PEER REVIEW EVALUATION OF THE INSTITUTE OF MARINE RESEARCH (IMR), BERGEN

June-September 1994

1. The Evaluation Panel and its mandate

1.1 The Panel

The following Panel was appointed in a letter from Viggo Mohr, Director for Bioproduction and Processing of the Norwegian Research Council on 28th February 1994.

Professor John Gray, Biological Institute, University of Oslo, Norway (Leader)
Dr. Katherine Richardson, Marine Ecology Institute, Danish Fisheries and Marine Research Institute, Denmark
Dr. Robert Dickson, Fisheries Laboratory, Lowestoft, England
Dr. Sebastian J. de Groot, Aquaculture and fisheries Management, State Fisheries Institute, Netherlands
Director Jakob Jakobsson, Fisheries Research Institute, Iceland
Manager Knut Vartdal, Vartdal Fisheries, Norway
Fishfarmer Cand. Real. Karl Olaf Jørgensen, Birkeland, Norway

In March 1994, Dr R.R. Dickson advised he was unable to take part in the work of the Panel. It was not possible to appoint a successor. The Panel wishes to record that a consequence of this the Panel is weak on expertise on chemical oceanography and that this weakness may colour our judgement on relevant aspects of the work of the Marine Research Institute, (IMR).

On June 2nd Manager Vartdal advised that he also could not take part in the work of the Panel. This has severely weakened the Panel in relation to the Mandate's section on the relevance of IMR's research to the Norwegian fishing industry. This area is not adequately covered by the expertise of the remaining members. As a consequence we believe that we are unable to satisfactorily fulfil this section of our mandate.

1.2 Mandate

The mandate given to the Panel on its appointment is as follows:

"The point of departure of the evaluation process must be the objectives that have been set out for the Institute's activities , in addition to its budgetary framework, sources of finance, technical and experimental equipment, scientific organisation and personnel situation.

A. Scientific quality:

- What is the national and international status of the Institute of Marine Research in terms of its scientific quality and selection of research topics?
- Are there areas in which the Institute of Marine Research lies at the forefront of research and/or has particularly strong prospects of doing so?

- Are there areas in which the Institute for Marine Research is weak, but in which it ought to have considerable competence?

Among the aspects that the evaluation ought to emphasise are:

- The scientific standard of the Institute compared with that of similar institutes in Norway and other countries
- The originality of its selection of projects
- Its choice of methodology and methodological expertise.

B. Scientific relevance:

- Does the Institute follow up the research strategy priorities of the Ministry of Fisheries?
- On the question of emphasis on, and allocation of resources to, fields of activity, does the research profile of the Institute match the wishes of its research sponsors?
- Is its choice of projects relevant to the problems and tasks facing the fishing and aquaculture industries, including resources and environmental monitoring?

C: **Future research activity:**

- Given the goal of the Institute of Marine Research, which is to be a leading international research centre in the fields of research of most relevance to the Institute, what recommendations does the evaluation committee have to make as regards its future activities?"

2. Basis of the review

The chairman met with the leadership of IMR on 17th March 1994. Taking into account the mandate, the structure and plan for the evaluation was agreed at this meeting. Since the research structure of the IMR has recently been reorganised around programmes of research it was decided that the peer review evaluation would be made at the level of the twelve research programmes within IMR. A short presentation of each programme would be produced in English, together with an overview of the budget and a standardised publication list for each programme divided into international, ICES and other publications. In addition an overview of the organisation of the institute would be provided together with tables showing the personnel and cruise programmes for 1994.

A programme was devised for the peer review which would take the form of a short presentation of each programme followed by interviews with the Panel. Two meetings of the Panel were held. The first from June 6th to 9th 1994 at the IMR in Bergen, when Programmes 1-6 were reviewed. Panel members, except Dr K. Richardson visited the Aquaculture Research Stations at Matre and Austevoll on June 9th. The second meeting of the Panel was held at the Flødevigen Marine Research Station on September 5th, where the Station was visited and activities presented. Programme 11

was reviewed at Flødevigen. On 6th and 7th the Panel met in Bergen, at the IMR and reviewed Programmes 6-10 and 12.

Following the first meeting of the Panel (6th to 9th June 1994) additional material was requested covering sample project proposals used for internal review purposes, on the age-structure and sex ratios of the staff, revised publication lists showing where publications are duplicated and the "Virksomhetsplan for 1994".

A list of documents used in the review is shown in the appendix.

3. Fisheries Research and Fisheries Institutes

3.1 Fisheries research

In prehistoric times, man was totally reliant upon nature to produce his food, which he then collected or caught to fit his needs. Gradually, through time, man has gained more and more control of the production of his own food. This has especially occurred through the development of agricultural practices where the farmer controls which crops will be sown and in what quantities. The capture of food through fisheries, however, still resembles early hunting practices in that modern fisheries are still almost entirely dependent upon nature's own production of the prey organisms. In an attempt to gain some control over the resource, efforts are underway to develop aquaculture and sea ranching activities. However, the major production of the resource is still in the hands of nature.

In order to ensure that fishing activities do not come to threaten their own existence by removing the production basis of the stocks, most developed countries have established fisheries research activities. In addition to assessing the size of the finfish and shellfish stocks and the impact of fisheries on them, these activities often include investigations relating to gear development and basic research aimed at describing the relationship between various environmental/ecological processes and the production of fish species. More recently, fisheries research in many countries has been expanded to include analysis of the interaction between fisheries and the ecosystem in general and activities aimed towards the development of aquaculture and sea ranching.

Fisheries research differs from basic marine biological research in that the latter has the goal of improving our understanding of the ocean as a whole and the organisms found in it through basic research. Fisheries research can, however, include basic research when the goal of this research is to better the existing understanding of the production of fish resources.

3.2 Fisheries Research Institutes in Scandinavia

The data that follows on Fisheries Research Institutes is taken from the European Directory of Research Centres in the Fisheries Sector 1994, printed for the Commission of the European Communities by Kluwer academic publishers. The data refers to 1991, unless otherwise stated.

It should be noted that there may be differences in the percentage of the total national investment in fisheries research which is directed to other national institutions between the countries compared here. However, for the purposes of comparison, it is assumed that the major portion of fisheries research activities is being carried out at the primary fisheries institutes.

Denmark

Danish Institute for Fisheries and Marine Research

Research activities	**Facilities**	**Staff**	**Research budget ECU/year**
Development of models for interaction between fish stocks and fisheries (multispecies) Studies of interaction between environment, fish stocks and fisheries Studies of processes within the food chain structure, e.g. plankton- fish larvae, feeding biology, physiology and recruitment Studies of effects of enhancement of marine species Fish diseases Development of hydro acoustic techniques	Research vessel and two minor vessels Indoor-outdoor small and large scale experimental tank systems Data bases, libraries, laboratories	Scientists 35 Others 70	5.000.000

Norway

Institute of Marine Research (Data updated to 1993: information from IMR)

Research activities	**Facilities**	**Staff**	**Research budget ECU/year**
Studies and monitoring marine life and environment, and interactions in the ocean and coastal waters Acquire new, up-to-date understanding of the marine resources important for the fishing and aquaculture industries Develop technological and biological bases on which to build rational, forward-looking fishing and aquaculture industries Provide the authorities and the fishing industry with advice on managing the marine environment and the marine resources Publish the results of research, for the benefit of the fishing and aquaculture industries and others	3 ocean going vessels and 2 fjord-operating vessels Two large aquaculture facilities Fish stock and environmental data bases. Indoor and outdoor small- and large-scale experimental tank systems, libraries, laboratories	Scientists: 122 Others 345 (crews inciuded)	32.227.142 (1993)

Sweden

Institute of Marine Research - National Board of Fisheries

Research activities	**Facilities**	**Staff**	**Research budget ECU/year**
Fisheries management, including stock assessment, multi-species biological models Environmental impacts Fish diseases Fishing techniques Aquaculture	Research vessels Rearing tanks	Scientists: 10 Others 45 (crews included)	2.451.900

Iceland

Marine Research Institute, Reykjavik (Data corrected by Director Jakobsson)

Research activities	**Facilities**	**Staff**	**Research budget (ECU/year)**
Fisheries management Stock assessment Multi-species biological models Oceanography Plankton ecology Aquaculture research	Research vessels Specialised research and analytical apparatus Data bases/libraries Rearing tanks for aquatic research	Scientists: 60 Others: 80 (crews included)	8.800.000

The specific resources devoted to fisheries research at IMR in 1994 are given in sections 4.2.1 and 4.2.2. The following data are taken from the Nordisk Statistiske Årsbok 1994 and are based on 1992 data. We have assumed that there is relatively little change in Gross Domestic Product (GDP), (which is equivalent to the Scandinavian use of BNP) over the period 1992 to 1994.

The Norwegian GDP is approximately NOK 757 000 million. The value of commercial fish landings in **Norway** was NOK 5 630 million in 1992. IMR's budget of NOK 231 million represents an investment in fisheries research of 0.03% of the Norwegian GDP and 4.1 % of fish landings. In Norway, unlike Sweden and Denmark the aquaculture industry is of major importance. In 1993 the first-hand value of this industry was NOK 6 000 million. The proportion of funds allocated to aquaculture research (NOK 31.6 million) compared with its value shows an investment of approximately 0.53 %. The investment in fisheries research as a whole (which includes aquaculture research), therefore represents 1.98% of the value of the combined commercial fish landings and the aquaculture sales.

By comparison the annual budget for the fisheries research institute in **Sweden** ("Havfiskelaboratoriet" in Lysekil and Karlskrona) in 1992-1993 was approximately

NOK 16.3 million. Approximately 80% of this funding came from the Fisheries Board. The value of fish landed in 1992 was NOK 676 million. The Swedish GDP is approximately NOK 1 636 000 million. Thus the investment in fisheries research represents approximately 2.41 % of the value of fish landings and approximately 0.04 % of the GDP.

In **Denmark**, the 1993 budget for the fisheries research institute (Institute for Fisheries and Marine Research in Charlottenlund and Hirsthals) was approximately NOK 36 million. As in Sweden, approximately 80% of this funding was supplied directly from the Fisheries Ministry. In addition to a marine fisheries institute, the Fisheries Ministry maintains a separate institute devoted to freshwater fisheries (Silkeborg). The value of fish landed in Denmark in 1992 was NOK 4 131 million. The Danish GDP is approximately NOK 947 876 million. Thus, the total investment in fisheries research in Denmark in 1993 was approximately 0.87 % of the value of the commercial fish landings and approximately 0.003 % of the Danish GNP.

In **Iceland**, the 1993 budget for the Marine Research Institute in Reykjavik was approximately NOK 72.3 million. About 84% of this funbding was supplied directly by the Ministry of Fisheries. The value of fish landings in Iceland was about NOK 4950 million while the Icelandic GDP is approximately NOK 44 500 millions. Thus the investment in marine research in Iceland constituted about 1.46% of the value of the landed fish (first hand value) and 0.16% of the Icelandic GNP.

3.3. Selected fisheries research institutes in Europe other than Scandinavia

Belgium

Rijksstation voor Zeevisserij, Oostende

Research activities	Facilities	Staff	Research budget ECU/year
Fisheries management Stock assessment Environmental problems and their impact on resources Fishing techniques Upgrading of fishery products Improvements of techniques for handling, storing, processing, packaging fish Methods for grading and quality assessment of fish	Research vessel Specialised computer hardware and software	Scientists: 12 Others: 25	approx. 1.3000.000

Germany

Federal Research Center for Fisheries, Hamburg

Research activities	Facilities	Staff	Research budget

			ECU/year
Fisheries management Stock assessment, recruitment, mortality, multi-species models Environmental problems Fishing techniques Fishing gear technology and echo-sounding Aquaculture Aqua- and mariculture Characteristics and upgrading of fishery products Quality and health aspects, standardisation and legislation	3 research vessels Recycling systems for aquaculture Analytic laboratories Material testing laboratory Documentation service Database, extensive libraries UW-video-system, processing of video-materials Echo-integration system	Scientists: 81 Others: 206	7.030.600

Netherlands

Rijksinstituut voor Visserijonderzoek (RIVO-DLO), Ijmuiden, Yerseke

Research activities	**Facilities**	**Staff**	**Research budget (ECU/year)**
Fisheries management Stock assessment Multi-species interactions Ecosystem effects of fishing activities Environmental problems and their impact on resources Fishing techniques Quality of fisheries products Fishery technology Aquaculture Molluscan fisheries research Stock assessments, population studies Fisheries management advice Interaction of molluscan fishery and ecosystems Culture of molluscan shellfish Culture techniques Storage of live molluscs Water quality in molluscan culture and fishing areas Bacteriological monitoring and studies Monitoring and studies of toxic phytoplankton species	Controlled environmental chamber Database, extensive libraries Specialised analytical apparatus Specialised software Seawater aquarium 4 research vessels*	Scientists: 26 Others: 67	7.500.000

*not included in research budget (Ministry of Agriculture and Nature management and Fisheries Directorate)

United Kingdom

Ministry of Agriculture, Fisheries and Food (MAFF) - Directorate of Fisheries Research, Lowestoft

Research activities	Facilities	Staff	Research budget ECU/year
Fisheries management Stock assessment Multi-species biological models Multi-disciplinary approach to fisheries management Marine biology of commercial species Physiology, behaviour and genetics Reproduction, recruitment, and ecology Plankton and productivity Oceanography Physical and chemical monitoring Modelling Nutrient conversion in estuaries Aquaculture Reproduction and juveniie stages of reared species Genetics Enhancement of stocks Fish and shellfish disease monitoring and research Hygiene standards for live bivalve molluscs Environmental protection-monitoring and research Impact of radioactive and non-radioactive pollutants on aquatic resources Contaminant behaviour and pathways in the aquatic environment Deep ocean disposal of radioactive wastes Biological impact of wastes dumped at sea Development of sensitive assays for pollutants Effect of humane activities: gravel dredging, oil exploration, coastal construction works, etc. Impact of fishing on benthic communities Modelling waste dispersion in coastal seas	2 research vessels Flume tank, rearing tank and sea-water aquaria Mesocosm Specialised computer hardware and software Specialised libraries and extensive databases Sophisticated chemical and radioactivity analytical facilities Electronic engineering laboratory with large acoustic test tank	Scientists: 285 Others: 158	28.000.00

Scottish Office Agriculture and Fisheries Department (SOAFD) - Marine Laboratory, Aberdeen

Research activities	Facilities	Staff	Research budget (ECU/year)
Fisheries management Stock assessment Multi-species biological models Environmental problems and their impact on resources Fishing techniques Selective gears Hydrodynamics of gears Other improvements in gears and /or fishing vessels Aquaculture Reproduction Disease, immunology, stress	Research vessel Rearing tank Mesocosm Data bases, extensive libraries Field site, electron microscope, specialised analytical apparatus	Scientists: 99 Others: 60	17.190.000

This comparison illustrates that the resources devoted to fisheries research at IMR are large compared with sister institutes in Scandinavia. The UK effort is larger involving some 45 million ECU's on fisheries research which involves 384 scientists. The importance of fisheries to the Norwegian economy is large in comparison to Sweden and Denmark. In addition IMR has responsibilities for managing fisheries resources in the North, Norwegian and Barents Seas, a wide geographic area and for managing the marine environment of an exceptionally long coastline.

3.4. Other relevant research institutes in Norway

3.4.1 The Norwegian Institute for Water Research (NIVA)

NIVA is an institute devoted to applied and strategic research mainly concerned with water pollution problems. It undertakes routine monitoring in coastal areas funded by the State Pollution Board (SFT) and in the marine field does research on coastal areas and fjords. It has research centres in Oslo, Grimstad and Tromsø.

3.4.2 The Norwegian Institute for Nature Research (NINA)

NINA is an institute devoted to applied ecology and the sustained management of nature. NINA carries out research, monitoring and environmental impact analysis in particular within population and community ecology on land and in freshwater. It conducts research on salmonids and on coastal ecology

3.4.3 Universities

At Bergen, Oslo, Tromsø and Trondheim Universities there are teaching and research facilities in marine science. At present only Oslo specialises in marine chemistry and only Bergen in oceanography, whereas marine biology is taught and researched at all four universities. Bergen and Tromsø have strong fisheries specialisations.

3.4.4 Norwegian Institute of Fisheries and Aquaculture Ltd (Fiskeriforskning)

This institute is an applied research institute owned by the Minsitry of Fisheries and the NORUT Group Ltd. The instuitute undertakes reserarch in the areas of marine biotechnology, fisheries and aquaculture technology, economics and marketing, aquaculture and marine resources. The institute has special duties as advisor to the fisheries authorities, and does stock assessment of commecially important species in Northern Norway and the Barents Sea.

3.4.5 Institute of Aquaculture Reserach Ltd. Akvaforsk

Akvaforsk is a resrach institute mainly owned by the Agricultural University of Norway and the Veterinanry College of Norway. The instiutute conducts research on selective breeding, genetics, nutrition and technology related to aquaculture, mainly salmonids. It has three research centres in Ås, Sundalsøra and Averøy.

3.4.6 Oceanor

Oceanor is a technological company that amongst other things, produces ocean buoys for monitoring and transmission of oceanographic data via satellite, which are widely used globally. It does research on development of automated marine monitoring methods.

4. Marine Research Institute, Bergen

4.1 Objectives and goals

The mission statement of IMR is given as:

> The Institute of Marine Research is an applied research institute which has the following objectives:
>
> - to investigate the environment and biology of the oceans and coasts, and develop suitable technology as a basis for fishing and aquaculture
> - to act as an advisory body for the Ministry of Fisheries, the Directorate of Fisheries, other authorities, the fishing industry and other industries in questions concerning the management of ocean and coastal biological resources and environment
> - to make known the results of its research and to disseminate information that will promote the Norwegian fishing industry and the interests of society in general.

4.2 Resources overview

The budget for IMR for 1994 as approved by the Norwegian Parliament is:

General **Research Vessels**

Post	Budget 1994 (thousands kr)	Post	Budget 1994 (thousands kr)
Salaries	66 000	Salaries	39 700
Goods and services	19 750	Goods and services	29 600
Special running costs	72 500	Special running costs	2 500
Total	**158 250**	**Total**	**71 800**

The activities of IMR are however run as research programmes where the two above costings are combined. It is at this programme level that IMR has been evaluated.

Programme budget 1994

Programme	Fisheries Dept	External sources	Total
1. Monitoring and assessment of the marine environment	11 800	1 000	12 800
2. Ecosystems Nordic Seas- "Mare cognitum"	15 400	4 000	19 400
3. Reproduction and recruitment	9 700	1 900	11 600
4. Resources ecology and multispecies modelling	14 900	4 600	19 500
5. Stock structure and abundance	60 100	2 100	62 200
6. Assessment	10 200	600	10 800
7. Young fish rearing	10 200	8 500	18 700
8. Aquaculture: growth and sexual maturation	10 200	7 000	17 200
9. Sea ranching and enhancements	4 600	9 800	14 400
10. Fishing gear technology and fish behaviour	14 000	4 000	18 000
11. Environment quality and fish health	6 600	4 000	10 600
12. Fisheries research in developing countries	0	9 000	9 000
13 Supporting projects	3 300	3 500	6 800
Total	**171 000**	**60 000**	**231 000**

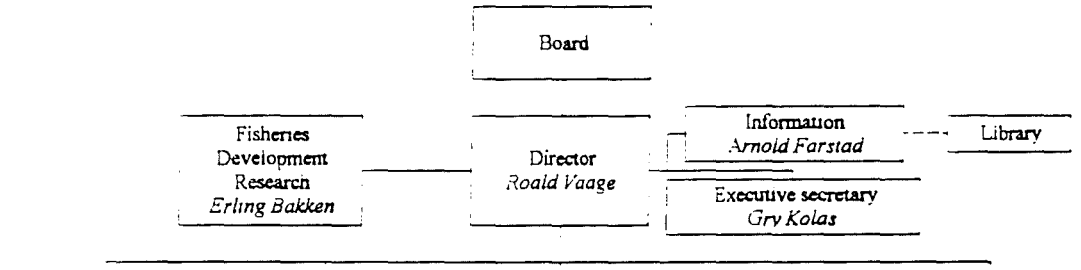
4.3 Personnel

The distribution of staff amongst categories is:

Category	Number in 1993
Management/Research Director	16
Scientific personnel	122
Project Leader	10
Engineer	29
Marine Research assistant/ Fisheries assistant	74
Laboratory assistant	10
Instrument technician	18
Technical assistant	10
Office staff (all categories)	71
Crew	107
Total	**467**

4.4 Organisation

The organisational structure of the institute is shown below:



Flodevigen Marine Research Station *Jakob Gjøsæther*	Department of Marine Resources *Asmund Bjordal*	Department of Marine Environment *Roald Sætre*	Department of Aquaculture *Vacant*	Administration and services *Maja Bauge*
	Pelagic Fish Division	Physical Oceanography Division	Marine Enhancement Division	Finance and Admin. Division
	Demersal Fish Division	Chemical Oceanography Division	Fish Health Division	Personnel Division
	Marine Mammals Division	Biological Oceanography Division	Austevoll Aquaculture Station: Marine Species Division	Computer Division
			Operations Division	
	Fish Capture Division	Ocean Data and Modelling Division	Matre Aquaculture Station: Salmonids Division	Research Vessels Division
			Operations Division	
				Electronic Instruments Division
				Tech. Services Division

The research **Programmes** are interdisciplinary and aim to cut across the sectorial boundaries of the **Departments** and **Divisions**. The budgeting units are at a lower level that of **Projects** and **Sub-projects** which are allocated within **Divisions.** Although **Programme Leaders** are responsible for the **Programmes** that they direct they have no budgetary responsibility which is at the **Project** and **Sub-project** level. Thus in the review we discuss not only the **Programmes** but also **Projects** and in some cases **Sub-projects.**

5. Review of Activities

5.1 Introduction

In the mandate for this review the IMR is described as an applied research institute. The Norwegian government has, in a white paper, (St. meld no. 28 (1988-1989) defined the different terms used to describe research. These are:

Research and development: activities of an original character conducted systematically in order to increase the fund of knowledge and to use this knowledge to find new practical applications. These activities cover:

Basic research: experimental or theoretical activities which are done primarily to discover new knowledge increasing our understanding of phenomena and observations without having a practical objective or use.

Applied research: activities of an original character to gain new knowledge, first and foremost to meet practical objectives and application.

Development work: Systematic work which uses new material and products, to develop new processes, systems or services, or to improve those which exist.

Whereas basic research is done primarily at academic institutions applied research is done at research institutes such as IMR. Basic research is usually judged in terms of its scientific quality which is usually assessed by the publication of the work in peer-reviewed literature of international standing. Nowadays it is common practice to use various measures of impact factor in addition to mere publication. Criteria such as the relative standing of the journal and the number of times articles are cited by peers are often used. On these bases it is possible to assess, within accepted methodological limits, whether or not the research done is near the forefront of science in the respective discipline.

With applied research it is necessary to judge not only the scientific quality but also the relevance of the research to society. In the case of the IMR relevance must be assessed in relation to the primary objectives of the institute, which are to ensure sustainable management of the environment and fisheries, including aquaculture, in the Norwegian coastal zones and ocean regions.

Thus in this review we apply criteria of a) the relevance to the Institute's objectives and b) the scientific quality of the research done. Both are in our view equally important.

In this review we recognise that Norway has jurisdiction over fisheries which stretch from the North Sea to the Arctic Ocean and Barents Sea and that the coastline is exceedingly complex with a range of habitats from exposed coasts to sheltered fjords. Thus the objectives of the IMR to manage sustainably the environment of Norway's coastal and oceanic living resources require considerable expertise and resources compared with other neighbouring countries. Furthermore, the fact that the total biomass of protein produced by the Norwegian aquaculture industry is now greater than that from Norwegian land-based agriculture and is achieved without State subsidies also needs to be recognised.

Since IMR has organised its research in cross-division (interdisciplinary) research programmes the Panel has made these programmes the basis of its review. We first make comments on the individual programmes and then draw general conclusions. As shown above (4.4) the programmes are divided into projects and often to sub-projects with goals described for programmes and projects.

5.2 The Review

First a general comment on the presentation of the programmes to the Peer review Panel. We had expected that each programme would present the best of its research and put this in context to other activities within the Institute. With some exceptions this did not happen. We were surprised that what we acknowledge as one of the Institute's world-class research interests, acoustics, was not presented to us. We had expected a presentation of the achievements and future direction of this work.

We were disappointed with some of the written and oral presentations which contained many spelling mistakes, inaccurate references to publications, illegible overhead tables, misjudgements of the time available for presentation and the importance of convincing the Panel of the relevance and quality of the work presented. With English language spell-checkers available on all modern word processors spelling mistakes on overheads are inexcusable. Some presenters apparently did not seem to take this review seriously. Professional presentation in English is important not only for reviews such as this but also if members of IMR are to be taken seriously in international fora. The potential entry of Norway into the EU will increase the need for IMR members to be able to perform effectively on the international scene.

As mentioned earlier, scientific performance is often judged on the basis of the number of publications produced. The performance indicator with respect to basic research is the "peer reviewed" publication which is almost always in English. However, in the case of strategic and applied research, "grey literature" (non-reviewed) publications often make a considerable contribution towards integrating science and management. Therefore, for an applied research institute such as IMR, it is appropriate to measure

scientific performance on the basis of production of both refereed, (i.e. peer reviewed) and grey literature.

In Figure 1, the number of refereed, ICES papers and reports produced per year (average in the period 1991-1993) are illustrated. ICES (International council for the Exploration of the Seas) papers are itemised separately because of the important role of ICES in providing advice on the state of fish stocks. This advice forms the basis for management decisions regulating fisheries. Reports, as used here, include reports published by IMR, reports to the research council and so on. Most of these reports are in Norwegian. Only reports for which there is a written record which can be obtained on request have been included. Thus, this category does not include contributions to ICES working groups, poster presentations, lectures etc. Popular scientific articles are not included in this analysis although the Evaluation Panel recognises that such articles have an important function in making the work of IMR known to the general public.

This analysis is based upon the data presented by IMR concerning publications in the period 1991-1993. After examining the originally supplied data, the Panel requested that the lists be edited so that duplication of papers in the different programmes was noted and the papers listed as being peer reviewed were actually from acknowledged peer reviewed journals. Unfortunately, even in the revised data material, a number of papers were improperly listed as peer reviewed in the Panel's opinion. Likewise, some papers listed as non-refereed were actually peer reviewed (i.e. ICES Science Symposia papers). Therefore, in this analysis, the Panel has used its own judgement in assigning the designation of "refereed". The Panel was not in a position to decide to which programme papers which were tallied under more than one programme should be assigned. Therefore, such publications are counted under all of the programmes for which they appeared.

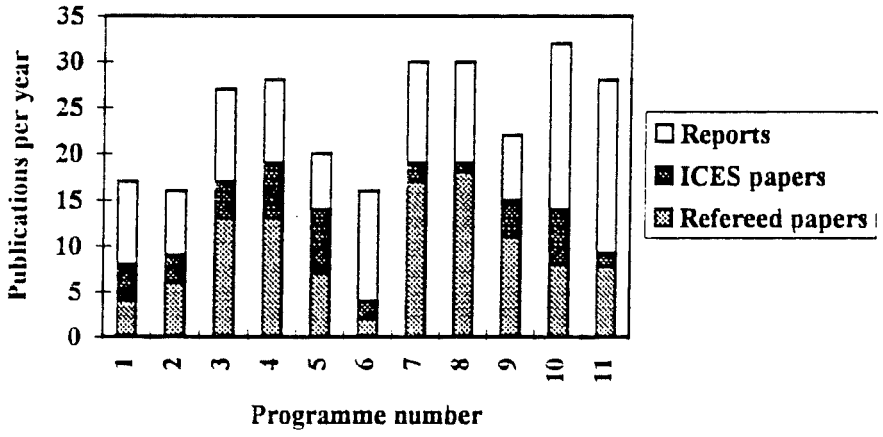


Figure 1 Analysis of publications at IMR 1991-1993.

In Figure 2, the publication performance per year for each programme is normalised to the number of scientist man years assigned to the programme in 1994 (data supplied by IMR). The publication rate per scientist varies considerably between programmes.

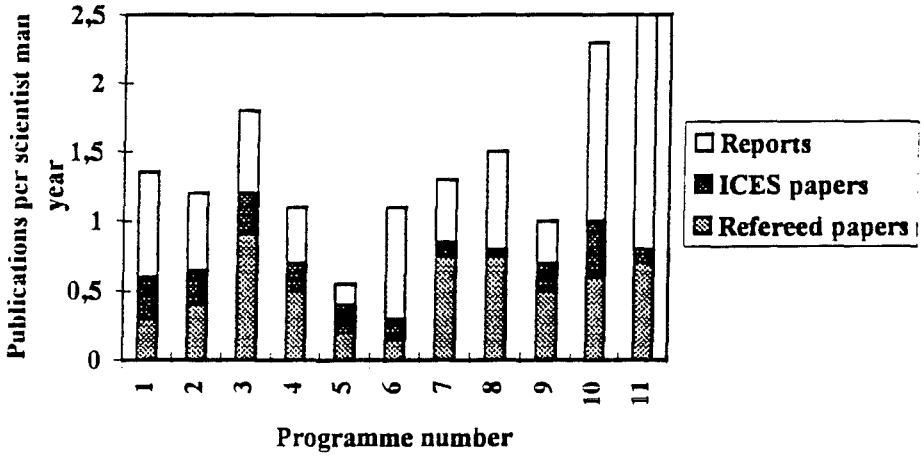


Figure 2. Analysis of publications at IMR standardised to scientist man-years.

The number of publications per programme appears to be a function of the external funding (Figure 3) with a clear increase in publication rate with the percentage of external funds.

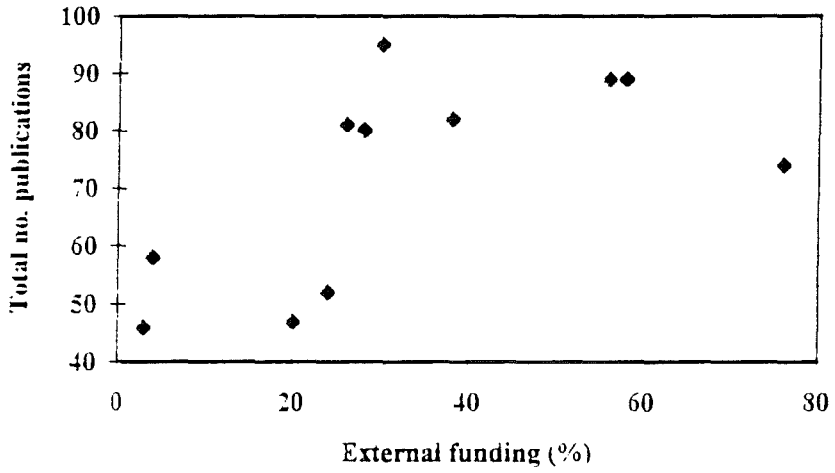


Figure 3. Publications at IMR as a function of external funding

In particular, the number of refereed publications appears to increase with external funding (Figure 4). There appears to be a slight decrease in the number of ICES papers with increased external funding.

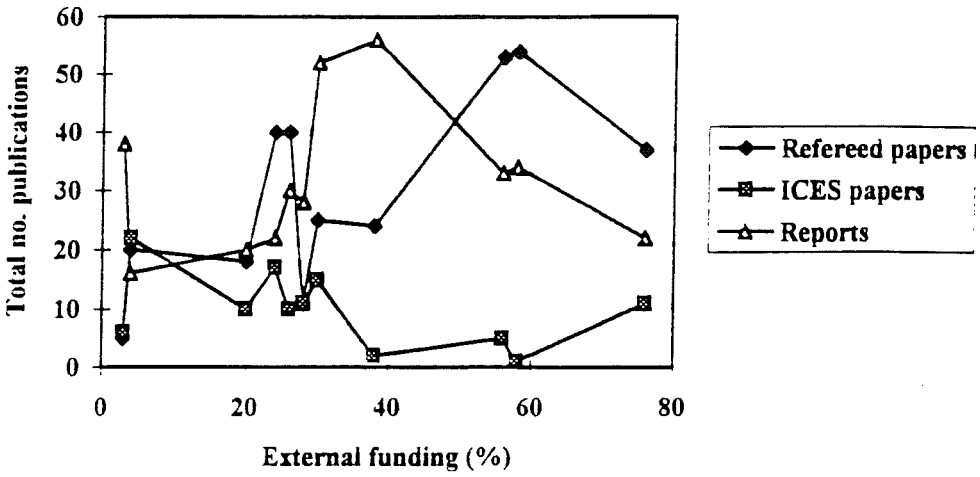


Figure 4. Different categories of publications at IMR as a function of external funding.

This pattern in publication performance leads the Panel to conclude that some percentage of "external funding" (i.e., that which IMR scientists are required to compete for) has a positive effect on scientific performance and production. The Panel believes, however, (see section 5.2.8), that a large percentage of external funding can be detrimental to the functioning of IMR as a whole. Therefore, we conclude that the "ideal" percentage of external funding in the various programmes within IMR may be of the order of 25-30%.

5.2.1 Programme 1. Monitoring and assessment of the marine environment

Objectives: to establish integrated, co-ordinated monitoring of the ocean climate, plankton and pollution in Norwegian coastal and ocean regions.

The total budget for the programme was in 1994 kr 20,794,325 with kr 5,596,000 coming from external sources. There are 15 separate projects, and an additional 5 sub-projects.

This programme is based on hydrographic surveys taken, either opportunistically on cruises primarily engaged on other projects such as stock assessment, or specific cruises at fixed hydrographic sections. In addition 27 fjords are analysed annually in the autumn.

In the presentation of this programme the Panel did not get a coherent view of the relevance of the projects and sub-projects to the overall aims of the programme or to related programmes. No distinction was made between monitoring, where there are specific goals that will be met such as testing that environmental quality standards are exceeded, and surveillance, where environmental variables are simply measured without there being specific tests made.

The data collected within this programme are fundamental to a number of IMR's programmes. For example it is important to know the scale and timing of the inflows

of Atlantic water to the Norwegian coast, Barents Sea and Skagerrak since this affects fish recruitment over wide areas. Likewise the Norwegian State Pollution Board has a need to assess the state of the marine environment and requires comprehensive surveys and analyses of trends.

The objectives of the programme are stated to be the establishment of integrated and co-ordinated monitoring of the ocean climate, plankton and pollution in Norwegian coastal and ocean regions. The Panel are concerned that as stated there is no way of knowing when or whether these objectives have been achieved. The Panel therefore, recommend that specific targets be set so that the achievement of these targets can be assessed, rather than an open-ended programme as is now the case.

The Panel is of the opinion that much of the programme's activities are "blind" data collection without having specific "users" in mind. In the Panel's view the inflow of Atlantic water to the Norwegian coast, the Norwegian Sea, the Barents Sea and the Skagerrak is of paramount interest for many of IMR's activities. Thus priority should be given to obtaining this data with reliability and precision. For the other routine recordings many are done at little cost in terms of time and effort (e.g. recording of hydrographic data on routine fish-stock cruises) and this data collection is probably cost-effective.

For many of the programmes at IMR there is a need for measurements of fluxes rather than concentrations. Yet this programme collects concentration data. Thus there is clearly need to respond more directly to the needs of other programmes.

The Panel support the continued automation of recording of data provided that priorities are clearly stated and identified. Likewise the development of a data-base for the whole institute also should be given high priority.

We recommend that there should be a comprehensive review (internal with an external expert such as Dr R.R. Dickson of the Fisheries Laboratory, Lowestoft) of all the routine data collected. This review should cover all the data collected within this programme.

Specific goals and if possible hypotheses should be erected for each series of data collected. Criteria should be devised for selection of data that will be recorded in different areas (e.g. what type of data, whether temperature, salinity, oxygen nutrients chlorophyll etc.), and the frequency that are necessary to meet the goals and hypotheses. Consideration should be given to application of new technology and automation where possible and these areas should be clearly identified and given priorities. Finally, the review should consider other related monitoring (e.g. NIVA's) and how best to achieve and integrated coverage.

5.2.2. Programme 2. Ecosystem Nordic Seas - "Mare cognitum"

Objective: to identify and quantify the most important factors and mechanisms causing variability in the ecosystem of the Nordic Seas, with the aim to predict fluctuations in ocean climate, production and fish stocks.

This programme had a budget of kr 27,781,390 in 1994 with 6,031,600 coming from external sources. The programme has 13 projects with 6 additional sub-projects.

The Panel like the overall aims of the project in that it is aimed at integration of knowledge of many components of the IMR research into a comprehensive framework. Ultimately this project will be the basis for collaboration with Universities in a national project. The framework of the project is to build a better understanding of ecosystem structure and function so that this will lead to better fisheries management in the long-term. In particular this approach is likely to be of benefit to the management of herring stocks.

In the Panel's view the goals are very ambitious and the Panel is not convinced that the projects will necessarily meet these goals. Again we believe that the goals and hypotheses are stated rather generally and it will be difficult to check whether these goals have been achieved or not. The Panel believes that there are too many projects and sub-projects and that the efforts are spread too thinly over too many topics.

In order for this project to be a success there is a need for measurement of fluxes rather than concentrations. The Panel endorses this view and have made a recommendation that Programme 1 looks into these needs. However, we noted that there was no indication presented of how flux measurements will be made or who would make them. Does the Institute have facilities for N^{15} work? Likewise there is, within this programme, a need for continued application of traditional and new acoustical methods and elsewhere we make a recommendation (see recommendation under Programme 5 Stock structure and abundance) that there should be a strategy within IMR for devoting funds to technological developments.

In order to achieve the ambitious goals stated the scientist:technical assistant ratio is too high. Extra technical help is needed if this programme is to succeed.

We recommend a clearer focus on fewer projects, with clearly stated goals and hypotheses and how one can measure whether or not these goals have been achieved. In addition contact should be made with scientists in the Faroe Islands, Iceland and perhaps Russia since all these countries have interest in this common area.

5.2.3 Programme 3. Reproduction and recruitment

Objectives: to increase the knowledge about how natural conditions affect survival and growth of the earliest life stages of fish, in order to contribute to: 1) ensure calculation of the year-class strength at an early stage and 2) clarify how human encroachments in the marine environment affect the recruitment of fish stocks.

This programme has a budget of kr 10,552,877 in 1994 with kr 1,698,400 coming from external sources. There are 11 projects and 6 additional sub-projects within this programme.

This programme was well-presented with a clear statement of the aims and objectives, achievements and constraints of the project. The Panel had a clear view of how the

programme was organised and its relation to other projects within the IMR. Furthermore, we applaud the regular programme meetings and believe that this is one of the reasons for the cohesiveness and integration of the programme as presented to us.

The Panel were impressed with the research on reproduction which is based on testable hypotheses and has led to publication in international journals. The Panel would like to encourage the group to make use of modern molecular techniques as these are likely to play a key role in the near future. Contact should be made to leading groups within Europe and the US.

Likewise the studies of turbulence and its effect on fish larval feeding and on microstructure of otoliths are of high international class and clearly relate to the overall aims of understanding the biology of the early life stages of fish.

The Panel are less convinced about the annual beach seine surveys. Just because this project has continued unchanged since 1919 is no justification for continuing into the future. We are pleased to note that a review of the data is planned.

We recommend that a review of the data collected in the beach seine surveys be initiated internally and then with an external consultant. Any future project resulting from the review should have clearly stated hypotheses and state clearly how any goals set will be tested.

5.2.4 Programme 4. Resources ecology and multispecies modelling

Objectives: to investigate food basis, population dynamics, stock density, distribution and migration patterns for all important living marine resources in our waters, and to evaluate and develop models for fish population dynamics which quantify the interaction between species and the effects of environmental fluctuation on fish stock development.

The budget is 13.640.000 with 5.702.000 from external funds. There are 16 projects and an additional 19 sub-projects within the programme.

The Panel were impressed with the presentation which gave a clear overview of the relationships between this Programme and the others at IMR. In the Panel's view this is a good quality programme that is central to the work of IMR. The undoubted success of this project as shown by the high number and quality of publications in international journals can clearly be related to the wise collaboration with University scientists, notably Aksnes and Giske. We believe that the ratio of external to internal funding of 25% is about optimal and that this is reflected in the ratio of applied to basic research which is also about optimal.

The Panel is however, concerned that there are too many projects and sub-projects and that co-ordination and integration of so many cannot be properly achieved. In particular the lobster project in the Skagerrak fits poorly within this programme.

We recommend that the goals and hypotheses for the project be revised following a thorough review of the projects and sub-projects which has the aim of reducing the number to a maximum of 4-5. Care should be taken to get in place a system whereby the progress on the programme can be evaluated by objective criteria.

5.2.5 Programme 5. Stock structure and abundance

Objectives: 1) to measure the abundance of fish stocks, marine mammals and invertebrates in relative or absolute numbers; 2) to establish stock unit/management unit of the most important fish stocks, seals, whales and invertebrates; 3) to improve methods for abundance estimation in order to increase the precision of the assessments and to minimise systematic bias; 4) to do the work as cheaply as possible within responsible limits.

The budget for the programme is 66.815.000 with 13.057.000 from external sources. There are 11 projects and an additional 29 sub-projects within this programme.

The Panel got a poor impression from the presentation of the integration and structure of this programme. It is by far the most expensive at IMR and therefore, needs a high level of scientific expertise and careful integration into other programmes in order to justify this expense.

It is argued that one of the most important functions of the IMR is the assessment and prediction of stocks of fish under Norwegian jurisdiction. Tradition weighs heavily with this programme in that the same cruises are conducted year by year at the same time and to the same areas. This is done in order to establish long-term time series necessary for calibrating survey indices. The programme makes heavy demands on ship time and even so this is supplemented by the hiring in of commercial trawlers for the Barents Sea surveys. In fact it was claimed that the hiring in of trawlers for this latter task was preferred.

We agree in principle with the statement made to us that multi-species management will not replace the need for single species surveys and management. However, we believe that surveys should continuously be optimised for the goals and hypotheses being investigated. To this end the Panel believe that there is a need to set clear goals and targets for the surveys in terms of the precision needed, cost-benefit analyses of alternative strategies etc. (i.e., How much accuracy in biomass estimates would be lost by conducting some surveys every other year instead of every year?)

The main survey in the Barents Sea takes place in January-March, whereas the Svalbard-survey takes place in autumn. The panel are conscious that over this period (January-March) there will be changes such as migrations of stock, temperature changes etc. which will influence the results. Thus there is need for as rapid a survey as possible at the time of the year when fish migrations are minimal. The panel recommend that the feasibility of joining the Svalbard and the Winter surveys be considered with the view of conducting a comprehensive survey of all areas at a time of least variability, i.e. during the autumn. The need to utilise modern acoustic

programme that "everyone else takes time from". Yet getting the assessments done correctly and in a time-frame appropriate to setting quotas in ICES should be a top priority.

We recommend that higher priority be given to prepare assessments (including multi-species assessments) than is done at present, 2 man-years is not enough. The possibility of hiring temporary staff in order to shorten the delay in making the annual statistics available should be investigated. This is a time-consuming process that needs to be free from distractions. This probably cannot be achieved if those involved are at their own desks, a disturbance-free environment is needed!

We recommend that consideration should be given to doing surveys in autumn using standardised methods and thereby there will be adequate time for making the assessments. This is the practice in Iceland and co-ordination with Iceland on this issue is desirable.

5.2.7 Programme 7. Young fish rearing

Objectives: to develop methods for cost efficient fry production of marine species in aquaculture.

The budget is 11.227.000 with 7.179.000 from external sources. There are 9 projects with an additional 13 sub-projects.

The Panel was given a clear presentation both of the programme, with excellent overheads, and presentation of the key problems studied. The publication record in international refereed journals is excellent. There is no doubt that this is an integrated research group which is well led. The research done responds to the key questions being asked within these aspects of aquaculture and development of techniques for rearing fish larvae has been highly successful. The halibut work developing from just two larvae through metamorphosis 5 years ago to hundreds of thousands in production today is a considerable achievement.

International collaboration has not developed as far as is desirable. We acknowledge that in some aspects, such as some short-term contracts there is a need for secrecy. However, we believe that the programme would benefit from wider international contacts.

Although some efforts are being devoted to copepod rearing (*Eurytemora*) in our opinion more effort should be devoted to this area. In relation to disease we note that the group is only just moving to new molecular techniques and although there is some collaboration with other programmes we feel that the tragic loss of Emmy Egidius and her contact net is still being felt. Disease research at IMR is still in its infancy and this area should be strengthened (see 6.1.3)

The programme obtains over 70% of its funds from external sources, which is a laudably high percentage. This high percentage of external funds encourages high productivity as judged by international publications, in order to maintain competitiveness when seeking research council funds. This is excellent. However, this high percentage of external funding has two unfortunate ramifications. The first is that

it discourages interaction between the primarily "externally" and primarily "internally" funded programmes. Much of the expertise and many of the methods developed in these externally funded projects could, with benefit, be applied to some of the internally funded programmes. Because many of the scientists/technicians associated with the primarily externally funded programmes are on "soft money" and must constantly account for their time use, they cannot "afford" to integrate their talents into other programmes, which would benefit from such interaction.

Another problem is that external funding leads to a differentiation between employees at the institute. To be permanently employed is for most preferable to being employed on s short-term contract. We were told, to our surprise that some staff have been on short-term contracts for over 10 years. IMR should note carefully the proportion of external funds within each programme. Whilst the optimal proportion between internal and external funds will vary with programme some guidelines need to be set and a strategy adopted for dealing with problems that arise with short-term contracts. The trade unions felt that this was a major issue that was not being tackled adequately by management. We make a recommendation on this matter which is a general one and not specific just to this programme, (see 6.2.6).

5.2.8 Programme 8. Aquaculture: health on-growth and sexual maturation

Objectives: to support and further develop a sustainable aquaculture industry based on natural conditions and natural resources by improving existing production methods and development of production lines for candidate species based on ecological and genetical principles.

The budget is 15.954.000 with 8.387.000 from external sources. There are 9 projects with an additional 21 sub-projects.

A good clear presentation was given with excellent use of overheads. We were impressed with the work on photoperiodism and its development from observation to practical application. The fact that growth rates could be increased, maturation altered and the period of egg production could be extended by simply manipulating the time exposed to light and dark cycles has great practical relevance which is already being used.

Other achievements such as the work on astaxanthin and the correlation between trypsin variants and growth are also of high quality and practical relevance. The planned future direction of applying knowledge gained from these two aspects to improve the quality of fish flesh is a sound direction to pursue and the basic expertise is available. Closer collaboration with the genetic studies being done by for example Dale, is needed. The group has a good record of international publications.

The photoperiod research however, illustrates the problem with external funding dominating the system. Although the practical applications are clear the underlying mechanisms, (e.g. is it period per se or quantity of light that has an influence) have not been elucidated. The fundamental science, which may in the long-term lead to even better management practices, has been left aside and efforts concentrated on the

practical aspects. Care needs to be taken to ensure a proper balance between efforts devoted to basic and applied research if the quality of the work is to be maintained.

The comments related to the balance between external and internal funding in 5.2.7 are equally relevant here.

5.2.9 Programme 9. Sea ranching and enhancements

Objectives: to conduct large-scale release experiments with coastal cod, salmon, lobster and scallops and to evaluate results with respect to the development of commercial ranching.

The budget is 12.355.000 with 8.712.000 from external sources. There are 9 projects with an additional 14 sub-projects.

Again the Panel were given a clear presentation of the programme, its aims and achievements. The PUSH programme (Program for encouragement and Stimulation of Sea-Ranching) is, we understand, the result of a political initiative to increase coastal fish stocks. Programme 9 has responded to the questions asked by developing techniques for growing cod, salmon and lobsters for release. This aspect has been highly successful and large numbers have been produced and designs for experiments to test the effectiveness of the releases produced. However, we have serious doubts that cod ranching can ever be an economic success but we note that the full results of the Øygarden experiment are not yet complete. Likewise careful attention needs to be given to sampling designs for both salmon and lobster releases so that the success can be properly measured. In this context application of power analyses to assess the likelihood of detecting changes need to be routinely applied.

We recommend that an international review of the cod and lobster release experiments be done as soon as possible on completion of the experiment so that appropriate experiments and resources can be devoted to future work.

In relation to salmon ranching returns suggest that it may be possible to enhance stocks provided that the correct genetic stocks are used for a given local area. Recent results from Iceland suggest that ranching is not as good a prospect as was believed when the PUSH programme began.

Controversy still rages over the increased risk of strays contaminating local genetic stocks. This is particularly a problem in small rivers which have never been populated by salmon are now populated and lead to effects on adjacent natural salmon rivers. We believe that all the potential side-effects have not yet been considered and the results of NINA's experiments on this topic have not been fully utilised.

We recommend that further development of contacts between NINA and Akvaforsk on these issues since what is needed is a complete appraisal using all available Norwegian expertise rather than pursuance of sectarian lines.

5.2.10 Programme 10. Fishing gear technology and fish behaviour

Objectives: 1) to develop fishing methods which only catch the biologically and economically optimal part of the stock without harming other stocks or other parts of the exploited stock (responsible fishing); 2) to develop fishing operations, fishing gear and storage methods which give the best possible quality, steady supply to the market, and lowest possible operating costs ; 3) to measure the most important stock characteristics by development of sampling gear with known and satisfactory precision.

The budget is 17.743.000 with 7.849.000 from external sources. There are 5 projects with an additional 17 sub-projects.

Up to 1974 there was no research on fishing gear in Norway and a new institute was started. The institute was incorporated within IMR as recently as 1991 and thus is still developing its contacts and research links. The presentation covered a number of projects but the Panel did not get a clear idea of the overall strategy and aims.

Basically fishing gear technology research seeks to improve commercial gear and develop new research tools used to give better scientific assessment of resources. Development of new commercial gear has been directed at reducing the percentages of bicatches in various types of fishery. This has led to the successful development of grid systems which allow small fish to escape. Yet to assess the efficiency of the nets it is necessary to develop research nets which then catch the escapees. In the Panel's view this has been done successfully and the programme contributes to the overall IMR aims.

Yet we detected that the group was extremely conservative and resistant to changes, preferring to work together rather than be integrated within other Programmes. It was even suggested to us that there was a low level of identification with Programmes and that the project level was the appropriate one. This is a view that we reject completely. We are certain that the opportunities for better integration by this group are not being attempted and that there are enormous benefits to be gained for IMR as a whole by such integration. For example calibration of acoustic signals depends on catches at various depths and new developments in catch technology are urgently needed and will be beneficial to the resource surveys. Likewise the development of traps should relate and be integrated in the work on olfaction being done in the aquaculture department; kazunoku-konbu and king crab catch technology needs integration with environmental data and ecosystem processes and net releases and video technology in this programme are widely used also in the aquaculture department. None of the links were indicated to the Panel and are sorely needed.

The programme is characterised by a large number of sub-projects, 19 which in our opinion makes for difficult management and unnecessary time-consuming book-keeping. Likewise the objectives are vague and as stated one cannot know whether they have been achieved or not. These need reformulating with testable hypotheses.

We recommend that this programme be completely restructured to provide better integration with other programmes at IMR. It is important that the integrity of the team is kept so that the practical developments and good international contacts are maintained.

5.2.11 Programme 11. Environment quality and fish health

Objectives: to increase the knowledge about how contamination affects the quality of marine systems and life conditions for fish, with special emphasis on the North Sea.

The budget is 3.739.000 with 533.000 from external sources. There are 8 projects and 1 additional sub-project.

The presentation of this programme was of an overview of the projects that had been completed and were ongoing. The Panel did not get a clear idea of the integration of projects into a programme nor how this would be achieved in future.

The chemical work done at IMR is of high quality and the results of their monitoring work have been invaluable in the North Sea Task Force. In this context the reports produced on the areas that IMR had responsibility are of very high quality. Both the expertise and equipment for development of techniques for analyses of toxic and/or bioaccumulatable organic chemicals are of good international standard. With the exception of this latter development work most work however, is of a routine monitoring-type nature. We feel that this is better placed in programme 1.

Work on fish health is nominally in this programme yet also appears in programmes 7 and 8. Yet there are no plans to extend the work to other biological effects techniques. The University of Bergen has developed biochemical techniques to a high level (Goksøyr) and the expertise there need not be duplicated in IMR. We find the overlap between fish health work done in other programmes unnecessary and are not convinced that of the emphasis on fish health within this programme is correct.

Likewise the modelling work on transport of organic material and contaminants and water exchange in fjords are also being done in other programmes (e.g. programme 1).

In summary we find that there is much duplication of work between this programme and others. Furthermore, there is no coherence to the programme itself.

We recommend that this programme be disbanded and projects with clear objectives distinct from those of other projects continue be transferred to other programmes, especially programme 1.

5.2.12 Programme 12. Fisheries research in developing countries

Objectives: to perform fishery-related research and contribute to the strengthening of national fishery research and management institutions in developing countries.

The budget is 32.736.000 with 32.388.000 from external sources. There are 8 projects and an additional 3 sub-projects.

This programme is financed entirely by external funds. It has been reviewed recently by NORAD and the Panel do not feel that they need to evaluate this research in detail.

We note that there is strong integration with IMR in that this programme relies on being able to use the wide range of expertise available in its research. In our opinion this is mutually beneficial to both parties in that IMR staff are exposed to other resources and problems that need to be solved and this can benefit their own research. The development projects gain from the wide range of first-class expertise available at IMR.

Some care needs to be taken in deciding which staff can be released for short-term contracts in the development programme since there are competing demands for key staff. We are confident that management already has the necessary plans in this regard.

5.2.13 Flødevigen Marine Research Station

The Flødevigen station has an anomalous position in the organisational structure of IMR (section 4.4) in that it is not a department and yet apparently has departmental status. The panel was given an excellent and clear overview of the history of the Station and its research components.

Assessing the Station *per se* it has a very good publication record, (but these publications are also assessed within the various programmes). We find that it is well-equipped for its purpose and has built up much expertise on environmental and biological systems in coastal systems and in the Skagerrak in particular. Most of IMR's expertise on phytoplankton and harmful algal blooms is at Flødevigen.

The station has good contacts with NIVA and the University of Oslo and good international contacts with Danish and Swedish workers working in the Skagerrak and North Sea areas.

Contacts with IMR, whilst good, could be improved. (As an illustration the presenter of programme 11, done at Flødevigen, had not visited the Station before). One way to achieve this would be to give the station Centre status with responsibilities for coastal research and monitoring. Such work is already the central part of the station and the focus on coasts would ensure better integration with other programmes at IMR since links would need to be better to Programme 1 and Programmes 7, 8 and 9. Programme 3 has its base at Flødevigen.

We recommend later in the context of a broader reorganisation that Flødevigen Marine Research Station be a Centre for Coastal Research and Monitoring (see 6.2.2).

6. Conclusions and Recommendations

6.1. The mandate

6.1.1. Scientific quality

The IMR is a large and complex institute with a staff of over 300 and has both basic and applied research functions. IMR has first-class research vessels and well-equipped

laboratories. Overall our impression is of a harmonious, well-run institute doing high quality research of relevance to fisheries management. In comparison to other fisheries research institutes IMR is undoubtedly among the world leaders.

We find that within the field of the development and application of acoustic methods to estimating fish stocks the IMR is doing world-class research. This is not least due to the excellent working relationships established with SIMRAD.

In a range of other disciplines the IMR has research of good international standard, as can be shown by the high quantity of publications in refereed international journals. Fields such as reproductive biology, effects of turbulence on fish larvae, zooplankton ecology, young fish rearing and on-growth and sexual maturity studies in fish are examples.

The IMR also has a reputation, within ICES, for sound and comprehensive analyses of fish stocks within its jurisdiction. However, we feel that this applied work is more pedestrian and simply uses methods and survey procedures as in previous years. The scope for innovation and rationalisation of the programme without loss of precision, in our opinion, is large. The balance between resources devoted to development work and routine work can be radically improved.

Likewise the monitoring programme is an applied programme and is also rather traditional and lacking in innovation. We believe there is scope for rationalisation without sacrificing quality.

6.1.2. Scientific relevance

We did not receive any information from the Ministry of Fisheries on their strategy priorities and thus are unable to answer whether or not IMR complies with the strategy.

IMR Programmes are generally relevant to the fishing and aquaculture industries either directly such as stock assessments, production of fish larvae or development of new fishing gear, or indirectly where couplings are made between the environment and fish stocks or in obtaining better understanding of the whole ecosystem such as the "Mare cognitum" programme.

In terms of resource allocation to Programmes we were surprised to discover, that the mechanisms for setting priorities for research and more routine studies was not explicit. Although the research is organised into cross-disciplinary research programmes, which we applaud, there is no system in place for reviews of internal proposals and no agreed criteria for setting priorities. For example all programmes contain a large number of projects and sub-projects. Project proposals are usually submitted verbally to the leadership group who then propose allocations of resources to the project. Similar research institutes to IMR have formal proposals with set specifications available over the computer network which are used for making annual submissions of proposals. This should be done at IMR. Defined criteria are needed for weighting projects such as relevance to the aims of IMR and the specific

programme and of equal importance the scientific quality of the proposal, documented by international publications or failing this by peer-reviews from outside the institute.

Likewise criteria should be set that are generally accepted and recognised that will help in deciding priorities between programmes. We are concerned that the balance between programmes does not seem to be fully discussed and that there may be an over-priority given to certain areas. Here we would cite the monitoring programme and the stock surveys as being given resources more on tradition than on any clear scientific and strategic priorities. We accept that the IMR has to devote much effort to obtaining the best possible stock assessments, but believe that there is a need to adjust the balance of resources between new technological developments which can both improve estimates and save resources and the quality of the surveys themselves.

We recommend that criteria be determined for assessing the quality of programmes and projects within IMR and that a formal proposal scheme be developed in order to standardised how annual applications for funding be made. Criteria should also be developed for making priorities between Programmes.

There is a need for more emphasis on statements of testable hypotheses which will also help in providing yardsticks against which the success or failure of a Programme can be measured.

6.1.3. Future research activities

In relation to future research plans presented to us we find that the proposals are not visionary enough; they are Department-based rather than Programme-based as one might have expected from the fact that Programmes are the key element of IMR's research strategy.

One major topic of general international interest which is not being tackled at IMR is the effect of fisheries on the environment. We suggest that this be considered carefully in any future plans.

Health and disease research, particularly related to wild fish does not, in our opinion, feature high enough in future priorities. We believe that there are important developments, particularly related to molecular biology, that need to be incorporated. This can probably only be done by recruiting from outside Norway or sending staff to appropriate institutes abroad for training. The need is not for a biochemist but for a molecular biologist specifically trained in relevant disease-related techniques.

We have noted in our evaluation of Programme 5 that there is little integration with environmental data. "Mare cognitum" is just such an integrating programme yet is not mentioned in the future plans for the stock structure research. We were impressed with the Miljørapport, which is the result of cross-disciplinary consultations within a Division and represents an excellent summary of IMR's expertise. The report provides integration between environmental data and stock assessments and makes highly useful predictions.

Another aspect that needs to be considered in relation to future research plans is that of technological development. Some countries have fixed targets such as UK where 10% of the overall budget is recommended be devoted to development of new instrumentation or techniques. We do not suggest a figure but believe that in order to maintain IMR's position as a leading institution there is a need to keep at the cutting-edge of technology.

6.2 General aspects

6.2.1 Organisation of research and monitoring

IMR has recently reorganised its structure and budgeting to programmes of research which are designed to cut across the traditional groupings of Departments (Centres) (see 4.4 for the structure). Within programmes projects and sub-projects are listed and time spent is accounted to separate projects or sub-projects. Yet during our interviews we were struck by the fact that most interviewees identified with the old departments rather than with programmes. Some programme leaders even suggested that the groupings were merely on paper and had no real meaning. Our analysis however, shows that the most successful programmes, (i.e. those with high levels of international publications and clearly integrated research such as Reproduction and recruitment, Aquaculture: growth and sexual maturation and Ecosystems Nordic Seas) were those that were committed to cross-departmental research and with leadership equally committed to this idea.

We believe that the international trends in modern fisheries research, as exemplified in section 3, are towards cross-disciplinary approaches. Thus we are convinced that the programme approach adopted is the correct one. In our judgement there is too much conservatism and clinging to traditional approaches and demarcations at IMR. We suggest that retention of the old division structure serves to hinder a cross-disciplinary approach.

We recommend that better integration of the work of IMR, more in tune with international trends in fisheries science and management should be considered such as the erection of Centres with a regional basis:

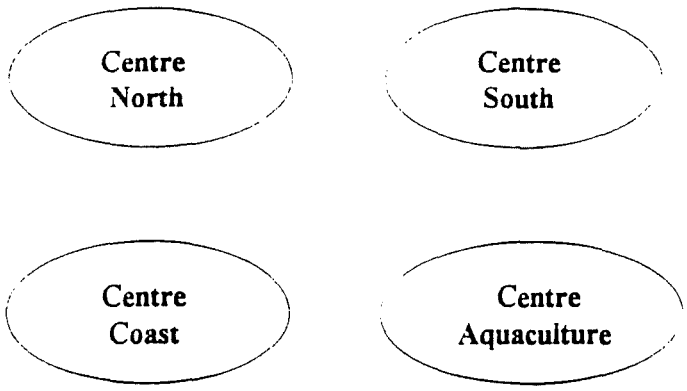


Fig. 1 Possible revised reorganisation of Centres

The descriptors North, South, Coast should not be interpreted as strictly geographical but rather to reflect the possibility to study the key components within ecosystems, such as given fish species over their ranges, and their relationships to the environment in which they live. We believe that this structure would, for example, enable environment, stocks and assessment to be integrated leading to better science and management practices in tune with understanding of environmental changes. The Miljørapport is an excellent example of just such a cross-disciplinary team in action where predictions are made, based on environmental data and stock assessments of future trends. The Centres themselves need to interact so that the expertise is used to the corporate benefit of IMR as a whole rather than to a narrow sector as at present. For example the expertise on growth and maturation from the aquaculture section is relevant to all the regional centres. Fish health and diseases will also transcend centre boundaries.

This suggested restructuring should not be interpreted that we are recommending a geographical relocation of part of IMR. On the contrary we believe that the strength of IMR is in the strong integration between Centres that already occurs and we believe that this can be even stronger. Thus it is important to keep IMR as an integrtaed whole in few geographical locations.

The fact that scientists work in one physical area where appropriate instruments are available does not in our judgement mean that such groups need to have a title. **We recommend** that the present Division names be discontinued as this will further help to build cross-disciplinary research groupings, which do not have to be, and indeed should not be, of a permanent nature.

The Panel is concerned about the large number of projects and sub-projects within each programme. This is particularly exacerbated by the need to record hours worked on each project. To our surprise we discovered that many programme leaders devoted less than half their working time to their individual programmes. In programmes 1, 3, 5, and 6 and the programme leaders used less than 500 hours on their programmes (which is less than 40% of the allocated hours per year of 1,300 hours).

Another anomaly from that we found in our analysis of hours committed to each project is in the Virksomhetsplan many projects have no hours allocated at all (e.g. Programme 2 sub-projects 2.06.2; Programme 3 3.10.3; Programme 4 4.09.4). We understand that this is due to the fact that external funds may not have been allocated to the projects/sub-projects and that since the Virksomhetsplan is revised a number of times per year these anomalies will not be carried forward to the revised plans.

A general problem that was raised by many groups was that within a Programme the Programme leader did not have a say over how the funds will be allocated. Programmes are apparently approved at departmental level and budgets set there. We believe that if Programmes are the central focus of IMR's research then the Programme Leader should be responsible for allocation of the funds within his programme. However, in making the following recommendation we acknowledge that there may be need for adjustments between Programmes within a year and that it is the Director who has overall responsibility for the work of IMR.

We recommend that in future budgets be based on submission of programme budgets, rather than project budgets, to the IMR leadership and that once approved after Peer-review these are allocated to the Programme Leader who has financial and scientific responsibility for the achievement of Programme goals.

6.2.2 Personnel

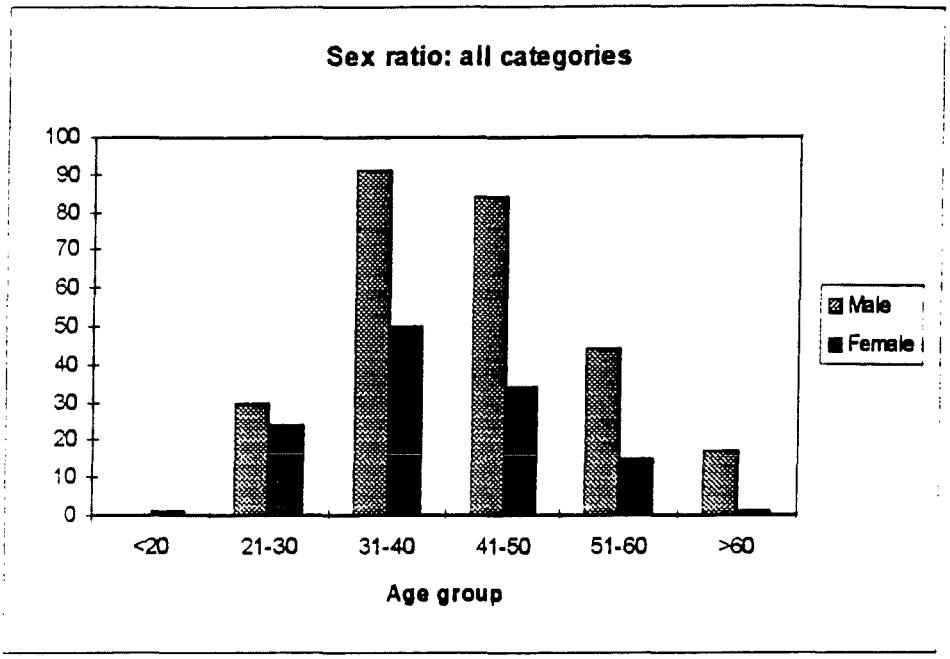
Throughout our interviews we were delighted to note the excellent personal working relationships that IMR has between its staff members at all levels. IMR was regarded as an excellent place to work, with high job satisfaction and a variable and interesting workplace. The management is to be congratulated on this achievement.

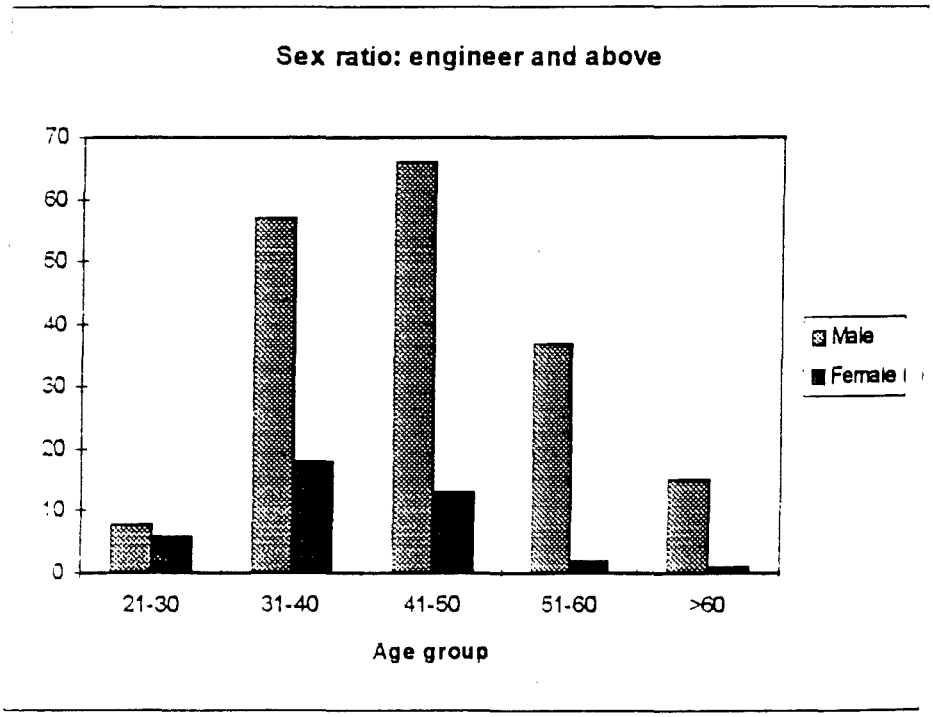
We note however, that the training policy for personnel is not explicit. There is clearly a need for development of a policy for personal development such as time to pursue a doctorate degree, free time for personal research (NINA has 30% but this is a high figure).

The Trade Union representatives, not surprisingly, were unhappy with the proportion of staff on short-term contracts. In some Departments, such as Aquaculture, over 40% of the staff were on short-term contracts. We were surprised to learn that some staff had been on short-term contracts for over 10 years and such cases clearly need attending to.

However, we believe that the high quality of the research done in the Departments relying on external contracts and as a consequence employing short-term staff, demonstrates that this is a very successful method of operation. **We recommend** that IMR should develop guidelines and a strategy for dealing with problems that arise through the increasing use of short-term contracts.

We have made an analysis of the sex ratios within IMR. The data are shown in figs 2 and 3.





This data shows clearly that there is an imbalance, particularly among scientific staff. We do not believe that this is due to any failings in the recruitment procedures at IMR, but rather reflects a national problem in Norway that there are few females with higher degrees within marine science. This is a problem that is more appropriate for NFR to consider, but we would urge IMR to keep a close eye on recruitment procedures.

There seems to be a tendency for recruitment to IMR from within a narrow geographic area. We are of the opinion that impulses and contacts with scientists and technicians

with a different training and background are advantageous. Within science influences, particularly from outside Norway, are important in maintaining excellence in research.

We recommend that IMR advertise vacant positions as widely as is practical in order to attract the best scientists to what is a first-class and well-equipped institution.

6.3 Recommendations

6.3.1 General

We recommend that:

- better integration of the work of IMR, more in tune with international trends in fisheries science and management should be considered such as the erection of Centres with a regional basis.

- the present Division names be discontinued as this will further help to build cross-disciplinary research groupings, which do not have to be, and indeed should not be, of a permanent nature.

- criteria be determined for assessing the quality of programmes and projects within IMR and that a formal proposal scheme be developed in order to standardised how annual applications for funding be made. Criteria should also be developed for making priorities between Programmes. In order to apply these criteria the possibility of establishing an internal evaluation group should be considered.

- in future budgets be based on submission of programme budgets, rather than project budgets, to the IMR leadership and that once approved after Peer-review these are allocated to the Programme Leader who has financial and scientific responsibility for the achievement of Programme goals.

- IMR should develop guidelines and a strategy for dealing with problems that arise through the increasing use of short-term contracts.

- IMR advertise vacant positions as widely as is practical in order to attract the best scientists to what is a first-class and well-equipped institution.

6.3.2 Research programmes

1. Monitoring and assessment of the marine environment

We recommend that there should be a comprehensive review (internal with an external expert such as Dr R.R. Dickson of the Fisheries Laboratory, Lowestoft) of all the routine data collected. This review should cover all the data collected within this programme.

2. Ecosystems Nordic Seas- "Mare cognitum"

We recommend a clearer focus on fewer projects, with clearly stated goals and hypotheses and how one can measure whether or not these goals have been achieved. In addition contact should be made with scientists in the Faroe Islands, Iceland and perhaps Russia since all these countries have interest in this common area.

3. Reproduction and recruitment

We recommend that a review of the data collected in the beach seine surveys be initiated internally and then with an external consultant. Any future project resulting from the review should have clearly stated hypotheses and state clearly how any goals set will be tested.

4. Resources ecology and multispecies modelling

We recommend that the goals and hypotheses for the project be revised following a thorough review of the projects and sub-projects which has the aim of reducing the number to a maximum of 4-5. Care should be taken to get in place a system whereby the progress on the programme can be evaluated by objective criteria.

5. Stock structure and abundance

We recommend that the programme clearly separates the survey work from methodology and statistical analyses. **We also recommend** that at least 10% of the budget be used on research and development aimed at rationalising surveys. Part of this money needs to be used for detailed statistical analyses of alternative approaches. In order to achieve this it is necessary to have an internal review with external consultants of the whole programme.

6. Assessment

We recommend that higher priority be given to prepare assessments (including multi-species assessments) than is done at present, 2 man-years is not enough. The possibility of hiring temporary staff in order to shorten the delay in making the annual statistics available should be considered.

We recommend that consideration should be given to doing surveys in autumn using standardised methods and thereby there will be adequate time for making the assessments.

9. Sea ranching and enhancements

We recommend that an international review of the cod and lobster release experiments be done as soon as possible on completion of the experiment so that appropriate experiments and resources can be devoted to future work.

We recommend that further development of contacts between NINA and Akvaforsk on these issues since what is needed is a complete appraisal using all available Norwegian expertise rather than pursuance of sectarian lines.

10. Fishing gear technology and fish behaviour

We recommend that this programme be completely restructured to provide better integration with other programmes at IMR. It is important that the integrity of the team is kept so that the practical developments and good international contacts are maintained.

11. Environment quality and fish health

We recommend that this programme be disbanded and projects with clear objectives distinct from those of other projects continue be transferred to other programmes, especially programme 1.

Appendix

List of documents used in review

1. Peer-Review Evaluation: Research Departments and Divisions. Prepared by IMR
2. Peer-Review Evaluation: Research Programmes. Prepared by IMR
3. Peer-Review Evaluation:Department of Aquaculture. Prepared by IMR
4. Havforskningsinstituttet Virksomhetsplan 1994 Version 2.0. 14.03.1994
5. Havforskningsinstituttet Toktprogram 1994.
6. Havforskningsinstituttet Personalpolitisk handlingsprogram.
7. Havforskningsinstituttet. Årsmelding 1993.
8. Note on the procedure of selecting internal projects at IMR
9. Publications list for international journals, ICES reports, IMR reports and other literature.