

JOINT FINAL REPORT

RESEARCH EVALUATION OF ECOLOGY

Research groups assessed

Environmental Protection Institute

Institute of Ecology

Tartu Observatory (part)

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Introduction

The three members of the review team from Finland and the United Kingdom visited three institutes to assess the quality of ecological research in Estonia – The Environmental Protection Institute (EPI) at Tartu Agricultural University, Tartu Observatory and the Institute of Ecology at Tallinn Pedagogical University - between October 29th and November 2nd 2000. Each had prepared a self-assessment report that detailed both core and funded projects, as well as providing details on financing, staff and publications.

For the most part, the review follows the groupings outlined in each self-assessment report and comments on their core project work. In one case (Wetlands and Coastal Ecology) we have chosen to divide the group and consider each habitat group separately. We also considered one project area (biosensors) to be outside our remit and more appropriate to a review of electrochemistry: we make only passing reference to this work here. Not all of the teams visited regarded themselves as ecologists, so there was often discussion on the appropriateness of the allocation of some groups to this review.

The review team was able to meet and talk to the directors and almost all the relevant researchers in the three institutes. In the case of EPI we were also able to talk to a cross section of students. Where possible the team examined both office accommodation and laboratories in Tartu and Tallinn but were unable to visit Johve.

The review team were also presented with review reports of an earlier visit to the Institutes of Zoology and Botany, the Institute of Botany and Ecology and the Forest Institute at Tartu and these included subject areas which might reasonably have been included within our brief. We note here the overlap but do not include the details of these projects in our assessment.

General comments

The reviewers identified four general research themes where it felt Estonian ecological science was especially strong, though these were not necessarily confined to a single research team :

- Landscape ecology
- Radiation biophysics and photosynthetic ecophysiology
- Remote sensing
- Palaeoecology

Most groups have been successful in attracting funding, both within and from outside Estonia. This has been possible because several groups enjoy a high international reputation and have established extensive contacts overseas.

Internal funding is seen by the research groups as generally fair and most thought the review system and the consequent allocation of funds by the ESF was considered and effective. However, the arrangements by which the Science Competency Council funds for core projects were distributed was less transparent, both to the researchers and to the reviewers, and attracted significant criticism. There is clearly a problem of the funding of infrastructure and most groups are struggling in poorly equipped laboratories. It seems likely that in some cases it has been necessary to use part of research grants to maintain essential infrastructure - an unsatisfactory development. Access to the international literature is improving though many researchers need to make special arrangements to ensure they remain up to date.

Nationally, strategic planning is required to oversee these issues and the support offered to different groups. Where grants have to be used to support the infrastructure, or where teaching is needed to ensure resources are adequate the quality of the research inevitably suffers. Groups should be encouraged to formulate their plans properly for recruiting new staff and the allocation of teaching duties. We make specific comments and recommendations about these issues later on but many of these matters are now quite urgent.

Although it diverts researchers away from fundamental research, and does not result in papers in international journals, the reviewers fully recognised the importance to Estonia of the preparation of key synthesis documents - such as the Estonian Biodiversity Strategy and Action Plan - upon which government policy will be based. In any given field it is important to ensure that the best available scientific advice is provided to government and that, as far as possible, the Estonian science community has available the range of expertise required for this. The reviewers also noted the efforts made by many groups to provide popular articles in Estonian to maintain public interest in science.

The reviewers were pleased to find the groups responsive and fully engaged with the review process. We were also impressed by their ability to communicate in English and greatly appreciated the efforts they put into both the meetings and the documents they supplied.

General Recommendations

The review team felt, that in developing its scientific research, Estonia needs to consider the following suggestions

- Establish a national strategy for research and development
- Identify and support centres of research excellence
- Basic funding of any research centre needs to be on a regular and predictable basis, with mechanisms for ongoing quality control
- All funding needs to be distributed in a transparent and accountable manner
- Salary scales and conditions of employment need to be improved to make a career in science more attractive
- The availability of the relevant scientific literature has to be improved and large well-organised libraries are needed where there is also access to web-based journals
- An improved communication infrastructure could mean that internet access could ensure that the available resources are used more effectively

- Small grants for young scientists have been shown to provide excellent value as seedcorn funding for the development of more major initiatives
- Major funding initiatives should support consortia and promote collaborations rather than single institutional teams
- Allied to the previous point, there should be a critical evaluation of the appropriateness of multidisciplinary teams in each institution and whether discipline-based groupings are more effective
- Maintain the link between the research institutes and the highest level of education
- Consider the scope for the use of a virtual university, especially for high-level teaching in some particular areas and consider the prospect for international co-operation where such resources might be shared

General issues

Several issues emerged from the meetings with the various groups that require special note.

All groups recognised that their difficulties in recruiting and retaining suitably qualified staff were closely linked to the comparatively poor salary structure for scientists in Estonia. Graduates are readily attracted out of research institutes or universities when most commercial organisations offer significantly better rewards. It was also clear from our discussions that able young scientists, who might prove immense assets to Estonian science, would be prepared to travel abroad to enjoy higher rewards and better facilities. This seems inevitable, despite their desire to support the national interest.

Whilst recognising the many demands on national resources the reviewers must point out that the facilities for much of the work being carried out were poor. In some cases, some very basic and relatively inexpensive facilities are needed. Research groups have shown considerable ingenuity in accommodating to this but it must be at the expense of their scientific output. Travelling to use equipment or facilities elsewhere, primarily outside Estonia, seems to be the solution adopted most frequently. Similarly, groups requiring more extensive access to the current scientific literature have a schedule of annual or biannual visits to other countries to remain up to date in their subject area.

The current level of support for ecological research is not sustainable over the long term, especially if Estonia wishes to capitalise on its undoubted intellectual assets. While it is true that each research group needs to define its own needs very precisely, a national strategic framework is required to develop support for science over the long term. This has to include a review of the both the funding for core research and the salary provision.

Tartu Observatory

The observatory is primarily an astronomical institute; originally founded in 1803 today the Institute is largely self-standing and separate from Tartu University from which it is isolated geographically and academically. The total staff at the Observatory has contracted considerably in recent years but this was regarded largely as a rationalisation by the Director, who considered that the best scientific groups had been retained.

The ecological research is carried out by a small group of biophysicists with expertise in atmospheric physics and whose prime interest centres on the remote sensing of vegetation and boundary-layer energetics. A group working on photosynthesis moved into the Plant Physiology department of Tartu University in 1992, but strong connections remain with the group.

The research staff includes scientists with a long record of significant achievements who are both internationally recognised and enjoy a position of high respect in the Estonian scientific community. It has been evident during our review that these scientists represent an important reference for young researchers in Estonia. In addition the team have developed instruments that have provided critical insights into their topic. More recently, these have been offered for sale.

Whilst the research work has not been compromised by the personnel changes at the observatory, it does face the problem of ensuring its continuation as the senior staff approach retirement. Its methods, instruments and strategy for future work mean that it still has considerable potential for innovative work but without strenuous efforts to recruit a new generation of researchers in the immediate future, the opportunities for interacting with the existing team will be lost. The research staff recognise this and some of the younger staff teach at Tartu University to maintain their contacts with potential researchers. Despite our discussion with the team any advantages of their separation from the University are not immediately obvious to the reviewers. We note also that their teaching is unpaid so this current arrangement appears to represent a drain on their resources.

As an alternative, and perhaps to reach a larger audience, the staff might consider developing teaching packages, available via the Internet, which could be used both nationally and internationally.

The ecological aspects of the research is not at the forefront of the team's thinking, but rather the development of the methods and models which describe reflectance by vegetation. This necessarily leaves some key questions unanswered, though the team is supported by a landscape geographer whose skills in remote sensing can allow further development at these larger scales. Indeed, with financial support and with collaborations with other groups in Estonia, the research could establish an Estonian school in the ecophysiology of light, working from the subcellular to the landscape. There might also be scope for developing work on laser remote sensing, in co-operation with the team at Tallinn. Any future large investment in equipment might reasonably be predicated on such developments.

Overall, the two main research efforts remain vibrant and enthusiastic, despite their long establishment and age profile. On one hand their capacity to secure foreign grants testifies to their international significance while on the other the lack of dissertations in recent years reflects their immediate problem.

Optical monitoring of Estonian vegetation

Principal investigators T. Nilson, A. Kuusk, U. Peterson

This research constitutes an interesting combination of various disciplines, such as physics, geography and ecology. The team undertakes fundamental research to understand better the light reflectance characteristics especially in forest environments. The work includes elaboration of novel algorithms to estimate diverse vegetation parameters from remotely sensed data. The fundamental physical modelling approach in this work is unique and provides an interesting comparison to other remote sensing based forest inventory attempts where statistical models are used to estimate forest characteristics from the image reflectance values. The team also utilises satellite data for more traditional, yet from the national perspective, indispensable mapping and monitoring tasks. This research includes identification of forest clear felling areas and monitoring of changes in land use for the arable land area.

It is evident that this team is professional and has an excellent national and international reputation as a group specialising in the development of novel methodologies for spaceborne remote sensing. Their scientific publication record is satisfactory and research funding and collaboration with other scientists is seemingly well developed. Possessing the most important collection of Landsat and Spot images of the country this group also has an important position as a national archive of remote sensing. The “Atlas of satellite images from Estonia” underlines the role of this team in the national context. The Committee note the high cost of purchase for these images but consider this expenditure to be nationally important. The Committee recommend that the team could further enhance the value and accessibility of this material by establishing a national remote sensing website.

The team put forward strong arguments for the purchase of two expensive pieces of new equipment that would considerably enhance their future studies. The Committee were not convinced that the work would not be possible without the spectral sunphotometer and recommends that the atmospheric correction data required be pursued with appropriate Finnish organisations. Under present financial conditions the purchase of the field spectroradiometer could only be justified if it was to be a national research instrument and crucial to more than just this project.

We were strongly concerned about the almost absent rising generation of researchers, especially physicists. This problem is a general European one for physicists and mathematicians and will not be solved easily. We recommend that greater efforts be made to find suitable students to provide the basis for the continuation of this field in the future. Many team members undertake considerable teaching of undergraduates in the local universities but this arrangement appears to be unpaid at present which we conclude is not a satisfactory arrangement. The potential this team possesses in the field of light reflectance physics in the natural vegetation is unique in Estonia and of great value internationally. We recommend that consideration be given to using the Internet as a useful platform for some teaching activities, possibly in the context of a “virtual university”. The Committee grade this project as **GOOD**.

Energetics of ground surface

Principal investigators J Ross, M Sulev, V Ross, M Mõttus

This programme is the continuation of many decades of work on the radiative balance of vegetation during which J Ross has established an international reputation in the field. The present studies comprise theoretical developments of radiative transfer models, the application of statistical techniques to radiation within a canopy, the design and development of new radiation instruments, and the application of the models and instruments to assessing productivity of willow species as possible energy crops in Estonia. There is considerable novelty in each of these lines of research, but we draw especial attention to the methods for measuring radiation components within the vegetation at various heights and using a partitioned model which specifically includes penumbra in the calculation of energy receipt inside the canopy. Many of the publications are in major international journals and represent significant advances.

Despite the level of the research and publications it is necessary to consider the unbalanced age structure of the group and its small size. Ross has a clear strategy for future work which is well within the immediate competence and capabilities of the group but the lack of junior members and the difficulty of attracting suitable physics graduates to the subject does not indicate a long-term future for this type of research. Without the continuing leadership and innovation of Ross it is difficult to see how this research field can survive.

The project has been able to attract a wide range of grants and has very good co-operative links overseas. It would seem sensible for there to be a much closer relationship between ecologists and his group if the advances they make with model systems are to be transferred to real heterogeneous communities. This is especially true of the work on energy crops which has clear parallels elsewhere in Estonia. The contribution to theoretical atmospheric physics is considerable but it is less clear that the work will have immediate

ecological benefits. Its benefits to Estonia are in terms of prestige rather than at the practical level at present. The Committee grades this project as **GOOD**

The Institute of Ecology

The Institute of Ecology and Marine Research was founded in 1989 and was integrated as the Institute of Ecology (IE) with the Tallinn Pedagogical University (TPU) in 1997. It remains autonomous from the University and is primarily a research institute though it is charged with taking an “active part in [the] education process”. In some respects its teaching responsibilities remain unclear – while most of its constituent groups carry out research supervision, not all of them teach on undergraduate courses.

Despite being part of TPU, the Institute is physically located in three towns and two locations within Tallinn. This provides particular challenges both for management and for research which straddles the different groups and one group (the North East Group) is isolated from the University and its undergraduates entirely.

In its current configuration, the organisation of the IE appears to be a relatively recent development. In its self-assessment report, the Institute provides a thorough strategy for its future development and amongst other things, it sees itself as an expert institution whose profile will be enhanced by attracting researchers from overseas. It also realistic about the need to address issues of equipment and salaries, but is less explicit about the strategies needed for each of the research groups. In particular, it is not clear how the non-Tallinn groups are to be further integrated over the long term. Clearly the work of the various groups differ according to their proximity to the University and the ease with which cross-disciplinary research can develop but this does not feature in its strategy. We suggest that the demands of teaching and also the need to bring on new researchers need careful consideration in the different groups. Equally, it might reasonably consider the opportunities for collaboration with other research groups outside the Institute, both in the EPI and Tartu Observatory

The report does recognise the need to publish its work in publications which have a wide international distribution. This differs significantly between groups and whereas some have extensive record of publishing consultancy reports, others primarily publish in international journals. As a whole the IE publishes a series of monographs that are distributed nationally and internationally and serve as syntheses of key research areas and also a dataset available to other researchers.

All groups are enthusiastic and committed to their research and provide a suitably academic atmosphere for the development of the research teams. The reviewers were pleased by the team spirit evident in most of the groups it saw and was confident that young researchers were benefiting from the ethos of the group.

In several cases, the research groups have extensive databases that could be exploited either through collaborations or systematic review and publication. Some of the teams have extensive international connections and it is clear that the IE is implementing a considered strategy of raising its international profile. We feel that it needs to be more proactive in developing the work in the North East group, most especially in encouraging more ecologists to work on the specific problems associated with the high level of pollution here.

Plant Stress Ecology

Principal investigators O Kull, Ü Niinemets, A Aan, A Kont, A Lukjanova, A Sõber, M Tobias, L Truus

Plant ecophysiology is an important field of research, attracting considerable funding and intellectual activity throughout the world because of its challenging nature and its relevance to resource management, especially agriculture and forestry. Forests cover a considerable proportion of Estonia and are an important source of national income so that a better understanding of the performance of the dominant tree species will be very valuable. The two core programmes and numerous research grants address aspects of the performance of key species of trees, mosses and vascular species in a very challenging and novel way. Especially noteworthy is the way the group have pursued their research objectives in natural communities rather than in the artificial communities and controlled environments that have characterised much ecophysiological research elsewhere. The large number of publications in main line journals testifies to the quality and originality of the ideas as well as to a determination to establish a reputation as a world-class group.

Both Kull and Niinemets have some excellent suggestions for future studies and a clear idea of how they could achieve their objectives. The group is well motivated, enthusiastic and with a good spread of ages which should allow continuous development, especially if they are successful with their funding applications. Their determined investment in new equipment has been a well considered decision in this fast developing field and has ensured that their technical protocols have stayed at an internationally competitive level. We learnt that the key item of equipment required for the anatomy studies has now been funded from a German grant. Their other equipment requests seem very modest and would certainly enhance their analytical and storage capabilities in a very useful way. However, their competence and capabilities are compromised at present by the lack of any adequate controlled growing facilities for experimental studies as the greenhouse at Tallinn is totally inadequate for many of the controlled experiments they should undertake.

The group have been very successful indeed at obtaining grants and have active international co-operations with some of the leading international groups. They appear to be working with hemispheric photography of forest canopies in much the same way as Tartu Observatory and the Committee recommends that the two groups collaborate more closely on this. Their location at Tartu, although inconvenient for managing the Institute of Ecology and less than ideal in promoting intellectual exchange between Institute groups, has the advantage of ensuring critical mass because they can work closely with the only other major group of plant physiologists in Estonia. Since they have chosen to use economically important species for many of their studies the work is of considerable significance for Estonia as well as making an important and significant contribution to the development of plant ecophysiology in general. The Committee grades the

programme as **EXCELLENT**.

Palaeoecology research group

Principal investigators J-M Punning, T Alliksaar, T Koff, K Tõugu

Global interest in palaeoclimates has grown as the implications of climate change have become more apparent. The patterns shown by previous climatic periods are preserved as proxies in sediments and peats and are considered invaluable in improving climate models. They can also be useful in establishing the

effects of previous human activities both locally and regionally and provide insights into ecosystem development. Estonia, with a large number of lakes and extensive peat deposits, is ideally situated for the use of palaeoecological techniques to characterise ecosystem changes, including the measurement of pollution.

The research lead by J-M Punning is ably supported by other strong scientists and comprises an enthusiastic and young team working together on a range of problems. Whilst the techniques in use are not novel in themselves their development and application to Estonian circumstances is very good. Especially important has been the studies on fly ash and the role this can play both as an index of pollution and as a temporal marker. The addition of charcoal as an indicator was an important extension of the studies which have also benefited from rigorous attempts to link pollen production with patterns of deposition found in the lakes.

The group benefit from having a clear strategy for their future development and an increasingly wide level of competence. They have sought active collaborations both inside and outside Estonia, undertaken major syntheses for the whole country on data about climate change and greenhouse gases and produced specific material on the subject for school children. They have access to considerable archival information which could be used to validate their analyses on land use changes. Their research publication record is excellent and in key journals that will enhance their reputation.

This palaeoecological research will make an important contribution at both the national and regional levels, whilst the opportunities in Estonian lakes coupled with the expertise and reputation of the group and its leader should ensure this group continue to develop their growing international reputation. The Committee grades this work as **EXCELLENT**.

Laser remote sensing group

Principal investigators S. Babichenko, L. Poryvkina, V. Varlamov, A. Leeben

The focus of this work is to develop novel technologies for rapid assessment of aquatic environments by active remote sensing and fluorescent technologies. The team has carried out unique basic research and product design of the Spectral Fluorescent Signature method that can be used to analyse various compounds in natural waters. The ecological dimension of this work is in the application of these technologies in rapid real time investigation of water ecosystems in the coastal areas of for example Estonia, Latvia and Norway. Whilst team members are primarily physicists and mathematicians, the team also includes one biologist.

It is obvious that the work done by this group has been both innovative and productive. Their record of scientific publications is good. The team appears at the same time enthusiastic, strategically oriented and modest in their vision for future initiatives. They do have an extensive collaboration network and success in research funding has been excellent. Team members are strong professionals in their own research field. However, despite its inspiring atmosphere the group appeared less enthusiastic than some others in undertaking supervision of young MSc or PhD researchers. In today's market environment it is to their credit that some part of this work has been both patented and successfully commercialised but we would urge that commercial development should not inhibit student training or continuing basic research. Future tasks particularly suitable for an ecological institute would include continued refining of these technologies to support aquatic research and monitoring, and the application of these technologies to solve relevant ecological problems.

The Committee recommend that the Institute consider its policy with regard to this team from a wider viewpoint. From the national perspective, this research has a potential to contribute to the Estonian economy both through the sale of environmental instrumentation technologies and monitoring services.

Closer interaction with a wider range of biologists could also lead into ecological research where unique in-house methods and knowledge would have a valuable role to play. We also consider that members of this team should contribute to university teaching, perhaps in conjunction with the group at Tartu Observatory. The Committee grade this project as **GOOD**.

Comprehensive environmental studies in the oil shale mining and processing area

Principal investigators V Liblik, H Kundel, M Pensa, A Rätsep, A Toomik

At present oil shale remains a key natural resource for Estonia, being the basis for the majority of the electricity production for the whole country. Its extraction by either opencast or underground mining causes severe environmental disturbance whilst its preparation for burning and its final burning in the power stations is the source of extensive regional pollution and the production of massive waste ash deposits. All of this gives rise to aerial and aquatic pollution problems, ranging from heavy metals to complex organic molecules, local subsidence and direct effects of both human and ecosystem health. These problems are not new and have been the focus of environmental studies for some time. A group permanently resident in Jõhvi mainly undertakes the present programme.

Most of the work of this group appears to use well-established standard technologies and is primarily focussed on environmental monitoring from a chemical and engineering viewpoint. The Committee felt that there was a lack of innovative thinking in this project. In their papers the group have provided a very detailed picture of the extent of the regional pollution including the effects of subsidence. The development of a model allowing calculation of mean annual theoretical aerial pollutant concentrations for the complex mixtures of pollutants produced from the oil shale preparation plants and the power stations was an important achievement but it now requires detailed investigations to provide ecological ground truth assessment to verify its predictions. Their studies on aquatic pollution provide a chemical baseline against which mitigation measures can be assessed and which allow prediction of the potential effects of closing mines.

The expertise in the group is primarily in chemistry and engineering, and the average age is quite old. In addition the group is spatially divorced from the intellectual opportunities afforded by the Institute or a university. There does not appear to be a clear strategy either for the future staffing of the group or for its objectives. Despite the presence of a young ecologist in the group it was admitted that there was little enthusiasm from students to work in the NorthEast area if they had to live there and therefore difficulties were expected in maintaining the group in the future. The Committee felt that the national importance of NorthEast Estonia was such that an active ecological research programme must be maintained. In considering how this might be achieved the Committee felt that the chemical monitoring of the type necessary for assessing pollution seemed more appropriate for either the oil shale company or the local authority to undertake, rather than the Institute. The future activities of the Institute in this area should be focussed on the ecological aspects of the effects of pollutants, and the restoration of ecosystems damaged by mining. This could be undertaken by staff based primarily in Tallinn, allowing a greater range of expertise to be deployed on the problems, attracting students to work on specific projects and adding significantly to the intellectual activities of both the Institute and the university. However, the Committee were concerned that the extensive background information and detailed unpublished data of the existing staff might be lost when they retire. Indeed, the Committee were told that in many cases there was little in the way of company records to document mining activities more than two decades ago so that there experience and data now constituted critical material for any researcher interested in historical pollution trends. Accordingly the Committee recommends that the Institute ensures that full documentation exists for all data collected by the present staff and that it is securely stored for future research.

The group have been very effective in gaining grants and have a remarkable degree of expertise in environmental impact assessment, skills which need to be retained in the Institute and for which this group

should provide training to other staff. It is clear that at present their expertise in oil shale is internationally recognised and, if deposits of oil shale elsewhere in the world come to be exploited, the Estonian experience will be internationally valuable. The Committee grade this work as **SATISFACTORY**.

Wetlands Research

Principal investigators M Illomets, E Karofeld, E Lode, R Pajula

With a considerable area of Estonia covered by wetlands this is a research field of national importance. European wetlands in general have been decreasing dramatically due to drainage for agricultural uses. Those remaining have assumed an increased importance from a conservation viewpoint and are the subject of detailed and comprehensive research in many other European countries.

Much of the work of the wetlands group has been concerned specifically with the growth and development of bogs and they have published consistently in both Estonian and international journals and symposia. The projects described have well-defined aims and they are now close to developing a model to describe the interaction of topographic change (hummock and hollow) with hydrology in bog building.

The group has enjoyed extensive contact with foreign universities and these have shown considerable interest in their long-term datasets. The Committee notes these have great value with some data extending back to 1910; we recommend that special attention be given to exploiting these data as soon as possible. These also reflect the significance of wetlands and bogs in Estonian ecology. For the same reasons, there have also been exchanges including special field courses. Much of this work has been supported by international grants and there has also been significant funding from the Estonian Science Foundation.

These connections have enabled the group to stay abreast of developments in their field and to extend the range of analytical work. Their collaborations within the Institute mean that they have also been able to assess the impact of airborne pollutants on bog development, as well as support its palaeoecological work. The extent to which the wetland and coastal groups are devising joint projects seems relatively limited though this was the expressed strategy of the whole group and at present we see little commonality in the key scientific questions for each group. A collaboration with Loughborough University on Estonian lowland wet grasslands was completed in 1996 and a national inventory of peatlands and peat reserves in 1997.

The group is beginning to develop their analytical and experimental approaches, especially as these relate to methane generation in bogs. These will provide important tests of their ideas about material flow within the bog. We suggest that there would be value in a workshop focussed on bryophyte research that brought together this group with the plant ecophysiologicalists and the palaeoecologists to develop new research ideas that linked their capabilities and interests. The group would benefit from reviewing its database and considering ways in which it could bring much of this material into the public domain. Subsequent data collection might be rationalized by identifying clear research objectives. Overall, this work was judged to be **GOOD**.

Research group on coastal areas

Principal investigators A. Kont, U. Ratas, E. Nilson

In a country with over 4000 km of shoreline and numerous islands and seashore habitat types coastal research is a very important topic. The northern coast is under increasing development pressure and land use planning in this zone requires adequate basic information concerning the distribution of the different coastal habitat types and their conservation value. Larger questions about the effects of sea level rise, the links between the coast and the coastal shelf, geomorphic processes of weathering and stability are all important attributes of coastal research.

We found little evidence of strategic planning of research by this team but this may be due to recent formation of the group. Most of the work done thus far appears to be descriptive in nature, consisting of inventories and mappings rather than problem oriented ecological research. Most publications are primarily of local interest and also scientific collaboration appears to be weak. A considerable number of grants appeared to have no published output. Descriptive research is acceptable and necessary at present due to the lack of basic information for some of the coastal areas but even under these circumstances more fundamental research could be included in the research agenda. We welcomed the project on monitoring of the coastal landscape and hope that the 26 areas selected will provide an important baseline not only for measuring change but also as a tool for testing hypotheses. During discussions with the team, we could appreciate the broad view of the experts concerning seashore habitats and their dynamics, such as the interaction between geomorphological processes, habitat diversity and the ecology of some plant species. However, many of these views appear speculative at present although they could be effectively addressed by well designed research in the future.

This group has potential for substantial and rapid strengthening of its research profile through strategic planning, specialisation, networking and the submission of manuscripts to international scientific journals. As far as we know the group does not yet have any recognised status among other coastal researchers in the Baltic but this situation could be changed by the above acts. The team would also benefit from increasing their intellectual interaction with other scientists and taking in new MSc and PhD students. The group might also adopt a role in the national clearing house mechanism for biodiversity as far as coastal questions are concerned.

Due to the above deficiencies the current status of this project is graded as **UNSATISFACTORY**

Environmental Protection Institute

This is a relatively young institute, founded in 1993 and was amalgamated with the Agricultural University in 1998. Its development, at a time when other institutes were contracting, has been very rapid and while it remains autonomous, it has become a faculty with a large teaching commitment. Currently its work is split between two buildings in Tartu with the chemistry laboratories at some distance from the main research centre. Recruitment to its undergraduate courses in Landscape Ecology and Landscape Architecture has been good and there is now strong competition for places. Today these courses require staff to devote nearly half of their time to teaching. As graduates are produced so many will move onto Masters dissertations and there is considerable scope for large research groups to emerge. All students with whom we talked commented on the friendly atmosphere in the Institute and the very open and positive interaction with research staff, which they greatly appreciated.

The undergraduate programmes and the research effort are both multidisciplinary. These can provide benefits for developing their key areas, especially in landscape ecology, but the Institute seems isolated from the existing expertise in the Institute of Zoology and Botany. Within the University this can lead to duplication of effort: for example, the ecology of migratory birds is studied in both institutes.

The Institute has been very successful in raising funds, the prime reason for their rapid growth in recent years. The Institute played a central role in compiling the Estonian Biodiversity Inventory and the associated strategy plan. However, there is a tendency for the core projects to be ill-defined and in some cases the Institute needs to properly define its research objectives. This would be helped by a coherent strategy for its future development, one that recognised its existing expertise and relevant work going on elsewhere.

The self-assessment report provided a list of projects and although it divided its researchers into six areas there is considerable overlap between projects. No clear research theme could be identified from this document. For most of the projects the contribution and role of different researchers was not obvious and the Institute could benefit by defining the responsibilities of researchers more precisely. Given the teaching loads of many of the staff and the number of projects to which they make a contribution, this sort of planning is critical. In particular, the Institute needs to ensure that there is an active dialogue within the research teams, perhaps through regular seminars or team meetings to ensure that projects remain on target and new ideas are developed freely.

Overall the report was not well prepared and offered no evaluation of its research effort to date. For the most part the project descriptions were poor and the nature of the work and its results only became apparent through discussion with the researchers.

The structure, dynamics and conservation applications of ecologically compensative areas.

Principal investigators M Klvik, K Sepp

The descriptive material provided for this project was considered completely inadequate by the Committee who had to establish the objectives and methodologies through discussions with Sepp. The project, completed in 1996, measured the effects of the structure and size of mid-field woodlots on selected ecological functions. In particular, it used bumble bees as indicator species and was able to show that their abundance and diversity was closely correlated with landscape structure. Method development and the practicalities of using landscape ecology as a means of estimating biodiversity were an important consequence of the work and subsequently featured in several national reports.

Outside of Estonia most of this research has been reported in conference proceedings and the team ought to have considered reporting their findings in international journals which would have been more helpful in establishing their reputation in this field. Currently postgraduates are undertaking developments of the methods, supported by a collaboration with the Geography Department of Tartu University. There is a recognition that their computing facilities and network capability do not facilitate method development because of the way file size limitations affect the availability of images and there is a need to upgrade their facilities if this type of work is to continue. Successful overseas grant applications may be the most realistic way of funding this and increasing the amount of data to which they have access. The Committee learnt that the team have made such applications for EU funding.

The postdoctoral work of Kalev Sepp and his participation in international colloquia as well as the group's willingness to seek further international collaboration should provide a firm foundation for its future development.. Their chances of securing such funding will depend on increasing their publication rate in international journals. The work on indicator species as surrogate measures of landscape complexity should be worthy of publication. The group is at present too small to adequately realize its ambitions in landscape ecology. Indeed, scope for publishing would be improved if the group extended its collaborations, primarily because in this way it may achieve the critical mass of researchers needed to be effective. For example, it might consider extending its work on Estonian biodiversity or the national environmental strategy or applying its methods to other countries. Currently its previous work on birds has been productive and there might be scope for work with other groups, perhaps outside EPI. Despite its disappointing publication record overall, this project was judged to be **SATISFACTORY**.

Evaluating abandoned agricultural landscapes on the aspects of environmental protection and economics and predicting environmental status changes up to 2010.

Principal investigators M Ivask, O Hiimäe, A Kosk, A Karjus, J Truu

Changes in European agricultural policies have had a dramatic effect on land use across Europe. These effects have been felt even in adjoining non-EU countries where economic returns for agriculture have been falling. In many marginal areas farm size has become too small or techniques are too inefficient to provide an adequate return and the land has therefore been abandoned. This has been a progressive problem in Estonia for the past 10 years at least and has major implications for national policies.

Again the Committee felt that the paperwork provided for this project was seriously inadequate. This project sought to describe the basic ecology and management of abandoned agricultural lands in Estonia. It was completed in 1997. The remit encompassed aspects of their pollution load, the nature of the soil and the soil community, the increase in phytomass production, the scope for using buffer zones and their development for growing energy crops. As such the project is confounded by the large range of objectives that were set, some of which do not appear to have been completed or perhaps addressed in any substantive way. The published work suggests that most progress was made in the use of riparian buffer zones to reduce nutrient loss and in characterising the soil biota and decomposition processes in Estonian forest soils. There appears to be no review of alternative strategies using 'EIA scenarios' as was proposed nor any publication of 'economically and ecologically grounded recommendations for the management of abandoned land'.

The Committee were told that wastes from intensive pig farms were part of the impact assessment and that abandoned land had been assessed as a potential means of treating the slurry. This did not feature in either the project summary or the published reports. A more systematic breakdown of the project, with clearly elucidated aims and well-defined experimental methods would be required to bring the work to completion. Equally, a greater appreciation of earlier work elsewhere and the potential for well designed experiments to inform current understanding might have produced data of interest to the larger scientific community. This is especially the case in proposing how to deal with slurry from intensive livestock production.

Whilst soil breakdown processes are of considerable significance for Estonia and the expertise for this work was largely in place, these results achieved do not add significantly to our understanding of decomposition processes. A greater insight into current thinking and methodologies, applying these particularly to waste treatment and the management of abandoned land is essential. Unfortunately the international collaboration on the growth of energy crops on marginal land which followed the end of this project led to no significant

publication record and there appeared to be no link to the work on energy crops at Tartu Observatory. In the future the team might consider the use of field trials and long-term experimental manipulations to assess the capacity for waste treatment as the soil biota and above-ground communities change. The current situation in Estonia affords the opportunity to produce useful data on managing successional communities for waste treatment, and it is also likely to offer important insights into the biotic determinants of nutrient cycling.

A clear strategy and new initiative for development of this important field is needed. The Committee suggest that the Institute should consider organising a workshop on abandoned land and inviting participants from other European countries that face similar problems. There may be European funding available for such an initiative. Overall, it may be that the demands on the project leader's time from an increasing commitment to teaching were too great to bring the work to a satisfactory conclusion. The Institute should consider whether such large-scale projects are compatible with a heavy teaching load. The Committee graded the project as **UNSATISFACTORY**.

Elaboration and application methods based on soil biota characteristics for environmental evaluating agricultural lands, and environmental-economical analysis.

Principal investigators M Ivask, O Hiimäe, A Kaaver, A Kosk, L Nei, M Nõmmela, T Püssa, R Ratas, M Truu

This project seeks to use the biota to develop an index in order to evaluate the condition of soils from lands under different management regimes, including abandoned agricultural land. It appears to have led on from the previous project. It includes an assessment of the impact of veterinary antibiotics on plant growth and the scope for their trophic transfer. The remit given also includes deriving recommendations for the management of abandoned lands and as such overlaps with the previous project. The team should review how these two core projects were organized and whether a clear distinction between soil microbiology and the ecology of the above-ground community is needed.

Again the Committee felt that the descriptive material provided was scanty but learnt a great deal from discussions with the researchers. The research has used microbial inhibition as the principal means of detecting the presence and concentration of antibiotics in pot trials, from which the group has collected some interesting data. There will be a need to analyze for these compounds to establish that they represent a significant threat in the field. At present the group is hampered by the limited facilities for microbiology and the lack of equipment to undertake analyses of complex organic products. There has been cooperation with some other parts of the Estonian Agricultural University to address this, but surprisingly there appears to have been no links to the veterinarians or any grazing trials to investigate if and how the antibiotics might enter the higher levels of the food chain. Such details of transfer and compound activity seem essential if this work is to carry conviction.

The use of the soil community as an indicator of soil fertility is perhaps more problematical, at least in establishing a novel approach or a simple management tool. Whilst some of this work has been published internationally there is no evidence of a tested methodology and no obvious recommendations for the management of abandoned land. A range of expertise is available to the project but this does not appear to have led to new or radical strategies for managing the land or addressing the pollution issue.

The group has attracted grants to assess processes and the communities of various forest soils but there is again little evidence of novel approaches or significant new insights. There is also no obvious connection to wider ranging management plans needed for abandoned land. It may be that the team seeks to provide a wide-ranging approach to the evaluation of agricultural and abandoned lands but this will demand a clear demarcation of roles and a coordinated schedule of work with clearer deliverables. The Committee concluded that this project was **UNSATISFACTORY**.

Express Methods for Environmental Monitoring

Principal investigators L Nei, J Haller, A Kosk, T Püssa, U Siitan

The measurement of environmental variables accurately, reliably and cheaply has lead many research groups to investigate the potential of new technologies. With his expertise in chemistry Nei has undertaken a project to use electrochemical methods for measuring phosphate, nitrate, nitrite and oxygen in sewage and soil. This was a short project with no indication of continuation. This was not an ecological project.

The Committee noted that the work was undertaken in collaboration with a foreign university, that Nei obtained two grants to support it and that there are a number of publications in international technical journals on the oxygen probe. There was no indication of a successful development of any other probes although the Committee learnt that prototypes had been developed and a paper on the nitrate probe had now been accepted for publication. The Committee consider that in future such a development could be better sited in a chemistry institute or department such as that in Tartu University and that the Ecological Protection Institute should confine itself to defining the environmental problem and field testing the instrument.

The structure, condition and dynamics of endangered and protected species, communities habitats and landscapes in relation to their protection in Estonia

Principal investigators A. Leito, U.Kukk, M. Kulvik, K.Sepp

Conservation is a complex activity requiring a great deal of ecological information to understand the threats to species and habitats and how these might be protected. Estonia has already undertaken a detailed biodiversity assessment of its terrestrial flora and fauna and is increasingly in a position to initiate conservation measures based on sound ecological principles and best practice. There will however be a continuing need to investigate particular species and habitats where land use has changed or new threats have arisen.

The project covers a wide range of methodologies from landscape level ecological research to the ecology and management of individual species of plants and animals. Changes in landscape types and landscape elements constitute an important theoretical and practical starting point for many of these studies. Individual research projects include aspects of both basic research and applied research.

Generally, this team is competent and capable in its field. The publication list includes more than 20 scientific papers and publishing frequency has clearly increased recently. However, conference proceedings outnumber articles published in peer reviewed international journals and from the titles, the Committee wondered if some material was being published more than once. We did not also observe major methodological nor theoretical innovations of wide international interest produced by this team.

The group includes gifted individuals but it does not seem to us that research strategies and perspectives have been thought through enough at the team level. In particular, ornithological studies appear to be somewhat isolated from the other research fields, both in terms of their thematic approach and scientific context. Population biological expertise is usually needed in ecological studies on threatened species but we could not see where such activity was occurring. We recommend that this group establish a more integrated research approach including strategic planning and more active interaction among the participating researchers. The team might benefit intellectually from recruiting more MSc and PhD students and by adopting a system for regular cross-disciplinary seminars.

Ecological research on threatened species is very valuable from the national perspective. However, scientifically it would be more satisfying if the group were able to extend their work by using a complementary approach of hypothesis testing to advance the theory as well as the practice of conservation. From our discussions with the group and its publication record, landscape ecology would seem to be the leading paradigm in which to place their hypotheses. The Committee grade this project as **GOOD**.