Tolfsen, ANNELI BOHNE KJERSEM; Torbjørn Midtun; & BJØRN EINAR GRØSVIK. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 24-26 January 2008. Platform.
- Gunn-Therese Sørland, Roger Lille-Langøy, Marte Rusten, Rune Male, Gunnar Mellgren, & Anders Goksøyr. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 24-26 January 2008. Poster.
- ANDERS GOKSØYR, Christina Charlotte Tolfsen, ANNELI BOHNE KJERSEM; Torbjørn Midtun; & BJØRN EINAR GRØSVIK. Abstract, 2nd Norwegian Environmental Toxicology Symposium, Trondheim, Norway, 2-4 April, 2008 (lecture).
- Pål O. Olsvik, Kai K. Lie & Anders Goksøyr. Are Atlantic cod in Store Abstract, 2nd Norwegian Environmental Toxicology Symposium, Trondheim, Norway, 2-4 April, 2008 (lecture).
- Marte Rusten, Roger Lille-Langøy, Gunn-Therese Sørland, Rune Male, Bruce Blumberg & Anders Goksøyr. Abstract, 2nd Norwegian Environmental Toxicology Symposium, Trondheim, Norway, 2-4 April, 2008 (lecture).
- Marianne Brattås, Silje Tingstad, Frode Uriansrud, Amund Maage and Anders Goksøyr. Abstract, 2nd Norwegian Environmental Toxicology Symposium, Trondheim, Norway, 2-4 April, 2008 (poster).
- Anders Goksøyr. Miljø 2015 – Åpningskonferanse, 18.-19. november 2008 (lecture).
- Karin Berg, Anne Christine Utne Palm, Anne Gro Vea Salvanes, Pål Puntervoll & Anders Goksøyr. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 22-25 January 2009. Lecture.
- Brattås M, Tingstad S, Zgoda V, Olsvik P, Goksøyr A. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 22-25 January 2009. Lecture.
- Anders Goksøyr, Roger Lille-Langøy, Marte Rusten, Bruce Blumberg & Rune Male. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 22-25 January 2009. Lecture.
- Goksøyr A, Lille-Langøy R, Rusten M, Blumberg b & Male R. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2010.
- Lille-Langøy R, Rusten M, Blumberg B, Male R & Goksøyr A Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2010.
- EIDE M, RUSTEN M, MALE M, GOKSØYR A. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2010.
- ANTONSEN N V, BRATTÅS M, BERG V, LYCHE J L, GOKSØYR A. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2010.
- Rusten M, Lille-Langøy R, Eide M, Bache SM, Davies R, Male R, Blumberg B, Goksøyr A. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (lecture).
- Odd André Karlsen, Silje Bjørneklett, Karin Berg, Marianne Brattås, Victor Zgoda, Ingvar Eidhammer and Anders Goksøyr. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (lecture).
- Marta Eide, Marte Rusten, Rune Male, Anders Goksøyr 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Fekadu Yadetie et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Silje Marie Bache, Marte Rusten, Anders Goksøyr 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Nina Vadøy Antonsen et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Silje Bjørneklett et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Davies R et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010

(poster).

- Ole Jakob Nøstbakken et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Lille-Langøy R et al. 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010 (poster).
- Rusten M et al. Norwegian Zebrafish Network Conference, Oslo, November 2010.
- Fekadu Yadetie et al. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 27-29 January 2011.
- Rusten M et al. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 27-29 January 2011.
- Lille-Langøy R et al. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 27-29 January 2011.
- Odd André Karlsen et al. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2012.
- Rusten M et al. Norwegian Society of Pharmacology and Toxicology, Beitostølen, Norway, 26-28 January 2012.
- BIOPROSP 2004, Tromsø, 13.-14. oktober 2004.
- NSFT Vintermøte 2005, Beitostølen 27.-30. januar 2005.
- Goksøyr A. International Consensus Meeting: Harmonisation of the Care and Use of Fish in Research, Gardermoen, Norway, 23rd - 26th May 2005 (invited speaker).
- DNVA Symposium on Endocrine disrupters - Occurrence in the bioenvironment and possible effects in animals and humans, Oslo 13.-14. oktober 2005.
- *VISTA-seminar, (*Oslo, 5. februar 2007): "Overvåking av toksiske effekter i havet: utvikling av nye metoder basert på biomarkører".
- *NCE Subsea Workshop, Integrert miljøovervåking – med fokus på nordområdene, (*Bergen 17. april 2007): "Overvåking av miljøeffekter i havet: utvikling av nye metoder basert på biomarkører".
- *Norwegian Society for Pharmacology and Toxicology, the Poulsson Lecture Seminar* (Oslo, December 8, 2009)
- *The Norwegian Academy of Science and Letters (DNVA) seminar "Multiple stressors" (*Oslo, 12. januar 2011)
- *Møteplass Marin: Marin bioteknologi (*Bergen 30. mai 2011)*:* "Marin bioteknologi: hvor kan universitetet bidra?"
- *Norwegian Society for Pharmacology and Toxicology, the Poulsson Lecture Seminar* (Oslo, September 6, 2012)
- *Forum for Offshore Environmental Monitoring* (Oslo, Norway, Oct. 30.-31. 2012)
- *Norwegian Society for Pharmacology and Toxicology, Annual Winter Meeting (Beito Feb. 23-25, 2014*
- *4th National Environmental Toxicology Symposium (NETS),* Stavanger, Norway, 23-25. October 2014.
- The Norwegian Society of Pharmacology and Toxicology (NSFT), Beitostølen, Norway (January 2014).
- The Norwegian Society of Pharmacology and Toxicology (NSFT), Beitostølen, Norway (2012).
- Environmental Pollution Conference. Norwegian Climate and Pollution Agency and Research Council of Norway, Oslo, Norway (2012).

popular/user-oriented talks:

- *Organiske miljøgifter og sykelig overvekt*. Invited by the Norwegian Academy of Science and Letters (Vitenskapsakademiet, Komite for geomedisin – mat, miljø, helse).

popular articles and media contributions (newspapers, TV, radio, film, blogs, etc.):

- Contributions to various broadcasted media:
  - On-going documentary on environmental pollutants with TV2
  - Broadcast participation in Schrødingers katt
  - Media contribution to CBS 60 minutes (Canada).
- Contributions to various printed media:
  - Bergens Tidende
  - Dagens Næringsliv

AQUACULTURE AND FISH HEALTH

- **Fish Disease Research Group (FDRG)**

popular articles and media contributions (newspapers, TV, radio, film, blogs, etc.):

- Mjaaland S et al. Hva skjer når laksen får influensa. (www.fuge.no, 17.11.2005)
- Mjaaland S et al. Laksen er lik mennesket. (www.kyst.no, 18.11.2005)
- Mjaaland S et al. Lakseinfluensa. (www.forskning.no, 21.11.2005)
- Hordvik I et al. Bioteknologisk FOU. Innspill fra Fiskesykdomsgruppen til Biotek 2012, NRC, 2009
- Hordvik I and Mortensen S. Ville reinsdyr trives best. BT-debattinnlegg, 25.08.2011
- Hordvik I and Lysebo EM. Profesjonsstudiet i Fiskehelse - status og utfordringer. Notat til det Matematisk Naturvitenskapelige fakultet, UoB, oktober 2011
- Hordvik I. INNSIKT-artikkel: Laksen har dobbelt sett med gener. *Bergens Tidende*, Fredag 24. januar 2014

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**

popular/user-oriented talks:

- NHF Årsmøte, Tromsø november 2008
- Organized a seminar on "introduced aquatic species at Espeland Marine Biological Station", with funding from the Nordic Marine Academy, with 17 participants from 6 countries

d. Please provide a list your most significant *international* dissemination activities (apart from scientific publications) in the period 2004-2013 (extracted from Cristin where possible). Categories to be included:

- contribution at conferences
- popular/user-oriented talks
- popular articles
- media contributions (newspapers, TV, radio, film, blogs, etc.)

Not all group members have maintained a detailed record of dissemination activities and contributions to conferences and media. Listed below is an illustrative list of recent dissemination activities undertaken by the research groups. Briefly, group members take part in several scientific conference series with oral and poster presentations, contribute to conference series arranged by the major international associations and disseminate recent findings quickly at workshops with the industrial sector.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**

Conference contributions:

- Various conference presentations, including co-organized theme sessions at the International Council for the Exploration of the Sea (ICES) Annual Science Conference in 2002, 2006, 2010, and 2014

Popular articles

- Feature article in *Nature*: Borrell, B. 2013. A big fight over little fish. *Nature* 493:597–598. doi: 10.1038/493597a.
- Feature article in *Science*: "News of the week" in *Science* 55, 2010 - In reference to (Utne-Palm et al. 2010),
- Featured in Alpha Galileo56. In reference to Utne-Palm et al. 2010 *Science*

Media contributions (newspapers, TV, radio, film, blogs, etc.)

- Carpenter, J., 2011. Fish shrinkage probed in lab. *BBC News | Science/Environment*. Available at: http://www.bbc.co.uk/news/science-environment-14852081
- Del Gorro del Mundo, *Beatriz y los peces millón*, Available at: http://gorrodelmundo.com/2012/05/23/del-gorro-del-mundo-56-beatriz-y-los-peces-millon/.
- Domínguez, N., 2009. El hombre adelanta a Darwin. *Público.es*. Available at: http://www.publico.es/ciencias/261635/hombre/adelanta/darwin
- Goldstein, R., 2009. Exploring human induced evolution in fish. *Conservation Maven*. Available at: http://conservationmaven.com/frontpage/2009/9/28/exploring-human-induced-evolution-in-fish.html [Accessed September 28, 2009].
- Manning, P., 2013. What Candy Can Tell Us about Fisheries Management. *Bang! Science Magazine*. Available at: http://www.bangscience.org/2013/12/what-candy-can-tell-us-about-fisheries-management/ [Accessed January 17, 2014].
- Video document: Backlund, B., Sigl, R. & Hartl, M., 2010. *The case of the shrinking cod*, Available at: http://www.evolution-of-life.com/en/observe/video/fiche/the-case-of-the-shrinking-cod.html

- **Marine Microbiology Research Group (MMRG)**

Popular/user-oriented talks

- dOCUMENTA (13) in Kassel, Germany 2012: Oral contribution and panes discussion on "Disowning Life: A Conference on Seeds and Multispecies Intra-action".

Media contributions (newspapers, TV, radio, film, blogs, etc.)

- Plankton portraits by Ellen Karin Mæhlum (http://www.ellenkarin.no/).
- Facebook and blogs from MicroPolar fieldwork (https://www.facebook.com/themicropolarproject, http://micropolar.blogspot.no/)

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**

Conference contributions:

- Rønnestad I et al. (2012) International Symposium on Fish Endocrinology, Buenos Aires, Argentina
- Eilertsen M et al. (2014) Fish Biology Congress, Edinburgh
- Gorissen M et al. (2014) Fish Biology Congress, Edinburgh
- Valen R. et al. (2014). Fish Biology Congress, Edinburgh August 2014.
- Thompson EM (2014). 5th EFOR meeting, Paris, France
- Thompson EM (2013). 1st JAMBIO International Sympsoium, Tokyo, Japan.
- Bouquet JM et al. BIOPUMP & CONFLUX Meeting, Holbæk, Denmark.
- Øvrebø JI et al. (2011) Cell Growth & Proliferation. Gordon Research Conference, Biddeford, Maine, USA

Media contributions (newspapers, TV, radio, film, blogs, etc.):

- Various newspaper and magazine articles concerning MDBRG research have appeared in international newspapers of the UK, Sweden, Belgium, Netherlands, France, Italy and Brazil

- **Environmental Toxicology Research Group (ETRG)**

Conference contributions:

- Regular contributions at the International Symposium on Pollutant responses in Marine Organisms series.
- Goksøyr A. *19th European Workshop on Drug Metabolism*, Kemer, Turkey, October 2004.
- *ISTC Seminar on "New Trends in Chemical Toxicology" (*Moscow, Russia, September, 2008)*:*
- *3rd Rendezvous a Concarneau, Where academia meets industry* (Concarneau, France, August 2011): "Marine biotech as a future industry: where can the university contribute?"
- *Woods Hole Oceanographic Institution, USA, seminar* (Woods Hole, October 2011): "From toxicogenomics to mechanistic insights - or the other way around? Studies of CYPs and nuclear receptor SXR in fish and marine mammals".
- *CSA Marine Biotech Workshop* (Olhana, Portugal, April 2012): "Marine biotechnology for aquaculture, fish health, and ocean health" (Anders Goksøyr & Hans Kleivdal).
- *Norman workshop at the VU University in Amsterdam on Occurrence, fate and effects of emerging pollutants in the environment – chemical analysis and toxicological assessment* (Amsterdam, November 2012): "Biological tools for effect assessment".
- Jerome Ruzzin. "Linking Persistent Organic Pollutants to the Metabolically Healthy and Abnormal Obese Phenotype". *Gordon Research Seminar on Environmental Endocrine Disruptors*. Lucca, Italy, May, 2014.
- J Ruzzin & A Goksøyr. Translational Research to Decipher the Health Impacts of POPs Present in Fatty Fish: The Case of Farmed Atlantic Salmon. *2014 Oceans and Human Health (OHH) Gordon Research Conference (GRC),* Biddeford, Maine, June 2014.
- Kleivdal H et al. 6th International Conference on Toxic Cyanobacteria. Bergen, Norway, June, 2004..
- Van Cauwenberge A et al. Ecological Relevance of Chemically Induced Endocrine Disruption in Wildlife. University of Exceter, United Kingdom July 2004. Poster. Abstr. no. P65.
- Bohne Kjersem A. et al. 6th Siena meeting "From genome to proteome: Biomarker Discovery & Imaging Proteomics. Siena, Italy Aug-Sept, 2004. Poster, Abstr no. 26, p. 140.
- Grøsvik BE et al. 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13) Alessandria, Italy, June 2005. Platform.
- Tolfsen CC et al. 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13), Alessandria, Italy, June 2005. Platform.
- Sundbäck LV et al.13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13), Alessandria, Italy, June 2005. Poster.
- Søfteland T et al. 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13), Alessandria, Italy, June 2005. Poster.
- Jonsson HD et al. 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13), Alessandria, Italy, June 2005. Poster.
- Eidem J.K. et al. 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13), Alessandria, Italy, 19-22 June 2005. Poster.

- Tolfsen, CC et al. 7th Siena Meeting from genome to proteome: back to the future. September 2006.
- Kjersem AB et al. 7th Siena meeting "From genome to proteome: Back to the Future. Siena, Italy Sept 2006. Poster, Abstr no. 28, p. 149.
- Schwesig D. et al. WFD2007 Conference, Lille, France, March 2007.
- Goksøyr A. et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (lecture).
- Berg K et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (poster).
- Grøsvik BE et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (lecture).
- Nøstbakken OJ et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (poster).
- Brattås M et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (poster).
- Kjersem AB et al. Abstract, 13th International Symposium on Pollutant Responses in Marine Organisms (PRIMO 14), Florianopolis, Brazil, May 2007 (lecture).
- Goksøyr A et al. 3nd NORMAN Workshop, Amsterdam, October 2007.
- Nahrgang J et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, May 2009 (poster).
- Grøsvik BE et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, Mai 2009 (poster).
- Førde HE et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, Mai 2009 (poster).
- Brattås M. et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, May 2009 (lecture).
- Berg K et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, May 2009 (lecture).
- Lille-Langøy R. et al. 15th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Bordeaux, France, May 2009 (lecture).
- Goksøyr A et al. 19th Annual meeting, Gøteborg, Sweden, June 2009 (lecture).
- Nahrgang J. et al SETAC Europe 19th Annual meeting, Gøteborg, Sweden, 2009 (poster).
- Goksøyr A et al et al Nordic Environmental Chemistry Conference, Longyearbyen, Svalbard, Norway, March, 2010 (lecture).
- Berntssen MHG et al. ISFNF2010, China, June 2010.
- Rusten M et al. European Society for Comparative Biochemistry and Physiology Conference, Alessandria, Italy, Sept. 2010.
- Karlsen OA, 27. European Society for Comparative Biochemistry and Physiology Conference, Alessandria, Italy, Sept. 2010.
- Yadetie F et al. 16th Symposium on Pollutant responses in Marine Organisms (PRIMO 15), Long Beach, California, USA, May 2011.
- Brattås M et al. 16th Symposium On Pollutant Responses In Marine Organisms (Primo 15), Long Beach, California, USA, May 2011.
- Karlsen OA et al. 16th Symposium On Pollutant Responses In Marine Organisms (Primo 15), Long Beach, California, USA, May 2011.
- Rusten M. 16th Symposium On Pollutant Responses In Marine Organisms (Primo 15), Long Beach, California, USA, May 2011.
- Karlsen OA et al. International Conference on Environmental Omics, Guangzhou, China, Nov. 2011.
- Ruzzin et al. The 50th Annual Meeting of the European Association for the Study of Diabetes (EASD), Vienne, Austria (2014).
- Ruzzin et al. The Gordon Research Conference in Oceans and Human Health, Biddeford, Maine, USA (June 2014).
- Ruzzin et al. The Gordon Research Seminar in Environmental Endocrine Disruptors, Lucca, Italy (May 2014).
- Ruzzin et al. The 7th Copenhagen Workshop on Endocrine Disruptors (COW2013), Copenhagen, Denmark (2013).
- Ruzzin et al. The 24th Spring Congress of the Korean Diabetes Association, Gwangju, Republic of Korea

(2011).

Media contributions (newspapers, TV, radio, film, blogs, etc.)

- "Elevage en eaux troubles", Envoyé Spécial (diffused 07.11.2013), FRANCE2. Envoyé Spécial is a documentary programme viewed by 3-7 million people (Source: Wikipedia). "Alimentation : Y a-t-il du Poison dans Nos Assiettes ?", En quête d'actualité D8
- Various popular articles written in France, Denmark and Sweden.

- **Ecological and Environmental Change Research Group (EECRG)**

Conference contributions:

- Telford, R.J. Pitfalls of using transfer functions to reconstruct sea-ice. PAGES Sea ice Proxy (SIP) working group Sea ice proxy synthesis and data-model comparison; 2014-06-23 - 2014-06-25. Invited presentation.
- Telford, R.J.; Li, C.; Kucera, M. Re-evaluating tropical LGM planktonic foraminifera assemblage-based sea-surface temperature reconstructions. EGU; 2014-04-27 - 2014-05-02

popular articles and media contributions (newspapers, TV, radio, film, blogs, etc.):

- Richard Telford's blog at http://quantpalaeo.wordpress.com/ averages approximately 2000 page views per month.

AQUACULTURE AND FISH HEALTH

- **Fish Disease Research Group (FDRG)**

popular articles and media contributions (newspapers, TV, radio, film, blogs, etc.):

- Robertsen B, Hordvik I, Jørgensen T. Immunsystemet hos fisk. In: Thomassen M, Gudding R, Nordberg B, Jørgensen L, eds. (NRC) *Havbruksforskning: Fra merd til mat,* ISBN 82-12-02277-3, pages 176-188, 2006
- Robertsen B, Hordvik I, Jørgensen T. The fish immune system. In: Thomassen M, Gudding R, Nordberg B, Jørgensen L, eds. (NRC) *Aquaculture Research: From Cage to Consumption*. ISBN 82-12-02408, pages 185-197, 2007
- Hordvik I. Immunsystemet hos fisk. In: *Vaksinehåndboken* (Intervet NORBIO) pages 37-46, 200
- Hordvik I. Development of the immune system in fish. In: Helvik et al. The fish larva: a transitional life form, the foundation for aquaculture and fisheries. *NRC report* from a working group on research on early life stages of fish; ISBN 978-82-12-02682-7 (pdf), pages 64-66, 2009
- Helvik JV et al. Hvordan kan kartleggingen av laksens genom bidra til å løse utfordringene i norsk havbruksnæring? *Utredning for Fiskeri og Havbruksnæringens Forskningsfond (FHF)*, 2013

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**
- Conference contributions
- Symposium on Ecological and Environmental Parasitology: "The impact of global change" (2005)
- Sixth International Crustacean Congres, Glasgow, Scotland, UK (2 presentations) (2005)
- 13th International Meiofauna Conference in Reclife, Braszil (2007)
- The Crustacean Society. Summer Meeting 2008 in Galveston, USA, June 9-13. (2008)
- The 1st International Congress on Invertebrate Morphology, August 17 – 21. (2008)
- Dansk Havforsker Møde, Fuglsangcentret, Mols, Denmark, January 18 – 20 (2011)
- The Crustacean Society's Summer Meeting, June 6-9, 2011, Honolulu, Hawaii (2011)
- The Crustacean Society Summer Meeting - 10th Colloquium Crustacea Decapoda Mediterranea conference June 3-7th in Athens (2012)
- University of Denver, Colorado, U. S. A (Invited speaker) (2005)
- National Institute of Water and Atmospheric Science, Wellington, New Zealand (Invited speaker) (2007)
- TCS Tokyo Meeting 20 – 24 September: The Significance of the Stylet in the Evolution of Parasitic Barnacles (Invited speaker) (2009)

e. List your international projects in the period 2004-2013, and comment on the development in international project cooperation in the period.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

Evolutionary Fisheries Ecology Research Group (EFERG)

For a full list of successful grant applications, the reader is referred to question 1 in the survey. In addition to these afore listed projects, there have also been three EU-funded projects hosted by the Institute of Marine Research with spill-over effects to BIO. There has been one unsuccessful attempt to attain EU funding through a Marie Curie Research Training Network application. Almost all activities have included international collaboration, regardless of the funding source.

Marine Microbiology Research Group (MMRG)

International projects have become increasingly important for funding of group research and activity since the first EU Framework Programme (MAST 1). Since then, the group has been engaged in international project cooperation with international activity steadily rising. National RCN-funded projects have been a significant driving force, contributed to this increase as they have become gradually more international with active partners from abroad. To illustrate this rise, 9 international projects had funding in the last half of the period (2009-13) compared to 4 projects in the first half (2004-08):

- BASICS: Bacterial single-cell approaches to the relationship between diversity and function in the Sea. EU 2002-2005.
- MIRACLE: Microbial Marine Community Diversity: from culture to function. EU 2002-2005.
- METAOCEANS: Meta-analysis of the ocean. EU 2005-2009.
- NUTRITUNNEL: 'Nutrient tunnelling' and other alternative pathways for mineral nutrients through the microbial food web to copepods. RCN 2008-2010.
- EPOCA: European Project of Ocean Acidification. EU 2008-2011.
- MERCLIM-BIO - Marine Ecosystem Response to a changing CLIMate. RCN 2008-2011.
- MESOAQUA Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean. EU 2009-2012.
- MINOS: ERC Advanced Investigator Grant. MIcrobial Network OrganiSation. EU 2011-2016.
- PHAEONIGMA: A novel cross-disciplinary approach to solve an old enigma: the food-web transfer of the mass-blooming phytoplankter *Phaeocystis*. RCN 2011-2014.
- Arctic Microorganisms: Microorganisms in the arctic: major drivers of biogeochemical cycles and climate change. RCN 2013-2016.
- OceanCertain: Ocean Food web Patrol – Climate Effects: Reducing Targeted Uncertainties with an Integrated Network. EU 2013-2017.
- MicroPolar: Processes and Players in Arctic Marine Pelagic Food Webs - Biogeochemistry, Environment and Climate Change. RCN 2013-2017.
- MIRACLES: Multi-product Integrated bioRefinery of Algae: from Carbon dioxide and Light Energy to high-value Specialties. EU 2013-2017.

Theoretical Ecology Research Group (TERG)

Throughout the project period 2004-2013, TERG has seen increased international cooperation with several members undertaking single or multiple long-term visits to collaborating laboratories abroad (Prof. Marc Mangel's lab in Santa Cruz, California). Reciprocally, throughout the last 10 years, Prof. Mangel, the foreign host, has also visited Bergen every second year and has since been granted a Prof. II position at the TERG, UiB. Similarly, Prof. Aksnes has had a long-standing cooperation with Prof. Marc Ohman at Scripps Institution of Oceanography and Prof. Fiksen spent a sabbatical in 2011-2012, visiting Michael Follows at Massachusetts Institute for Technology, Cambridge, and Boston. Another researcher is currently visiting Leigh Simmons at the

University of Western Australia in Perth for a one-year research visit. The group's large international network is also reflected in their publications.

MARINE AND ENVIRONMENTAL HEALTH

Marine Developmental Biology Research Group (MDBRG)

- EU, QoL, QLRT-2001-01801 'Photoperiod control of puberty in farmed fish: Development of new techniques and research into underlying physiological mechanisms', 2002 - 2005
- COST Action: FA0801- (2008-12) LARVANET- Critical success factors for fish larval production in European Aquaculture: a multidisciplinary network (project proposal preparation, planning and submission)
- NORAD- SRV 2701 (2008- 12) Improving training and Research Capacity at the Nha Trang University, Vietnam- Phase II (UiT, UiB, NTNU, NUT)
- EU- FP7-KBBE-2007-2A. (2009-13) LIFECYCLE. Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture. (Collaborative project, Large scale Integrating Project, Partner)
- Fund. Ciência e Tecnol. Portugal. (2011-13) Towards fishmeal-independent fish diets: the role of taurine (PTDC/MAR/117047/2010) (part. w/CCMAR)
- Spanish Ministry of Science and Innovation. (2011-14) Assessment of daily rhythm in the feeding activity and the digestive function in reared larvae of marine fish. Improving the feeding protocols. (partner w/ Inst. Ciencias Marinas de Andalucía, Cadiz, Spain)
- NORAD (2013) Norhed Seed Funding: Incorporating Climate Change into Ecosystem Approaches to Fisheries and Aquaculture Management (partner w/ Nha Trang Univ and Univ of Tromsø)

Environmental Toxicology Research Group (ETRG)

- EU/QLK-4-CT-202-02286 Easyring (2003-2005). Partner and WP leader.
- Involvement of PXR (SXR) in the effects of *ortho*-PCB congeners in zebrafish (NIH project w/John Stegeman, WHOI, USA) (2011-2014). Collaborator.
- The iCod and the Nuclear receptor project also involved several international collaborators in Sweden, Denmark, UK, and USA.
- No EU applications have been successfully funded since EASYRING, although the group has maintained continuous efforts to apply for new EU funding. To this end it uses its international network in research collaborations outside of the regular funding schemes. This is a continuous development.

MARINE BIODIVERSITY

Marine Biodiversity Research Group (MBRG)

The number of internationally coordinated projects and associated funding have shown an increasing trend. To illustrate, the list below provides specific examples of international projects in which MBRG has been involved during this period.

- Co-investigator (PI: Andreas Waninger, Biological Institute) "Evolution of animal body plans as inferred by developmental biology, morphology, molecular phylogeny, and palaeontology. " HUMAN RESOURCES AND MOBILITY (HRM) ACTIVITY, MARIE CURIE ACTIONS, Host fellowships for Early Stage Research Training (EST) Dkr (2005)
- Co-investigator (PI: Professor Carsten Rahbek, Biological Institute) "Center for Macro-ecology and Evolution: How to explain distribution and life on Earth" (2009)
- The Carlsberg Foundation "The shore crab in its home range (2009)

- Co-investigator (PI: Professor Carsten Rahbek, Biological Institute, Copenhagen) "Center for Macroecology, Evolution and Climate Change" (2010)
- The Norwegian Species Databank "Norwegian cumaceans" (2010)
- The Norwegian Species Databank Species inventory of the Sognefjord (2013)
- Co-investigator: The Norwegian Programme for Capacity Building in Higher Education and Research for development (NORHED), "Climate change impact on marine biodiversity and fisheries aquaculture in Vietnam" (2013)

f. Provide examples of other central international activities, e.g. marketing and networking, and comment on the development in these activities in the period.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Marine Microbiology Research Group (MMRG)**

Arrangement of international symposia, workshops and courses has represented a strategic means to obtain international contacts and improve group networking. Examples of central international activities that the group has coordinated or been heavily involved in:

Conferences:

- Sixth International Conference on Toxic Cyanobacteria, 2004.
- Marine Virus Workshop 2007. EURopean network of excellence for OCean Ecosystem ANalysis (EUR-OCEANS) & SCOR WG 126 on Role of Viruses in Marine Ecosystems.
- Annual Meeting of the Nordic Microscopy Society - SCANDEM 2012
- 100-years Anniversary for Armauer Hansen. 2012 - International seminar on Armauer Hansen, Lepra and *Mycobacteria*.

Networks:

- EUR-OCEANS network of excellence. Leading Theme 4 "Biogeochemistry"
- MESOAQUA Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean.
- ESSEM COST Action ES1103: Microbial ecology & the earth system: collaborating for insight and success with the new generation of sequencing tools.
- NENUN Nordic Environmental NUcleotide Network.

Miscellaneous:

- SCOR Working Group 126 on Role of Viruses in Marine Ecosystems. 2005-2009.
- NIMBios (National Institute for Mathematical and Biological Synthesis) Knoxville, Tennessee. Member of working group on "Ocean Viral Dynamics" 2012 - 2014.
- Activity Leader in the IPY project Polar Aquatic Microbial Ecology (PAME) (IPY Activity ID No.71). 2006-2009.
- Group PI served as editor in journal Aquatic Microbial Ecology, Scientific Advisory Board member for establishing the International Society for Virus of Microorganisms (ISVM) and member in the ESF Marine Board Working Group on Marine Microbial Diversity.

MARINE AND ENVIRONMENTAL HEALTH

Marine Developmental Biology Research Group (MDBRG)

MDBRG has had extensive and continuous collaboration with EU, Asian and North American countries. Continuously ongoing collaboration with researchers in Japan and USA since 1980s has resulted in a large number of joint published papers.

Environmental Toxicology Research Group (ETRG)

ETRG has been actively contributing to the development of an international Oceans and Human Health community, through participation in workshops (http://www.ecehh.org/wp-content/uploads/2013/11/Message-from-Bedruthan.pdf) and the Gordon Research Conference/Seminar series on Oceans and Human Health. During the latter the group had two invited lectures at the 2014 OHH GRC in Biddeford, Maine, USA, and group PI, Anders Goksøyr was elected vise-chair for the 2016 and co-chair for the 2018 meetings. ETRG researcher, Jerome Ruzzin, was elected co-chair for the 2016 GRS on Environmental Endocrine Disruptors

MARINE BIODIVERSITY

Marine Biodiversity Research Group (MBRG)

Central international activities, e.g. marketing and networking involve the group's continuously ongoing collaborations within colleagues in Scandinavia, EU, Asian and North America. The development of named activities is reflected in the publication records of the group, listed above for the evaluated period.

7 Cross-disciplinarity

ToR: “Consider to which extent cross-disciplinarity and organization in cross-disciplinary centres has contributed to strengthening and developing activities in the focus area.”

If relevant, please report separately for your major research topics/research groups in this section.

Please comment on the degree of cross-disciplinarity of your research activities and education programmes, and the extent to which cross-disciplinarity and organisation in cross-disciplinary centres have contributed to strengthening the research and education activities within marine studies at UiB in the period 2004-2013.

Previous evaluations of Norwegian Research in Biology have recognized the excellence of the numerous research groups at BIO. Given a developing shift from traditional organism and biome-based disciplines towards process and system-oriented studies such as developmental biology, evolutionary biology and ecology, the resultant new integrative biology can be viewed an overarching, interdisciplinary biology which encourages yet greater interdisciplinary with fields such as physics, chemistry, geology and medicine. It also entails a stronger emphasis on mathematics and informatics through computational biology and bioinformatics. The establishing of BIO 10 years ago involved a boost to cross-disciplinary teaching and research in the biological marine sciences. New research groups were formed with people from all the old departments, and as we moved into new buildings in 2009 this process has continued. The effect of this is that researchers with a wide range of backgrounds are mixed together, with substantial potential for cross-fertilization of ideas, methods and cultures. Each group at the department has seen exciting initiatives towards integrative research, cross-disciplinary collaboration and cooperation across the research groups. This cross-disciplinarity extends beyond the faculty and department levels, however, as exemplified by promising new developments within cross-disciplinary research on fish recruitment dynamics, with links to fisheries, aquaculture and basic developmental biology. BIO has strengthened the fish health area with a research initiative on salmon lice, which led to establishment of The Sea Lice Research Centre, a Centre for Research-based Innovation appointed by the Research Council of Norway. This Centre is hosted by the University of Bergen and started activity in 2011. The latter, a notable example of a new research/educational area that has arisen from cross-disciplinarity within the department and its peripheral academic communities. In turn, this center provides strong potential for further cross-fertilisation between basic and applied research. Also the interdisciplinary research group of geomicrobiology that led to the establishment of the CoE *Center for Geobiology* is prominent example of how interdisciplinary can lead to the development of a new discipline.

Below are examples of interdisciplinary provided by the groups regarding their research activities and education programmes, and the extent to which cross-disciplinarity and organisation in cross-disciplinary centres have contributed to strengthening the research and education activities within marine studies at UiB in the period 2004-2013.

FISHERIES ECOLOGY AND MARINE ECOSYSTEM DYNAMICS

- **Evolutionary Fisheries Ecology Research Group (EFERG)**

The research core lies in evolutionary and population biology but includes most disciplines in marine

science and many other branches of classic biological research, i.e. genetics, physiology, behaviour, and biological oceanography. Outside biology, we are working at the interface with resource economics and resource management. The group's activity in fisheries economics represents a cross-disciplinary activity in itself.

- **Marine Microbiology Research Group (MMRG)**

Marine microbial ecology includes a multi-disciplinary field of research which embraces biology/microbiology, molecular biology, genomics, bioinformatics, chemistry, physics, oceanography and modelling. The group has internal expertise on all of these fields but collaborates extensively with researchers that specialise on marine chemistry and climate research, bioinformatics, marine physics, ecosystem modelling etc.

- **Theoretical Ecology Research Group (TERG)**

TERG is a very cross-disciplinary group, working across the biological domain, from microbes to birds and humans – from small-scale physics and oceanography to the evolution of sociality, mating behavior and economics. This is made possible as they are skilled in theory and modelling while some common principles (evolution) stretch across all these topics.

- **Aquatic Behavioral Ecology Research Group (ABERG)**

Much of the marine research activities and education programmes of the ABERG have shared cross-disciplinarity with the department of mathematics.

MARINE AND ENVIRONMENTAL HEALTH

- **Marine Developmental Biology Research Group (MDBRG)**

Several recent MMRG projects are cross-disciplinary in nature. Projects like 'Moderne settefiskproduksjon av laks - normal utvikling og velferd i intensive oppdrettsystemer' (2006 – 2009), 'Optimal smolt production and post smolt performance in the High North - Seawater intermixing, low temperatures and intensive rearing' (NORSMOLT, 2008 – 2011) and 'Optimalisert postsmolt: et paradigmeskifte for norsk lakseindustri' (2012 – 2014) explore the interface between technology and biology, focusing on the development, physiology and welfare of salmon in intensive production systems, including the novel, closed containment system for post-smolt rearing, currently under development in Norway. Further, our initiative towards an SFI (CtrlAQUA) crosses disciplines of biology, technology, fish health, remote sensing etc. In addition, the group performs cross-disciplinary research on appetite control and digestive function with UiB's, Department of Medicine at UiB (since 2005) and on nutrient sensing, duodenal and stomach function with UCLA's Department of Medicine (since 2013). Cross disciplinary research with Uni Research has led to participation in committees for establishing a cluster for Marine biomass exploitation/bioprospecting, for developing new interdisciplinary Master's program in Energy, and for participation in an EMBRC initiative to upgrade European marine biological stations for research and teaching purposes. Cross disciplinary research with UiB's Department of Medicine and Department of Ophthalmology (since 2007) on the topic cell adhesion and development. Experience and findings from the group's research "trickle down" into the education programmes, and are communicated to students in aquaculture and fish physiology.

- **Environmental Toxicology Research Group (ETRG)**

Cross-disciplinarity is the basis of environmental toxicology, so the group endeavours to provide the students a background in chemistry, molecular biology, ecology, bioinformatics, statistics, etc. ETRG research collaborations mirror the need for cross-disciplinarity, where links have been established to other relevant research groups in the field. The group strives to contribute to the establishment of a

Centre for Ocean and Human Health at the University of Bergen, bringing together all the various aspects of research on this topic at the University, across departments and faculties.

- **Ecological and Environmental Change Research Group (EECRG)**

AQUACULTURE AND FISH HEALTH

- **Fisheries Ecology and Aquaculture Research Group (FEARG)**

Ample examples exist of cross-disciplinary research in the group:
- Hard rock and CalMarO projects (using otoliths as environmental recorders), involve climate researchers/geochemists/modelers/archeologists in addition to a.o. fisheries scientists at IMR.
- Cooperation with fish nutritionists at NIFES
- Cooperation in archaeology and vegetation ecology under application EU INTERREG
- Cooperation with modelers and economists in development of fisheries models (Balanced harvesting), and presentations at various UN and World Bank sponsored fora.
- Collaboration with microbiologists, technologists in development of fish skin based assays for determining fish health.

MARINE BIODIVERSITY

- **Marine Biodiversity Research Group (MBRG)**

The research conducted in the Marine Biodiversity Group is interdisciplinary in nature and includes classic taxonomy/systematics, phylogeny, evolutionary biology, ecology, histological research, developmental biology and molecular biology.

8 UiB's strategic committee for marine research

ToR: "Assess utility value/function of the strategic committee for this focus area."

Please comment on your department/centre's experiences with UiB's strategic committee for marine research, its value/function for developing the field, and if relevant how the organisation of the focus area may be improved.

At the department level, the UiB's strategic committee for marine research mandates are acknowledged, respected and implemented through the capacity of the department leader. Due to the committee members' broad backgrounds of expertise, it has been perceived as a very good forum to discuss marine research inter-disciplinarity across its activities. Among the research groups, however, the strategic committee has been minimally prominent. With regard to the committee's value or function for development of the field, the general consensus among the groups is that the department's activities have ensued, regardless and independent of the committee's input or recommendations. The extent of the committee's influence and/or impact on prioritization and development of marine research areas has also been minimally noticeable to members of the departmental leadership. In summary, therefore, the strategic committee could potentially serve a greater function if revitalized and used and supported by the UiB leadership as a strategic body, but its mandates are followed and the scope of its authority and autonomy supported by the department leadership.

9 Administrative resources and support

ToR: “Assess the associated academic communities combined administrative resources and support functions.”

Please describe the types of administrative resources and support available to your department/centre, and give your opinion on the adequacy/sufficiency of the resources and support, and if relevant what ought to be improved.

After the merger of the 5 previous units into BIO, the researchers report an increased professionalism, competence and capacity of its administrative staff. The Department of Biology’s administrative resources adequately and sufficiently support Marine research and teaching at the Department of Biology. Of the approx. 220 staff members employed at BIO, approximately 27% of these are technical and administrative. Of these, the majority is directly involved in research and teaching support and in the Research Council’s 2010 Evaluation of Norwegian Research in Biology, BIO’s administrative and technical staff were described as “competent and service-minded” and recognized as one of the department’s professional and organizational strengths. Like any university administration however, the same general requirements apply to the administrative services at the Department of Biology. Unlike particularly specialized research areas, Marine Research does not require any additional, specified experience or expertise in the administrative area, although it should be noted that any initiatives (by administrative services or otherwise) to increase the department’s visibility and influence in our public funding bodies, such as the Research Council of Norway would be regarded as a positive development. BIO also utilises the administrative support offered by the faculty and the Department of Research Administration. Technical support, on the other hand, requires to a much larger extent specific competences relevant for different aspects of marine research. The evaluated period has also been characterized by a continuous and rapidly developing state-of-the-art infrastructure, for which the Department of Biology has been able to meet the need for quantitative and qualitative technical support by hiring highly qualified technical staff. It remains a challenge for BIO however to continue to meet this ever-increasing need for competence and to allocate enough resources for technical support.

10 Strengths, weaknesses and challenges

If relevant, please report separately for your major research topics/research groups in this section.

Please describe what you see as the main strengths, weaknesses and challenges for research and education within marine research at UiB, and how the field should be developed further.

Excelling in science and education requires strategic and long term planning. Having had marine research and education as a broad and long term strategic area of commitment UiB it has been possible for UiB's researchers to make a prominent impact in the international marine science research communities and to contribute to important knowledge transfer to the society locally, nationally and internationally.

BIO was established on the 1st of January 2004 by the merger of the former Departments of Botany (BI), Fisheries and Marine Biology (IFM), Microbiology (IM), and Zoology (ZI). The UiB Centre for Environmental and Resource Studies joined BIO in 2006. The scientific foundation for BIO, developed prior to the merger in 2004, states that BIO shall "*have strong research groups within the breadth of biological sciences, […] be the strongest academic environment for marine biology in Norway,* and *have a clear plan for development related research*." There is also an overlap between the marine research area and the development related research as many of the research questions we ask also within the marine area are of importance in the developing countries.

Marine biology and Aquaculture are considered both economically and geographically important for Norway and throughout BIO's ten years' of existence BIO has prioritized basic research in marine biology, through (i) a focus on fostering high quality in marine research (notably marine microbiology, ecological modelling, taxonomy, biodiversity, developmental biology and evo-devo) including prioritizing new positions and facilities for these groups, (ii) establishing a joint microbiology-geology research group (2005) and thereafter a Center of Excellence (CoE) in geobiology, Center for Geobiology (CGB) (2007), (iii) establishing cross-disciplinary fish-rearing facilities to ensure access to research material and strengthen experimental basic research on fish recruitment and development, (iv) stronger focus on marine developmental biology, including establishing a five million NOK zebrafish facility shared with The Department of Molecular Biology, a facility for appendicularians and a facility for salmon lice, (v) taken on coordination of a Nordic research school (the Nordic Marine Academy), (vi) specific actions targeted at improving research quality in aquaculture, fish health and development biology, including merging subcritical groups, encouraging application of computational and molecular methods, and exploiting potential synergies through new collaborations with high-quality basic science environments both within BIO and externally, (vii) established the Sea Lice Research Center, a Center for Research-based Innovation (CoRI) (2011) and (viii) the aim of the merger into BIO was to strengthen research by providing a common structure and culture. In consequence, we have throughout the last ten years seen a rise in the quantity, quality, and scientific relevance of our marine research (ref: National Evaluation of Biology 2010).

BIO has also throughout the evaluation period been a partner in the CoEs *Bjerknes Centre for Climate Research* and *Centre for Integrated Petroleum Research*; one Nordic CoE *Climate Change Effects on Marine Ecosystems and Resource Economics*; and the *The Michelsen Centre for Measurement Science and Technology, a* CoRI. We also coordinated the EU MESOAQUA network of European mesocosm facilities, of which the Marine Biological Station (MBS) at Espeland, Fana, was a part, and BIO received infrastructure funding from the RCN to establish the CODE national knowledge platform for the early stages of marine fish.

One of our professors in marine biology, Thingstad, has obtained an ERC Advanced Investigator Grant and received the RCN Möbius Prize for research that was performed at MBS, among other places. During the evaluation period, BIO has recruited a Bergen Research Foundation Young

Investigator Grant candidate (BFS) within the marine field (Heino - within evolutionary effects of fisheries.
In 2014 BIO was awarded a Centre of Excellence in Education – *bioCEED* – which aims to improve our education in marine as well as other biological areas.

Below please find a SWOT (Strengths – Weaknesses – Opportunities – Threats) analysis within the marine field as seen from the department's and research groups' perspectives:

Strengths

Research and education

- Large scientific milieu with high competence across a broad spectrum of biology; empirically, methodologically, and theoretically
- Research groups (comprising permanent scientific staff, technicians, researchers, post-docs, PhD students and MSc students) with a strong sense of common research goals, and where the complementary expertise and skills of group members are valued and exploited
- Some groups are international leaders within their field: marine and geo-microbiology and marine ecosystem dynamics
- Extensive research and teaching portfolio within the UiB strategic priority of marine sciences and the national priority areas of climate and polar research which also have marine interfaces
- Strong links between research strength and education profile, good recruitment of students at all levels, and a well-functioning research education
- Cross-disciplinary research approach with learning potential across the disciplines;
- Research themes addressing fundamental properties of individuals and populations engage numerous research groups and allow pursuit of many fundamental scientific questions;
- Substantial scientific diversity and strengths related to marine biology in general and fish biology / fisheries / aquaculture / fish health in particular
- Organism biology is essential to all biological disciplines and associated research encompasses a broad comparative developmental approach (Oikopleura – teleosts - human medicine) resulting in applied research topics supported by public interest;
- research orientation in areas with international focus and rapid scientific progress;
- Strong contact and collaboration (i.e. the Bergen Museum and Uni Research, IMR, NIFES) benefits network-building;
- High scientific and publication activity.

Funding

- Competitiveness for external funding nationally and internationally – both due to infrastructure and scientific quality of researchers. ;
- Collaboration with local academic communities increases access to funding sources;
- BIO's broad research focus enables competition for a wide range of programmed funding and attracts collaborative partners.
- Success in excellence schemes such as CoE, NCoE, BFS, CoE in Education, CoRI

Facilities and resources

- Strategic location characterized by a high concentration of marine researchers within a small area, with ready access to equipment and animal resources, providing a solid base for high-quality research. It is imperative in the future to stick to this, and not to spread the human resources on different localities;
- BIO has created opportunities for new collaborations over shared research methods, complementary research approaches, joint lab management, and shared infrastructure

- Extensive innovative drive, industrial contact and collaborative activities linked to ongoing and potential SME businesses
- Excellent infrastructure for research and education: advanced laboratories, field stations and research vessels, and an attractive location for field-based research Strong, broad and active local, national and international networks of collaborations and recognition of our research, scientists and expertise
- Long experience (>30 years) in marine pelagic experimental ecology (mesocosms / microcosms) and other marine fields
- Great diversity of taxonomical expertise
- Extensive collaboration within the groups

Personnel

- Highly competent employees who are enthusiastic about their research fields and who identify emerging challenges and opportunities
- Students are interested, motivated and effectively recruited
- Strong engagement of faculty members on academic/scientific boards and committees
- Affiliation of active and knowledgeable emeriti

Weaknesses

Research

- Untapped potential for integration between research directions: empirical vs. theoretical; applications of biostatistics; modelling; bioinformatics; and molecular methods
- Strong involvement of faculty members on boards and committees limits their academic activities
- Increasing administrative demands (e.g. time sheets for project work, project expense documentation (e.g. shared running costs on instruments according to recorded use).
- Organism biology rarely in fashion at the research council and traditional taxonomy is time consuming

Funding

- insufficient basic funding hinders long term strategic opportunities
- Calls from relevant NFR programmes often address specific short-term, production-driven questions
- limited funding to update equipment with few to no means to budget costs financed by research groups for instrument repair / replacement
- Ship-time for cruises in Arctic regions billed to the projects.
- Low fraction of externally funded pure researchers among the staff.

Facilities and resources

- Research quality would have benefitted from higher investments in maintenance and upgrade in some of our research stations and facilities, and from improved coordination
- Deficiencies regarding data storage and bio-banks frustrate optimal safe-guarding and scientific exploitation of existing, often hard-earned, data and samples
- limited interactions between bioinformatics, whole genome approaches and biology

Personnel

- Lack of expertise/research in some fields e.g. zooplankton ecology and bioinformatics.
- Loss of personnel through retirement without replacement results in loss of expertise.

- Group members, besides the PIs are largely dependent on external or temporary funding. Few possibilities to keep promising master students
- Some groups are small and therefore vulnerable.
- Ageing faculty reduces flexibility and increases the need for BIO to rejuvenate and reinvent itself as an investment-worthy group
- Need for taxonomists in bio-prospecting

Opportunities

Research and Funding

- Open competition pool for some PhD positions could support embryonic ideas leading to downstream external funding as well as keep promising master students
- Research areas (e.g. evolution of biological processes, planktonic trophic interactions) hold synergy with biomedicine
- increased collaboration with academic communities in UiB's periphery (e.g. IMR, the University Museum, NIVA, UniRes, Sars, NIFES and CBU)
- increasing synergy possibilities with national and international industrial partners
- need to keep up with steadily faster research activity of global competitors and/or collaborators (can be a strength if successfully achieved or a weakness if not accomplished)
- Possibilities for exposure in media (everyone loves a good animal story)

Facilities and resources

- Application of zebra fish and molecular tools to marine models
- Synergy from co-localization with other groups at BIO, MBI and Sars
- Additional synergy if MRI is relocalized to Marineholmen
- Biodiversity laboratory
- Espegrend Marine biological station for workshops, field and lab experiments and field courses
- Research vessels and unique cruise opportunities
- The unique marine environment literally outside labs and offices
- Culture facilities for marine organisms

Threats

Research and Funding:

- Long-term scientific planning can be distracted by the need to compete for external funding, most of which is programme-oriented, and limited ability to fund long term strategies, limits potential for future funding
- Dependence on external funding for doing experimental research and training PhD and Master students
- Calls from applied NFR programmes often inapplicable, too few and/or too narrow
- great dependence on strategic decisions and structure of the RCN and EU,
- local strategic priorities unclear and poorly funded
- Competition of funding induces a "chasing the money" syndrome (compromising clearly articulated pursuit of long-term institutional vision).
- Large (and prestigious) international projects with many partners and insufficient funding require large "own contribution" or additional national funding.

Facilities and resources

- Uncertainties concerning the future localization of the Marine Biological Field Station and mesocosm facilities.
- mechanisms for obtaining significant, modernized, equipment upgrades are few, laborious and lengthy, reducing opportunities to respond effectively to new research and collaborative opportunities
- Need to maintain and uphold our strategic location and not to spread the human resources to different localities.

Personnel

- Large span in group research activities contributes to less scientific interaction within the group compared to others which follow a more stable-like organization and narrow focused agenda. BIO risks undermining some of their own research groups' profiles by adapting to the research profiles of other larger collaborating institutions.
- Legal constraints in hiring non-permanent labour have negative consequences for post-doctoral researchers' career development and building of strong research groups
- Increased implementation of non-scientific duties

11 Additional information / comments

The box below, although not part of the original self-assessment form, was added in order to provide some additional information for the evaluation panel regarding our responses to some of the previous questions.

In several of the questions stated above (Chapter 6) regarding such issues as major dissemination channels, national and international promotional activities and project development, the same holds true across most, if not all, of the research groups. Generally speaking, in marine biological research communities, the major modes of traditional dissemination apply, namely publication in high-impact peer-review international journals, oral and poster presentations at local and/or international conferences, meetings and symposia. Furthermore, popular scientific channels such as traditional (e.g. newspapers, magazines, radio, television) and social media have become increasingly more common during the assessment period, particularly the latter. In the feedback fields, it should thus be noted that only group responses containing unique information, specific to the group rather than the whole, were included to exemplify BIO's rich diversity.

Curriculum Vitae

Name:	Sigurd Olav Stefansson
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ISI statistic (June '15):	147
ISI h-index (June '15):	39
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Education

Dept. of Fisheries Biology, University of Bergen (UiB), 25.06.1986

Cand. scient. Thesis: Lysperiodens virkning på vekst og smoltifisering hos laks (*Salmo salar* L.)

Dept. of Fisheries and Marine Biology, UiB, 10.12.1990

Dr. scient. Thesis: The influence of light on growth and parr-smolt transformation of Atlantic salmon (*Salmo salar* L.): Effects of spectral composition, light intensity and photoperiod
External examiner: Dr. Richard L. Saunders, DFO, Biological Station, St. Andrews, Canada

Professional experience

Institute of Marine Research (IMR), Matre Aquaculture Station, Research fellow, Norwegian Fisheries Research Council 'Miljøforholdene i settefiskproduksjon', 07.1986 - 08.1988
Dept. of Fisheries Biology, UiB, Associate Professor (Amanuensis), 08.1988 - 06.1990
IMR, Matre Aquaculture Station, Senior Scientists, 01.07. - 31.12.1990
Dept. of Fisheries and Marine Biology, UiB, Associate professor 12.1990 – 03.2001
Department of Fisheries and Oceans, Biological Station, St. Andrews, Canada, post-doc. (Norwegian Fisheries Research Council), 05. - 12.1992
Dept. of Biology, UiB, Professor, 01.04.2001 – present
Univ. of Massachusetts at Amherst and Conte Anadromous Fish Research Center, Turners Falls, MA, USA, Sabbatical, 08.2003 – 07.2004

Research Prize

EWOS Research Prize 1995 (... for sin betydelige forskningsinnsats for norsk akvakulturnæring…)

Projects

National projects

NFFR V.701.146 'Miljøforholdene i settefiskproduksjon', 1986 - 1988
NTNF HB 23.22395 'Lys i fiskeoppdrett', 1987 - 1989
NFFR V.701.211 'Halvtårssmolt', 1988 - 1990
NFFR V.701.236 'Lys i matfiskproduksjon', 1989 - 1991
NFFR 1401-701.321 'Smoltkvalitet og helse', 1991 - 1993
NFR 108848 'Smoltkvalitet, sesonguavhengig utsetting og tidlig sjøvannsfase', 1995 - 1998
NFR 108098 'Postsmoltøkologi – trofisk nivå og vandringer', 1995 - 1997
NFR 110993 'Miljømessig og arvelig regulering av vekst hos ung kveite i oppdrett', 1996 - 1999
NFR 122845 'Det arvelige grunnlaget for smoltifisering hos oppdrettslaks og villaks – en grunnleggende studie', 1998 - 2000
NFR 133964 'Vannbehov og vannkvalitet under intensiv smoltproduksjon. Hva er grenseverdiene og hvordan unngå skadelige effekter av lav vanngjennomstrømming, lav pH og høg CO_2 under intensiv smoltproduksjon?', 2000 – 2002
NFR 133937 'Control of age at first sexual maturity (puberty) in farmed Atlantic salmon', 2000 – 2002
NFR 149790 'Distribution and ecology of post-smolt and salmon at sea', 2002 - 2005
NFR 149796 'The importance of early marine feeding on the growth and survival of Atlantic salmon post-smolt in Norwegian fjords', 2002 - 2006
NFR 153230 'Environmental control of smolt brain development', 2003 – 2005
NFR 165331 'Environmental impact and molecular regulation of the osmoregulatory gill during parr-smolt transformation in Atlantic salmon', 2005 – 2007

NFR 163429 ‘Optimisation of harvested halibut by lowering maturation, increasing growth and improving flesh quality’ 2005 – 2007
NFR 165239 ‘Sjøvannsinnblanding i intensiv smoltproduksjon: effekter på helse, velferd og risiko for vintersår’, 2005 – 2007
NFR 172504 ’Nitric oxide regulation of development in fish: emphasis on the light-brain-pituitary axis and gill during salmon smoltification’, 2006 - 2008
NFR 1722630 ‘Progressive, modern production of juvenile Atlantic cod’ (PROCOD), 2006 - 2009
NFR 172514 ‘Moderne settefiskproduksjon av laks - normal utvikling og velferd i intensive oppdrettsystemer’, 2006 - 2009
NFR 184997 ‘Optimal smolt production and post smolt performance in the High North - Seawater intermixing, low temperatures and intensive rearing’ (NORSMOLT), 2008 – 2011
NFR 190469 ‘Fish welfare assessment through brain function: Impacts of environmental stress on brain plasticity and behaviour’, 2009 – 2011
NFR 199800 ‘The smolt probe - novel tools for assessment of smolt quality and marine performance in Atlantic salmon’, 2010 – 2012
NFR 199518 ‘Early puberty in salmon males in seawater - causes and consequences for hypoosmoregulatory ability and welfare’, 2010 – 2013
NFR 199482 ‘Cod Development CODE’, 2010 – 2013
NFR 222215 ’The smolt brain model: Unraveling nature´s regulation of neural plasticity’, 2013 – 2015
NFR 233870 ‘Welfare of Atlantic salmon postsmolts in closed-containment production systems, using a function-based approach’ (SalmoFutura), 2014-2016

National strategic programs (Research Council of Norway)

114646 ‘Teori- og eksperimentbasert studie av rekruttering hos marin fisk’, 1995 - 1998
136260 ‘Smolting in Atlantic salmon: the interrelationship between physiological, endocrine and immunological changes, and their genetic regulation’, 2000 - 2006

Other national programs (Fiskeri og havbruksnæringens forskningsfond, FHF)

FHF/NFR 155157 'Vannkvalitet – smoltkvalitet', 2003 – 2005

International projects

Nordisk Industrifond 88.107 'Helårlig produksjon av atlantisk laks ved styrt kjønnsmodning og smoltifisering', 1988 - 1991
EU, FAIR-CT96-1410 ‘Environmental and neuroendocrine control mechanisms in finfish reproduction and their application in broodstock management’, 1997 - 1999
EU, FAIR-CT97-3544 ‘A multidisciplinary evaluation and optimization of the production characteristics of different strains of commercially cultured flatfish’, 1998 - 2000
Wallenberg foundation, 1997 - 2001
‘Aquaculture and Fisheries Development: Basic Research on Finfish Reproduction and Growth Enabling the Intensification of Aquaculture’
‘The Multiple Gonadotropin-Releasing Hormones (GnRH) of Fish: Functions and Potential Use for Spawning Manipulations in Commercially and Ecologically Important Fish Species’
EU, QoL, QLRT-2001-01801 ‘Photoperiod control of puberty in farmed fish: Development of new techniques and research into underlying physiological mechanisms’, 2002 - 2005
EU, LSF ‘Marine Pelagic Food Chain Research’, (Contract N^{o} ERBFMGECT950013)

Research collaborators/topics:
Professor Niall Bromage, University of Stirling, Skottland
Temperature effects on melatonin in post-smolt Atlantic salmon (*Salmo salar*), 1997
Professor Sjoerd E. Wendelaar Bonga, Katholieke Universiteit Nijmegen, Nederland
The effect of temperature on growth performance and stress resistance in two generations of turbot (*Scophthalmus maximus* Rafinesque), 1997
Influence of temperature and feeding ration on the bioenergetics of juvenile turbot (*Scophthalmus maximus*) and Atlantic halibut (*Hippoglossus hippoglossus*), 1998
Dr. Richard FitzGerald, University College Cork, Irland
The effect of different initial size distribution on the growth of Atlantic halibut (*Hippoglossus hippoglossus* L.), 1998
Dr. Ewa Kulczykowska, Marine Biology Center of Polish Academy of Sciences, Gdynia, Polen

Melatonin – Arginine vasotocin relationship during development of *Salmo salar*, 2001
EU, Improving Human Potential, Access to Research Infrastructure, Institute of Aquaculture, University of Stirling, Scotland, Contract HPRI-CT-1999-00106

Professor Niall Bromage

Endocrine regulation of growth and food intake in salmon smolts, 2000/2001
EU, FP7-KBBE-2007-2A, 222719, LIFECYCLE—Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture (01.03.2009 – 28.02.2013)

Centre

Centre for research based innovation (SFI): Centre for Research-based Innovations in Controlled-environment Aquaculture (CtrlAQUA), 2015 – 2023. http://ctrlaqua.no/

Teaching

Completed Univ. of Bergen programme on teachin g and pedagocics, 1994
Member of Dept. of Biology programme board for teaching (several appointments)

Courses

BIO 104 Comparative physiology
Course responsible, teaching, assessment, quality assurance
BIO 203 Introduction to Aquaculture
Course responsible, teaching, assessment, quality assurance
BIO 291 Fish Biology II - Fish Physiology
Teaching, assessment, quality assurance
BIO 304 Specialisation in Aquaculture Biology
Teaching, assessment, quality assurance
BIO 375 Fish Diseases - Water Quality
Course responsible, teaching, assessment, quality assurance

Supervision

Cand. scient. and Master students:

43 students completed their degree

Dr. scient and PhD students:

11 students completed their degree, 2 students currently under supervision

Post-doc researchers:

3 finished

Committees

Chair/member of boards appointed by the Research Council of Norway in the area of aquaculture (Havbruk), 1997 – 2007
Appointed as an external expert by the Norwegian Scientific Committee for Food Safety (Vitenskapskomiteen for mattrygghet, VKM) in ad hoc groups to answer requests on fish welfare issues
Appointed as external expert by the Directorate of Fisheries in panel to review applications on experimental licenses (current)

Selected publications (2012 – present)

2015

Salmerón, C., Johansson, M., Asaada,M., Angotzi, A.R., Rønnestad, I., Stefansson, S. O., Jönsson, E., Björnsson, B. Th., Gutiérrez, J., Navarro, I. and Capilla, E., 2015. Roles of leptin and ghrelin in adipogenesis and lipid metabolism of rainbow trout adipocytes *in vitro*. *Comp. Biochem. Physiol.*, A 188, 40-48. doi:org/10.1016/j.cbpa.2015.06.017

2014

Sundh, H., Nilsen, T.O., Lindström, J., Hasselberg-Frank, L., Stefansson, S.O., McCormick, S.D., Sundell, K. (2014). Development of intestinal transport mechanisms during smoltification in Atlantic salmon smoltification and acclimation to seawater. *J. Fish Biol*. 85, 1227-1252. doi:10.1111/jfb.12531

Handeland, S.O., Imsland, A.K., Nilsen, T.O., Ebbesson, L.O.E., Hosfeld, C.D., Pedrosa, C., Stefansson, S.O., (2014). Osmoregulation in wild Atlantic salmon smolts transferred to seawater at different temperatures. *J. Fish Biol.*, 85, 1163-1176. doi:10.1111/jfb.12481

Einarsdóttir, I.E., Gong, N., Jönsson-Bergman, E., Sundh, H., Hasselberg Frank, L., Nilsen, T.O., Stefansson, S.O., Sundell, K., Björnsson, B.Th., (2014). Plasma growth hormone binding protein levels in Atlantic salmon (Salmo salar L.) during smoltification and seawater transfer. *J. Fish Biol.* 85, 1279-1296. doi: 10.1111/jfb.12473

Imsland, AK, Handeland, SO and Stefansson, SO, 2014. Photoperiod and temperature effects on growth and maturation of pre- and post-smolt Atlantic salmon. *Aquaculture International*, 22, 1331-1345. doi: 10.1007/s10499-014-9750-1

Handeland, SO, Imsland, AK, Ebbesson, LOE, Nilsen, TO, Hosfeld, CD, Teien, HC and Stefansson, SO, 2014. Osmoregulation and growth in offspring of wild Atlantic salmon at different temperatures. *Env. Biol. Fishes*, 97, 285-296. doi: 10.1007/s10641-013-0151-5

2013

Nilsen, TO, LOE Ebbesson, SO Handeland, F Kroglund, B Finstad, AR Angotzi, SO Stefansson, 2013. Atlantic salmon (*Salmo salar* L.) smolts require more than two weeks to recover from acidic water and aluminum exposure. *Aquatic Toxicol*., 142, 33-44. doi.org/10.1016/j.aquatox.2013.07.016

Imsland, A. K., Handeland, S. O., Björnsson, B. Th. and Stefansson, S. O., 2013. Long-term effects of photoperiod and temperature and their interaction on growth, gill Na^+,K^+-ATPase activity, seawater tolerance and plasma growth hormone levels in Atlantic salmon. *J. Fish Biol*., 83, 1197-1209

Grassie, C., V.A. Braithwaite, J. Nilsson, T.O. Nilsen, H-C. Teien, S.O. Handeland, S.O. Stefansson, V. Tronci, M. Gorissen, G. Flik & L.O.E. Ebbesson, 2013. Aluminum exposure impacts brain plasticity and behavior in Atlantic salmon (*Salmo salar*). *J. Exp. Biol*., 216, 3148-3155, doi:10.1242/jeb.083550

Angotzi, A. R., Stefansson, S., Nilsen, T. O., Rathore, R. M. and Rønnestad, I. 2013. Molecular cloning and genomic characterization of novel Leptin-like genes in salmonids provide new insight into the evolution of the Leptin gene family. *Gen. Comp. Endocrinol.*, 187, 48-59, doi: 10.1016/j.ygcen.2013.03.022

Handeland, S. O., Imsland, A. K., Ebbesson, L. O. E., Nilsen, T. O., Hosfeld, C. D., Teien, H. C. and Stefansson, S. O., 2013. Osmoregulation and growth in offspring of wild Atlantic salmon at different temperatures. *Environmental Biology of Fishes*, 97, 285-296.

Handeland, S. O., Imsland, A. K., Ebbesson, L. O. E., Nilsen, T. O., Hosfeld, C. D., Baeverfjord, G., Espmark, Å., Rosten, T., Skilbrei, O. T., Hansen, T., Gunnarsson, G. S., Breck, O. and Stefansson, S. O., 2013. Low light intensity can reduce Atlantic salmon smolt quality. *Aquaculture*, 384-387, 19-24. doi: org/10.1016/j.aquaculture.2012.12.016

Handeland, S. O., Imsland, A. K, Björnsson, B. Th., Stefansson, S. O. and Porter, M. 2013. Physiology during smoltification in Atlantic salmon: effect of melatonin implants. *Fish Physiol. Biochem.*, 39, 1079-1088. doi: 10.1007/s10695-012-9765-3

Urke, H.A., Kristensen, T., Arnekleiv, J.V., Haugen, T.O., Kjærstad, G., Stefansson, S.O., Ebbesson, L.O.E. and Nilsen, T.O., 2013. Seawater tolerance and post-smolt migration of wild Atlantic salmon *Salmo salar* × brown trout *S. trutta* hybrid smolts, *J. Fish Biol*., 82, 206–227, doi:10.1111/j.1095-8649.2012.03481.x

2012

Koedijk, R., Imsland, A. K., Folkvord, A., Stefansson, S. O., Jonassen, T. M. and Foss, A., 2012. Larval rearing environment influences the physiological adaptation in juvenile Atlantic cod, *Gadus morhua. Aquaculture International*, 20, 467-479. doi 10.1007/s10499-011-9478-0

Urke, H.A., Kristensen, T., Arnekleiv, J.V., Haugen, T.O., Kjærstad, G., Stefansson, S.O., Ebbesson, L.O.E. and Nilsen, T.O., 2012. Expression of gill ion transporters, sea water tolerance and post smolt migration of wild Atlantic salmon, *Salmo salar* L, x brown trout, *Salmo trutta* L, hybrid smolts, *J. Fish Biol*., 00, 000-000 (accepted with minor revisions)

Sandbakken, M., Helvik, J. V., Ebbesson, L. and Stefansson, S., 2011. Isolation and characterization of melanopsin photoreceptors of Atlantic salmon (*Salmo salar). J. Comp. Neurology*, 520, 3727-3744

Kroglund, K., Finstad, B., Pettersen, K., Teien, H.C., Salbu, B., Rosseland, B.O., Nilsen, T.O., Stefansson, S.O., Ebbesson, L.O.E., Nilsen, R., Bjørn, P.A., Kristensen, T., 2012. Recovery rates in Atlantic salmon smolts following aluminum exposure defined by changes in blood physiology and salmon lice resistance. *Aquaculture*, 362, 232-240. doi:10.1016/j.aquaculture.2011.04.041

Finstad, B., Kroglund, K., Bjørn, P.A., Pettersen, K., Rosseland, B.O., Teien, H.C., Nilsen, T.O., Stefansson, S.O., Salbu, B., Nilsen, R., Fiske, P., Ebbesson, L.O.E., 2012. Salmon lice induced mortality of Atlantic salmon postsmolts experiencing episodic acidification and recovery in freshwater. *Aquaculture*, 362, 193-199. doi:10.1016/j.aquaculture.2010.10.037

Stefansson, S.O., Haugland, M., Björnsson, B.Th., McCormick, S.D., Holm, M., Ebbesson, L.O.E., Holst, J.C., Nilsen, T.O., 2012. Growth, osmoregulation and endocrine changes in wild Atlantic salmon post-smolts during marine migration. *Aquaculture*, 362, 127-136. doi:10.1016/j.aquaculture.2011.07.002

Kling, P., Jönsson, E., Nilsen, T. O., Einarsdottir, I. E., Rønnestad, I., Stefansson, S. O. and Björnsson, B. Th., 2012. The role of growth hormone in growth, lipid homeostasis, energy utilization and partitioning in rainbow trout: interactions with leptin, ghrelin and insulin-like growth factor I. *Gen. Comp. Endocrinol*., 175, 153-162 (doi.org/10.1016/j.ygcen.2011.10.014).