Estonian Higher Education Accreditation Center

Evaluation of Estonian aquatic research

Institutes evaluated:

Department of Hydrobiology of the Institute of Zoology and Botany,
Estonian Agricultural University (Tartu)

Estonian Marine Institute (Tallinn)

Visit dates:

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Expert team:

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Part I

General overview

Introduction

The evaluation team consisted of prof. Erik Bonsdorff (Åbo Akademi University), prof. Hannu Lehtonen (chair, University of Helsinki), prof. Markku Viitasalo (University of Helsinki) and director, Doc. Ilppo Vuorinen (University of Turku).

Organisator of the evaluation was the Estonian Higher Education Accreditation Centre (EHEAC). The evaluation was carried out through an examination of documents and a series of visits, interviews and consultations with research staff and students over the period 30 October - 2 November 2000. Each evaluator had previously received self-assessment reports of the Estonian Marine Institute (EMI) in Tallinn and the Department of Hydrobiology of the Institute of Zoology and Botany (IZB), the Agricultural University of Tartu. Additional material was provided by the evaluated institutes, laboratories, research groups and individual scientists during the visit.

The visits to institutes started with a general introduction of institute organization, financing, and main research topics given by the directors of each institute. The second stage consisted of leaders of research teams, or alternatively department heads, describing the reserch activities topic by topic. Finally, the evaluators met the individual researchers and interviewed them in their offices. During these meetings the researchers were also asked to give a few representative publications for a closer inspection.

Approach to the evaluation

The evaluators were asked to

1) judge the activities of research and development institutions and the research topics implemented by them to ensure the state funding for internationally recognised research and development;

2) identify deficiencies in the activities of research and development institutions;

3) give recommendations on the development concerning research and development and research areas necessary to the state of Estonia.

The team was given the following materials: A working schedule, principles and criteria for evaluation of research and development institutions, and self-evaluation reports created by the Estonian Marine Institute and the Institute of Zoology and Botany

The team arrived on 29 October 2000 in Tallinn, was shortly briefed and transferred to Tartu during the same evening. The team visited the Institute of Zoology and Botany of the Estonian Agricultural University on 30 October and in the evening also the Võrtsjärv Limnological Station. On 31 October the team visited the Limnological station again and was transferred in the evening to Tallinn. On 1 and 2 October the team visited the 4 sections (physics, modelling, fisheries and biology) of the Estonian Marine Institute.

Each institute was evaluated using the following criteria on a four-point scale (excellent, good, satisfactory, unsatisfactory):

1. the novelty of the results of research and development;
2. the quality of research and development, including publication record;
3. the strategy and perspective of research;
4. the competence of research groups and their capability for development;
5. success in applying for funds and grants;
6. national and international co-operation;
7. the implementation opportunities for the research results and their importance for the Estonian society;
8. the correspondence of research end development to the international level.

In addition to these criteria, weight was also given to the quality of research in relation to financial and material resources, and material basis. Weight was given to scientific

(academic) competence of the research groups, links to students at MSc- and PhD-levels, and other outputs of the research done. Also, consideration was given to the general financial and organisational status of Estonian research. In the following the research institutes and laboratories are briefly discussed, followed by more specific comments and recommendations.

Part II

General comments

General remarks on and recommendations for Estonian science organisation and funding

The evaluation team got an overview of the present organisation of Estonian science, research and development, and also of the channels for state- and other funding. It became evident for the Team that Estonian science has undergone turbulent changes during the 1990's. The focus of our evaluation, however, is to look ahead rather than to judge the past.

As a general statement, we emphasises the need for continuous (and long-term) financial support for aquatic (limnic and marine; basic and applied) research. It was positively noted that aquatic science in Estonia has been, and still is, highly appreciated also by society.

We noted that the structure of Estonian science funding is maze-like and hard to overview for an outsider. Regarding funding, it was noted that the budgets at institute-, department- and project-levels are not fully transparent, which makes it difficult to evaluate productivity in relation to funding. Further, the system with no real permanent positions for the academic/scientific staff (some 5-year appointments, some shorter), and very short (usually one-year) financing terms combined with part-time salaries is clearly counter-productive. It is strongly recommended that a clear financing system will be created, which will enable research planning in three- to five year periods. Also, the age-structure of the departments should be looked at; it cannot be meaningful to re-hire retired scientists to oversee the continuation of research programs. The growing links to international (mainly EU) funding will partially solve this problem, as it is wise to adapt the national funding to the international rules. On the other hand, we positively noted the tendency of promoting the young, talented scientists, to high positions. This obviously created a fresh atmosphere, but may have its drawbacks on individual level. If loaded with administrative duties, the personal scientific development of these scientists may be delayed. This may be a negative trend in the long run.

The Team noted that within all the evaluated units, a substantial proportion of the scientists and/or PhD-students were related through close family-ties. This is a striking feature within the Estonian aquatic research, which may have a profound impact on the structure and functioning of the research groups and departments. This feature, for an outsider, raises the question of the risks with nepotism, which should always be avoided in science, especially in a system with limited access to funding. On the other hand, we have found that some of the family-groups have produced good results, and thus we acknowledge that this issue has two sides. We suggest, however, that this matter be given a thorough thought, and that such close family-ties at small research institutions be avoided in the future. Also, some concentration of organisational power was noted, which may be counterproductive in the long run (an example is the leadership at the EMI, with the director and both vice-directors currently representing the same field). All such problems could best be avoided by an open application-process for all positions, and by using external referees in the selection process. Thus any bias will be avoided, and increased transparency is gained.

There is an urgent need to build up financial infrastructure in order to enable the institutes to purchase large and expensive research equipment. There also was a general need of extensive restoration of facilities (labs, offices, aquarium rooms) in several of the evaluated institutes. Restoration of facilities is needed in order to increase the access of Estonian research institutes for foreign visitors. There seems to be a tendency among the evaluated research institutions to support science by collecting applied projects, or monitoring work, which then produce money that can be directed to proper research. This is an undesirable situation, and should be corrected by proper long-term financiation. There is also a certain unbalance with financing and scientific results in the way that a lot of resources are spent on international agencies such as ICES while the bulk of scientific publications is coming from departments not involved in those activities.

We had no possibilities to judge the entire hydrobiolgical research in Estonia, since a substantial part of it was situated in the University of Tartu, which was evaluated by another group. Further, we were not able to visit the field stations in Pärnu and Saaremaa. Thus this report only partially covers the field of aquatic research. It was evident that poor decision making in the possible merging of evaluated institutes has created an unsecure atmosphere at both IZB and EMI. Stability is vital in order to eliminate speculation and facilitate strategic planning.

Increased mobility is needed, especially for younger researchers, both by making it possible for them to have post doc periods abroad, and also by enabling Estonian institutions to receive foreign visitors. Students were generally content with the supervising they received. The use of foreign supervisors for PhD students proved to produce good results. There is a need to increase the possibilities of private funding and foreign contacts (courses, meetings) for junior researchers.

Generally we considered that publishing biased towards the Proceedings of the Estonian Academy of Science, which in itself is a qualified scientific journal but not giving the Estonian researchers the international audience they need. As a tool for domestic output

of research results it is practical, however. It should be stated, that our judgement of the quality of research is primarily based on internationally accessible data and publications, and – in a few cases – monographs and books. Reports and minor national papers have not been analysed in any detail. At this point, the need for a good national library within the field of general aquatic science is stressed.

The self-evaluation reports were generally well done and useful for this purpose. However, some research projects had evidently been artificially joidned under large headings. This cannot be the optimal way of streamlining the management, and may give the reader an erroneous picture of a research theme being uncontrolled or poorly managed in relation to others.

Part III

Evaluation of institutes and research groups

Department of Hydrobiology,

Institute of Zoology and Botany,

Estonian Agricultural University,

General overview of the Department of Hydrobiology

The Department (head: PhD Ingmar Ott) is divided into a group of River Biology (head: MSc Peeter Pall; supervisor: Dr. Arvi Järvekülg), located in small offices at the IZB in Tartu, and the Võrtsjärv Limnological Station, at Lake Võrtsjärv some 40 km from Tartu. The limnological sector is divided into several subgroups (see below), led by Ingmar Ott, Külli Kangur, Tiina Nõges and Arvo Tuvikene.

The Department of Hydrobiology at the Institute of Zoology and Botany (Estonian Agricultural University) had in July 2000 a total staff of 47 persons (24 scientists, 23 technicians or assistants; of these a substantial proportion were part time hired). During the period 1995-2000 2 PhD- and 14 MSc-degrees have been supervised through the Department. During the same period 46 peer-reviewed papers were published in journals indexed in Current Contents, and some 40 in other international journals of reasonable standard.

After discussions with the representatives of the station, we met the MSc and PhD students alone, without the presence of supervisors and researchers. Students form a potential for this department. Their development should be supported by better finances, student facilities, access to international courses and conferences. They felt, however, unsecure about their dual affiliation (two universities). They were generally content with the amount and quality of supervising they get. Accommodation at the station is limited during the courses, however, which restricts the use of the Võrtsjärv station for, e.g. international training in limnological research and ecology. On the whole, the site offers great potential for education at all academic levels, with good access to attractive field sites and solid background information. The availability of boats (both small and slightly larger) must also be improved, however.

The status of hydrobiology in Tartu is somewhat confusing with institutes at both the Estonian Agricultural University and University of Tartu, and with the Chair in Hydrobiology presently also linked to the Estonian Marine Institute. For the future, limnological research and education in Estonia would benefit from close cooperation between all institutes, and from pooling some resources (boats, experimental facilities etc).

General comments on the Department of Hydrobiology

The level of novelty of the results of research and development is at present **satisfactory,** but a solid foundation for scientifically productive and rewarding analyses exists in the various data bases.

The quality of research and development is **satisfactory/good.** Main focus has been on descriptive research, and the more process-oriented work has only begun.

A common strategy and perspective of research is lacking. Perspectives for future research are mostly not clearly defined.

The competence of research groups, as judged by their scientific output, is very variable. Most of the groups, however, have good capability for development. Also, success in applying for funds and grants is highly variable between groups, with some exceptionally succesfull teams.

In many cases we got the impression of unwillingness for national cooperation. This seems to be caused by financial problems, as well as unsecurities regarding the merging of the institutes. International co-operation, in contrast, was more vivid, and is based on individual networks, and mainly is directed towards Finland.

Implementation opportunities of the research results are **good** and their importance for the comprehensive management plan of Estonian aquatic resources is high.

The correspondence of research and development to the international level is **satisfactory** due to limited international publication.

Evaluation and recommendations for the Department of Hydrobiology

The current status of the research is generally satisfactory. We strongly recommend a closer collaboration between groups and suggest that, after the completion of their current book project, the expertise of the River Biology group will be actively used within the research done at the Limnological Station of Lake Võrtsjärv. The facilities of IZB in Tartu should be improved; good facilities generally leave more time for creative thinking.

We recommend more support for restoring and developing aquarium facilities at the Lake Võrtsjärv-station. Improved experimental facilities would enable verifying the field phenomena with controlled experiments, and would attract international visitors. The boats at the station were in poor condition and should be replaced with new ones, both for research and education.

Evaluation of the specific research themes at the Department of Hydrobiology

Group of river biology (theme leader Dr. Arvi Järvekülg, MSc Peeter Pall as the administrative leader)

The group has completed an impressive manuscript for a monograph on Estonian rivers based on data gathered during 1987-97. They have collected a database on river morphometry, hydrology, hydrochemistry, trophy, pigment content, bacterio- and phytoplankton, phytobenthos, bottom and fish fauna. This database has been used for classification of the Estonian rivers and some good papers on micro- and macroalgae have been produced.

The group consists of four researchers and four assistants, five of them are on a part time basis only. In this respect the group has been poorly financed. In future, the group plans to use the data base for detailed numerical analysis. That work will form a part of one PhD study.

Despite the pioneering nature of the work and the undoubted value of the database collected, the scientific level of the group is considered as **unsatisfactory** according to international standards. The way ahead would be to incorporate the expertise of the group into the studies conducted at Võrtsjärv Limnological Station. Comparison of the data base with similar investigations abroad (e.g. combining the river database with remote sensing work done by enviromental authorities) would be useful.

Lake Peipsi (theme leader senior scientist PhD Külli Kangur)

This research group studies species interactions and relations between trophic levels in Lake Peipsi. The group has recently produced several papers in peer-reviewed journals and a couple of high-quality books (one as a special issue in a respected international journal, and one highly informative and well-illustrated popular book in Estonian; an English version is also underway).

The group consist of six researchers and several students, and they co-operate with the Group of Biometrics. This cooperation should be strengthened further, in order to improve numerical treatment of the data. The group involves students at both EAU and the University of Tartu, and offers possibilities for both MSc- and PhD-students.

The group has mainly produced taxon-specific descriptive work with limited innovation. The group also seems to lack a common focus/plan which affects their future prospects negatively. Their vision for the future is modelling the hydrochemistry and plankton using long-term data sets, maintenance of biodiversity and feeding of fish on benthic animals, but it remained unclear how this will be done.

We rate this group scientifically as **satisfactory/good** and recommend them to develop a more problem-oriented approach with testable hypotheses in order to reach an international audience. Collaboration with other groups in this field is strongly recommended.

Stratification of small lakes (theme leader PhD Ingmar Ott)

The group investigates lake typology based on multiparameter monitoring of several hundeds of lakes. Currently the group centers on ten small lakes, their DOC, humic substances and microstratification during summer.

The group consists of some fifteen participants working together with the group of shallow lakes (see below). Connection to physical research is poor, although the work is dealing with physical phenomena. The scientific work itself is considered as **satisfactory**, but publication output of the group is poor. The results include interesting studies on particular lakes, such as Lake Verevi with a strong deep chlorophyll maximum. These environments should offer interesting questions for future research. The group has future potential in interpreting results concerning microstratification, possibly linking the field data to experimental testing.

Shallow lakes (theme leader ass. prof. PhD Tiina Nõges)

This group is working on Lake Võrtsjärv and has linked long-term changes of water level with biological parameters. The group consists of 15 participants, largely overlapping with the group studying stratified lakes. The group also includes several obviously enthusiastic students, that have well-defined research topics and good individual supervising.

This is a group with a clear modern scientific profile, as regards background knowledge, questions posed, methods used, and linking of the work to a general theoretical ecological framework. The group has reached important applied results, such as the comparison of internal and external loading in the Lake Võrtsjärv. The publication record of the group is considered to be **good,** but having considerable potential in the future to reach an excellent level internationally. Taking into account the present level of resources, the overall rating of the group is **excellent**. We strongly recommend further support for this research group, and especially encourage an experimental approach, as well as studies linking the long-term data with macroclimatic changes.

Biomarkers of water pollution (theme leader PhD Arvo Tuvikene)

This study includes fish toxicology and macroinvertabrate monitoring in rivers. Also, an experimental approach has been used, and close ties to international co-operators have been developed.

The group consists of only two researchers, and thus direct comparison with the larger groups is difficult. The toxicology group has good international contacts and also a good publication record, reaching the international scientific community. Overall rating of the project is **good**.

We recommend more support in the form of manpower, equipment and experimental facilities. The goals of the group should be better integrated with those of the other groups within the department. In particular, physiological studies could benefit the work done in shallow lakes (i.e. Lake Võrtsjärv).

Estonian Marine Institute (EMI)

The Institute is directed by prof. Toomas Saat (not present during the visit of evaluators) is divided into sections of (1) Marine Physics (head: Jüri Elken), (2) Marine Modelling (head: Rein Tamsalu), both located in poor facilities, separated from the other sections, and with no proper laboratories or library facilities, (3) Fisheries research (head: Tiit Raid), located in modern facilities with good infrastructure, secretariat, and main library of the institute, and (4) Marine Biology (head: Georg Martin), located away from the main Institute, but in modern and adequate facilities.

The Estonian Marine Institute has a total staff of 93 persons (42 scientists, 51 technical staff; of these several were hired on a part time basis). During the period 1995-2000, 8 PhD- and 20 MSc-degrees have been supervised through the Institute. During the same period, 52 peer-reviewed papers were published in journals indexed in CC, and some 47 in other international journals of reasonable standard.

Estonian Marine Institute, Section of Marine Physics

The section of Marine Physics has a staff of 16 scientists and 4 assistants, and is headed by Prof. Jüri Elken. Location: Paldiski Str. The facilities currently occupied by the section of Marine Physics are poor, and small renovations have been financed through their research budget.

General comments on the Section of Marine Physics

There is a high degree of novelty in the results of research and development as several papers interlink physical and biological research in an imaginative way.

Research and development are generally of **good/excellent** international quality, reaching a broad international audience.

The strategy and perspective of research is unclear as future prospects may depend on management decisions (merging of the institute with Tartu university). We noted that the opinion of this section on the unification with Tartu University differed from that of the other sections of the institute. Partly for the same reason, recruitment of young scientists into the Section of Marine Physics seemed unsecure.

The general competence of research groups within marine physics is **good**. Their capability for development is high, but the future and research directions of the section are dependent on management decisions.

Success in applying for funds and grants has been **good**, with contacts to several international programs and funding agencies. Due to close collaboration with e.g. the Finnish Institute of Marine Research, the section has got additional support (access to shiptime).

National and international co-operation is **good.** Further expansion towards ice physics and surface wind waves was emphasized by the research team, and is also advocated by the evaluators.

The implementation opportunities for the research results and their importance for the Estonian society are **good**.

The correspondence of research and development to the international level is **good/excellent** due to publication in international core journals, but we see a risk in student recruitment in the future, which may pose a problem on the longer term (already some brain drain has occurred).

Evaluation and recommendations for the Section of Marine Physics

General evaluation is good/excellent. Combining the talents and expertise of the modelling section with those of the physics section is highly recommended. Also, infrastructure for financing large research gear should be developed. Closer links to biology and fisheries are needed. There is a clear need for a centralised EMI-effort to promote cooperation and improve the working conditions for both physics and modelling sections. It is in the interest of the whole Estonian Marine Institute that the premises at Paldiski St. are renovated as soon as possible.

Evaluation of the specific research themes in the Section of Marine Physics

Baltic Sea water and material exchange processes and their impact on Estonian coastal waters (theme leader Prof. Jüri Elken)

This is a research group for traditional oceanography, which aims to integrate the knowledge on local hydrodynamic processes into concepts and models on basin-scale hydrodynamics and material exchange. The group consists of 11 scientists and 2 masters students with technical positions.

The group has a high international publication profile with about 15 papers in international peer-reviewed periodicals in the past five years, indicating the general interest in their results.

The project is currently in the process of synthesizing its previous findings, and has good prospects for further international publishing. The level of equipment (computers) was considered good. Future development requires increased access to shiptime. Good international contacts were found in this group.

General evaluation is **excellent** with high international effect. We strongly advocate continued support.

Dynamics of turbulent processes and non-linear waves (theme leader senior scientist Tarmo Soomere was abroad during our visit)

This is a smaller project which has been merged with the project below for technical reasons. The publication record of the project is weak, with no international output since

1996. We recommend a reformulation of goals and that this project is truly integrated with other research so that the obvious skills of the scientists are used in a broader context. The questions posed for this project are valid and interesting, and could gain international recognition through cooperation. Overall rating of this group is **satisfactory**.

Estimation of ecological conditions of Estonian coastal waters and lakes by optical methods (theme leader senior scientist Helgi Arst)

The group is measuring biological production in lakes and coastal waters with optical remote sensing methods. They have collaboration with the mathematical modelling group, but suffer somewhat from lack of proper facilities and resources. Within this project and the turbulence project there is a clear risk of losing scientific potential, since certain talented researchers have moved abroad.

The group has a **good** publication record with 10 papers in international journals over the past five years. Future prospects include remote sensing devices onboard an aeroplane and/or satellite, compared with ground-truth measurements for calibrational purposes. Overall rating for the group is **good**.

There is high potential for applicability of the results from remote sensing, and further development should be supported. We recommend the group to continue and increase their international co-operation. To reach this goal proper laboratory facilities are needed.

Estonian Marine Institute, Section of Marine Modelling

Section head: Prof. Rein Tamsalu; staff: 5 scientists and one part-time technician. Location: Paldiski Str.

General comments on the section of Marine Modelling

Due to its limited size and resources, this group should be more closely associated with the Section of Marine Physics. As with the physics section, the condition of some of the rooms was very poor, and the space available per scientist was clearly below the average of the institute. The premises available for the section of modelling should be immediately renovated.

Evaluation and recommendations for the Section of Marine Modelling

The group clearly possesses great potential, and has developed models that should be integrated with the work of the physical section. Cooperation with biologists and fisheries researchers of EMI is also recommended.

Evaluation of the specific research themes in the Section of Marine Modelling

Marine ecosystem modelling (theme leader prof. Rein Tamsalu)

This group has focused on making predictive models on the marine ecosystems (including physico-chemical variation and some pelagic productivity). The group has spent great effort on developing their models, and applications for ”real-world” testing is encouraged.

The publication record of this group is **satisfactory**, with 5 international peer reviewed papers in high-quality journals during the last five years.

The present status of the section is somewhat stalled, as most effort is being put into further refinement of the existing model. The financing of the project is mainly dependent on EMI-funding, and external project-support should be actively sought for.

The overall evaluation is **good**. The development of the section is however too dependent on one person, which may limit innovation within the research group. We therefore strongly recommend that this group will, in order to broaden its perspectives, join forces with the section for physics, and look for cooperation with domestic biologists as well.

Modelling the influence of hydrodynamic processes on the ecosystems of Gulf of Riga and applied problems in the Väinämeri (theme leader Senior Scientist Ülo Suursaar)

This project leans on specific research grants for the analysis of relating climatological situations to hydrodynamic processes in the Gulf of Riga and Väinämeri sea areas. This group has produced one paper within the period of evaluation. The Gulf of Riga-project has ended, and the Väinämeri-part is funded through the year 2000 only.

The results would have a high value for the Section of Marine Biology, but this opportunity has seemingly not been fully taken. The evaluation of this project is thus **unsatisfactory**, since the goals are not clearly linked to other work done in the Institute.

There was some international co-operation in the Mediterranean area, which is seen as a nice exception in the othervise so much Baltic Sea oriented international co-operation of the Estonian scientists.

Estonian Marine Institute, Section of Fisheries Research

<u>General comments on the section of Fisheries Research</u>

The novelty of the results of research and development is **satisfactory**, but a solid foundation for advanced analyses exists in numerous data bases and long-term information.

The quality of research and development is **satisfactory.** Focus has been mostly on descriptive research and monitoring, and the process-oriented analytical research has been of minor importance altough.

A focused strategy and perspective of research is lacking. Studies are primarily planned to serve the needs of fish stock assessment and monitoring (important goals, as such, but little attention has been given to scientific development of the monitoring).

The competence of different research groups is variable. Most of them have excellent knowledge and capabilities to use traditional methods and descriptive research. There are also research groups whose capabilities for successful development are promising, and using modern and innovative approaches.

Success in applying for funds and grants is **good** at both domestic and international level, due in part to the economic importance of fisheries, and in part to active contacts internationally (through such agencies as ICES).

International cooperation is **good**. However, most of it occurs with scientists in the regulatory meetings of ICES and other international organisations. These contacts produce mostly monitoring and stock assessment reports, not high standard scientific publications. Some young scientists have worked several months abroad. We got an impression that there exists some unwillingness to "real" cooperation between scientists from other sections of EMI. Also scientific cooperation with other Estonian scientists seems not to be well developed.

The implementation opportunities of the research results are **good** and their importance for the Estonian society is high, due to the high value of fish resources.

The correspondence of research and development to the international level is **unsatisfactory** due to the low number of international publications in high-standard peer-reviewed journals.

Evaluation and recommendations for the Section of Fisheries Research

The current status of the research is generally satisfactory. Closer co-operation with other sections of EMI is needed. The present relative isolation of the fisheries section cannot serve the scientific goals of fisheries research. The fisheries section has very valuable and comprehensive long-term time series from a number of fish stocks. The continuation of these series stresses the urgent need for a research vessel. We also recommend more support to experimental and problem-oriented research.

Evaluation of the specific research themes in the Section of Fisheries Research

Impact of climate and human activity on structure and functioning of the ecosystem of the Baltic Sea (theme leader prof. Evald Ojaveer)

This is an interdisciplinary project which is based on extensive time series on several climatological, hydrographical and biological parameters. The group consists of 7 scientists.

During 1995-2000 the group has produced only one publication in an international peer-reviewed journal. Two valuable books are currently underway. Time series-data mainly serves as a basis for the other studies of fisheries section. The aim is to develop a basis for long term prognosis of fish stocks and their management. **Good** international contacts were found in this group and they should be used for a more problem-oriented research. The group should also have closer cooperation with other sections, especially with the modelling section of EMI.

Generally the project can be considered as one of the most important scientific achievements of the EMI, although the output to scientific community is only **satisfactory**. The lack of ship time has recently hampered the continuation of sampling of these important time serieses. We strongly recommend the continuation of sampling. More rigorous statistical treatment and testing of explicit hypoteses is required for publication in international peer-reviewed periodicals. Overall rating is **satisfactory.**

Status of the Estonian fish stocks (theme leader PhD Tiit Raid)

The four sub-projects below are intended to promote and guide the sustainable harvesting of fish stocks. The work rests, however, strongly on traditional descriptive and monitoring approaches and is rated as scientifically **unsatisfactory.**

Pelagic fish stocks (theme leaders: herring: Assistant prof., PhD Tiit Raid; sprat: research scientist Olavi Kaljuste)

These studies are performed for the needs of ICES and IBSFC and they form the basis for monitoring and management of Baltic pelagic fish resourses in ICES sub-divisions 28, 29 and 32. The group consists of 4 scientists. **Good** international contacts were found in this group.

The group is experienced in traditional fish stock assessment and monitoring methods. The publication profile is **unsatisfactory** with the exception of the doctoral thesis by Tiit Raid.

The project suffers from the lack of ship time which has recently partially prevented the continuation of fish sampling. We strongly recommend the continuation of sampling. The present time series is unique in the Baltic Sea area and provides good opportunities for high-standard scientific work. Development of problem-oriented approach with testable hypotheses is needed in order to reach international audience.

Demersal fish stocks (theme leader Tenno Drevs)

This project includes the monitoring of flounder stocks in the Estonian fishing zone. Also cod is monitored in years when it is available. These studies are performed for the needs of ICES and IBSFC and they form the basis for monitoring and management of demersal fish resourses in ICES sub-divisions 28, 29 and 32. Despite considerable value of the database collected, the scientific profile of the group is **unsatisfactory** due to lack of peer-reviewed international publications.

Coastal fish stocks (theme leader Leili Järv)

These studies include monitoring of coastal fish stocks, such as perch, pikeperch, smelt, ide, roach and vimba bream. The group consists of 4 scientists. The project has produced many impressive time series but these have resulted in only a few publications of good international level. Publishing quality is generally **unsatisfactory** and has occurred primarily in Estonian. Success in applaying for funds has been limited but international contacts have increased during recent years which provides good opportunities for successful development of these studies. More active publishing of the resultsin international peer-reviewed journals is, however, recommended.

Migratory fish stocks (theme leader Dr Mart Kangur)

This project consists of monitoring of salmon and trout parr densities in Estonian salmon and sea trout rivers and gives an overview of reproduction and recruitment of these species. The group consists of 3 scientists. They have collected a time series which is not used for publication in international high-standard journals. The publications produced are descriptive with limited innovations and their scientific value is **unsatisfactory**. The group has, however, wide international contacts within the Baltic Sea area. We recommend a more problem-oriented approach and continuation of sampling the valuable time series.

Biodiversity; Adaptation of fauna of the Baltic Sea and its relationship to productivity of the sea: case studies of eelpout / Distribution dynamics and the role of the recent newcomer* Cercopagis pengoi *in the ecosystem of the Baltic Sea (responsible scientist Henn Ojaveer)

This is not a research theme but a collection of several topics centered around one researcher. It includes e.g., ecology of invasive species and eelpout. The publication profile of the person is, however, one of the best in the Section of Fisheries Research and has produced several publication in international periodicals. More focusing is apparently underway during the current funding period. The scientific profile of Henn Ojaveer is **good.**

Parasitological investigations (theme leader Vello Kadakas)

This is a small group investigating fish diseases and parasites. The work has included a 22-year monitoring of the parasitological status of the main fish stocks in Estonian waters. This database could be an important asset for the institute, but has seemingly not been investigated in connection with other long-term data. The publication record on an international level is virtually non-existent, and the evaluation of the group is **unsatisfactory**. However, because of the applied importance of knowledge on fish diseases and parasitology, we recommend this research theme to be strengthened. A new goal-setting and a better coordination of investigations with other research themes of the institute is needed. A very intriguing focus for future studies may be investigation of parasite associations and their use as environmental biomarkers. Also, regaining competence on bacterial and viral aquatic pathobiology is recommendable.

Environmental impact assessment (theme leader Dipl. Eng. Ahto Järvik)

These studies include several small projects which are financed by companies etc. Most of them are short-term projects which are not expected to produce publications to international peer-reviewed journals. These studies require a considerable part of the time of scientists. However, for the fisheries section these small projects may be necessary because state finances have decreased.

Estonian Marine Institute, Section of Marine Biology

This section has a staff of 18 persons (4 senior scientists, 5 research scientists, 3 assistants and 6 technicians), and is located at Marja Str. 4D. Head of section: Dr. Georg Martin.

General comments on the Section of Marine Biology

The level of innovation is **good**, with a strong feeling for current advances in international integrative marine ecosystem-analysis. This attitude will lead to new approaches, and creates a dynamic atmosphere within the section.

The overall quality of research and development is **good** with the potential for further growth and advancement both nationally and on the international level.

The research strategy and the perspectives of research are **good**. They are directed towards manipulative and experimental testing at various levels, enabling close links to other fields of general ecology.

The competence of the research group is **good**, and the capability for development is excellent, with strong individual development at hand. Several MSc- and PhD-students are affiliated with this section through universities in both Tartu and Tallinn.

Success in applying for funds and grants has so far been **satisfactory**, but growing international contacts seems to enhance the possibilites for further external financing.

National cooperation has been **unsatisfactory**, but international contacts are **good**, especially through joint projects (e.g. the Gulf of Riga-project).

Implementation opportunities for the research results and their importance for the Estonian society are **good** through the monitoring activities and educational aspects (several young members in the teams).

Correspondence of research and development to the international level is generally **good**, but so far restricted to only a few solid publications in highly rated international journals.

Evaluation and recommendations for the Section of Marine Biology

The overall rating for the Section of Marine Biology is at present good. The section however shows great potential and enthusiasm, and we feel that the international breakthough is close at hand. Some criticism must be raised due to limited national co-operation. Also, the groups could have started to publish earlier in internationally highly rated periodicals, which is now the evident way forward. We emphasize that the funding received by the section is clearly below the average of the institute, which is in contrast with the scientific achievements. We therefore recommend a stronger support for the Section of Marine Biology. Especially developing the experimental facilities would increase the possibilities for gaining international recognition.

Evaluation of the specific research themes in the Section of Marine Biology

Transport of energy and matter in coastal areas with different trophic conditions (theme leader Professor Henn Kukk)

Plankton research: This theme is centered on studying the development of phytoplankton communities (especially cyanobacterial blooms) and the ecology of the invasive cladoceran *Cercopagis pengoi* (with supervision from the Section of Fisheries Research). This group contains 6 persons, and currently development is towards understanding and predicting the relationships between hydrodynamics and algal blooms.

The evaluation team feels that the present focus could lead to international recognition, as some high-quality papers have already been published in international cooperation. The overall rating of the plankton-group is **good**, and we feel that continued support should be guaranteed.

Benthic research encompasses both phyto- and zoobenthos, and includes basic and applied aspects. 7 persons are currently active within this field. In recent years, the use of experiments has gained importance. Presently the merging of algal and faunal studies into process-oriented experimental testing of hypotheses is underway. In the past five years some 6 papers in journals with an international refereeing-system have been published. The quality of journals could still be increased, however. We rate this team as **satisfactory/good**, and we foresee a strong development with international potential. Continued financing is thus advocated.

Physiological studies include primary production of benthic littoral algae and influence of cyanobacterial toxins on zooplankton. This group consists of two scientists and two assistants. The team has excellent international contacts, and certain important publications have recently been produced. There also is a connection to European research in the form of a project. Our rating of this group is **satisfactory/good**, and we forsee a favourable development within these topics. Financial support should therefore be secured.

Monitoring and applied research

Monitoring includes coastal and offshore studies of benthos, plankton and seals according to the HELCOM-program and national monitoring demands. Included in the routine monitoring are also nutrients and potentially hazardous components and/or pollutants. So far, publication of results has been rather descriptive, but we see a more holistic and analytical approach emerging, and advocate continued support.

Part IV

Final remarks

We feel that, on the whole, Estonian aquatic research has great potential for the future. The main problems are partly linked to problems with funding, and partly to the fact, that so many structural changes have taken place during the past decade.

By focusing on fewer, more integrated groups, and simultaneously concentrating funding through a more open budgeting, resources could be used more effectively. Further, we feel that some specific, additional funding is needed for facilities, equipment, ship time, and post doctoral training.

We hope that Estonian limnetic and marine, basic and applied research will benefit from our suggestions. We thank all the evaluated persons, groups, laboratories, departments and institutions for their openness and positive attitude to our detailed and sometimes awkward questioning.

We also wish to express our gratitude to the Estonian Higher Education Accreditation Center for very good arrangements, and great hospitality during our stay.

The overall rating of Estonian aquatic science based on the information at hand is **SATISFACTORY.**

Tallinn, 4 November 2000

Hannu Lehtonen Erik Bonsdorff Markku Viitasalo Ilppo Vuorinen

(chairman)