

Higher Education Quality Assessment Center of Estonia

Joint Final Report

Institutes evaluated:

Institute of Zoology and Botany

Estonian Agricultural University

Institute of Zoology and Hydrobiology

University of Tartu

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Part I

General Overview

The Higher Education Quality Assessment Center of Estonia invited three experts from Finland to evaluate the zoological research done in **the Institute of Zoology and Botany (IZB), Estonian Agricultural University** and in **the Institute of Zoology and Hydrobiology (IZH), University of Tartu**.

The expert team visited IZB and IZH 11-12 October, 2000, according to the prepared Agenda.

The expert team was given the following material:

- Self-assessment report of IZB (195 pages, including CVs of researchers)

- Self-assessment report of IZH (52 pages + CVs of researchers)
- Principles and criteria for evaluation of research and development institutions
- Agenda for Evaluations of Research Institutes in Estonia, Autumn 2000

Unfortunately, the Self-assessment report of the Institute of Zoology and Hydrobiology, Tartu University, was unclearly written and the structure of the report poorly organised. However, after site visits and discussions with researcher we were able to form a clear general view of the research done at the Institute for the basis of our evaluation.

The visits of the Expert Team were hosted by the following persons:

- Dr. Urmas Tartes, Director of Institute of Zoology and Botany, Estonian Agricultural University
- Dr. Jüri Kärner, Director of Institute of Zoology and Hydrobiology, University of Tartu
- researchers from the Institutes (described in more detail in Part III)

In the following, we present General Comments (Part II), Description and Evaluation of Research Topics (Part III) and Conclusions (Part IV).

Part II

General Comments

The major emphasis of the evaluation was on assessment of the level of zoological research at the Institute of Zoology and Botany (IZB) at the Estonian Agricultural University and at the Institute of Zoology and Hydrobiology (IZH) at University of Tartu. However, during the evaluation, we observed several general points which influence scientific work at both universities, and which, in our opinion, need to be addressed if Estonian zoology is to be optimally developed.

1. The temporary nature of university teaching positions

All the teaching positions, and most other positions, at the universities are 5-year, renewable, nonpermanent positions. The rationale for such positions in Estonia

and in other countries is that by having 5-year terms, one guarantees that the scientists remain active throughout their career, since their performance is assessed at regular intervals. However, it is our feeling that such a situation generates several unwanted effects. For example, during the fixed term, it is clear that the scientists will be concerned with their own future success rather than the development of the discipline as a whole. As a consequence, the development of teaching, long-term planning of research and adopting time-consuming new approaches will be of second priority. Furthermore, the university salaries are non-competitive as compared to private sector. If, in this situation, research and teaching at universities cannot even give job security, it is possible that the most suitable persons for research do not choose a university career. Thus, our opinion is that in the future, a majority of university teacher positions should be permanent. However, it is clear that there should be an initial 5-year period after which the research and teaching performance is assessed and decision made about making the position permanent. Also, it is clear that the directors of the departments should be elected for fixed term (from the permanent staff).

2. Development of graduate and postdoctoral studies

At present, it appears that graduate studies are unstructured, and there is no integration of, e.g., foreign study periods to the degree courses within Estonian universities. We feel that development of doctoral study programs in different major areas coupled with a structured graduate student scholarship program would be helpful. We also feel that study periods abroad are very important for the development of doctoral students, since the Estonian science base is and will remain rather thin owing to the small population of the country. It was commendable that many of the active research groups have utilised the possibility of sending graduate students to foreign laboratories. However, unless the role of studies abroad is formalised within the Estonian system, there is the undesirable possibility that some of Estonian's best graduate students end up in foreign universities in which case their input in Estonian science may be lost. Also, development of an Estonian grant system for postdoctoral studies would be useful, especially for recruiting foreign postdoctoral fellows to the internationally competent groups working in Estonian universities. We feel that while good Estonian postdoctoral workers will have no trouble in finding foreign sources for their research in leading international laboratories, only Estonian granting agencies have the responsibility of generating an international atmosphere within Estonian departments.

3. Development of integrative study programs

For continued development of zoological research, it is important that an integrative approach is adopted. This requires that both the traditional and newly erected boundaries between taxonomy, ecology, physiology and molecular biology be actively broken down. In the evaluation we observed that ecological research in many cases would benefit from more thorough background in physiology and that taxonomic studies would require

integration of traditional and molecular methods. We also noted that there is valuable and important taxonomic expertise in Estonia, but that the field had difficulties in recruiting young scientists (a problem shared with many other countries). It is possible that recruiting young scientists into taxonomy would be easier if molecular biology approaches were emphasised already early in the studies. Thus, in order to develop zoological research further into international top level, even undergraduate study programs should integrate teaching at different functional levels.

4. Integration of departments.

It is commonly realized that the organization of Estonian scientific institutions is still in a stage of transition from a previous system built on completely different basic principles. The current process of (very necessary) integration of scientific research and teaching within the framework of the universities cannot, of course, automatically produce optimal institutional divisions: inevitably, overlapping and simply less purposeful structures arise and are maintained for some time. In a small community with very limited resources, organizational “doubling” within one field is more likely to bind administrative energy and hamper collaboration than stimulate research by generating healthy competition. Specifically, we see no *scientific* foundation whatever for the separation of Tartu zoology into two institutes (IZB and IZH), and general considerations speak strongly for unification (the need for a broad spectrum of technical approaches to effectively address problems in modern integrative biology, attaining “critical mass” in staff, funding etc.). Also, unification of institutes will help in arranging “support facilities”, such as the biometrics group presently in the IZB, also to cover areas such as molecular methodology, electron microscopy etc. We have no naïve belief in the power of administrative measures to enforce collaboration and creativity, and we acknowledge that functional collaboration exists even today at several levels. The main point, however, is that there are no positive reasons (scientific or practical) to support the division, and we strongly recommend that all zoology be united in one institute.

The situation for hydrobiology is similarly problematic, although somewhat different. It seems clear to us is that this field should be united, probably as one institute including the Estonian Marine Institute (splitting off the hydrobiology from both the IZH and IZB).

5. Scientific collections: a Karl von Baer National Museum of Natural History?

The valuable Estonian zoological collections (as well as the rest of the natural history collections) are presently dispersed in an entirely unsatisfactory fashion in at least three institutes in Tartu alone. Modern management, accessibility and maintenance require that the collections of national and international importance be urgently united at least in an organizational sense, followed by the creation of satisfactory common facilities on an economically feasible time scale. We propose that a National Museum of Natural History be formed, which could appropriately be named in honour of the most famous scientist of Tartu University Karl von Baer. It could take over as one department the tasks of the present Baer museum, which is somewhat awkward as part of the IZB. We further propose that, besides the fauna of Estonia, those of the countries of the former Soviet

Union be a special priority in view of the historical background of Estonian taxonomy. This kind of profiling is desirable in order to produce maximal international impact with limited resources.

6. Cooperation in teaching and research between faculties

Owing to the relatively small sizes of departments within Estonian universities, research at good international level requires that faculty boundaries do not hinder teaching and research. It was obvious from the material presented in the evaluation that, at present, especially the Medical Faculty of Tartu University does not appreciate that closer contacts to the IZH would be beneficial to both partners. To be able to adopt an integrative approach to zoology, the IZH would benefit from the expertise in physiology and immunology, which are naturally present in the Medical Faculty. On the other hand, there is unique knowledge of developmental biology within the IZH, which would be very useful for the Medical Faculty.

Part III

Evaluation of Individual Institutes according to Research Topics

Institute of Zoology and Botany, Estonian Agricultural University

Ecophysiology and Ecology of Insects

Principal investigators

Urmas Tartes, Toomas Tammaru, Tiit Teder and Alo Vanatoa

Description of the projects

There are several (partly) separate projects focused on insect ecophysiology and ecology, which we choose deal with under a common heading to emphasize potential common interests. With respect to groups shared between IZH and IZB, the ornithological research led by Raivo Mänd will be dealt with in connection with the IZH, while the research of Toomas Tammaru is included in the present context. Given this division, the entomological ecology/ecophysiology represents the major line of zoological research in the IZB, and the one that seems to hold most future promise. The projects concern (1) respiratory and circulatory physiology, especially for pupal stages, (2) host-parasitoid relationships, (3) determination and evolution of body size.

Present status

Respiration, circulation, metabolism and movement in insects in different stages of development (Urmas Tartes and Alo Vanatoa). The group works in a field of insect physiology where it is well positioned to make original and significant contributions. It is especially strong in long-term noninvasive measurement of pupal function, relying on skilful use of basic physiological techniques. The aim is “to analyse real-time coordination between respiration, circulation and body movements as well as to understand changes in physiological functions during individual development in maintaining homeostasis, and to analyse diversity and correlations between different species”. The publication output is somewhat meagre, although average in the present context (ca. one peer-reviewed article per year) and in reasonably good international journals. In addition, tens of articles have been published in Estonian. The major limitation to scientific impact seems to be a lack of strong hypotheses associated with sole reliance on a single level of measurement.

Host-parasitoid relationships (Tiit Teder). A moth-parasitoid (Hymenoptera) interaction is used as a model system for studying aspects of parasite and host ecology in relation to life histories. This research is only beginning (one article 1999), but on the basis of our discussions we are convinced that it offers a great number of interesting problems which in this system are amenable to study by a broad field-laboratory approach. Teder has also published a study on genitalic variability in one hymenopteran species, which is interesting, but at this stage remains somewhat isolated.

Determination and evolution of body size (Toomas Tammaru). This research addresses central evolutionary-ecological questions related to life histories, optimal resource allocation and herbivore-plant interaction. Largely done in international collaboration, it is on a consistently high level. Productivity is only ca. one article/year, but the papers appear in good international journals. While some of the work is done on birds, the prospects for original contributions may be best in the insect systems.

Prospects for the future

There is little doubt that the groups may go on producing acceptable, good and sometimes even excellent work at a reasonable rate, maybe in quite new constellations. However, there would seem to be much unrealized potential in the expertise collected

under the present heading. Our concerns are twofold. The physiological research seems to lack a strong sense of direction and “big” questions. The ecological projects, on the other hand, suffer from the limitations known from similar enterprises almost everywhere, being confined to a limited sphere of observables and modelling and most often completely neglecting the specific physiological processes that constitute essential parts of the interactions.

Evaluation and recommendations

Each of the projects on insect ecology and ecophysiology in itself may be rated as **good**. However, we strongly recommend that the groups enter into closer collaboration around one or two of the models they now have for answering central biological questions. Insects offer enormously attractive objects for integrated research transcending the barriers between ecological and functional studies. The insect research at the IZB could form the basis for an **excellent** program combining the ecology with physiology and (by extended collaboration) molecular biology.

Ornithological Research Projects

Principal investigators

Anders Kuresoo, Vilju Lilleleht, Leho Luigujõe and Kalev Rattiste

Description of the projects

Ornithological studies at the IZB focus on three main topics: (1) Research and monitoring of migrating waterfowl, (2) Two detailed case studies of the population biology and reproduction strategies of the Common Gull and Great Snipe and, (3) Studies on the distribution, changes and conservation of the Estonian avifauna.

Present status of the projects

The long-term study of the *Common Gull* population started in 1962 and has continued as a detailed field study to the present. This is an internationally valuable and unique data set on the strategies of a long-lived, monogamous bird. The characteristics of individual birds, like age, body condition, blood parasites and phenotypic traits are related to the reproductive behaviour and strategy. The research is partly carried out in collaboration with Uppsala University, Sweden. However, at present, there is little documentation of the results. Only two articles have appeared in peer-reviewed journals. Studies of *Great Snipe* have only recently been started and have produced one international article. The researchers have collaboration with the Norwegian Institute of Biology. The studies of the *Estonian avifauna* have produced several national articles and books in Estonian and

a few articles in general international books. The project of migrating waterfowl and wetland birds is to be carried out in collaboration with other European projects (e.g. Dutch Ecological Institute) and has produced several national articles and international reports. In both projects (Estonian avifauna and migration of wetland birds) articles in peer-reviewed journals are few (3). Three doctoral dissertations are expected in the Common Gull and Great Snipe projects.

Future prospects

The study on the Common Gull represents a unique data set and has potential to produce internationally valuable articles. We feel it is important to maintain funding for the project at a basic level. However, in addition to continuing the long-term data gathering on individually marked birds, the researchers should formulate detailed hypotheses and design both the data gathering in the field and experimental setup to solve specific problems (e.g. the importance of indicator traits in sexual selection and body condition). Experimental manipulations can be done, for example, in a separate colony.

We found the studies of Estonian avifauna important at a national level for education and to increase knowledge in Estonian nature and nature conservation. In addition to applications on national level, the bird migration project has importance as a part of international projects that study the migration strategies and conservation of migrating birds.

Evaluation and recommendations

Originally all the bird projects lacked detailed and well organized plans of data collection and experimental design. Such planning is, however, required in order to reach international standards in ecology. Similarly, the proposed doctoral studies are poorly planned and organized. Since the Great Snipe and Estonian avifauna studies have not progressed beyond the original “observational” stage, we rate them as **satisfactory**. On the other hand, during data analysis of the Common Gull project, specific questions have been formulated with the result that this unique long-term study has progressed to the level **good**.

Biomarkers of Environmental Pollution

Principal investigator

Arvo Tuvikene

Project description

Although this project technically belongs to the Department of Hydrobiology, which was not part of the present evaluation, the topic is clearly zoological, and for this reason the both direction of the IZB and we felt that its inclusion in the present evaluation was desirable.

The project focuses on the use of biochemical and physiological parameters as pollution indicators. Major emphasis has been placed on the effects of polyaromatic hydrocarbons on the detoxification enzyme activities in fish. Recently, the research approach has been widened to include olfactory responses of fishes to polyaromatic hydrocarbons. The topic is highly relevant in terms of Estonian environment, since a major source of pollution from Estonia to the Gulf of Finland is oil shale processing which releases large amounts of polyaromatic hydrocarbons.

Present status of the project

Dr. Tuvikene has obtained his Ph.D. from University of Tartu in 1997. During the period leading to the Ph.D., and during the period up to the present, Arvo Tuvikene has been very active in engaging in international collaboration – a large part of the research for Ph.D. was carried out in University of Kuopio in Finland. Postdoctoral research has been carried out at the University of Oslo in Norway. Furthermore, Dr. Tuvikene is a principal investigator in a U.S. Environmental Protection Agency-funded project *Monitoring nutrient loads and responses in river and estuary systems in the Baltic Republics*. The international collaboration is evident in the publication profile of Dr. Tuvikene: most of his research has been published in international journals with reasonable or high standing within the field of environmental (aquatic) toxicology such as *Aquatic Toxicology* and *Environmental Health Perspectives*. The research is thus clearly of competitive international standard.

Up to the present, the research has been carried out by the principal investigator alone or with international collaborators. Presently, there are one or two students associated with the topic. Considering the importance of the topic in terms of the Estonian environmental research, this situation is not optimal.

Future prospects of the project

The research topic is of such nature that it should have possibilities of expanding: the Ph.D. work, and work during the postdoctoral period by the principal investigator has been of good international quality and he has extensive international contacts. It is also clear that Arvo Tuvikene is knowledgeable about which future trends are likely to be important in his chosen research field. He has also been able to obtain some relatively expensive equipment required for ongoing studies (e.g. high pressure liquid chromatograph). The major material obstacle of carrying out extensive experimental work in fish ecotoxicology in Võrtsjärv Limnological Station (or elsewhere in Estonia) is the lack of suitable experimental aquarium facilities.

However, in the discussions with the principal investigator it appeared that he is quite content with the present situation, although this places limitations to the development of the research topic. It appears that his major research input would be of personal experimentation with international collaborators also in the future.

Evaluation and recommendations

This small research topic – originally the Ph.D. project of Arvo Tuvikene – has reached good international standing, and thus, the present status of the project is **good**. The principal investigator is now at the stage of his career at which the research group should be formed, and the importance of the topic established in Estonian science. Some small steps to this direction have been made, but in the discussion we did not see a major effort towards this direction. Thus, although we feel that the project in principle has possibilities to become an important one provided that the will, the enthusiasm and the funds are available, our feeling is that with the present approach the prospects remain only **satisfactory**.

Taxonomic Research

Principal investigators

Eino Krall, Jaan Viidalepp and Mart Rahi

Project description

Although the different projects have different taxonomic groups of interest, the evaluation treats them as one entity, since the problems and possibilities are similar regardless of the taxonomic group.

The IZB has valuable taxonomic expertise. Eino Krall is a world-renowned expert on nematodes, Jaan Viidalepp's research concentrates on lepidopteran taxonomy and systematics, especially that of *Geometridae*, and the work of Mart Rahi plays a supportive role in providing electron microscopic expertise useful for taxonomic work.

Present status of the projects

Although it is quite clear that the personnel involved has got thorough expertise in their chosen topic of study, it is also clear that this expertise has not become disseminated in the world literature as extensively as would have been possible. There are only a limited number of international publications during the past five years, as indicated in the self-evaluation report (3 on nematodes and 5 on insects). It should be pointed out, though, that a similar situation is prevalent in traditional taxonomy in many other countries. In

addition to publication in international journals, the taxonomists in the IZB have disseminated their results in monographs in English, Russian and Estonian.

The major problem with traditional taxonomy in many countries today is the reluctance of scientists to become involved in molecular methodology and in ecological investigations. It is commendable that in the projects evaluated this is not entirely the case – Eino Krall is coauthor in investigations of phylogenetic relationships of some nematodes using ribosomal DNA markers, and Jaan Viidalepp leads investigations on the ecology of clouded apollo. Furthermore, former students of Jaan Viidalepp have reached prominent positions within the entomological research community of Estonia.

Another common problem in taxonomy is that there are few if any researchers carrying the tradition further. This is also the case in the IZB: the leading scientists are in their sixties and there appear to be no young scientists to continue the tradition.

Future prospects of the project

The future of taxonomic studies in the IZB looks gloomy. In the self-evaluation report of the institute it is stated that the expertise on nematode taxonomy is lost, and the same fears can be associated with entomological taxonomy in a few years when the present experts retire. Thus, unless new recruitment is made, this field of research disappears in its entirety. Furthermore, it is not clear from the present evaluation material, how molecular methods and traditional taxonomic studies could be integrated in the present research environment. Also, it remains unclear how the taxonomic expertise will be utilised in the investigations of Estonian biodiversity.

Evaluation and recommendations

Since there are still senior scientists with thorough taxonomic expertise in the IZB, the situation regarding taxonomy is **satisfactory**. However, with the retirement of major scientists and owing to the lack of young taxonomists within the department, the situation will become **unsatisfactory** in the future. Because of this, the direction should make every effort to integrate the valuable collections of the IZB with those in the University of Tartu – combining the forces could guarantee that the entomological and other zoological collections could be effectively used, and could be utilised in future studies in taxonomy which employ both traditional and molecular methodology.

**Institute of Zoology and Hydrobiology, University of
Tartu**

Animal Development Studies. Application of Molecular and Genetic Methods.

Principal investigators

Alar Karis and Jüri Kärner

Project description

The project as described in the self-assessment report includes two quite separate parts, one on animal development and one on biodiversity. We acknowledge the laudable intent of the group not to isolate the molecular approaches as a domain of arcane, biomedical activity, but integrate them as a normal technique in all biology. Still, we choose to treat biodiversity research at the IBH in its entirety under one heading (see further below) and focus here on the developmental biology. The major research line concerns the role of certain transcription factors in the early development of, in particular, the urogenital and nervous system.

Activity up to the present

The main project started only in the beginning of this year. A decisive impulse seems to have been the appointment of the PI Alar Karis to the chair of Integrative Zoology in 1999. The extensive collaboration with the Estonian Biocentre and the Department of Gene Technologies, including establishment of transgenic facilities, has boosted the activity of the department immeasurably. The research group encompasses 7 senior researchers and unites molecular-biological competence with skill in classical light- and electron-microscopic morphology. Besides the main line clarifying the manifold role of the GATA group of transcription factors, there are some other molecular studies, notably on the tumor-suppressing protein p53. The project has produced 6 original articles or manuscripts only in this year, all published in or submitted to high-level international journals.

Prospects for the future

The group is in a very dynamic phase. The main projects represent a very high international level and prospects for the immediate future are exciting.

Evaluation and recommendations

The rating of both the present status and the future prospects of the developmental biology research is **excellent**. Developmental biology will remain one of the hottest areas in biology over a foreseeable future, and studies on the regulation of gene expression by

transcription factors will answer questions on both developmental sequences and on environmental cues affecting development. It is satisfying that this field is well-represented in the university of Karl von Baer. On a cautionary note, it will be of crucial importance to ensure that the molecular and transgenic facilities at the Estonian Biocentre remain accessible to zoological research (this as well as other with less medical connections), i.e., to avoid a lapse into the trenches of “biomedicine” versus “zoology”.

Ornithological Research Projects

Principal investigators

Raivo Mänd and Peeter Hõrak

Description of the projects

The research group in ornithology at the Institute of Zoology and Hydrobiology, University of Tartu consists of the following researchers: prof. Raivo Mänd (principal investigator), Dr. Peeter Hõrak (senior research fellow), Dr. Indrek Ots (research fellow) and Mati Kose, Asko Lohmus and Vallo Tilgar (doctoral students). Based on the site visit and discussion at IZH, the main topics of the ornithological research are: (1) Life-history trade-offs in birds, (2) Sexual selection in birds, and (3) Behaviour of individuals and populations in heterogenous environments. In addition, habitat selection and conservation ecology of Estonian birds are studied.

Present status

The topics of the ornithological research are popular also at the international stage. Sexually selected traits in birds (plumage characteristics, parasite load, body condition and their relationships) and relationships of these traits to the survival and reproductive success of individuals are studied intensively throughout the world. The effects of calcium on breeding performance of forest birds and immunological responses to parasites are among less studied topics so far. Immunological studies are done in IZH in other vertebrates (Amphibia) as well. The ideas of the studies and hypotheses to be tested are important, some of the topics are new but not necessarily unique. However, the results add to our knowledge on the mechanisms of sexual selection and the strategies of individual birds to improve their reproductive success and on mechanisms affecting their survival. Similarly, the experimental studies on the effects of calcium limitation on habitat selection and breeding performance of forest birds are valuable. The information of the project on the habitat selection of forest birds, with special attention to raptors, is

based on the Self-assessment report of IZH. Results of this project have importance and applications in conservation biology at the national level.

The research, including education of doctoral students, has been done in collaboration with the University of Turku, Finland, University of Uppsala, Sweden, Moscow State University, Russia and Universite Pierre et Marie Curie, France.

The research group has recently produced more than 20 articles in peer-reviewed, most of them in highly rated journals and tens of scientific and popular articles in Estonian (mostly by Raivo Mänd). The competence of the research group is of high international standard.

Future prospects

An important new aspect in the immunological research is the impact of parasites on health, behaviour and condition signals in Greenfinches (information is based on the site visit and discussion). This is an experimental approach and a novel topic with hardly any previous data, even internationally. Results on the impacts of parasites and diseases on the condition of individual animals are urgently needed in behavioural ecology. These together with other aspects on behaviour presently studied will further raise the level of the ornithological research in the IZH. Our additional observation is that the junior researchers of the ornithology group are at the stage where they are capable to start their own, independent research projects.

Evaluation and recommendations

We rate the bird studies in the IZH as **good**. However, they may be developed to reach the level **excellent**. This will require that the present topics are complemented with studies on functional effects of parasites on the phenotype and studies on the behaviour of individual animals.

Biodiversity Studies on Estonian Fauna

Principal investigators

Toomas Saat and Alar Karis

Project description

Two major projects at the Institute of Zoology and Hydrobiology are concerned with biodiversity research. Since they address a common topic, they are treated under a single heading, although they are separate projects, and although the prospects and recommendations are given separately for both projects.

The biodiversity part of the project *Animal development and biodiversity studies: application of molecular and genetic methods* is led by Alar Karis and Urmas Saarma, and is at the moment concerned with population genetic analysis of large carnivores in Estonia, brown bear, grey wolf and lynx. In addition, studies on the recolonisation of the Baltic Sea and Estonian lakes by bullhead after the Ice Age are underway. In these studies the emphasis is in the use of molecular markers for evaluating the population sizes, relationships between populations etc. Additional plans include, for example, radiotelemetry to follow the home range of individual animals.

The project *Biodiversity of Estonian Fauna* is led by Toomas Saat. The project aims at assessing the diversity of several groups of animals and the state of rare and protected species. The project also tries to evaluate if changes in communities and key species populations have taken place, and to evaluate what the role of nonendogenous species in aquatic ecosystems is.

Present status of the projects

Alar Karis' project utilising the molecular biology methods in biodiversity studies was started a year ago. There are, apart from the project leader, three research scientists or university teachers involved in the project. At this stage, the project concentrates on a limited number of species and research objectives. Studies have so far yielded one international publication on the brown bear population in Estonia. Based on the site visit and discussions, it appears that the group has the required methodology well in hand. This gives promise for successful development of the project.

Toomas Saat's project is a loose network of individual investigations, which often remain faunistic or taxonomic collection of data. The project description indicates that personnel comprising 11 senior scientists is associated with the project. Some of the scientists involved have an acceptable international publication record, but the overall publication output is meagre with only five publications in international journals during the period 1997-1999. Furthermore, most international publications are on topics which are not directly associated with biodiversity research.

Future prospects of the projects

It is clear that the personnel available will only be able to study a limited set of questions. This point has been observed in the project led by Alar Karis. In contrast, Toomas Saat's project requires significant focussing of the goals in order to become a valuable contribution to biodiversity research.

It is also clear that biodiversity research will require traditional taxonomic expertise, field biological approach and molecular biological methods. Since all are available in the institute, the biodiversity projects should define and focus their goals so that the different types of investigations are utilised in all the chosen subprojects. Undoubtedly, studies on the large Estonian carnivores can form a model for such integrative investigations, since they are already underway, and will yield results in the near future.

Evaluation and recommendations

Although Alar Karis' project has only recently been started and has not previous publications, the present status of the project is, in our opinion, **good**, since the early results have clearly shown the utility of the chosen methodology. We expect that such studies will have an important impact on the management of large carnivores in Estonia in future.

The present status of Toomas Saat's project is **satisfactory**, since it remains a loose collection of individual investigations with no coherent framework. If one tried to address all the different questions presented in the project summary, both manpower and funds would need to be manifold as compared to the currently available ones. However, if the research goals were defined more precisely on specific topics that can be covered by the leading investigators, valuable results could be obtained.

In the future, it is important that the two projects on biodiversity are integrated and address specific questions utilising the whole range of methods from molecular level onwards. Based on the expertise available in Tartu we expect that the projects will encompass specific entomological, ornithological, ichthyological and theriological questions. Examples for such questions, which have significant general importance could be, e.g., the ecology and population biology of clouded apollo, since it is increasing in numbers in Estonia but is declining in most other parts of Europe, the role of introduced species in aquatic ecosystems etc. If the personnel of the IZH can utilise the possibilities, the expected overall status of the research is, in our opinion, **good**.

Hydrobiological Research

Principal investigators

Tiina Nõges and Toomas Saat

Project description

Research on hydrobiology in the IZH of the University of Tartu depends mainly on the facilities available in the Võrtsjärv Limnological Station in the IZB of the Estonian Agricultural University. It is expected that this research is also evaluated in the connection of evaluating the research of hydrobiology of the Estonian Agricultural University. Thus, this evaluation is only concerned with the zoological aspects of the research.

The research of the chair of hydrobiology, Tiina Nõges involves research on stratified lakes, on shallow lakes and on large lakes. In addition, there is a group on ichthyology which is associated with the Estonian Marine Institute under the direction of Toomas Saat.

Present status of the project

From the zoological point of view, the studies on fishes are associated with the biodiversity project lead by Toomas Saat. The fish biology group has produced international publications especially on the factors affecting development in fishes and on the effects of environment on reproductive mechanisms in fish. With regard to the hydrobiological research of Tiina Nõges and coworkers, the factors affecting zooplankton and higher trophic level communities in the shallow Lake Võrtsjärv are of particular interest. The research on this topic, as on other aspects of hydrobiology, is of solid international standard. The results have, for the most part, been published in international journals.

Future prospects of the project

The development of hydrobiological and ichthyological research in the IZH requires that the interrelationships between Hydrobiology in Tartu University and in Estonian Agricultural University remain healthy, and connections are further strengthened. In addition, after Estonian Marine Institute is associated with University of Tartu, the roles in teaching of the different bodies involved in hydrobiological research will have to be further clarified. It is possible that if the chair of hydrobiology within Tartu University remains a teaching position without associated experimental facilities, the progress of hydrobiology in Tartu University and in all of the scientific community in Estonia may be affected.

Evaluation and recommendations

The research carried out by hydrobiologists and ichthyologists in Tartu University represents acceptable international science, and can thus be rated **good**. However, unless sensible administrative decisions are made on the future integration of hydrobiology facilities in teaching and research, the prospects for future development of hydrobiology in IZH of Tartu University remain **satisfactory**.

Part IV

Conclusions

The overall standard of zoological research in Estonia is quite good. During the past years international contacts have developed at a satisfactory rate, and, as a consequence, many of the research groups are working on topics that are considered up to date by the respective scientific communities. It is clear that since the population base of Estonia is small, international top-class science can only be reached in specific topics. With regard to the present evaluation, we feel that the research on developmental biology, insect ecology and ecophysiology, and some topics in ornithology have the potential to be at the highest international level with the provision that they develop their own unique profiles. In addition, there are several other research areas in which quite acceptable international standards have been or can be reached.

With regard to material resources for continued development of Estonian zoology, the availability of equipment is at a reasonable level (although there is always a need for improvement and modernisation). A major deficiency was observed in the availability of scientific journals and other pertinent literature. With regard to personnel resources, every effort should be made to make the research atmospheres increasingly international at the Estonian departments. Furthermore, the research atmospheres should be made integrative so that the zoological teaching and research encompasses different levels from molecules to ecosystems, also taking into account the needs for traditional taxonomy and systematics.

We also felt that, although scientific collaboration can work regardless of administrative units, the present situation in which zoological research is carried out at two institutes with largely overlapping personnel and research topics is not optimal. Development of a single institute can, therefore, be considered as a major goal. Such development, however, should not be coupled to a reduction of staff, since already at present the teaching load of personnel is reasonably high. Rather, any institutional rearrangements could be carried out together with a strengthening of the position of the teaching and research personnel, for example by introduction of permanent positions.

Tallinn October 14, 2000

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