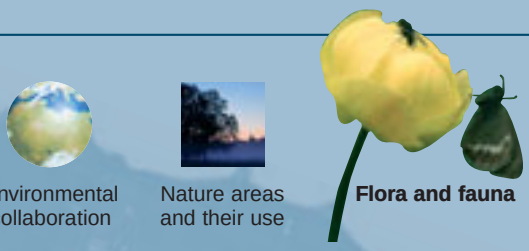
Directorate for **Nature Management**

Utredning 2005-1

Introduced Marine Organisms:

Workshop on Risks and Management Measures

Trondheim, Norway 10-11 may 2004



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Trondheim, Norway 10-11 may 2004

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Summary and conclusions

On 10-11 May 2004, a 'Workshop on Introduced Marine Organisms: Risks and Management Measures' was held in Trondheim (Norway), as a means to enhance a wider cross-sectoral understanding, dialogue and collaboration for combatting marine introduced (*i.e.* alien) organisms and their associated detrimental ecological and socioeconomic effects. The workshop's specific aims were, considering Norwegian perspectives, to examine and draw attention to: a) the threats from marine introduced (*i.e.* alien) organisms at the global, regional, and national scales, including the activities and vectors that introduce and transfer them; b) the ecological and socioeconomic impacts of alien organisms (*e.g.* parasites and diseases, harmful algal blooms, competitors, genetically modified organisms): past and present status, and possible future developments; c) the international agreements and legislation, especially those affecting Norway, which address the introductions of alien organisms; d) the risks, and monitoring, control and management measures applicable to combating the spread of alien organisms, including the strengths and weaknesses of these; and recommendations regarding more effective measures (*e.g.* in the areas of research, management and regulation) to counteract the detrimental effects of alien organisms.

The report describes the background and concept for the workshop, includes seven keynote presentations, and the outcomes arising from working group sessions regarding identifying 1) the main concerns regarding risks and impacts; 2) proposals for future national actions concerning research, management/regulation and information dissemination; 3) bottlenecks: important impediments against effective measures; 4) proposals for improving cross sector collaboration to reduce threats and impacts; and 5) proposals for establishment of particular types of international collaborative projects.

Sammendrag og konklusjoner:

"Workshop om marine fremmede organismer, risiko og tiltak" ble arrangert i Trondheim 10.-11. mai 2004, med formål å utvikle bredere dialog, forståelse og samarbeid for å motvirke uheldige økologiske og sosioøkonomiske virkninger fra introduksjoner av marine organismer. Workshopen fokuserte spesielt på a) truslene fra marine introduserte organismer i global, regional og nasjonal målestokk, og også de aktiviteter og vektorer som introduserer dem, b) de økologiske og sosioøkonomiske effekter (f eks parasitter og sykdommer, skadelige alger, konkurranse om leveområder), status og mulig utvikling, c) internasjonale avtaler og lovverk – særlig de som angår norske forhold - som gjelder introduserte organismer, d) risiko, overvåking, kontroll og virkemidler for å regulere introduserte organismer - inkludert styrker og svakheter av disse – og forslag til tiltak for å motvirke skadelige effekter.

De antatt alvorligste trusler ble identifisert. Noen forslag til nasjonale tiltak gikk på å utarbeide et system for kartlegging, overvåking og konsekvensvurdering av marine introduserte arter, samt å danne fagnettverk og utarbeide en tverrsektoriell nasjonal strategi på området. Noen identifiserte flaskehalsene var ansvarspulverisering, kunnskapsmangel, samt treghet når det gjelder å iverksette tiltak. Blant forslagene til tverrsektorielt samarbeid var å etablere en nasjonal ressursgruppe, samt etablere et stakeholder-forum med periodiske møter. Av internasjonale tiltak ble det bl a foreslått internasjonale samarbeidsprosjekter, felles-finansiering av forskning med lang tidshorisont, samt et integrert nettverk mellom Norge og tilliggende land for raskt å avdekke og reagere på marine introduksjoner.

Forord

10. og 11. mai 2004 arrangerte DN, i samarbeid med FHL Havbruk, Norges Rederiforbund og Statoil, og med bidrag fra Havforskningsinstituttet, Mattilsynet, Norsk institutt for naturforskning og Sjøfartsdirektoratet en workshop om introduserte marine organismer. Målet med workshopen var å utvikle bredere dialog, forståelse og samarbeid for å motvirke uheldige økologiske og sosioøkonomiske virkninger fra introduksjoner av marine organismer. Denne utredningen inneholder foredragene fra workshopen, samt oppsummering av gruppearbeid og konklusjoner fra disse.

Femti personer fra forskning, forvaltning og interesseorganisasjoner deltok. Statoil ved Arne Myhrvold var vertskap for arrangementet. Anne E. Langaas var ansvarlig på vegne av DN.

DN vil rette en takk til Statoil for imøtekommenhet og profesjonell bistand med planlegging og praktisk gjennomføring, til Norges Rederiforbund for å ha sponset workshopen økonomisk, og til FHL Havbruk for samarbeid om planleggingen. Takk til foredragsholdere og sesjonsledere for å ha bidratt til å belyse de ulike tema på en grundig måte. Vi retter spesielt en takk til. Chris Hopkins/AquaMarine Advisers®, for planlegging, utarbeiding av faglig grunnlag og rapport, samt oversettelse av materiale fra norsk til engelsk. Til sist takk til alle som møtte fram og bidro til interessante diskusjoner, og til gruppearbeid med konklusjoner som kan danne basis for videre arbeid.

Preamble

On 10-11 May 2004, a workshop on introduced marine organisms was arranged by the Directorate of Nature Management in collaboration with the Norwegian Seafood Federation (FHL) - Aquaculture, the Norwegian Shipowners' Association and Statoil, and with contributions from the Institute of Marine Research, the Norwegian Institute for Nature Research, the Norwegian Maritime Directorate and the Norwegian Food Safety Authority. The aim of the workshop was to enhance a wider cross-sectoral dialogue and collaboration to counteract the threats from marine introduced organisms and their associated detrimental effects. This report contains the lectures, and summaries and conclusions from the group works.

Fifty stakeholders participated. Statoil by Arne Myhrvold hosted the workshop. Anne E. Langaas was responsible on behalf of the Directorate for Nature Management.

The Directorate for Nature Management would like to thank Statoil by for kind and professional support with planning and carrying out the workshop, the Norwegian Shipowners' Association for economic support, Norwegian Seafood Federation – Aquaculture for their valuable cooperation. We also thank the lecturers and the session chairs for contributing to throw light on the subjects in a thorough way. A special thank to Chris Hopkins/AquaMarine Advisers®, for planning, preparing the special basis and the report, and translating material from Norwegian to English. And at last, thanks to all who showed up, and who contributed to interesting discussions and to group work that lead to conclusions which will serve as a basis for further work.

Trondheim, mars 2005

Yngve Svarte
Direktør Artsforvaltningsavdelingen

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1 Introduction

1.1 The introduced organisms issue

The introduction and transfers of alien species (also called non-indigenous, exotic, invasive etc., see Annex 1 for terminology)—irrespective of whether the causes of such movements are intentional or accidental—can have far-reaching and often harmful impacts on the recipient aquatic and terrestrial ecosystems. Alien species *inter alia* act as vectors for new diseases, alter ecosystem processes, reduce biodiversity, and cause socioeconomic consequences for humans (Williamson 1996; Weidema 2000; Mack *et al*. 2000; Mooney *et al*. 2000; Perrings *et al*. 2000; Leppäkoski *et al*. 2002). Accordingly, the issue of alien species is one of the critical and growing environmental concerns affecting the conservation of biodiversity, including impacts on ecosystems, habitats and their associated species (CBD 1992; WWF/IUCN 1998; Sandlund *et al*. 1999; McNeely *et al*. 2001; Anon. 2003, 2004). Global trade and commerce, as well as the human agricultural and industrial enterprises, drive the process of biological invasions (Williamson 1996; Lovel 1997; Weidema 2000). The many vectors that facilitate the introductions and spreading of alien species include transport via shipping-related ballast water discharge and hull fouling, horticulture, the aquarium trade, tourism and recreational activities, and removal of natural barriers (*e.g.* construction of man-made canals) (Gollasch & Leppäkoski 1999; Hopkins 2001; Gollasch 2002). Once introduced to an area, natural transfer processes (*e.g.* dispersion by water currents and wind) may supplement the further spread of alien species. Accordingly, a series of important international agreements and instruments have played a critical role in fostering the requirement to prevent, reduce, monitor and control the introduction and transfers of alien organisms.

Recently greater focus has occurred on the alien marine[1] species that have become established in Norwegian waters, where several species have caused major ecological and socioeconomic impacts (Hopkins 2000, 2001, 2002). Norwegian living marine resources are an important and highly valuable component of biodiversity be they managed for harvesting (*e.g.* aquaculture where wild species have become farmed either intensively or extensively, and fisheries resources are harvested from wild communities) or for nature conservation and protection purposes (*e.g.* protection of vulnerable species and habitats). For example, Norway is amongst the world's largest exporters of seafood in terms of economic value, and has the planet's principal resource of wild Atlantic salmon. Thus, the introduction of alien organisms forms a very serious threat to the ecological and socioeconomic basis for this production. Norway has the world's third largest maritime fleet in terms of tonnage, with substantial traffic occurring not only internationally but also along the 57 thousand kilometres of the Norwegian coastline. Additional oil and gas related maritime activities on its continental shelf are connected with the country's major position as an exporter of these commodities. Thus, the potential ecological and socioeconomic interactions between maritime operations and marine biodiversity in Norway are significant, particularly regarding the introductions and transfers of marine organisms. Accordingly, there is both a need and a responsibility for Norway to proactively respond with knowledge and adaptive measures that address the threats and impacts from alien species to ecosystems and their associated biodiversity.

1.2 The aims of the workshop

In support of the above-mentioned national needs, the Norwegian Directorate of Nature Management (DN) arranged a '**Workshop on Introduced Marine Organisms: Risks and Management Measures**' from 10-11 May 2004 by DN at Statoil's Research Centre, Rotvold, Trondheim (Norway), in collaboration with Statoil, the Norwegian Seafood Federation (FHL) - Aquaculture, the Institute of Marine Research, the Norwegian Maritime Directorate, and the Norwegian Shipowners' Association. The workshop was held to enhance a wider multisectoral understanding, dialogue and collaboration for combatting introduced organisms and their associated detrimental ecological and socioeconomic effects. The specific aims were, considering Norwegian perspectives, to examine and draw attention to: a) the threats from alien organisms at the global, regional, and national scales, including the activities and vectors that introduce and transfer them; b) the ecological and socioeconomic impacts of alien organisms (*e.g.* parasites and diseases, harmful algal blooms, competitors, genetically modified organisms): past and present status, and possible future developments; c) the

[1] **"Marine species"** is any aquatic species that does not spend its entire life cycle in fresh water (ICES 2003).

international agreements and legislation, especially those affecting Norway, which address the introductions of alien organisms; d) the risks, and monitoring, control and management measures applicable to combating the spread of alien organisms, including the strengths and weaknesses of these; and e) making recommendations regarding more effective measures (*e.g.* in the areas of research, management and regulation) to counteract the detrimental effects of alien organisms.

The Workshop was intended for persons and organizations involved in science, education, management and regulation connected with living resources, nature and the environment, and shipping. The participants are listed in Table 1.

2 Opening of the Workshop and welcome addresses

Janne Sollie (Director of the Directorate of Nature Management, DN) welcomed the participants who represented a very substantial number of the important actors with major interests and responsibilities regarding the issue of introduced marine organisms. The workshop was the result of cooperation between DN, the Norwegian Seafood Federation (FHL) - Aquaculture, the Institute of Marine Research, the Norwegian Shipowners' Association, the Norwegian Maritime Directorate and Statoil. It was especially positive that the involved industries and environmental interests had come together to face the challenges posed by introduced marine organisms.

She emphasized that the aim of the workshop is to develop a dialogue among the interested parties to prevent the undesired ecological and socioeconomic effects of marine introductions. Already in 1982 the UN Convention on the Law of the Sea (UNCLOS 1982) referred to the issue of introduced marine species. The 1992 Rio Conference (UNCED 1992) identified introduced species as one of the most serious threats to biodiversity. Since then, an increasing awareness of the impacts of marine introductions has resulted in the issue being included in numerous international agreements and other instruments. On 12 February this year, the UN's International Maritime Organization (IMO) agreed on a global convention for the control and management of ships' ballast water and sediments (IMO 2004). Several of these international agreements will be considered in greater detail during the course of this workshop, as will the threats viewed in terms of ecological and socioeconomic perspectives. The keynote speakers will consider these perspectives in greater depth, but it is worth focusing on some general statistics concerning what introductions cost us. In 2002, the Norwegian newspaper *Aftenposten* reported that ballast water pollution from shipping incurs costs to various industries of more than NOK 100 billion annually, and represents one of the four greatest threats to the oceans and marine resources.

In Norway, the introduced red king crab has been seen, in certain quarters, as an increasingly important economic resource for some coastal fishers. In an interview in 2003, one fisher optimistically estimated earning about Norwegian kroner (NOK) 300 thousand from a few weeks' catches of this crab. However, the detrimental ecological and socioeconomic impacts of this introduction have not been adequately identified and elaborated as yet.

The combating and control of introduced species can be both highly contentious and lead to disputes, as illustrated by attempts to manage the salmon ectoparasite *Gyrodactylus salaris* that was inadvertently introduced to Norway in the beginning of the 1970s. Major rotenone treatment has taken place in several important salmon waterways in order to try to rid them of *Gyrodtactylus* (Johnsen *et al*. 1999). At the national level, the annual economic loss due to *Gyrodactylus* is estimated at about NOK 250 million. Four years ago, DN conducted a cost – benefit analysis of rotenone treatment in the Steinkjer watershed, which indicated that the direct costs of treatment were about NOK 5 million while the benefits for wild salmon were estimated at NOK 1.25 billion[2] (Mørkved & Krokan 2000). The cost of the national action plan to combat *Gyrodactylus* is estimated to cost NOK 350 million (Anon. 2000). Such an engagement manifests not only an environmental commitment but also illustrates the substantial economic importance of wild salmon for local human communities and recreation and tourism.

In 2002, the alien phytoplankter *Chatonella c.f. verruculosa* caused substantial impact on the fish farming industry in southern Norwegian (Sørlandet) waters. The vector of this introduction, whose original area of distribution is the seas around Japan, was probably from the discharge of ballast water from a single ship, which resulted in about NOK 50 – 100 million in socioeconomic damage. This example emphasizes the need to implement the *precautionary principle*, as once an organism of this type has been introduced there is very little one can do to eradicate it. Clearly, harmful phytoplankton introductions represent a major threat to farmed fish.

Another example can be drawn from the Great Lakes of North America, where introduction of the European Zebra mussel via shipping in the 1980s has resulted in several indigenous species being out-competed and replaced by this mussel,

[2] Calculations are based on the 15 most important salmon watercourses connected with Trondheimsfjorden, which is the second most important fjord for Atlantic salmon.

damage to fishing nets, blockage of pipes and other outlets (Khalanski 1997). Measures to eradicate this species have failed dismally. Up to about 2000, the cumulative costs of trying to eradicating the mussel, unblocking or replacing pipes, etc., have amounted to about USD 5 billion (ca. NOK 34 billion) (Khalanski 1997).

The general increasing trend in sea temperature in northern temperate and boreal regions is likely to facilitate the establishment of new introduced organisms in Norwegian waters that previously have not been able to flourish under Norwegian climatic conditions (Hopkins 2001, 2002). A possible scenario involves global warming involving substantially increased ships' traffic through the Northeast Passage, whereby more species from the North Pacific can be transferred on hulls and in ballast water to the Barents Sea. The snowcrab (*Chionoecetes opilio*), normally distributed in the northern Pacific and the northwest Atlantic, has been found since 1996 in Russian and Norwegian waters of the Barents Sea, probably transported by ballast water discharge.

The lessons to be learnt from marine introduced organisms can be extrapolated from international experiences and summarized as follows:

- Ecological, economic and sociological consequences of introductions are often unforeseen and may eventually be very substantial;
- The impacts of introductions may take many years before they become manifested.

In Norway, one has previously focused more on terrestrial introductions – not least because they are easier for us to notice on land. As a coastal nation, Norway has a long tradition of utilizing marine resources for a major proportion of its gross domestic product, and hopefully this will continue in the future. Accordingly, it is paramount that we take the threats to our biodiversity very seriously, before such resources are ruined.

It is important that we act to prevent or hinder the introduction and establishment of alien marine organisms, as once they become free in the wild it is almost impossible to eradicate them. It is not appropriate to wait until their impacts become clearly manifest – it is necessary to be precautionary in our actions. In terms of sustainability, we should be concerned, in accord with the precautionary approach as outlined in Principle 15 of the Rio Declaration '*where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation*'.

The two-day workshop aims to develop a dialogue, improved understanding, and collaboration with a view to combat the unfortunate ecological and socioeconomic impacts of introduced marine species. Our basic starting views are likely to be diverse. One is looking for answers to several open questions, such as:

- Have the problems related to ballast water been solved by the newly agreed IMO Ballast Water Convention? What are the main threats remaining?
- Is our management of national waters able to provide for the early detection of new introductions?
- What national and international measures will result in the greatest effects and what are the current bottlenecks limiting progress?
- Is Norwegian legislation appropriately developed to handle the challenges, and what are the current weaknesses?

Although several threats are recognized and many milestones have already been reached, there is still much to be achieved. There are great expectations that this workshop will result in several mutual benefits for all the involved parties.

Thanks are due to all those who have planned, prepared for and co-sponsored this workshop. Statoil have kindly provided the attractive venue and facilities for the arrangement as well as supplying coffee and lunch for the participants. We are grateful to Chris Hopkins, an internationally recognized capacity on introduced marine organisms, for having made a major input in the planning and preparation of the workshop.

Eli Aamot (Senior Vice-President for the Environment, Statoil) and Arne Myhrvold (Discipline Adviser Environmental Management and Environmental Risk, Statoil) welcomed the participants to Statoil's Research Centre at Rotvold. They emphasized Statoil's engagement in good environmental practice. Statoil recognized the potentially serious nature of ballast water mediated introductions of marine organisms, although there was no evidence that Statoil's activities had caused the introduction of harmful species. The company wished to obtain as much knowledge as possible on how to limit marine introductions. Statoil's harbour constructions at

Kårstø, Mongstad and Tjeldbergodden were the recipients of large amounts of ballast water.

When the Snøhvit field in the Barents Sea starts production, the management of ballast water will be one of the challenges, and work is already in progress to furnish appropriate solutions. Statoil is committed to following the resolutions arising from the UN's IMO, and will meet the requirements of the new IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments when it comes into force. Statoil is working to reduce the risks of marine introduced species: using appropriate technology, conducting monitoring, and applying relevant knowledge. Among others, a feasibility study is being conducted of technology that Statoil has developed. Furthermore, the company is scrutinizing, and supporting, the development of additional technology for ballast water treatment. Statoil is also developing a monitoring programme in order to detect possible alien marine species with a view to limiting their further spread and reduce the causes of the problem. Statoil's environmental policy includes the goal of causing 'no damage to the environment'. This goal includes conserving biological diversity, and accordingly hindering the introduction of alien species. Statoil's operations result in a substantial transport of crude oil from Norway by shipping. Thus, such activities also contribute to the discharge of ballast water in our coastal waters. Even in the absence of evidence that our operations have resulted in the introduction of any harmful species, we are applying the precautionary approach by supporting the development of technology for cleaning ballast water as well as for environmental impact assessments. Therefore, Statoil had actively supported the current initiative of holding a workshop to gather expertise regarding the issue of marine introduced organisms, in order to contribute to increasing competency and promoting measures towards combating introductions.

Chris Hopkins (Professor and Director, AquaMarine Advisers) presented the concept of the workshop, as illustrated below (Fig. 1).

3 Presentations

The seven keynote presentations, in Norwegian, delivered during sessions 1-3 are found on the DN website:
http://www.dirnat.no/

3.1 Session1: Introduced marine organisms – Problems and preventative measures

Session Chair: Chris Hopkins; Rapporteur: Eva Degré (Adviser, DN).

In opening the session on the problems and measures connected with alien organisms, Chris Hopkins quickly drew attention to several of the key international conventions, agreements, directives and codes of conduct/guidelines concerning preventing the effects of introductions of alien organisms (Table 5).

3.1.1 Marine Introductions – What really is the problem?

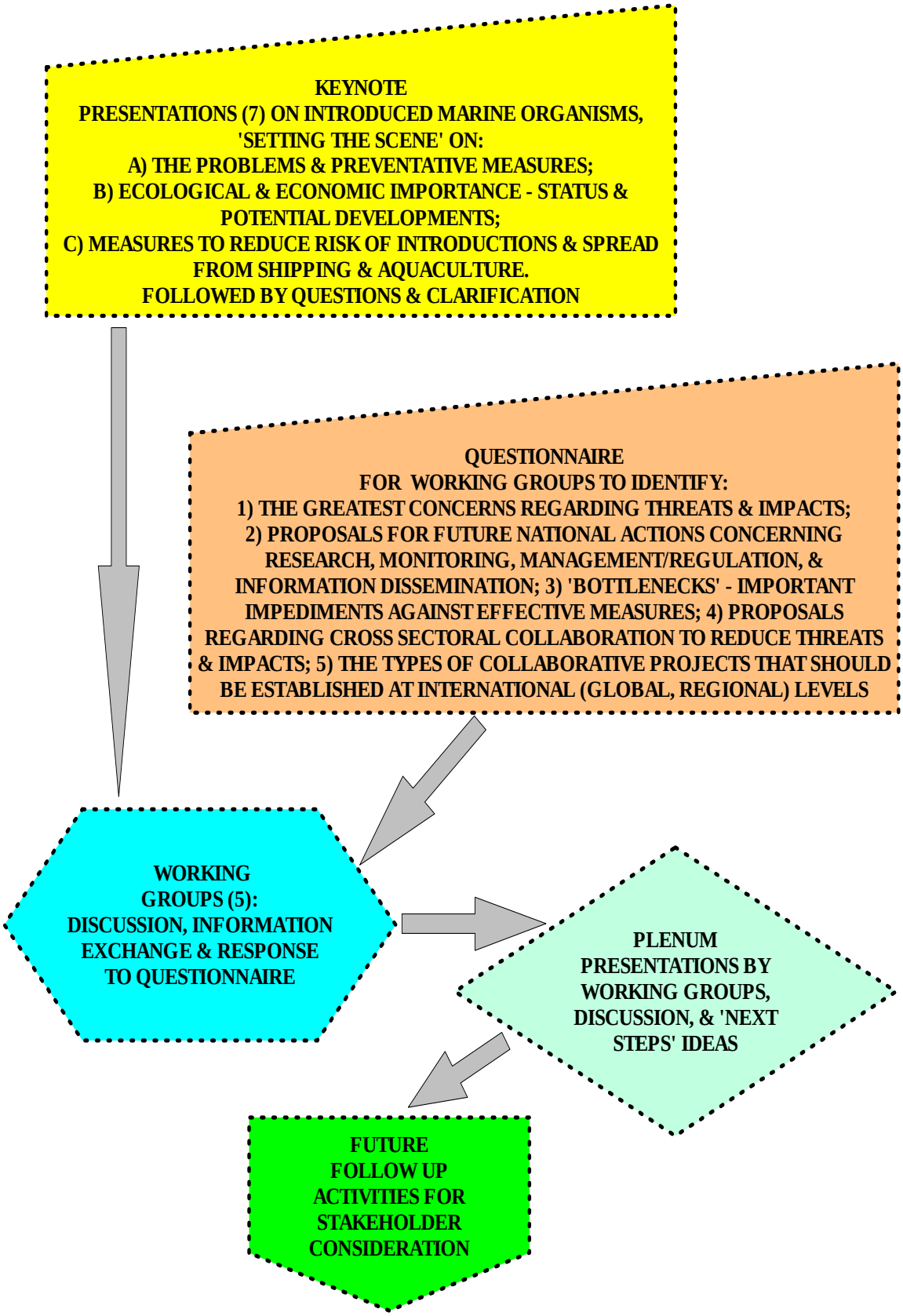
Ingrid Bysveen Mjølnerød (Adviser, DN).

The introduction of alien organisms is one of the greatest threats to biodiversity.

Introduced species threaten biodiversity by changing whole ecosystems, displacing species completely or partly, bringing new pathogens and diseases, and forming hybrids between genetically differently adapted populations of plants and animals – that may in turn even change the genetic composition of the original population or stock.

It is difficult to predict the effects of introductions, and a marine species that has established itself is essentially impossible to eradicate from the ecosystem. Most introductions are unintended, and accordingly are more difficult to regulate than other environmental impacts. Environmentally impacted or stressed environments are the most liable to be invaded by introductions. Climate warming is a stress factor that has the potential to facilitate substantially more marine introductions along the Norwegian coast.

Fig. 1. Illustration of the concept for the workshop.



Vectors

The main vectors for introductions of marine organisms include shipping through ballast water discharge and hull fouling, and aquaculture through intended and unintended introductions that can include secondary 'stowaway' organisms introduced with the primary introduction. Topical examples of relatively recent introductions into Norway include the red king crab (*Paralithodes camtshaticus*) and the American lobster (*Homarus americanus*).

The single most important vector of marine introductions is shipping, which accounts for more than 80% of all global goods transport and which annually transfers about four billion tonnes of ballast water to new recipient sea areas. It is estimated that about 4 500 species are at any moment traveling around the world in ships' ballast tanks. To illustrate the volumes that one is dealing with one can note that one supertanker contains enough ballast water to fill about 2 000 Olympic sized swimming pools. The transfer of species via ballast water has increased during the last decades primarily as a result of the marked increase in international ships traffic coupled with faster vessels that contribute to a greater chance that organisms can survive longer shipping routes. Another possible reason may be that harbours are getting less polluted and organisms are better able to survive there and be loaded with taking in of ballast water. It is also notable that the phasing out of single hulled vessels with replacement by doubled hulled vessels has contributed to ballast water crossing the equator not being heated up as much as before, such that temperate species have a greater chance of surviving the journey. In Norway, the Sture shipping terminal in Hordaland annually receives about 18 million tonnes of ballast water and so is one of Europe's main recipients for ballast water.

Examples of major problem species that have been introduced in marine systems

A small ctenophore called 'Leidy's comb jelly' (*Mnemiopsis leidyi*), indigenous to the eastern coast of the USA, was introduced to the Black Sea in ballast water about 1982. Its introduction caused the collapse of the Black Sea ecosystem, resulting inter alia in an annual loss of about USD 30 million to the region's fisheries, two million persons lost their jobs and the accumulated economic loss due to this species in the region amounts to over USD 400 million. In 1993, the estimated biomass of this species in the Black Sea was 900 million tonnes: equivalent to about 10 times the world's annual fish harvest that year.

The zebra mussel (*Dreissena polymorpha*), a Ponto-Caspian species, was introduced to the Great Lakes of North America where it has caused massive ecological and economic damage. In this invaded area it taken over the niche of many filter feeders, blocked up water intakes on boats and machinery, and fouled piers and port installations. The costs of trying to remove and control this mussel, and repair the damage caused in North America amounts to about USD five billion annually.

Marine introductions have also resulted in direct harm to humans. It is believed that cholera transported in ballast water from South Asia to Peru in 1991 was the cause of the greatest cholera epidemic for several hundred years in South America in which several million people were infected and resulted in about 10 000 mortalities.

Norway, so far, has been spared the worst effects of introductions, but one has no means of knowing what lies in wait around the corner. In Norwegian waters, about 46 alien species have become established. The best known are the red king crab and American lobster, but noxious algae probably form the greatest threats in addition to parasites and diseases, which in the case of furunculosis and *Gyrodactylus salaris* caused costs of more than NOK two billion over a 15-year period. The so-called japweed (*Sargassum muticum*) arrived in parts of the North Sea area in the 1970s, as a stowaway connected with human induced movements of Pacific oysters, and drifts to new localities with water currents. The japweed has spread along the Norwegian coast and has ousted other bottom living algae, fouled shorelines and harbours as well as caused problems for the aquaculture industry. The snowcrab (*Chionoecetes opilio*) is the latest registered marine introduction in Norwegian waters, but is originally from the northern Pacific and northeastern Atlantic, but was first registered in the Norwegian sector of the Barents Sea in 2003. The Chinese mitten crab (*Eriocheir sinensis*) is has apparently not yet established a self-sustaining stock in the Oslofjord – Østfold since its first registration in 1976. This crab originates from southeast Asia but has spread into several parts of Europe, such as Germany, where it has caused serious economic and ecological damage. A near relative of this crab, which also comes from Asia, is causing substantial damage in the littoral zone in France and Spain where it

produces problems for aquaculture. Several major blooms of harmful phytoplankton are connected with ballast water discharges: for example, *Chatonella*—originally from Japan—was first noted in southern Norwegian waters in 1998 when it killed 350 tonnes of farmed salmon, and has since then caused repeated damage.

Some topical examples of international agreements concerning alien organisms

Many international Conventions and agreements are aimed at combatting aquatic alien organisms. These include the Bern Convention on the Conservation of European Wildlife and Natural Habitat (Bern 1979), the Bonn Convention for the Conservation of Migratory Species of Wild Animals (Bonn 1979), the UN Convention on the Law of the Sea (UNCLOS 1982), the Convention on Biological Diversity (CBD 1992), the Rio Declaration of the UN Conference on Environment and Development (UNCED 1992), the FAO Conduct for Responsible Fisheries (FAO 1995), outcomes from the International Conferences on the Protection of the North Sea (IMM97, NSC 2002), and IMO's International Convention for the Control & Management of Ship's Ballast Water and Sediments (IMO 2004).

IMO has worked since the early 1990s with the development of a dedicated ballast water Convention aimed at regulating the discharge of ballast water and associated sediments from ships. The Convention was adopted in February 2004, but many practical issues remain to be solved before it comes into force. The challenges include: the cleaning technology is currently insufficiently developed; ballast water exchange under passage can take several days to conduct and may place crew and passengers at risk; agreed areas for allowing ballast water exchange to take place need to be better determined; differing opinions as to who—such as the ship-owners, the flag State, the harbour authorities—pays the costs for cleaning the ballast water; exactly how one controls that the ballast water is 'clean' and the correct criteria to apply to new cleaning methodology/measures. About 40 States connected with IMO are working to come to agreement on these matters.

National regulations regarding alien organisms

Legally binding national directives for regulating the introduction of marine organisms are generally weak. As a result of the European Economic Area Agreement, Norway cannot deny a person from other States in the Agreement from initiating aquaculture activities in this country with their own stock as long as the stock is certified as being free from disease. However, currently Norway is developing a national directive for handling ballast water as an appropriate step in implementing the new IMO ballast water Convention.

Unfortunately, we currently have little information concerning the distribution of marine species in our coastal waters. Most of our detailed information is based on the areas surveyed by universities and other marine institutes with their marine stations, but this leaves most of the coastal areas sparsely surveyed regarding scientific surveys and monitoring of biodiversity.

Wishes for the future regarding the management of introduced marine organisms

The issue of introduced organisms must be raised to a higher level on the political agenda, including providing greater resources for mapping introduced organisms. More funding is needed for monitoring the marine environment and its biodiversity in general and specifically the effects of introduced organisms. There is a pressing need for good international and national regulations for ballast water management that will promote the development of new cleaning technology, and it is necessary to develop strong judicial measures that forbid the import and distribution of alien marine organisms. Norway, as a nation that to a great extent exists on marine organisms ought to place greater focus on the environmental threats posed by alien organisms, which can result in lasting damage to our coastal areas.

3.1.2 The Convention on Biological Diversity and Norway's responsibilities regarding alien species

Heidi Hansen (Adviser, DN).

The Convention on Biological Diversity (CBD) was adopted in Rio de Janeiro in 1992 (CBD 1992). So far 188 States have ratified the CBD, and the Parties to the CBD are obliged to regularly report on what actions they are carrying out respective to their CBD responsibilities. Norway as a State has ratified the CBD and so it is Norway as a State that must fulfill its CBD responsibilities. These responsibilities fall on all the sector Ministries. The Ministry of the Environment has the coordinating responsibility

in Norway. In 2000, the CBD Parties were obliged *inter alia* to provide reports giving an overview of how their national regulations are managing the problems regarding alien invasive species and how far work connected with implementing Article 8(h) of the Convention has progressed.

Article 8(h) of the CBD states that:

'Each Contracting Party shall, as far as possible and appropriate:

Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species'.

The above-mentioned reporting in the case of Norway indicated that specific areas were quite defective. This is a matter that we must work to improve, such that next time one can deliver a report that shows that we have progressed further with implementation.

The introduction and spreading of alien organisms is currently viewed as one of the major threats to biodiversity, especially in geographically and evolutionarily isolated ecosystems. The Convention is very clear regarding the Parties responsibilities regarding the problem, and in 2002 the Conference of the Parties in the Haag (Netherlands) adopted guidelines as to how the Parties should implement Article 8h: 'Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species' (CBD 2002). The Guidelines are divided into four pain parts: a) General; b) Prevention; c) Introduction of species; and d) Mitigation of impacts. The following provides a synopsis of the Guidelines. The full text of the Guidelines is found on the CBD website: http://www.biodiv.org/decisions/default.aspx?m=COP-06&id=7197&lg=0

General

There is great uncertainty in predicting how alien invasive species will be introduced and spread, and what impacts they will have on biodiversity. Thus, it is important that we apply the precautionary principle as the basis of our efforts to prevent both unintended and intended introductions. This is especially important with regard to risk analysis. The precautionary principle should be applied in assessing whether an alien species should be eradicated, contained or controlled. A lack of scientific certainty about the diverse effects of introduced species should not be used as an argument for delaying or avoiding actions such as eradication, containment or control (Guiding Principle 1).

The Guidelines have a three-stage hierarchical approach to the problem of alien species. Preventing the introduction of alien invasive species is the most cost effective action and it is preferred regarding environmental considerations. Efforts at preventing the introduction of potential invasive species should be prioritized. Thereafter, a possible invasive species should be eradicated as soon as it its presence is detected. If it is not possible to eradicate the species, it is important to contain its further spread as well as establishing long-term control measures (Guiding Principle 2).

Measures to deal with invasive alien species should be based on the ecosystem approach (Guiding Principle 3).

Regarding alien invasive species, States should be aware of the risks that national activities in their own region can cause for surrounding States. Thus the involved Parties should take individual and common responsibility to minimize the risks of spreading invasive species. The Parties ought, as far as possible, disseminated information on species that may be invasive (Guiding Principle 4). It is vital to have good knowledge about the problem, and monitoring is the key to early detection of new unwanted species (Guiding Principle 5).

Preventative measures

States should impose border controls and quarantine measures for alien species that are or may become invasive to ensure that intended introductions do not occur without the approval of the appropriate authorities, or for minimizing unintentional or unauthorized introductions (Guiding Principle 7).

Information exchange and dissemination is an important preventative measure, and States should contribute to the development of databases that provide information about invasive introduced species in order to limit their introduction and spreading. Databases should provide information on alien species concerning monitoring, mitigation and control activities, potential threats to neighbouring countries, taxonomy, ecology and genetics (Guiding Principle 8). Depending on the situation, a State's responsibility may be either completely internal or it may necessitate collaboration with other States. Bilateral and multilateral agreements, focusing especially on

the detrimental effects of introductions, may be established for regulating trade of particularly problematical alien species (Guiding Principle 9).

Introductions of species

It is important that a species that is or may become invasive in a State cannot be intentionally introduced without the consent of the appropriate authority. A risk analysis, that may include an impact assessment, should form the basis for such consent in the case of a first time introduction or to a new ecological region in a country. The burden of proof should include the requirement to demonstrate, by the proposer of the introduction, that the species is unlikely to threaten biodiversity. Such an introduction should be based on the precautionary approach, and lack of sufficient scientific certainty and knowledge regarding an alien species should not be used as a reason for approving an introduction (Guiding Principle 10).

All States should have in place provisions to deal with unintentional introductions or unintentional introductions that have become established and invasive. Common pathways for such introductions need to be identified and provisions put in place to minimize these introductions. Activities in the sectors of fisheries, agriculture, forestry, horticulture, shipping (including the discharge of ballast waters), ground and air transportation, construction projects, landscaping, aquaculture including ornamental aquaculture, tourism, the pet industry and game-farming, are often pathways for unintentional introductions. Environmental impact assessments for these activities should include the risk of unintentional introductions of invasive species (Guiding Principle 11).

Mitigation of impacts

As soon as one has detected the establishment of an alien species, States should take steps to eradicate, contain, control, and mitigate adverse effects. Techniques used for eradication, containment and control invasive species should be safe for humans, the environment and agriculture, and they should be ethically acceptable to stakeholders in these areas. In accord with national policy and legislation, an individual or entity responsible for the introduction—when they have failed to comply with the national laws and regulations—should cover the costs of control measures and biological diversity restoration (Guiding Principle 12).

If feasible, eradication is the best way of dealing with the establishment of invasive alien species. The best opportunity for eradicating invasive alien species is in the early stages of invasion, when populations are small and localized. Thus, it is critical that cooperative early detection and monitoring systems are in place (Guiding Principle 13).

When eradication is not appropriate, containment of invasive alien species may be the appropriate strategy where this is feasible (Guideline 14).

What should Norway do to fulfill its responsibilities connected with Article 8(h)

In 1997, a Norwegian Parliamentary Report was published entitled 'Environmental protection policy for a sustainable development' ('Miljøvernpolitikk for en bærekraftig utvikling') (Anon. 1997). The report provides an account of the Norwegian follow up of the CBD, and describes the main ecological challenges. In this connection, the spread of alien organisms is raised as one of the themes. In 2001, a Norwegian Parliamentary Report was published entitled 'Biological diversity – sector responsibility and coordination (Biologisk mangfold – sektoransvar og samordning) (Anon. 2001), which is the result of collaboration between 16 Ministries and their subsidiary agencies aimed at following up the CBD. This latter report is a political tool for Norway's follow up of the CBD, contains measures that will be carried out in the period 2001-2005, and *inter alia* states in section 2.2.4 that one of the key challenges is to '*avoid unfortunate spreading of alien species*'. Almost all Ministries have drawn up sector-related environmental action plans that describe the various sectors' challenges concerning biological diversity.

In the environmental action plan of the Ministry of the Environment the following points are highlighted as important measures regarding introduced species:

- Review and coordination of regulations on this issue. Development of appropriate jurisdiction concerning introductions. Establishment of judicial panels for biological diversity and increased sectoral awareness of existing regulations;
- Better control of both intentional and unintentional introductions;
- Better state of readiness regarding eradication of damaging introductions;

- Measures for increased knowledge, knowledge sharing and collaboration between different sectors.

Several laws and directives under different sectors regulate introductions and the importing of plants, animals and microorganisms in Norway. An important challenge is to review the current regulations concerning the introduction and spread of species, in order to plug holes and carry out improvements if necessary. The 'Biodiversity Panel' (BLUT) was established, and is now concluding its work by making proposals for a new 'nature diversity law'. The introduction and spread of alien species has formed an important part of this panel's work.

The environmental protection authorities do not have the right of authorization (*i.e.* sanction) in the regulations concerning intended introductions. The regulations concerning intended introductions are under the authorization of such sectors as agriculture and fisheries. The discharge of alien organisms in ballast water is interpreted as an unintentional introduction, and can be managed under Chapter 11 of the 'Law on State Control of Ships' Seaworthiness, etc.' (Norwegian: 'Lov om Statskontrol med Skibes Sjødygtighed m.v.'). This Chapter of the seaworthiness law is delegated to the Ministry of the Environment, which in this connection is supported by the Maritime Directorate.

3.1.3 Plenum comments and discussions

Regarding the presentation by Ingrid Bysveen Mjølnerød, comments and discussion occurred about:

- whether the cholera epidemic referred to in South America had been due to the discharge of ballast water or to human faeces flushed from the ship's sewage system. The difficulty in unequivocally determining the specific source of alien introductions was recognized. However, it was noted that the discharges of alien pathogens and diseases from both these shipping-related sources obviously represent genuine threats;

- the benefits of more actively establishing geographically wide-reaching research collaboration on the issue of alien marine organisms, as introductions and transfers of marine organisms occur both within regions and between regions. There is currently a general lack of collaboration on this issue between Norwegian institutions and one's in such areas as Australia, and North America, compared with collaboration at the Nordic and European levels. In Australia and the USA, for example, a high level of focus and funding had been given to this issue, and there are some worthwhile lessons to be learnt by Norwegian research and policy institutions;

- the role of the Water Framework Directive (WFD, EC 2000) in monitoring and assessing alien marine organisms. It was pointed out that invasive species are identified as a potential pressure impacting water bodies in the WFD, and that it is the degree of damage that invasive species cause to native flora and fauna that is the focus of concern in assessments carried out for the Water Framework Directive. However, our current knowledge concerning the documented impacts of alien organisms and reference levels are scant. It was emphasized that the process of implementing the WFD is under development and clearly there are opportunities to apply further focus on marine alien organisms in the WFD;

- the relatively large number of international agreements and intergovernmental organizations, as well as national sector- or industry related governmental institutions, which ought to work more closely and comprehensively to combat the threats and risks arising from alien marine organisms. Although this cooperation is evidently developing, there is need for better and more transparent mechanisms for improving consultation, and clearly defining mandates and responsibilities, etc;

- the degree of motivation of maritime-related companies, such as Statoil for its new terminal for processing and shipping liquefied natural gas at Melkøya in Finnmark, to speedily bring into use cleaning technology as it becomes available. In responding, a representative of Statoil confirmed the company's dedication to carry out good environmental practice related to ballast water management.

Regarding the presentation by Heidi Hansen, comments and discussion occurred about:

- the right of authorization of the Ministry of the Environment concerning introduced

organisms, in which it was it was made clear regarding intended introductions that the Ministry of the Environment was only able to regulate the import of fish species according to the 'Law on Salmon and Inland Fish' ('Lov om Laksefisk og innlandsfisk m.v.'). Eels that will be set out in freshwater are the responsibility of the Ministry of the Environment, but eels in seawater are the responsibility of the Ministry of Fisheries and Coastal Affairs. It was emphasized by a representative of the Ministry of Fisheries and Coastal Affairs that it did not want aquaculture to be carried out using non-indigenous species. Reference was made to the Parliamentary Report on 'Biological diversity – sector responsibility and coordination ('Biologisk mangfold – sektoransvar og samordning') (Anon. 2001) concerning some of the measures that are applicable to introduced organisms;

- whether it is possible today to culture exotic (*i.e.* non-indigenous) species in non-isolated enclosures such as cages. It was explained that such an application for a license must be considered by the Ministry of Fisheries and Coastal Affairs and by the Food Safety Authority according to a complex set of regulations. In this connection, the evaluation had to consider the risks of the species escaping and establishing itself in nature as well as the possible spread of parasites and diseases. Thus, it is difficult to obtain permission for this type of enterprise. Import regulations for non-indigenous species must harmonize with the relevant regulations under the European Economic Area Agreement;

- unintended introductions via shipping, it was confirmed by the representative of the Maritime Directorate that the Ministry of the Environment was the authorizing agency under which the Directorate was accountable for this purpose;

- the need to ensure that the issue of alien species in regional environmental assessments and action plans receives an appropriately high level of scientific as well as political priority and attention. It was noted that the progress report of the 2002 Fifth Conference on the Protection of the North Sea (Nilsen *et al.* 2002) has observed that scant activity has occurred in the OSPAR Commission since 1998 on the issue of marine alien species, apparently due to the issues currently also being handled by ICES and IMO. Thus, it is important that the alien species issue does not fall 'between two chairs' regarding sectoral authority and engagement. Concerning the 'Integrated Management Plan for the Barents Sea' ('Helhetlig Forvaltningsplanen for Barentshavet') that is currently under development, it was noted that all the environmental impact assessments (EIAs) mention alien species. The shipping-related EIA is limited to the increasing risks and scenarios connected with alien species but it does not mention the actual threats. Marine management in general includes many actors, so the issue of alien species is not extraordinary in this respect. However, the alien species issue is complex and relatively new in marine management terms and so productive consultation and integration of viewpoints is important.

3.2 Session 2: Ecological and economic effects – Status and possible developments

Session Chair: Kjell Maroni (Research & Development Director, Norwegian Seafood Federation - Aquaculture); Rapporteur: Arne Bretten (Consultant, Environmental Protection, Office of the County Governor of South Trøndelag).

3.2.1 Introduced organisms and their effects on wild salmon

Kjetil Hindar (Senior Scientist, Norwegian Institute for Nature Research. Co-authored by Øystein Aas, Norwegian Institute for Nature Research)**.**

Background

Introduced organisms are among the greatest threats to biodiversity and resident biological resources. Several introduced organisms, in the form of cultivated plants and animal husbandry, are among our most important food producers. It is extremely difficult to predict the effect of such organisms. We can provide general biological knowledge about invasion potential and vulnerability from invasions, but we don't always understand why one species may become a pest while another related species doesn't establish itself. A general rule, originating from studies of plants in the United Kingdom, indicates that of all introduced species about 10% become established

and, of these, about 10% become invasive species. The difficulty in predicting the invasion potential of a species is seen from comparisons of closely related species, whereby one may become invasive while the other has hardly spread from its original arrival site. The biology of species introductions are not the only point of interest: the vulnerability of the environment or ecosystem to invasions is important in evaluating how easily new species may become invasive. Experience shows that isolated, and often species poor, environments are vulnerable and especially environments that have been modified by humans. Accordingly, fresh- and brackish waters are generally more vulnerable to introductions than offshore marine environments. As the focus of this presentation is on wild Atlantic salmon (*Salmo salar*), which migrates from freshwater to saltwater and back again during the life cycle, attention will be given to the effects of introduced species in all these environments. Consideration will not be given to the effects of escaped farmed salmon, although the effects are serious enough, as the species was already resident in the recipient environments in Norway.

Wild salmon as a resource

Wild salmon have been of importance for humans as long as Norway has been inhabited. Salmon are depicted in several thousand year-old rock paintings and engravings, and feature in our earliest laws, place names, local history as well as the economy of many small communities in the path of salmon migrations along the coast and rivers.

Salmon is the first wild species to figure in its own Norwegian Official Report (Norges offentlige utredninger, NOU 1999). This report emphasizes that the total salmon stock has been decreasing in Norway for several decades, and that this recession is due to a combination of several natural and human caused factors, of which introduced species were one. However, Norway is one of the countries in the natural distributional area of the species that continues to have a high proportion of viable salmon populations (WWF 2001).

Total socioeconomic value

The socioeconomic importance of salmon can be calculated in several ways. In economic analysis one frequently distinguishes between *use* value and *non-use* value. The use value of salmon is primarily connected with their direct economic value, which is the value of the fish as food and for fishing tourism and fishing recreation. Included in the use value are the indirect value, *i.e.* the ecosystem services provided by the species, and the option value, *e.g.* the value of the salmon's genetic variation. Among the non-use value is the existence value, which is the value we attach to knowing that the species occurs in nature, and the conservation value, which includes diverse values of the species for future human generations.

For salmon in Norway, the direct economic value is estimated at NOK one billion annually for the 50 most important rivers. This is primarily due to the value of fishing tourism and fishing recreation, which are of substantially greater value than the food value of the fish. Data from Scotland and Iceland suggest that the potential value—especially for sport fishing—is greater than that of current values. Sport fishing for salmon has had an economic value for many small communities in Norway for more than 150 years. English books from the early 1900s indicate that large sums were paid for fishing in the most popular rivers of the time: about GBP 100 – 400 per season, equivalent to about NOK 100 – 410 thousand in today's value, was not unusual.

The indirect value, the option value, and the values that are not connected with use, are more difficult to determine; even though they are not necessarily less important. For example, a study indicates that inhabitants along the Thames in England are willing to pay NOK 150 million per year in order to get salmon back in the river (*i.e.* existence value).

Who causes introductions and why?

The introduced aquatic organisms that have had the greatest importance for wild salmon have mainly been spread by aquaculture, the stocking of fish in nature, and research. Spread by shipping, which is documented as probably being the most important vector for introduced marine organisms, applies mainly to species that we know little about regarding their effects on salmon. In aquaculture, the spread of introduced species is partly intended (e.g. the farmed species) as well as unintended; the latter include pathogens, parasites and symbionts that are connected with the farmed species, as well as the escape into the wild of the farmed introduced species. Diverse fish enhancement operations can also lead to the spread of introduced aquatic organisms. The main cause is the direct release of the fish species, thereafter the building of fish ladders and other forms of habitat modification can also lead to the

spread of introduced organisms. Research has also resulted in the introduction of alien species.

Use of live bait in sport fishing can also lead to the spread of introduced alien species. Additionally, we should anticipate that the spread of alien aquatic species will occur via trade in aquarium organisms, fishing gear, live import and processing of food, and all types of transport of water.

The effects of introductions on wild salmon

The parasite *Gyrodactylus salaris*, which was probably introduced to Norway with fish or their eggs for aquaculture research in the 1970s, spread by the release of fish and natural dispersal and has reduced the salmon stock by an average of more than 85% in the approximately 40 rivers into which the parasite has spread. The loss of salmon catch in the rivers is calculated at about 45 tonnes per year and it would probably have risen to 60-90 tonnes per year in the absence of remedial measures. This represents about 15% of salmon production in Norway. In Lærdal, the rural district has been estimated to loose NOK 10-15 million per year due to the parasite. The value of the lost river fishing for the whole of Norway is estimated at about NOK 50 million, which would probably have been doubled without the application of remedial measures. Combatting measures for the parasite are substantial—rotenone treatment in the Steinkjer rivers alone has cost about NOK 4.5 million.

Furunculosis, a fish disease caused by the bacteria *Aeromonas s. salmonicida*, has been spread to Norway at least twice: first with rainbow trout to Østlandet in the 1960s and subsequently with salmon smolts from Scotland to the Norwegian aquaculture industry in the 1980s. In the first instance outbreaks occurred in Numedalslågen, and in the second instance the bacterial disease spread to many watercourses and epidemic conditions were registered in such areas as Aursunda in Nord-Trøndelag and Eidselva in Song and Fjordane. Furunculosis does not appear to have had a long-term ecological effect, although fish kills are periodically observed, for example, in Aursunda, The economic loss is mainly due to sports fishers avoiding watercourses where the disease occurs.

The geographic origin and probable pathways for the spread of *G. salaris* and *A. salmonicida* have been the focus of much discussion. The same applies also to a range of other (micro)parasites, bacteria and viruses. Recent molecular biological methods being applied in dispersal biology are likely to provide the answers to such questions.

The rainbow trout (*Oncorhynchus mykiss*), which originates from the west coast of North America, is an internationally important aquaculture species, including in Norway. The species has also been intentionally released in several localities. The rainbow trout does not appear to be able to establish itself in the wild in Norway, except in some 'unusual' localities such as in a few lakes in high mountains and in earth-ponds in which it is the sole fish species. One does not know for certain why rainbow trout have such a poorly developed invasive potential. Several hypotheses have been promoted, including that the species: 1) has been domesticated so long that its natural survival ability has declined, 2) is not adapted to our flood disturbance regimes, or also 3) is not adapted to parasites (myxozoans) that live naturally on Atlantic salmon and trout (*Salmo trutta*). An important question is how sure we can be that rainbow trout will not be invasive in the future, when we do not fully understand what factors limit it today?

Another species is the Pacific pink salmon (*O. gorbuscha*), which was released over many years in rivers of the Kola Peninsula. The species probably reproduces in the rivers that drain the White Sea. We do not know whether the species can spread to Norwegian water courses. A greater problem regarding the spread of fish species is probably the spread of small species of freshwater fish. For example, a species such as the minnow (*Phoxinus phoxinus*) has substantially increased its area of distribution since a 1918 baseline registration occurred. There are probably several reasons for their spread, but use of the species as live bait is believed to be the most important.

Future aquaculture and wild salmon: conflict or mutual fate?

It is possible that aquaculture will be a cause of future introductions, as it has been previously (Naylor *et al.* 2001). It is also possible that aquaculture can function as a 'watch-dog' for the effects of fish diseases and harmful/toxic algae on wild salmon, which would go unnoticed in the absence of such monitoring in aquaculture assemblages. The greatest conflicts will probably occur in connection with impacts that have little if any effects on the aquaculture industry but which have detrimental effects on wild salmonids.

New aquaculture species can be a source of unexpected impacts on wild salmon. However, as the Norwegian aquaculture industry has been against the import of new species in recent years, in accord with the interests of wild salmon, it is unlikely that new aquaculture species will result in the transfer of exotic species to Norwegian waters.

The major future threats will perhaps come from industries and species where we have believed we are safe without having conducted rigorous risk analyses, for example connected with trade and transport of organisms involving the aquarium industry.

Conclusions

Wild salmon continues to have a substantial socioeconomic value in Norway. Introduced species have played a significant part in eroding this value and are likely to carry on doing so in the future. Introduced parasites/pathogens from aquaculture and stocking have previously had the greatest detrimental effects. Ballast water discharge, which is a substantial source of spreading marine introduced organisms, is not known to have effects on wild salmon. The biology of invasions has large gaps in knowledge and is often experience-based. Thus, the major future threats are likely to originate from human activities that we do not expect to cause impacts, due to the absence of conducting thorough risk analyses.

Further reading

Bakke & Harris (1998); Fausch *et al.* (2001); Hindar *et al.* (1996); Hopkins (2000, 2001); Hutchinson (1997); Johnsen & Jensen (1991, 1994); Naylor *et al.* (2001); NOU (1999); Youngson *et al.* (1998); WWF (2001).

3.2.2 Aquaculture and introduced organisms: Industry opportunities and environmental threats

Tormod Venvik (Adviser, Norwegian Seafood Federation: Aquaculture).

With the exception of hunting, fishing and farming of salmon, just about all Norwegian food production has been based on introduced species. Most of the agricultural products that we eat have been brought here by human efforts. The historical record shows that the exchange of species and genetic material has formed a central part in human culture. What would France be like without the grape vine, Brazil without coffee, and Norway without the potato? Nature has permitted the spread of genetic material through migration, wind, and transport by ocean currents, etc.

Introduction and transfers of species and genes are a natural component of the balance of nature. However, it is not difficult to find examples of introductions of new species, intentionally or unintentionally carried out by humans, or resulting from coincidence and natural conditions, which have had major adverse consequences.

Aquaculture and introduced species

Aquaculture in Norway is quite a young industry with its commercial roots originating about 30 years ago, but which this year will generate about NOK 10-15 billion. This industry plays a substantial role in maintaining commercial activities and settlements along the coast. We remain convinced that the aquaculture industry has a further potential for development, both regarding the culture of traditional species and new species.

A precondition for development of the industry is that it is sustainable and in accord with nature's principles. In Norwegian aquaculture our relationship with introduced species depends on two viewpoints:

- 'Desirable' species that represent intended introductions viewed from commercial goals;
- 'Undesirable' species that have arrived unexpectedly or as a result of some unregulated activity.

Introduced commercial species

In Norway today we have three different species that have been introduced for commercial aquaculture production. These species are:

- Rainbow trout (*Oncorhyncus mykiss*);
- Pacific oyster (*Crassostrea gigas*);
- Manila clam (*Ruditapes philippinarum*).

Rainbow trout

The rainbow trout that today are used in Norwegian fish culture originate from so-called Californian 'Camloops'. Camloops are a type of freshwater trout that, like Norwegian trout, have a sea-going stock called steelhead. Rainbow trout were imported to Europe about 1875, and the first individuals arrived in Norway via Denmark about

1900. Later, additional genetic material was brought in from Sweden and probably from other countries.

Rainbow trout were kept solely in freshwater for many years. The first attempts to place these trout in seawater occurred in the early 1960s. This was successful despite the species having been kept in freshwater for several thousand generations. Currently, Norway produces about 50-70 thousand tonnes of rainbow trout annually that are worth up to about NOK 1.5 billion. The accumulated production of rainbow trout has reached about NOK 15 billion, emphasizing that the introduction of this species to Norway has resulted in a substantial economic benefit.

Rainbow trout have not been able to reproduce naturally in Norwegian rivers. The reasons for this are not fully clear. Thus, escaped rainbow trout have not contributed significantly to the displacement of natural trout and salmon stocks. Other adverse impacts have not been associated with rainbow trout in Norway.

Pacific oysters

Pacific oysters were introduced to Norway at the end of the 1970s with a view to their commercial culture. These oysters are biologically easier to produce and grow faster than the European flat oyster (*Ostrea edulis*). Accordingly, Pacific oysters are now the dominant species in European oyster culture, not least because the Pacific species is resistant to some parasites/diseases (*e.g. Bonamia*) that represent a major problem for European oysters both in nature and in culture. Bonamia has not been recorded in Norwegian waters, a feature that ought to result in good possibilities for the production here of flat oysters. There is currently a small cultured production of Pacific oysters in Norway, but it is uncertain as to whether this species can establish self-sustaining reproductive stocks here. However, in some other areas where the pacific oyster has been introduced, this species has caused major problems.

Manila clam

The Manila clam was first imported to Norway in 1987 for cultivation purposes. Some individuals that were set out survived for many years but there were no signs of successful reproduction in nature. Currently, there is no commercial cultivation of this species in Norway.

The introduced 'problem'

One can focus on the following, which in Norway may be considered—fully, partially or possibly—as introduced 'problems'. These are:

- Furunculosis;
- *Gyrodactylus salaris*;
- Algae;
- Jellyfish.

Furunculosis

Aeromonas salmonicida is a bacterium that causes furunculosis, a very infectious and deadly disease of salmon. This disease has occurred naturally in Norwegian rivers, for example in Numedalslågen, before salmon culture was started in Norway. So it is quite certain that a natural infective reservoir of these bacteria, of its normal type and its atypical variants, is found in Norwegian waters. However, furunculosis was not a problem for Norwegian salmon culture before 1986 when smolt imported from Scotland were found to be carriers of the disease. The transmitted disease spread widely among farmed Norwegian salmon, and caused serious problems with resultant major economic costs. The import of the smolt from Scotland was approved by the veterinary authorities and so Norwegian fish farmers could reject any responsibility for the results. However, there is no disagreement that this import was self-inflicted and that the aquaculture industry today is considerably more wary about such operations. Furthermore, the outbreak of furunculosis contributed to the start of comprehensive work to develop vaccines that resulted in excellent results. At the same time, the disease problems also contributed to improvements in routine running-operations, from which the industry has generally gained great benefits. Furunculosis outbreaks have not been noted in Norwegian fish farms during the last three years.

Gyrodactylus salaris

In the early 1970s, salmon smolts were imported from Sweden to Norway for aquaculture purposes. Some of these smolts were infected with the parasite *Gyrodactylus salaris*, and it is clear that the parasite was further transferred to Norwegian rivers. This import was also approved of the veterinary authorities and occurred in parallel with other import. Apparently this parasite has been spread by other means besides smolt import. *G. salaris* is easy to control and treat in fish farms and so is not a problem for the industry today, and

it is important to emphasize that fish farmers today do not contribute to the spread of *G. salaris*.

Algae and jellyfish

Quite frequently there are major blooms of algae and large quantities of jellyfish that cause problems in fish farms. Most of these cases are due to common algae (*e.g.* dinoflagellates) or jellyfish, but their concentrations can cause problems. In other cases the blooms may be due to toxic algae, some of which may be indigenous species (*e.g. Chrysochromulina*) and occasionally may be introduced species brought to Norway, for example, by ballast water transport (*e.g. Chatonella* sp.). These unusual or harmful blooms undoubtedly cause problems for the aquaculture industry. However, they have not been particularly dramatic so far, with a few exceptions in terms of affecting running operations and causing economic costs. In several cases, it appears that the news media have made more of the problem than the documented troubles faced by fish farmers. Nevertheless, the aquaculture industry fears that some alien species may be introduced that can cause serious damage, and so the industry welcomes international regulations aimed at reducing the risks from introductions.

Experiences from aquaculture in other countries

In southern Chile, rainbow trout were released for sport fisheries. These have reproduced naturally and today maintain stable stocks. On the other hand, escaped salmon and trout from fish farms further north in the country have not successfully reproduced, but Chinook salmon (*Oncorhynchus tshawytscha*) have proved an exception through some reproductive success. In the southern Pacific, it does not appear that escaped Atlantic salmon have managed to reproduce naturally in rivers. Various molluscs introduced into new areas have, however, caused some extensive problems, such as the introduction and wide spread of Pacific oysters into New Zealand.

Conclusions

The aquaculture industry in Norway has, during its relatively short history, made some environmentally related mistakes. These mistakes have primarily caused problems for which the industry itself has had to pay. This is probably the major reason why the industry has made great environmentally based improvements that can be an example to many other industries. The industry is determined to build further on these improvements. Good environmental practice is the foundation upon which the industry's existence and continuing development depends.

3.2.3 The red king crab – introduced species and also a valuable fisheries resource

Jan Sundet (Senior Scientist, Head of Shellfish Research Group at the Institute of Marine Research, Tromsø).

Introduction and spreading

The red king crab (*Paralithodes camtshaticus*) was first introduced during the 1960s through a series of importations of adults, juveniles and larvae (Orlov & Ivanov 1978). Most of these crabs were imported near the Kamchatka Peninsula in the Sea of Japan, but some were collected from the Okhotsk Sea. The introduction to the Barents Sea was part of a larger program in the former Soviet Union whereby about 900 species were transferred to new areas and about 80-90 of these became established. The red king crab is one of these introductions, which has previously been viewed as a 'success'. However, attempts had been made to introduce this crab as early as the 1930s but the project was hampered by inadequate transport opportunities (Olsen 2003).

Since the 1960s introductions, the red king crab has spread both eastwards and westwards in the southern Barents Sea. In the east, the crab has reached the mouth of the White Sea and Cape Kanin as well as northwards to Goose Bank. Russian scientists believe that the crab has reached its most easterly distribution in the Barents Sea as the low water temperature limits its living and reproducing there. In the west, the crab has reached Hammerfest in Finnmark county of Norway (Anisimova *et al*. 2003). Some crabs have also been caught in the Lofoten area further south, but there are strong indications that these are due to human caused transport of crabs from east Finnmark. Even though some crabs have been caught outside about 12 nautical miles of the coast of East Finnmark, it appears that the main movement of the crab's distribution has been westwards and southwards in Norwegian coastal waters. The reasons for this spread are unknown. However, it is known from the Bering Sea that individuals undergo long migrations during the year between shallower areas near the coast and more deep offshore areas (Rodin 1990, Stone & O'Clair 1990). On the Finnmark coast the distance

between shallow and deeper areas is short, should the crab require such migrations in Norwegian waters. The expanded distribution noted on the Norwegian side of the Barents Sea reflects a major increase in the scientific stock estimates carried out since the early 1990s. These estimates indicate that the stock of adult male crabs has increased from about 54 thousand individuals in 1995 to about 1.3 million individuals in 2003 (Anisimova *et al*. 2003). This probably also reflects a similar increase in the total stock of red king crab in the Norwegian zone of the Barents Sea.

The crab's ecological impact

The main question in Norwegian research directed at the red king crab is what effect it, as an alien species, has on the ecosystem. Limited funding has resulted in little being done on this topic. The first that was done on this topic was to study what the crab's diet was in Varangerfjorden. The findings showed that the crab is an omnivore, but that prey such as polychaete worms, small bivalves and some echinoderms figured more frequently than other prey (Sundet *et al*. 2000). The diet varied seasonally from autumn to spring, probably reflecting the crab opportunistically eating whatever is available in its area. Beyond this information, there is currently a lack of information that demonstrates the crab has had an impact on the ecosystem. However, divers have reported from southern Varanger that a previously known bed of Iceland scallop (*Chlamys islandica*) has disappeared since the crab became abundant in the area. This resulted in the establishment of a project at the Norwegian College of Fishery Science, funded by the Research Council of Norway, which studied the crab's prey preference amongst species that are commonly found on Iceland scallop beds (Jørgensen *et al*. 2003). This project is scheduled to be concluded in 2004, but the Institute of Marine Research (IMR) plans to continue it.

In the 2003 Norwegian State Budget, IMR received an increase in funding to start research on the ecological effects of the red king crab. Annually about NOK 4.7 million of IMR's budget will be focused on this work. A research plan has been developed, which has two main aims (www.imr.no/):

- Determine how quickly and far the red king crab can spread in Norwegian fjords and coastal areas and in open waters;
- Study potential changes in ecosystems resulting from the crab's presence in the same areas.
-

The above-mentioned research plan contains numerous prioritized research topics that have shorter or longer time perspectives.

By-catch in other fisheries

The most evident effect of the red king crab so far is as by-catch in the traditional coastal fisheries. The crab causes major problems as by-catch in gill nets and longlines set for cod (*Gadus morhua*) and lumpfish (*Cyclopterus lumpus*), which has been studied since 1997. The results indicated that this by-catch increased until 1999, since when there has been a substantial decrease (Hjelset *et al*. 2004). This decrease is due to several causes, including the movement of fishers away from their traditional fishing grounds, due to the problems caused by these crabs, to new grounds with fewer crabs. Another possibility for the decrease in by-catch may be due to a generally different depth distribution occupied by the crab compared with the fish.

The problem of crab by-catch has resulted in the start of development of new or modified gear fishing directed at cod, for example gear development to raise gill nets, longlines and pots above the seabed to prevent the crab from reaching the caught fish. Gear development studies aimed at reducing the by-catch of red king crab has only just begun and more research is needed in this area.

The crab fishery

The economic value of the catch of red king crab has increased correspondingly with increases in the catch quota. With the current kg price of about NOK 75, the average caught crab weighing about 4 kg represents a high value to some fishers. The first-hand (*i.e.* paid to fishers) value of the catch of red king crab in Norway has increased from about NOK 1.3 million in 1994 to about NOK 61 million in 2003. Today the total value of the crab quota is greater than that arising from the total cod quota in East Finnmark, emphasizing the great economic importance of the red king crab in this part of Norway.

The increase in the total quota for red king crab also reflects the total number of vessels that take part in the fishery. The fishery, which was organized as a 'research fishery' from its start in 1994 until 2002, started with only four vessels in 1994 but increased to 197 vessels between seven

and 15 m length in 2003. The fishery is pursued by using pots from October until the end of December, with the duration of the fishery being dependent on the crab's quality.

The public debate about the crab

In the open debate in Norway about the red king crab, many points of view and stories have been circulated that are not based on reality. This has been especially extensive regarding the discussion about the impact of the crab on the ecosystem, whereby tales of dramatic effects have in turn been used as arguments for eradicating the species from Norwegian waters. As mentioned earlier, with the exception of the Island scallop beds that have disappeared there are currently no indications of ecosystem effects caused by the crab. Normally many years of research are required to demonstrate ecosystem effects. All the other tales about the crab's ecologically damaging effects in Norwegian waters have not been documented, and thus should be considered speculative and so blur the discussion.

For the time being, there is only one legitimate ecological argument in the Norwegian discussion about the red king crab, and this is that it is an introduced species. This ought to be sufficient for everyone as a reason that the red king crab should not occur in the Barents Sea.

3.2.4 Plenum comments and discussion

Regarding the presentation by Kjetil Hindar, comments and discussion occurred about:

- the chance of rainbow trout becoming established in Norwegian waters. This was considered to be unlikely both with respect to the long time this species has existed in the wild in the country and to the possibility that myxosporean parasites, which are not endemic to North America where the species originates, may limit the ability of the rainbow trout to establish itself (Hindar *et al.* 1996)

- the possibility for using genetically modified fish in Norwegian aquaculture. A representative from FHL emphasized that genetically modified fish was not an area that the industry in Norway considered to be attractive. The industry is more concerned about the poor control of fish and other organisms coming into the country via the aquarium business.

Regarding the presentation by Tormod Venvik, comments and discussion occurred about:

- the length of time that it may take for introduced organisms arriving in Norwegian waters to establish themselves and to become invasive. It was pointed out that sometimes introduced organisms could become established and invasive very quickly after first entering a country or area, while other alien organisms may require repeated introductions and spreading over a course of many years before suddenly become invasive. Thus, there is no guarantee for future events concerning introduced species;

- the costs of vaccinating salmon smolts against furunculosis. It was noted that it currently costs about NOK 1.0 to vaccinate a smolt against furunculosis and simultaneously against infectious pancreatic necrosis virus and other diseases, and that this had been very effective. However, the costs of developing such vaccines had been considerable;

- the extent to which the Norwegian aquaculture industry has evaluated the risk of marine introductions from ballast water discharge, and the possibility that diseases may be transferred to farmed fish from wild fish that are caught for fodder for farmed fish. Fish farming representatives explained that advanced risk analyses had not been conducted on the likely impacts of ballast water induced introductions on the fish farming industry, but the industry is very concerned about the possibility of future detrimental consequences on the industry unless more effective preventative measures are introduced at the international and national Norwegian levels. Concerning the quantity and quality of fodder for farmed fish, it was noted that the industry depends on the sustainable management of the fish stocks and fisheries concerned, and there is continual focus on being able to secure a stable supply of marine protein and lipid as well as finding alternative supplies to these should there be a shortfall;

- the threats posed by harmful/toxic algae in Norwegian waters, such as the alien phytoplankter *Chattonella c.f. verruculosa*. On the one hand, *Chatonella* has so far caused quite limited damage to the industry in southwestern Norway, but on the other hand there is a definite risk that this annually

blooming phytoplankter may be transported further northwards by the Norwegian Coastal Current and by further ballast water transport. As opposed to parasites and diseases, which frequently can be treated effectively by medically-related means, it is unfeasible to control invasive microalgae once established.

Regarding the presentation by Jan Sundet, comments and discussion occurred about:

- concerns for the possible spread of a fish blood parasite *Trypanosoma murmanensis* via the leech *Johanssonia arctica* infesting the red king crab (McKenzie *et al.* 2000), and indications that the degree of infection of cod by the trypanosome has increased in areas of the Barents Sea into which the crab has moved;

- the extent to which Norway should be obliged to manage the red king crab in the Barents Sea as a 'shared' stock with Russia. This is a complex matter and depends *inter alia* on: a) the species being included among the legitimately regulated fishable stocks, and total allowable catches, covered by the Joint Norwegian – Russian Fisheries Commission for 'common' Barents Sea stocks, and b) eventual delineation of the geographical area in Norwegian waters in which unregulated fishing may be allowed for containment purposes;

- the lack of a proper risk assessment for Norwegian waters concerning the spread of the red king crab including its influences on ecosystems and the socioeconomics of coastal human settlements;

- scientific research about the biology and ecology, including multispecies relationships, monitoring and assessment of the red king crab stock, with the prevailing opinion being that these aspects have received too little attention too late. There was a predominant view that these limitations should be redressed quickly through more focused funding and capacity building.

3.3 Session 3: Measures to reduce risk of introductions and spread of alien species from shipping and aquaculture

Session Chair: Terje C. Gløersen (Safety and Environment Director, Norwegian Shipowners Association); Rapporteur: Anne E. Langaas (Adviser, Directorate of Nature Management).

3.3.1 The IMO Convention on control and management of ballast water and sediments from ships

Sveinung Oftedal (Senior Adviser, Norwegian Maritime Directorate).

The International Convention for the Control and Management of Ships' Ballast Water and Sediments was adopted on 13 February 2004 at the International Maritime Organization (IMO) in London (UK). Before then, IMO had agreed several ***voluntary*** guidelines:

- In 1991, Resolution MEPC.50(31);
- In 1993, Resolution A.774(18);
- In 1997, Resolution A.868(20).

Objectives and content of the Convention

The main aim of the new Convention, which will be ***mandatory*** for the Contracting Parties when it comes into force, is '*to prevent, minimize and ultimately eliminate the risks to the environment, human health, property and resources arising from the transfer of Harmful Aquatic Organisms and Pathogens through the control and management of ship's Ballast Water and Sediments,….*'.

The Convention comprises: a Preamble: a preface to the convention that explains its background and the main aims of the Convention; Articles: Defines the functional requirements of the Convention and are the legal basis for the Regulations; Regulations: explaining the explicit demands of the Convention; Guidelines: supplements to the regulations.

Article 1 – Definitions

These include simple definitions of what is meant by ballast water, 'ballast water management', 'harmful aquatic organisms and pathogens', etc.

Article 2 – General obligations

These are aimed at the Contracting Parties (*i.e.* States), who commit themselves to implement the Convention. The States are *inter alia*: encouraged to cooperate on implementation, compliance and enforcement of the Convention; they may, in accord with international law, introduce more stringent requirements; they shall endeavour not to impair or damage their environment, human

health, property or resources, or those of other States; the ballast water management practices used shall not cause greater harm than they prevent; they shall cooperate to address threats and risks to sensitive, vulnerable or threatened marine ecosystems and biodiversity beyond limits of national jurisdiction in relation to ballast water management.

Article 3 - Application

The Convention applies to all the ships of the Contracting Parties in international traffic. It does not apply to ships that operate without ballast water, nor does it apply to ships having permanent, non dischargeable ballast in sealed tanks. There will be no more favourable treatment of non-Party ships.

Article 4 - Control of the transfer of harmful aquatic organisms and pathogens through ships' ballast water and sediments

Each Party shall ensure that ships flying the Parties' flags comply with the Convention's requirements. Each Party shall, according to their capabilities, develop national policies, strategies and programmes for ballast water management in their ports and territorial waters.

Article 5 - Sediment reception facilities

The Parties shall ensure that there are facilities for the reception of sediments at localities where cleaning or repair of ballast tanks occurs. These facilities should not cause undue delay for ships, and shall provide for safe disposal of sediments.

Articles 6 – 17

Ships are required to be surveyed and certified (Article 7 - *Survey and certification*)and may be inspected by port State control officers (Article 9 - *Inspection of Ships*) who are able to verify the ship possessing a valid certificate; inspect the Ballast Water Record Book; and/or sample the ballast water. If there are concerns, then a detailed inspection may be carried out and '*the Party carrying out the inspection shall take such steps as will ensure that the ship shall not discharge Ballast Water until it can do so without presenting a threat of harm to the environment, human health, property or resources*.'

The specific articles refer to the following issues:

- *Article 6 – Scientific and technical research and monitoring*
- *Article 7 – Survey and certification*
- *Article 8 – Violations*
- *Article 9 – Inspection of ships*
- *Article 10 – Detection of Violations and control of ships*
- *Article 11 – Notification of Control actions*
- *Article 12 – Undue delay of ships*
- *Article 13 – Technical assistance, cooperation and regional cooperation*
- *Article 14 – Communication and information*
- *Article 15 – Dispute settlement*
- *Article 16 – Relationship to international law and other agreements*
- *Article 17 – Signature, ratification, acceptance, approval and accession*

Article 18 – Entry into force

The Convention shall enter into force 12 months after ratification by at least 30 States, whose combined merchant fleets constitute at least 35% of the world's gross merchant shipping.

Article 19 – Amendments

The Articles may be amended by explicit acceptance. The regulations may be amended by tacit acceptance. The Convention may be amended by holding a Conference.

Articles 20 - 22

Are concerned with the following issues:

- *Article 20 – Denunciation*
- *Article 21 – Depository*
- *Article 22 – Languages*

Annexes:
Section A – General provisions

These include:

Regulation A-1 Definitions
Regulation A-2 General applicability

'*Except where expressly provided otherwise, the discharge of ballast water shall only be conducted through Ballast Water Management in accordance with the provisions of this Annex*'.

Regulation A-3 Exceptions
Exceptions relate to situations related to the ship's safety and emergencies, and where ballast water is taken up and discharged at the same place including 'high seas' areas.

Regulation A-4 Exemptions
Exemptions may be granted in individual cases after a risk assessment.

Regulation A-5 Equivalent compliance

Section B – Management and control requirements for ships

These include:

Regulation B-1 Ballast water management plan
All ships are required to have an approved plan for ballast water management

Regulation B-2 Ballast water record book
All ships shall log their ballast water operations. Record books shall be kept onboard the ship for a minimum of two years, and thereafter in the Company's control for at least three years. During this time the record books must be readily available for inspection.

Regulation B-3 Ballast water management for ships
This phases in ballast water cleaning technology based on specified dates, differentiated according to the ship's ballast water capacity. Ships shall meet given standards as from a specified year unless the ship delivers its ballast water to a reception facility.

The phasing-in plan (performance targets) is:

Ship's year of construction	*Ballast water capacity*	*Phasing-in date for cleaning technology*
Before 2009	1500 – 5000 m^3	2014*
Before 2009	< 1500 m^3 and > 5000 m^3	2016*
2009 and later	< 5000 m^3	2009
2009 – 2012	> 5000 m^3	2016
2012	> 5000 m^3	2012

The phase in date is defined to the first intermediate or renewal survey after the effective date.

Regulation B-4 Ballast water exchange
Whenever possible, ballast water exchange should be conducted at least 200 nm from the nearest land and in water at least 200 m deep, taking into account Guidelines developed by IMO. In cases where the ship is unable to conduct ballast water according to the Guidelines, this should be in all cases at least 50 nm from the nearest land and in water at least 200 m deep. States may also designate areas nearer land where ballast water exchange may be conducted. Ships shall not be required to deviate from their intended voyages to conduct ballast water exchange in areas at least 50 nm from land and in water deeper than 200 m. Where a ship does not pass an area where ballast water exchange can be conducted according to regulation B-4, the ship has a right to discharge untreated ballast water. The ship is not required to conduct ballast water exchange where such an operation threatens its safety.

Section C – Special requirements in certain areas

Regulation C-1 Additional measures
One or more Parties may, subject to IMO approval and consistent with the UN Law of the Sea, impose additional measures to prevent, reduce, or eliminate the transfer of Harmful Aquatic Organisms and Pathogens through ships' Ballast Water and Sediments.

Regulation C-2 Warnings concerning ballast water uptake in certain areas and related flag State measures

A Party should notify mariners of areas under their jurisdiction where ships should not load ballast water due to detrimental conditions (*e.g.* toxic algal blooms, sewage).

Section D – Standards for ballast water management

Regulation D-1 Ballast water exchange standard
Ships performing ballast water exchange shall do so with an efficiency of 95% volumetric exchange of ballast water. For exchanges by the pumping-through method, pumping through three times the volume of each ballast water tank shall be considered sufficient. Pumping through less than three times the volume may be accepted provided the ship can demonstrate that at least 95% volumetric exchange is met.

Regulation D-2 Ballast water performance standard
Ships shall discharge <10 viable organisms per m^3 ≥50 micrometers in minimum dimension and <10 viable organisms per ml <50 micrometres in minimum dimension and ≥10 micrometers in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations.

The indicator microbes, as a human health standard, include, but are not be limited to: a) toxicogenic *Vibrio cholerae* (O1 and O139) with <1 colony forming unit (cfu) per 100 ml or <1 cfu per 1 gram (wet weight) zooplankton samples; b) *Escherichia coli* <250 cfu per 100 ml; c) Intestinal Enterococci <100 cfu per 100 milliliters.

Ballast water management systems must be approved by the Administration in accordance with IMO Guidelines (Regulation D-3 *Approval requirements for Ballast Water Management systems*). These include systems which make use of chemicals or biocides; make use of organisms or biological mechanisms; or which alter the chemical or physical characteristics of the Ballast Water.

Regulation D-3 Approval requirements for ballast water management systems
These must be approved by the Administration according to IMO Guidelines, and include systems using chemicals, biocides, organisms or biological mechanisms, that alter the chemical/ physical characteristics of the ballast water.

Regulation D-4 Prototype ballast water treatment technologies
Ships participating in a programme approved by the Administration to test and evaluate promising treatment technologies may be allowed a leeway of five years before having to comply with the requirements.

Regulation D-5 Review of standards by the Organization
IMO's MEPC must, three years before the phasing in of treatment technologies, review the Ballast Water Performance Standard taking into account several specified criteria. MEPC should determine whether appropriate technologies are available to meet the required standards.

Section E – Survey and certification requirements for ballast water management
Provides requirements for initial renewal, annual, intermediate and renewal surveys and certification requirements for ships over 400 gross tonnage to which the Convention applies.

Guidelines:
IMO's MEPC has been charged with formulating, within a period of two years, 13 Guidelines for the Convention. In MEPC, Norway has been given the main responsibility for drafting the Guidelines connected with Regulations A-4, C-1 and D-4.

Concluding remarks

- Adoption of the new Convention represents the most important milestone for reducing the risk of spreading alien organisms via ballast water transport;
- However, it will take a substantial time before the Convention comes into force, and the Convention may even be amended before it comes into force;
- The Convention may actually be implemented in specific geographical areas before it globally comes into force.

Further information on the Convention and ballast water issues can be obtained from the Global Ballast Water Management Programme's (GloBallast) website:
http://globallast.imo.org/

3.3.2 EC Directive 91/67 – The animal health basis for distributing aquaculture animals and products

Ivar Hellesnes (Norwegian Food Safety Authority).

The Norwegian Food Safety Authority ('*Mattilsynet'*) is a specialized agency organized under the Ministry of Agriculture and Food, which—as from 1 January 2004—represents a merger of the Norwegian Animal Health Authority, the Norwegian Agricultural Inspection Service, the Norwegian Food Control Authority, the Directorate of Fisheries' seafood inspectorate, and local government food control authorities. The NFSA's goal is that consumers should have healthy and safe food and safe drinking water. We promote human, plant, fish and animal health, environmentally friendly production, and ethically acceptable farming of animals and fish. The Norwegian Food Safety Authority also performs duties relating to cosmetics and medicines, and inspects animal health personnel.

Regarding the Norwegian Food Safety Authority's regulatory responsibilities connected with marine issues, it should be noted that the European Economic Area Agreement involving Norway focuses to a major extent on the EC Fish Health Directive (EC 1991), Fish Diseases Directive (EC 1993) and Bivalve Shellfish Diseases Directive (EC 1995). The Norwegian Food Law (*Matloven*) replaced the Fish Diseases Law (*Fiskesykdomsloven*) as from 1 January 2004. The judicial responsibility involving fish

diseases lies with the Ministry of Fisheries and Coastal Affairs.

The following aspects of this presentation are focused primarily on the animal health basis for distributing aquaculture animals and products addressed by EC Directive 91/67, the so-called EC Fish Health Directive (EC 1991).

Implementation of EC Directive 91/67

The Directive concerns the health aspects associated with the distribution, sale, and import and export of aquaculture animals and products. The Norwegian regulations concerning this Directive entered into force as determined by the Ministry of Agriculture on 14 October 2003, replacing a) the regulations regarding animal health conditions for the import and export of aquatic animals, products and infectious objects as determined by the Ministry of Agriculture on 29 December 2000, b) the regulations on monitoring and control of the outbreak of individual infectious diseases of fish and other aquatic animals, as determined by the Ministry of Agriculture on 31 December 1998, and c) the regulations on infectious haematopoietic necrosis (IHN) and viral haemorrhagic septicaemia (HIS) zones, as determined by the Ministry of Agriculture on 27 February 1998. This brought in new regulatory changes applying to the control of health connected with aquaculture animals regarding the operation of aquaculture establishments, smolt provisions, and transport provisions.

Distribution regulations

These regulations determine the animal health requirements for the distribution and import of aquaculture animals. It should be noted that there is no standing requirement for movements of aquaculture animals within the same zone, which in the case of Norway means that the whole country is considered as a single approved zone on the basis of the national lack of occurrence of IHN and VHS, in the case of fish, and *Bonamia ostreae* and *Marteilia refringens*, in the case of oysters.

According to the requirements for distribution in § 5, there must not be any clinical signs of disease on the day prior to transport of the aquaculture organisms concerned, neither should the animals or products be connected with slaughtering or destruction as part of a program for eradication of the specified diseases not should they originate from aquaculture assemblages placed under any restrictions on the grounds of animal health considerations.

Regarding import of aquaculture animals to Norway from the European Union or an European Economic Area State, key regulatory features include determination of the specified species for import against a list of approved as well as non-approved species for such purposes, the production of a legitimate transport document, and the origin of the particular species from an approved aquaculture assemblage from within an approved zone. Any dispensations against import, as outlined in § 26, must not conflict with the European Economic Area Agreement.

Health control regulations

As determined by the Ministry of Fisheries and Coastal Affairs, the general provisions for health control of aquaculture animals require that a veterinarian or fish health biologist must be contacted for control purposes when increased mortality is noted or when there is a suspicion of disease. A health journal must be kept and filled in.

Establishment of fish farms

Regulations were approved as a result of the abolition of the Fish Diseases Law (*Fiskesykdomsloven*) and build on § 7 of the former Fish Diseases Law. Guidance notes are currently being developed. Key words regarding the establishment of fish farms include distance categorization between farm entities, suitable localities, and operational requirements. The Food Safety Authority shall remark on food safety in accord with the change in the Aquaculture Law (*Oppdettsloven*).

3.3.3 Plenum comments and discussions

Regarding the presentation by Sveinung Oftedal, comments and discussion occurred about:

- the evident need to develop and agree as soon as possible the Guidelines for the new IMO Convention on ballast water management, and that the ballast water treatment standard cannot be met by treatment methods and technology that are currently available. The standard is believed to be attainable by the time ballast water exchange is phased out. In case this does not occur, there are openings in the Convention to review and amend the

treatment standard in line with technical development;

- the intention of Norway, together with the European Union/European Economic Area States, USA and Japan to quickly ratify the Convention. There is a good chance that such a block of important maritime trade countries can harmonize their ballast water regulations, and thereby apply greater leverage towards achieving the required global consensus including the coming into force of the Convention. The Norwegian position on ballast water emphasizes the environmental aspects, and wants the global shipping regulations to be place under IMO auspices;

- Norway, as a Party to the European Economic Area Agreement, is bound to implement the EC Directives that arise in connection with the new Convention. It is important that Norway is actively involved in preparatory work to develop the pertinent regulations (*e.g.* Directives) with the EC at an early stage in order not to be left behind, although matters often take substantial time in the EC—not least due to the increased size of the EC.

Regarding the presentation by Ivar Hellesnes, comments and discussion occurred about:

- the Norwegian view that the current EC Directive 91/67 needs to be overhauled. Improvements should incorporate more relevant and applicable solutions to limit the health risks (*e.g.* pathogens and parasites) associated with the distribution and relocation of aquatic living resources products. The European Commission has collected national comments connected with amending the Directive. The Norwegian aim is to achieve greater national independence in determining which diseases one wishes to take actions on, based on the reasoning that there is substantial national and regional variability as to whether a particular disease represents a threat or not. Currently the European Commission has tended to view the Directive as a 'placing on the market' regulation, which limits the potential for changing it, whereas viewing it as an 'intra-Community' Directive will open up the option for European Economic Area States to apply nationally based measures. The current Directive limits the ability of individual States to apply regulatory measures about pathogens and parasites that are not included on the existing list. Besides EC Directive 91/67, several other EC Directives, which are applicable to Norway, are also connected with pathogens/diseases and genetically modified organisms (GMOs) of relevance to the marine IAS issue (*e.g.* EC 1993, EC 1995, EC 2001). Although the EC Wild Birds (EC 1979) and Habitats Directives (EC 1992) include reference to alien species, Norway is not obliged to apply these Directives according to the European Economic Area Agreement;

- the fact that the current Directive 91/67 does not apply where one has existing regulations on the protection of species. However, in addition to species regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973), Norway prohibits the import of certain living species on the basis of their associated disease spreading potential. It should also be mentioned that a number of species are prohibited from import according to other acts such as the Wildlife Act and the Product Control Act. However, the European Commission has stated that prohibition of species based on these grounds cannot be based on Directive 91/67 or any other EC Directive. Thus, if Norway is to continue with its current practice it must be based on environmental regulations concerning the protection of species. Accordingly, the Ministry of Fisheries and Coastal Affairs has requested that the Ministry of the Environment collaborates in assessing the extent to which relevant protection of species issues can be further incorporated into the appropriate regulations in order to plug possible loopholes;

- the relatively stringent Norwegian regulations governing the import of species for aquaculture to the country, irrespective of whether these species are indigenous or alien. This reflects the desire of the authorities to be precautionary regarding controlling the possible translocation of diseases from potentially unfamiliar localities, and to apply quarantine conditions when in doubt. This conduct is broadly supported by the Norwegian aquaculture industry.

4 Group work

4.1 Session 4: Identification of problem areas and future collaborative measures

Session chair: Odd Terje Sandlund (Chief Research Scientist and Coordinator Development Cooperation, NINA); Rapporteur: Chris Hopkins.

Sandlund and Hopkins exchanged their roles later during the session.

Five working groups (see Table 1) addressed the tasks set for them in the questionnaire on marine invasive alien species (IAS) (Table 3).

Having completed their tasks, the working groups met together in plenary session. The working group chairs (Sveinung Oftedal; Helge Botnen; Stian Johnsen; Hanna Lee Behrens; Aina Valland) each presented a brief verbal report of their findings , followed by comment and critique by all the participants.

The main findings of the working groups are presented in the boxes in sub-sections 4.1.1 – 4.1.5. The ordered points are based on a merger of the brief, but highly concordant, reports presented by the five working groups, supplemented by the rapporteurs' notes that take account of the various comments and clarifications that followed the presentations.

In considering the tasks involving research, management/regulation and information dissemination, the working groups noted that careful attention should be given to weighing, at the national level for any particular marine IAS, the risks against the benefits, and the consequences of new introductions and translocations for neighbouring States. The importance of following the CBD (e.g. COP and SBTTA) decisions and guidelines on IAS was emphasized.

4.1.1 Main concerns regarding risk and impacts

a) Shipping (ballast water & hull fouling) & aquaculture (use of new species): ➔ introduction & spread of marine IAS (harmful/toxic phytoplankton blooms, *e.g. Chatonella*; diseases & parasites, *e.g. Gyrodactylus*, furunculosis, eel swim bladder nematode; macroalgae, *e.g. Sargassum muticum*; shellfish, *e.g.* red king crab; genetic 'pollution' of stocks/populations, *e.g.* resident Atlantic salmon populations).
b) Poor non-mandatory ballast water management procedures: ➔ facilitates introduction & spread of marine IAS.
c) Introduction & spread of red king crab: ➔ irreversible changes to vulnerable species, habitats & ecosystems, transfer of parasites. ➔ socioeconomic impacts on coastal communities.
d) Human induced climate warming: ➔ increased establishment & spread of more cosmopolitan marine IAS in boreal-arctic areas.
e) Lack of applicable scientific knowledge (*e.g.* biology, taxonomy, ecology, multispecies interactions) & public awareness regarding marine IAS issues: ➔ inferior assessment of threats and poor predictability of potential impacts on ecological 'goods & services' & socioeconomics.

4.1.2 Proposals for future national actions concerning research, management/regulation and information dissemination

	Research	***Monitoring***	***Management/regulation***	***Information dissemination***
a)	Fund pure & applied research (*e.g.* life histories & biology, taxonomy, ecology, multispecies interactions, ecosystem functioning & effects, monitoring/assessment, control & combating, evaluation of legislation), on marine IAS issues.[3]	Devise a periodic mapping, monitoring & assessment system for marine IAS.[4]	Develop & publish a cohesive national policy on marine IAS, with supporting strategy & goals for its implementation, *e.g.* for publication in the Norwegian Official Report (Norges offentlige utredninger, NOU) series.	Develop an internet-based network, with website portal, giving open access to updated knowledge on marine IAS issues, for strengthening cross-sectoral awareness & concerted action for monitoring, assessment, management/regulation of marine IAS.[5]
b)	Foster closer collaboration between the natural, technological & social sciences.	Establish a national database, as part of a monitoring & assessment system, with an inventory of known & expected marine IAS linking with a network of regional & global databases.[6]	Implement effective management & regulatory measures (*e.g.* combatting, controlling & eradication) essential for restricting the risk of establishment & spread by marine IAS.[7]	Conduct a mapping exercise to identify the stakeholders/end users[8] for information dissemination on marine IAS, & determine the best way (*e.g.* media) for such dissemination.

[3] This knowledge is fundamental for improving the capacity to predict risks & spreading, as well as for devising optimal measures for regulating, controlling & eradicating marine IAS.

[4] This should be cost effective, responsive & able to be integrated into existing Norwegian & international programmes (*e.g.* fisheries, environment, biodiversity). Regular, efficient & comprehensible procedures should be developed for assessing the data provided by the monitoring programmes in order to determine the changing status & trends (*e.g.* time series) of marine IAS, with timely dissemination of results including establishing effective early warning & rapid response systems for new unwanted introductions, & subsequent combating & eradication measures.

[5] The portal should be constructed to a) form a hub linking the national databases & regional information resources in the Nordic/Baltic region, & b) further connect the network with the websites of other regional & global activities & networks related to invasive alien species. The portal should provide access to the searchable regional database of experts, a bibliographic database, links to the existing lists & inventories of marine IAS, & provide other services. Services listed in the recommendations of the Joint Convention on Biological Diversity/Global Invasive Species Programme Informal Meeting on Formats, Protocols & Standards for Improved Exchange of Biodiversity-related Information CBD Report UNEP/CBD/COP/6/INF/18. The portal should function as both an input & output mechanism for online Internet users from all branches of society to access information & data from the Norwegian database & its cooperating international associates.

[6] The database should be harmonized with common CBD-approved formats and standards The database should function as an online reference system open for use by workers and managers in the environmental and living marine (*e.g.* fisheries and aquaculture) resources sectors, the shipping and maritime operations sectors, monitoring institutions, researchers, students, and other stakeholders in the public and private sectors. The database should provide inventories of the marine IAS that are present in Norway, with a compilation of species accounts of the most invasive species. These species accounts should, wherever possible, include species taxonomy and identification features, area of origin, vector of introduction, distribution history in the region and specific area, abiotic environmental and habitat preferences, life cycle information, risks concerning ecological and economic impacts, best practices for eradication and control, and bibliographies of the relevant literature. GIS supported distribution maps of marine IAS should be produced, facilitating the monitoring and assessment of the status and trends of introductions and further spread of marine IAS in the country and region.

c)	Develop applied research to improve the design & performance of mapping, monitoring & assessment systems for marine IAS.	Conduct risk assessments for the main shipping pathways responsible for transporting marine IAS to Norwegian 'hot spots' (*e.g.* ports & shipyards), & establish monitoring & control schemes.	Review & improve the national laws & litigation on IAS.	Produce popularized scientific presentations aimed at specific stakeholders (*e.g.* TV, radio, magazines, newspapers, internet), & improve the education & understanding of journalists, regarding marine IAS issues.
d)	Develop techniques & methodologies, including models, for environmental impact assessments & risk analysis concerning marine IAS.	Establish a national catalogue of experts on marine IAS.[9]	Speedily develop the required Guidelines for the new IMO Convention.	Conduct national training courses & workshops etc. that disseminate information (*e.g.* threats, risks & impacts, management/regulation, combating & control practices) on marine IAS for stake-holders.
e)	Compile & evaluate control & eradication measures for marine IAS.	Establish greater participation & cooperation involving the navy, coastguard, port & harbour authorities, shipping companies, &	Work for the early ratification of the new IMO Convention.	Promote active national participation in governmental & non-governmental organizations (NGOs) that further the timely exchange of information & knowledge on marine IAS of relevance to management & regulation.[10]

[7] The success of these measures depends *inter alia* on better awareness and understanding amongst a wide group of stakeholders in society as to how the goals of numerous international agreements and instruments may be applied at regional, national and local scales through appropriate policies, litigation and operational practices.

[8] For example, shipping, aquaculture, fisheries, offshore oil and gas, ports/harbour, customs and border control, tourism and recreation, secondary and tertiary education and environmental sectors.

[9] This should facilitate the development of a system of common databases on marine IAS (see above), with a view to achieving harmonization according to common approved formats and standards, focusing on invasive species that threaten biodiversity and covering all taxonomic groups. The databases will provide inventories of the marine IAS that are present in the respective countries, with a compilation of species accounts of the most invasive species. These measures, as a whole, are expected to strengthen the monitoring and assessment of IAS in Norway in aquatic ecosystems of the Nordic/Baltic region, and to provide an important contribution towards developing a Nordic/Baltic early warning system on the introductions and transfers of marine IAS.

[10] These activities include *inter alia* those connected with the: CBD's Conference of the Parties (COP), its Subsidiary Body on Scientific, Technical & Technological Advice (SBSTTA) and its Clearing House Mechanism (CHM); European Environment Agency (EEA); European Inland Fisheries Advisory Commission (EIFAC); European Research Network on Aquatic Invasive Species (ERNAIS); Global Invasive Species Programme (GISP) and its Information Management Working Group (IMWG); ICES Working Group on Introductions & Transfers of Marine Organisms (WGITMO); Joint ICES/IMO/IOC Study Group on Ballast Water & Other Ship Vectors; IMO's Marine Environment Protection Committee (MEPC) and its subsidiary Ballast Water Working Group (BWWG); North Atlantic Salmon Conservation Organization (NASCO); Nordic – Baltic Network on Invasive Species (NOBANIS); Nordic - Baltic Invasive Species Information Management Working Group (WGISIM); OSPAR Commission's Biological Diversity Committee (BDC); IUCN Invasive Species Specialist Group (ISSG); Regional Biological Invasions Center (RBIC);

		aquaculture industry (in addition to scientific institutions) to improve monitoring of marine IAS.		regulation.[10]
f)	Develop effective cleaning technologies for ballast water management		Develop harmonized tools for regional & local municipalities—including port/harbour authorities—to apply measures for implementing the new IMO Convention.	
g)	Propose recommended localities for ballast water exchange in accord with the new IMO Convention		Use the potential of the coastguard to play a major role in controlling/enforcing ballast water exchange regulations, *e.g.* use of approved sea areas for exchange, inspecting Ballast Water Record Books, *etc*.	

h)	Establish a national Centre of Excellence[11] focusing on marine/aquatic IAS.		Appoint a single national authority (*e.g.* Ministry or specialized agency) to have overall responsibility for coordination of management/regulation of marine IAS.	
i)	Quantify & predict the role of different maritime activities in the introduction & spread of marine IAS, & propose appropriate control measures		Incorporate marine IAS as a prominent element in applying the ecosystem approach to management, including actively implementing the precautionary principle.	
j)	Identify the actors (*e.g.* industry/trade groups, regulatory authorities, educational establishments) requiring information on the risks of IAS, including finding the best media for delivering such information		Ensure that coastal zone management plans proactively take account of marine IAS issues.	

World Organization for Animal Health (OIE); and Databases such as the FAO Database on Introductions of Aquatic Species (DIAS), GISP's Global Invasive Species Database (GISD).

[11] A Centre of Excellence (CoE) is a structure where research & technological development (RTD) is performed of world standard, in terms of measurable scientific production (including training) and/or technological innovation. Key features of a CoE include: a 'critical mass' of high level scientists and/or technology developers; a well-identified structure (mostly based on existing structures) having its own research agenda; capable of integrating connected fields and to associate complementary skills; capable of maintaining a high rate of exchange of qualified human resources; a dynamic role in the surrounding innovation system (adding value to knowledge); high levels of international visibility and scientific and/or industrial connectivity; a reasonable stability of funding and operating conditions over time (the basis for investing in people and building partnerships); sources of finance which are not dependent over time on public funding. The CoE should contribute to the longer term building of capacity focusing on IAS, including enhancing teaching capability at undergraduate and graduate levels, as well as providing scholarships.

4.1.3 Bottlenecks: important impediments against effective measures

a)	Lack of political will to highly prioritize the issue of marine IAS.
b)	Sluggishness of management/regulatory authorities to apply national actions needed to fully implement existing international agreements & instruments (*e.g.* precautionary principle and the ecosystem approach to management) regarding marine IAS.
c)	Pulverization of authority regarding management/regulation authority for marine IAS.
d)	Lack of knowledge/understanding of threats & risks, as well as potential unpredictability, regarding introduction & spread of marine IAS, & lack of awareness/understanding of the 'intrinsic value of nature' (*e.g.* ecological economics, ecosystem goods & services, ecophilosophy).
e)	Lack of multidisciplinary groups having a broad-based range of appropriate skills & experience from diverse practically orientated stakeholders/end users (in addition to the core natural & social sciences).
f)	Neutrality & passivity of scientists, limiting their willingness to actively engage in issues where science borders on politics.
g)	Deficiency of earmarked funding for longer term research & development programmes focused on issues connected with marine IAS.[12]
h)	The anticipated long time elapsing before ratification by the required number of Parties, & subsequent coming into force, of the new IMO Convention.
i)	Lack of sufficiently developed cleaning technology & testing facilities for ballast water & sediments, needed to meet the standards set by the new IMO Convention.
j)	Lack of motivation amongst some ship owners & Flag States to participate in or comply with ballast water exchange & management regulations, related to the international competition in the shipping sector & an associated interest to cut costs.
k)	Lack of a comprehensive national policy document, including a strategy & objectives to bring about its implementation, on marine IAS. This policy is needed to achieve consensus regarding measures for dealing with marine IAS issues (*e.g.* the red king crab).
l)	Lack of sufficient national laws & litigation focusing on the introduction & spread of alien organisms. This is related to the lack of a national policy on these issues, which also limits the effective national implementation of international agreements.
m)	Lack of explicit regulations for coordination of environmental impact/risk assessments for marine IAS, & what institution is authorized to conduct these assessments.
n)	Insufficient information on risks connected with introductions of IAS for tourism/tourists/tour operators, the restaurant trade, & sports/recreational fishers (*e.g.* in codes of conduct).

[12] There is a perception in some quarters of the research funding communities that the practically orientated work on marine IAS is of inferior 'quality' due to a tendency for the outputs being reported on in thematic books, working group documents & the report series of environmental agencies, rather than in scientific journals that receive a high publication score. Research on IAS issues is of comparatively recent vintage & so relatively few persons have a long & outstanding publication record in this field.

4.1.4 Proposals for improving cross sector collaboration to reduce threats and impacts

a)	Establish an inclusive stakeholder forum on marine IAS issues for periodically organizing relevant meetings, and addressing confidence building activities, including information and knowledge exchange, capacity building and 'outreach' activities.[13]
b)	Constitute a National Resource Group on marine IAS issues, with supporting network of key contactable persons and institutions.[14]
c)	Delegate overall coordination responsibility to a single governmental authority for marine IAS matters regarding monitoring and management/regulation.[15]
d)	Devise and implement collaborative schemes to apply greater cross sectoral pressure on politicians regarding increasing awareness and funding directed at marine IAS issues.

4.1.5 Proposals for establishment of particular types of international (e.g. regional, global) collaborative projects

a)	Enhance international and regional cooperation for creating common information and coordination systems on marine IAS issues.[16]
b)	Create a distributed but integrated network for an early detection, warning and rapid response system for marine IAS involving Norway and neighbouring countries.[17]
c)	Enhanced funding of longer term research and development programmes on marine IAS issues.[18]
d)	Establish an EC funded ERA-NET project focusing on marine IAS.[19]
e)	Promote integrative biodiversity science focusing on marine IAS issues, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge.[20]
f)	Increase collaboration on standardizing methods, techniques and procedures for monitoring, assessing, managing/regulating (including policies and litigation), controlling and eradicating marine IAS.
g)	Build a catalogue of ongoing national, regional and global projects on marine IAS matters.
h)	Promote collaborative links with projects, programmes and institutions working on marine IAS issues in strategically important countries.[21]
i)	Support international development cooperation for capacity building in the field of marine IAS.

[13] This includes arranging training courses, workshops/seminars, and establishing newsletters aimed at the 'grass roots' of the involved industries such as shipping, aquaculture, etc.

[14] This will *inter alia* advise on relevant activities aimed at facilitating cross sectoral coordination of appropriate activities (*e.g.* research, monitoring and assessment, management/regulation), strengthening collaboration, and promoting wider awareness and information dissemination.

[15] Integrative processes should provide more visible signs of practically orientated and effective cross-sectoral results involving governmental authorities.

[16] This should increase access to knowledge and build capacity, harmonize and standardize work programmes and procedures (*e.g.* developing databases for collecting and accessing data and information, and establishing systems for monitoring and risk assessment), avoiding unnecessary duplication and thereby increasing efficiency and sharing costs (CBD 2002).

[17] For example, the recent initiative on the Nordic-Baltic Network on Invasive Species, NOBANIS.

[18] For example, by the Nordic Council of Ministers (*e.g.* the recent NOBANIS initiative), the European Community (*e.g.* lobbying for inclusion in the EC's new Framework Programme for Research and Technological Development, FP7), continuation of the GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast).

[19] The ERA-NET scheme is about the coordination and cooperation of national and regional programmes and aims at the national and regional programme makers and managers. These are, in most countries, either working in the Ministries or working in national funding agencies, which implement programmes on behalf of their governments.

[20] For example, the DIVERSITAS Programme.

[21] Such countries include the USA, Australia, New Zealand, and the European Union, with a view to strengthening exchange of key persons, ideas, information and knowledge, and for developing collaborative projects.

4.1.6 Comments on outcomes from working groups

Many participants commented on the high degree of consensus and general overlap in the outcomes from the five working groups. This was considered to be due to a) constituting the membership of each of the working groups from a sufficiently large number of persons, who represented a wide blend of expertise from many sectors, and b) providing time, albeit relatively limited, for discussions leading to better understanding and achieving greater consensus. Several of the participants would have liked more time made available for the discussions in the individual working groups leading to better ranking of the points, whilst also acknowledging that there was enough time to arrive at sufficiently robust conclusions in responding to the questionnaire.

5 Concluding remarks

Concluding comments were made Chris Hopkins, and by Anne Langaas on behalf of DN, Aina Valland on behalf of FHL – Aquaculture, and Arne Myhrvold on behalf of Statoil. These emphasized the following points:

- The workshop had made an important contribution to bringing diverse people and institutions together, for exchange of views and increased understanding, concerning the critical issue of marine introduced organisms, in order to a) examine the ecological and socioeconomic concerns regarding the risks and impacts resulting from such organisms, and b) make recommendations for future actions for redressing the problems through *inter alia* strengthening collaboration and information dissemination, and contributing to enhanced research, monitoring, assessment, and improved elaboration of policy and regulatory measures to combat and control recent and new introductions and their spread.
- The outcome from the workshop emphasized the overall cooperation and consensus that had been achieved by the participants, including recommending various ways to make progress in facing the challenges connected with marine IAS. The wide ranging recommendations should be seen as an inter-related 'toolbox' of measures to apply leverage involving a critical mass of concerted actions. It is hoped that the participants in the current workshop, supplemented by additional recruitment, will continue in the future to interact both informally and formally on issues connected with marine alien organisms.
- Based on the success of the current workshop, the interested stakeholders would take account of the outcome and recommendations from the workshop in conferring together on appropriate ways to carry the current initiative forward, and for this purpose would arrange appropriate consultations and lobby activities. In support of this, the report of the workshop would be widely circulated to promote reporting and information dissemination commitments at the national and international levels.

In addition, Magna Bjerga (Research Council of Norway) noted that many of the proposals arising from the workshop had relevant research and development perspectives that deserved to be seriously considered for funding by the Research Council of Norway and other institutional funding agencies at national and international levels. Thus, the emergence of appropriate applications for research funding—which must meet the necessary criteria involving quality, relevance and include international dimensions—should be encouraged.

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7 Tables and annexes

7.1 Table 1. List of participants.

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7.2 Table 2. Schedule for workshop programme.

Day 1: 10 May 2004	**Time (hrs)**
Registration	10.00 – 12.00
Lunch	12.00 - 13.00
Welcome: Eli Aamot, Statoil	13.00 - 13.10
Opening: Janne Sollie, Directorate of Nature Management (DN)	13.10 - 13.20
Session 1: Introduced marine organisms – problems and preventative measures	Chair: Chris Hopkins Rapporteur: Eva Degré
Ingrid Bysveen Mjølnerød (DN): Marine introductions – what really is the problem?	13.20 - 13.50
Heidi Hansen (DN): The Convention on Biological Diversity and Norway's responsibilities regarding alien species.	13.50 - 14.20
Coffee break	14.20 - 14.40
Session 2: Ecological and economic importance - status and potential developments	Chair: Kjell Maroni Rapporteur: Arne Bretten
Kjetil Hindar og Øystein Aas (NINA): Introduced organisms and their effects on wild salmon	14.40 - 15.10
Tormod Venvik (FHL-Aquaculture): Aquaculture and introduced species: Industrial possibilities and environmental threats.	15.10 - 15.40
Jan Sundet (IMR): The red king crab – introduced species and also a valuable fisheries resource	15.40 - 16.10
Session 3: Measures to reduce risk of introductions and spread of alien species from shipping and aquaculture	Chair: Terje C. Gløersen Rapporteur: Anne E. Langaas
Sveinung Oftedal (Norwegian Maritime Directorate): The IMO Convention on control and management of ballast water and sediments from ships	16.10 - 16.40
Ivar Hellesnes (Norwegian Food Safety Authority): Information about EC Directive 91/67 – The animal health basis for marketing of aquaculture animals and products	16.40 - 17.10
Dinner at Rica Hotel Nidelven	20.00
Day 2: 11 May 2004	**Time (hrs)**
Session 4: Identification of problem areas and future collaborative measures	Chair: Odd Terje Sandlund Rapporteur: Chris Hopkins
Working group topics: **a):** Risks, monitoring, regulation and combating of introduced marine organisms – strengths and weaknesses **b)**: Proposals for important research, management and regulatory measures	09.00 – 11.30
Coffee break	Self service in working groups
Plenum presentations from working groups	11.30 – 13.00
Conclusions, next steps and closing of the workshop	13.00 – 13.30
Lunch	13.30-14.30

7.3 Table 3. Questionnaire issued to individual participants for working groups.

Taking into account the presentations and discussions on Day 1, your own knowledge and referring to table 4, fill in this questionnaire as specifically as you can before starting the group work deliberations (Day 2). The outcome from each working group will be reported in plenum. The working group outcomes will be discussed and critiqued in plenum with a view to producing a consensus summary.

No.	Tasks on introduced marine species				
1)	What are your main concerns regarding threats & impacts?	a)			
		b)			
		c)			
2)	Proposals for future national actions concerning:	Research	Monitoring	Management/ regulation	Information dissemination
		a)	a)	a)	a)
		b)	b)	b)	b)
		c)	c)	c)	c)
3)	Bottlenecks; important impediments against effective measures	a)			
		b)			
		c)			
4)	Proposals for improving cross sectoral collaboration (*e.g.* shipping, aquaculture, environment & fisheries management, research, etc.) to reduce threats & impacts	a)			
		b)			
		c)			
		d)			
5)	What types of international (*e.g.* regional, global) collaborative projects should be established?	a)			
		b)			
		c)			

7.4 Table 4. General recommendations to deal with the introductions of alien species (modified after Weidema 2000, Hopkins 2001 and CBD 2002).

Legal and institutional needs
Unintentional introductions of species should be prevented
• International conventions and guidelines on this subject should be implemented nationally
• Pathways of introduction of invasive alien species should be identified and appropriate measures should be taken to minimize incursion and manage risks
Intentional introductions of species should be controlled
• No first-time intentional introduction or subsequent introductions of an alien species already invasive or potentially invasive within a country should take place without prior authorization from a competent authority of the recipient states.
• National and regional biodiversity strategies and action plans should be developed and implemented to address the threats to biological diversity posed by invasive alien species
• The involvement of all stakeholder groups should be facilitated in national and regional alien species strategies and action plans
• National legislation should be reviewed (and corrected if inadequate)
• National authorities in charge of control of intentional introductions should be established
• Risk assessment procedures before and monitoring after an intentional introduction are to be established and should be incorporated into environmental impact assessments
• Joint forums for consultation, coordination, and cooperation should be established
• Collaboration with trading partners and neighboring countries should be established to address threats of invasive alien species to biological diversity in ecosystems that cross international boundaries, to migratory species and to address matters of common interest
Management and control
Monitoring and dissemination of information should be improved
• Alien species should be included in monitoring programmes
• Regional cooperation should be established to improve monitoring of alien species
• Information ("early-warning-systems") should be developed to enable early detection of alien species and the spread of alien species into new areas
• Priority should be given to preventing the introduction of invasive alien species, between and within States
• Recommendations and strategies should be developed to take into account effects of alien species on populations and naturally occurring genetic diversity
Control methods must be developed
• Appropriate efficient and environmentally sound control measures are needed
Knowledge and research
• Research on introduced species should be funded and encouraged
• Groups that may contribute to preventive work should be targeted with information and education. These groups include policy makers at all levels of government, the private sector and quarantine, customs and other border officials as well as the general public
• Public awareness about alien species and the risks associated with the introduction of alien species must be improved
• Criteria for assessing risks from introduction of alien species to biological diversity at the genetic, species and ecosystem levels should be developed
• International scientific and technical cooperation should be promoted and facilitated
• Databases and clearing-house mechanisms should be developed to disseminate information on the prevention, early detection, monitoring, eradication and/or control of invasive alien species

7.5 Table 5. Examples of international conventions, agreements, directives and codes of conduct/ guidelines concerning preventing the effects of introductions of aquatic alien organisms.

Note: The list is intended to be illustrative rather than definitive.

Bern Convention on the Conservation of European Wildlife & Natural Habitat (Bern 1979)
Bonn Convention on Migratory Species of Wild Animals (Bonn 1979)
UN Convention on the Law of the Sea (UNCLOS 1982)
Rio Declaration of the UN Conference on Environment & Development (UNCED 1992)
Convention on Biological Diversity (CBD 1992), and 'Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species' (CBD 2002).
European Community: Birds Directive (EC 1979); Fish Health Directive (EC 1991); Habitats Directive (EC 1992); Fish Diseases Directive (EC 1993); Bivalve Shellfish Diseases Directive (EC 1995); Water Framework Directive (EC 2000); Directive on the Deliberate Release into the Environment of Genetically Modified Organisms (EC 2001)
UN Convention on the Law of Non-navigational Uses of International Water Courses (UN 1997)
International Plant Protection Convention (IPPC 1951)
FAO Code of Conduct on Responsible Fisheries (FAO 1995), including supporting Technical Guidelines (FAO 1996, 1997)
International Council for the Exploration of the Sea: 2003 Code of Practice on the Introductions & Transfers of Marine Organisms (ICES 2003)
International Maritime Organization: Guidelines for the Control & Management of Ship's Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms & Pathogens (IMO 1997); International Convention for the Control & Management of Ship's Ballast Water & Sediments (IMO 2004).
North Atlantic Salmon Conservation Organization: Resolution ('Willamsburg Resolution') by the Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimise Impacts from Aquaculture, Introductions and Transfers, and Transgenics on the Wild Salmon Stocks (NASCO 2003)
OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic: Annex V of the OSPAR Convention (OSPAR 1998)
International Conferences on the Protection of the North Sea: Statement of Conclusions of the Intermediate Ministerial Meeting on the North Sea: Integration of Fisheries & Environmental Issues (IMM 1997); Bergen Ministerial Declaration of the Fifth International Conference on the Protection of the North Sea (NSC 2002)
World Conservation Union: Guidelines for the Prevention of Biodiversity Loss Due to Biological Invasion (IUCN 2000)
World Organization for Animal Health: Aquatic Animal Health Code (OIE 2004)

7.6 Annex 1. Terminology and definitions regarding alien species.

In the literature a wide range of terms, some of which are synonymous, have been used to describe species or organisms that are 'new' in an area. These include terms such as 'non-indigenous, alien, exotic, introduced, translocated, transferred, transplanted and invasive'. Common for these terms is the understanding that the species or stocks (*e.g.* genetic integrity) have been moved outside of their normal range by human activities, either intentionally or unintentionally. Unless otherwise specified, definitions are based on the IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species (IUCN 2000): http://www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm).

Term	Definition
Native species	A species, sub-species or lower taxon, occurring within its natural range and dispersal potential (*i.e.* within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans)
Alien species (non-native, non-indigenous, introduced, foreign, exotic)	A species, subspecies, or lower taxon (*e.g.* a variety, race, provenance or stock) occurring outside of its natural range and dispersal potential (*i.e.* outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.
Alien invasive species	An alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.
Introduction	The movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce), outside it's historically known natural range, within the same country or in another country.
Established species	Species occurring as a reproducing, self-sustaining population in an open ecosystem, *i.e.* waters where the organisms are able to migrate to other waters (Anon. 1996).
Incidental species	Alien species that have been introduced through human agency into a new area, but have not become established in the wild (OSPAR 1997).
Unintentional introduction	An introduction made as a result of a species utilizing humans or human delivery systems as vectors for dispersal outside its natural range. (The introduction is incidental to the main transaction taking place (often trade), but may have major environmental consequences).
Intentional introduction	An introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential. (Such introductions may be authorized or unauthorized).
Secondary introduction	One that takes place as the result of an intentional or unintentional introduction into a new area, when the species disperses from that point of entry into areas it could not have reached without the initial (primary) human aided introduction. (OSPAR 1997).
Transferred species	Any species intentionally or accidentally transported and released within its present range (ICES 2003).

7.7 Annex 2. Explanation of acronyms used in the document.

BDC	Biodiversity Committee (of OSPAR)
CBD	Convention on Biological Diversity
CHM	Clearing-House Mechanism (of CBD)
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CoE	Centre of Excellence
COP	Conference of the Parties (of CBD)
DIAS	Database on Introductions of Aquatic Species (of FAO)
DN	Norwegian Directorate of Nature Management
EC	European Commission/European Community
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EIFAC	European Inland Fisheries Advisory Commission (of FAO)
ERNAIS	European Research Network on Aquatic Invasive Species
FAO	Food & Agriculture Organization (UN)
FHL	Norwegian Seafood Federation
FP7	EC's Seventh Framework Programme for Research and Technological Development
GBP	British Pound (Currency)
GISD	Global Invasive Species Database (of GISP)
GIS	Geographic Information Systems
GISP	Global Invasive Species Programme
IAS	Invasive Alien Species
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organization (UN)
IMR	Institute of Marine Research, Norway.
IMWG	Information Management Working Group (of GISP)
ISSG	Invasive Species Specialist Group (of IUCN)
IUCN	International Union for the Conservation of Nature — The World Conservation Union
MEPC	Marine Environment Protection Committee (of IMO)
NASCO	North Atlantic Salmon Conservation Organization
NCM	Nordic Council of Ministers
NGOs	Non-Governmental Organizations
NINA	Norwegian Institute for Nature Research
NOBANIS	Nordic-Baltic Network on Invasive Species (funded by the NCM)
NOK	Norwegian kroner
OIE	World Organization for Animal Health
OSPAR	OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic
RBIC	Regional Biological Invasions Center
SBSTTA	Subsidiary Body on Scientific, Technical & Technological Advice (of CBD/COP)
SGBOSV	Joint ICES/IMO/IOC Study Group on Ballast Water & Other Ship Vectors
USD	United States Dollar
WFD	The EC Water Framework Directive
WGISIM	Nordic - Baltic Invasive Species Information Management Working Group
WGITMO	Working Group on Introductions & Transfers of Marine Organisms (of ICES)
WWF	World Wide Fund for Nature

Utredninger oversikt

2002

2002-1:	Finprikkauren på Hardangervidda	50,-
2002-2:	Forvaltning av fiske i innsjøer med fritt midtparti	50,-
2002-3:	Utvikling og utsetting av elvetrål, River-Fish-Lift, (RFL).	50,-
2002-4:	Effekter av kalking på fjellvann	50,-
2002-5:	Bekkekalking med skjellsand og kalkgrus	50,-
2002-6:	Produksjon av abbor og mort i næringsfattige moderat forsura skogsvatn, med mulig effekt av kalking	50,-
2002-7:	FORSKREF – Forskning- og referansevassdrag. Årsrapporter Atna og Vikedal 1997 -1999.	50,-
2002-8:	Bestandsstatus for laks i Norge 2001. Rapport fra arbeidsgruppe	50,-

2003

2003-1:	Contamination of the terrestrial environment near the Norwegian - Russian border: Arsenic, chromium, cobalt, and selenium in vegetation.	50,-
2003-2:	Bestandsstatus for laks i Norge 2002. Rapport fra arbeidsgruppe	50,-
2003-3:	Mulige skadevirkninger av vassdragskalking på biologisk mangfold	50,-
2003-4:	Friluftsliv for funksjonshemmede. Anbefalinger om tiltak for å bedre funksjonshemmedes muligheter til friluftsliv	50,-
2003-5:	Laksen er tilbake i kalkede Sørlandselver - reetableringsprosjektet 1997-2002	50,-

2004

2004-1:	Store og Lille Hovvatn i Aust-Agder - en samlerapport etter 25 år med forsuringsundersøkelser og kalking.	50,-
2004-2:	Sportsfiske etter sjøørret i Trondheimsfjorden Deltakelse i fisket og estimering av fangst	50,-
2004-3:	Satellittdata til kartlegging av arealdekke. Utprøving av beslutningstremetodikk i Østfold fylke	50,-
2004-4:	Vannkjemisk og biologisk utvikling i innsjøen Vegår i Aust-Agder etter 17 år med kalking	50,-
2004-5:	Moser i kulturlandskapet og registreringer i åkerkanter og beitemark i Trondheimsfjordområdet.	.50,-
2004-6:	Bestandsstatus for laks i Norge 2003. Rapport fra arbeidsgruppe	50,-
2004 –7:	Vossolaksen - bestandsutvikling, trusselfaktorer og tiltak	50,-

2005

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Directorate for Nature Management
The Directorate for Nature Management (DN) is the central professional organ for nature management in Norway. DN was established in 1985, as a department under the Norwegian Ministry of Environment.

Authority to manage natural resources is given through a variety of laws and regulations. Apart from its legally specified tasks, the Directorate also has a responsibility to identify, prevent and solve environmental problems through collaboration with, and the provision of advice and information to other authorities and population groups.

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