



Biologists and the Environment The Role of the Professional in a Changing World

European Communities Biologists Association



BIOLOGISTS AND THE ENVIRONMENT
The Role of the Professional in a Changing World

**Report of a Workshop organized by the
European Communities Biologists Association
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Edited by:

L. H. Grimme (FRG), G. Moretti (Italy), A.v.d. Schraaf (NL) and T. Sonnichsen (DK)

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Aims of ECBA

1. To represent the professional interests of biologists to the European Communities.
2. To ensure the professional competence of biologists within the European Communities.
3. To facilitate the exchange of information of professional matters relating to the work of biologists within the European Communities.
4. To facilitate free movement of biologists within the European Communities.
5. To promote exchange of those teaching biology in all classes of educational establishment.
6. To promote co-operation and exchange of information between the national biological societies about their activities throughout Europe.
7. To advise the EEC and the public in general on biological matters having implications for society.

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Secretarial: Lektor Per Rosenkilde Zoophysiological Laboratory A
Universitetsparken 13, DK-2100 Copenhagen o

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I. INTRODUCTION

The European Communities Biologists Association (ECBA) was founded in 1975 to represent the professional interests of biologists to the European Communities and to ensure the professional competence of biologists within these communities. One of the first activities of ECBA was, therefore, to review the educational systems of all participating countries. Two workshops were subsequently organized

- (1) to examine the biological curricula in universities (Amsterdam, 1975)
- (2) to examine primary and secondary school biology (Salzburg, 1980).

The special character of biology derives from the fact that a biologist needs insight, at all discernible levels, into living matter — from molecular and cellular levels through organs and organisms to the level of populations, ecosystems and the whole biosphere. Such a person is able, with additional specialized training, to pursue a professional carrier in many divergent fields, viz,

- (a) research in industry, in universities, and other institutions
- (b) planning and management in industry and government
- (c) teaching in schools, institutions and universities

More recently biologists have entered other fields which are rapidly developing, viz

- (1) biomedical fields
- (2) health education and
- (3) biotechnology.

It is the intention of ECBA to organize discussions of these various emerging fields so that changing requirements and attitudes may be met.

The workshop "Training and Employment of Biologists for/in Environmental Professions" collects, collates and summarizes the new developments and needs which are desirable in the different member countries of the European Communities in a situation of intensive use and management of natural resources and its consequences for a healthy environment.

State of **the** Environment

The environment has, with regard to official statements, been improving consistently since 1970. There has been an improvement in air quality, a less noticeable improvement in water quality, but no return in the loss of natural habitats. The topics of acid rain, groundwater contamination and the disposal of hazardous wastes, particularly finding alternatives to landfilling, are on the list of emerging environmental problems. One characteristic of these problems is that they may affect any or all of air, water, and land. The book "World Environment 1972-1982" published by the United Nations

Environment Programme (UNEP) offers an independent analysis of trends and priorities in a number of resource and environmental areas. It comments on the changes that have occurred in the different components of the environment since the Stockholm Conference of 1972. It states a list of unassessed problems, including

- carbon dioxide build-up
- chlorofluoro carbons in the atmosphere
- indoor air pollution
- groundwater depletion
- contamination of drinking water by toxic chemicals
- continuation of farm practices that cause soil erosion
- loss of genetic material in vanishing species of plants and animals.

While in 1972 it appeared that most environmental problems were still localized and national in nature, by 1982 issues emerged that required international and joint attention: acid rain, disposal of hazardous wastes, the ozone layer, carbon dioxide buildup and others.

The Stockholm Action Plan contained 109 specific recommendations on ways to clean up the environment. It is evident that only minor parts of them have been satisfactorily addressed: there are still global problems as desertification, deforestation, transfrontier pollution and degradation of the "commons", i.e. the major water bodies, and permanent loss of genetic material inherent in the estimation of populations and species. Thus, the unsolved problems are many.

While the problems are becoming more difficult, more complex and are larger in scope, the need for competence in dealing with discussions on environmental issues is becoming greater. Environmental research and communication of the results of that research has to be conveyed to legislators, administrators, environmental planners, conservationists, and business leaders. Scientific biology has to play a more significant role within an inter-disciplinary approach of identifying and defining environmental issues for a more rational use of natural resources to satisfy man's needs and at the same time to maintain their self-regenerating capacity and stability of seed resources.

The Role of Biologists

Industrialisation, urbanisation and the intensification of agriculture are proceeding steadily. This will have a continuously increasing impact on nature and the human environment: changes in habitats, loss of habitats and a number of directly human related physical, chemical, biological and sociological influences will have significant effects on the whole biosphere, on ecosystems, populations, organisms and on the health and wellbeing of both human communities and of individual human beings. Planning departments all over the world are well aware of this situation and many different ways are trying to make use of the environmental sciences to develop a broad prevention strategy aimed at preventing damage.

It is evident, that biologists from their training have the knowledge, the skills and the altitudes to understand the dynamics of nature: the dynamics of structures and functions at different levels of complexity of the biosphere and are also able to give answers to problems in maintaining the use of the endangered living world.

- o A trained biologist, even prior to any specialization, has a basic insight into the structure, function and evolution of the three levels of biosystems: cells, organisms and ecosystems. He has a secure grounding in the physical sciences and mathematics, since much of contemporary biology springs from biochemistry, biophysics and biomathematics.
- o A trained biologist also has an understanding of the relationship between biology and society, is aware of his special social responsibilities and has a basic knowledge of the didactics and history of biology and the philosophy of science.
- o A trained biologist, can provide for the decision maker, basic information on living systems and affecting all aspects of human, animal and plant life of a quality, no other professional can provide.

Despite of this basic training of a biologist, stated as a "core-programme" of four years of study in the report on the ECBA-workshop on "Biology Curricula at Universities" it has to be extended by a phase of specialization, which according to the proposal of ECBA will occupy normally one year. Within the total of five years, a biology student will pass additional advanced studies and will have a period of biological research. Those studies are preparatory for specialization towards professional fields in basic research, teaching, biotechnical professions or planning, management and monitoring of the environment. It was the aim of this workshop to gather together alt aspects of Environmental Biology in order to specify the contribution biologists can make in environmental technology, management, planning, conservation and training, and to consider the elements in biology which have to be included in order to develop the professional competence of biologists in environmental issues.

II. OBJECTIVES OF THE WORKSHOP

The workshop with its original title "Training and Employment of Environmental Biologists" primarily had the following aims: to exchange information about the present position in the various countries; to consider how specialized training in ecology relates to broader courses in biology; to discuss improvements in the training now available; and to recommend to governments the benefits of a wider use of environmental biologists in all the fields mentioned before.

The assembly of representatives of the member bodies of ECBA and experts from different countries concentrated these aims into two main objectives, which were subdivided:

- To identify and to define the *professional needs* for environmental fields (data/in-

formation; research; monitoring; communications; integration of standards, criteria and particularly environmental impact assessment into planning on all levels; interdisciplinary relations with engineers, planners, chemists, agriculturists, foresters, lawyers; role of biologists in environmental problem solving and decision making, present employment of environmental biologists within various countries) © To discuss and to consider the *training needs* for environmental biologists (summary of present training in environmental biology within the various countries; ecology as a component of first degrees; postgraduate specialization in environmental biology: EEC directives and their implementation: what are implications for training (e.g. environmental toxicology).

III. PROFESSIONAL NEEDS FOR ENVIRONMENTAL FIELDS

Nowadays a keynote of public policy is, that economic and technical development will be accompanied by measures designed to maintain or even improve environmental quality. This is recognized by different national and international committees and also by legislative steps taken in some countries (United States of America, Canada, Australia and New Zealand). These affect actions that are environmentally significant. In Western Europe most of the members of the EEC have shown interest in encouraging productive harmony between man and his environment, to prevent or eliminate damage to local environment and to the whole biosphere, to stimulate the health and welfare of man and to increase the understanding of ecological systems, the rational use of natural resources and their regeneration where necessary.

However, as Andre Gorz discusses it in his book "Ecology and Freedom", the difficulties governments face in trying to solve problems of environmental damage and misuse of natural resources, will force all governments, especially those of capitalistic societies, to interfere more and more by environmental legislation and restrictions, ending up with a super-surveillant society. This may lead, according to the concept of Andre Gorz, to eco-l'ashism.

The problems or crises of an ever-deteriorating environment are not nationally restricted, nor are they confined to heavily industrialized nations. The waste and by-products of human existence and the extended use of natural resources recognize no political boundaries. They are global problems and have technical as well as human dimensions: there is some new awareness and widening concern for the physical quantity of *non-renewable resources* available to man; there is a growing social concern for the *quality of life* based on the realization that pollution and un-recycled wastes affect that quality; and current patterns of resource depletion and distribution have raised ethical questions especially in connection with the maintenance of plant and animal life. Man's use of nature involves rational priorities and ethical choices. Only basic changes in values and attitudes will guarantee the legacy of future generations, but technological and legislative remedies at least will buy time for man to mend his way. Values and attitudes do not develop in a vacuum. There is need for environmental

awareness, knowledge and skills. Environmental problems confronting us today will ultimately depend on human commitment and involvement if solutions are going to be successful. A common basic level of awareness of the interrelationship between man and his environment is needed, if the goal of a quality environment is to be achieved in the long run. To develop public awareness for the environment there is a need to broaden the knowledge and understanding as well of the general public as of disciplinary specialists and professionals, like biologists and to equip them with a good measure of environmental awareness and appreciation. These activities will have both immediate and long-range effects if undertaken comprehensively. For this, the immediate need is

- © the in-service training of existing specialists and professionals and
- the provision of new fields of option for future students within environment related disciplines and profession.

However, the broad and mainly technical implications of many of the environmental problems point to an emerging need for environment-related scientific skills. These skills are needed for problem areas, which resemble themselves fields of perspective employment as well: *Land Use Planning, Conservation, and Pollution and its Control*. To work in these Fields, requires

- a *social dimension* of an inter - and multi-disciplinary approach (cooperation, co-ordination, information, projecting, language/terminology, cost/social relevance thinking) and
- *qualities* of competence (scientific and technical competence: environmental scoping system analysis including inventions, evaluations, planification, measurements, simplification; as well competence in methods of management and leadership).

In the following pages are summarized the fields, in which environmental biologists could play a proper part in environmental research, planning and technology to improve exploited ecosystems, to maintain nature for future generations and to prevent damaging methods in the use of natural resources.

Serving society for its needs of nature conservation necessitates the involvement of qualified environmental biologists in public authorities and institutions and in private sectors of productive industries, controlling institutions, and public relations activities, from local to national and international level.

Professional Fields

The diversity of human activities in exploring and exploiting natural resources is evident: agriculture, forestry, horticulture, fisheries, hunting, water use (sewage, fresh and fowl), extractive industry, off-shore activities in the sea etc. It has consequences for public and environmental health, in aspects of education, teaching and training, information by different media, research media, and development, energy use,

demography, different soft ware technologies (informatics), for biotechnologies and conservation (protection, management and development).

Biologists are already involved in most of these different kinds of activities. According to the Register of Environmental Biologists established by the Council of the British Institute of Biology, London, to give one of many examples, the corporate member biologists listed there by their experience and academic qualifications, are working and competent to advise on the following environmental and applied ecological matters:

Agriculture	Conservation (Wildlife)	Pest Control	Pollution
Algology	Ecotoxicology	Pollution-Aquatic	
Aquatic Biology	Environmental Education	Pollution-Atmospheric	
and Resources	Environmental Impact Assessment	Pollution-Estuarine	
Arid Ecosystems	Environmental Planning and Policy	Pollution-Freshwater	
Coastal Ecology	Estuarine Ecology Fisheries Forestry	Pollution-Heavy Metals	
Conservation (Birds)	Hydrology Industrial Effluents	Pollution-Pesticides	
Conservation (Habitats)	Industrial Siting Land Reclamation	Saltmarshes	
Conservation (Invertebrates)	Landscape Science	Tropical Ecology	
Conservation (Mammals)	Land-Use	Turfgrass	
Conservation (Nature)	Limnology Nuclear Power	Urban Ecology	
Conservation (Soils)	The register aims to establish the professional standing of applied ecologists and environmental biologists in relation to that of engineers, planners and surveyors. It also is intended as a list of consultant environmental biologists and serves to direct inquiries to appropriate people. The basic criterium for inclusion on the Register is a five years responsible experience in environmental biology as a biologist.	Waste Disposal	
Conservation (Vertebrates)		Water Quality and Management	
		Wildlife Management	

Register is a five years

responsible experience in environmental biology as a biologist.

All these working areas and fields of employment might be summarized to *Land Use Planning, Conservation and Pollution Control* (Tab. I).

The National Board for Science and Technology of Ireland has summarized the Sectoral Manpower Requirements in environmental management into three sections:

- Local Authority Environmental Manpower Requirements
- Environmental Manpower Requirements of Industry
- Environmental Manpower Requirements of State and State-sponsored Agencies.

These three sections dominate the objectives for educational programmes in these three

specific areas of environmental management. It also acknowledges professional fields for the

- Developing Public Awareness on the Environment and
- Developments in Health Education

as additional main sectors, where education and training has to be considered.

Professional Needs

It is evident from the diversity of environmental fields, in which biologists are professionally involved, that certain criteria, categories and qualifications are needed to get competently involved in problem-solving activities. Such professional needs include the *instrumentation, methodology* and value judgement and objective application in various *positions* available.

The main instruments for environmental biologists to be professionally engaged in are legislation, planning evaluation of environmental standards, and administration. Among them Environmental Impact Assessment (E.I.A.) has become a dominant role as "*an activity designed to identify and predict the impact on the bio-geophysical environment and on man's health and wellbeing of legislative proposals, policies, programmes, projects, and operational procedures, and to interpret and communicate information about the impacts*" (Scientific Committee on Problems of the Environment (SCOPE)).

Environmental Impact Assessment is in its early stages although there are now some E.I.A. methods available and mandatorily applied especially in the United States following the passage of the National Environmental Policy Act (NEPA). EIA can be regarded as a useful model to show the need as well as the possibility to engage environmental biologists in other fields of environmental concern as well. The *methodologies* to be enacted and applied by environmental professionals include scientific/technical, social and managing capabilities. Environmental scoping system analysis requires inventions — evaluations — planifications — measurements to be able to monitor, to analyse problems, risks, alternatives and to propose valuable solutions of environmental problems to different agencies in the fields of environmental concern. In view of the broad range of impacts to be considered (biogeophysical, chemical, social, economic), there seems no doubt that all the methods are necessary to solve environmental problems or even the methods necessary for an effective E.I. A. cannot be undertaken by an investigator or professional of a single discipline: an interdisciplinary team effort is required, and the team should involve professional representatives from both the natural and social-economic sciences.

There are activities of the Commission of the European Economic Community (EEC) to evaluate the needs for E.I.A. methods and techniques at both Member State and Community level and to make proposals of the most appropriate ways to meet these needs, especially by introducing effective education and training. From such initiations

other fields of environmental activities are likely to arise.

Biologists in environmental positions of different levels will be called upon exercise qualities like *professional credibility* with the aspects of theoretical knowledge, practical awareness, rigorous analysis, explicit assessment and interdisciplinary connection, *skills and insight* with the aspects of qualitative definition, quantitative enumeration, systems description and systems intercalibration, *professional approach* with the aspects of imagination (flair), conduct, judgement, confidence, willingness, teamwork and vocation, *work management* with the aspects of career management, operational planning, managerial responsibilities, *communication* with the aspects of information analysis (including display) and public relations, and *administration* with the aspects of policy studies, administrative and legal process, and negotiation. Besides these requirements, an environmental biologist should be able to evoke, where appropriate, a *bio-ethical motivation* in the -handling of environmental issues where living organisms are concerned and where an awareness of the respect for life is required.

Within the overall frame-work of environmental politics the professional biologist working in the environmental field should be able to provide the basics of an *bio-political evaluation* for political issues to politicians themselves, as well as to the general public.

IV. TRAINING NEEDS FOR ENVIRONMENTAL BIOLOGISTS

It will be clear from the previous chapter that a great diversity in environmental fields eliminates the possibility of only one specific and "ideal type" of an environmental biologist. There is a great variety of positions and working fields where environmental biologists might be or even have to be involved and therefore there exists a number of different categories of biologists working on environmental problems. This great diversity in types of positions and needs for specific environmental working fields eliminates also the possibility of an universal environmental education and the establishment of a universal training programme towards a professional environmental biologist.

No single curriculum or institutional approach can serve universally, nor even would it be desirable if it could. Environmental problems vary from country to country and among different categories of environmental impacts. Therefore different priorities in the establishment of environmental education programmes are necessary. They force to base the establishment of education programmes on the analysis of different professional needs. The diversity, complexity, and sheer numbers of environmental problems facing man suggest that the scope of environmental education programmes be as broad as possible: each country should provide as broad a range of environmental education as possible.

The analysis of the Tab. 1 (p: II) shows that environmental biologists will have a number of *instruments* at their disposal in order to function in the different positions (legislation, assessment, planning, administration). They also will have special *working - methods* (social, scientific-technical, managing). From this framework of Tab. I and for each "type" of an environmental biologist a more distinct description of different "profiles" of environmental biologists can be deduced in terms of working fields, positions, instruments and methodologies. A careful description of the different possible profiles will enable general final terms for an educational training programme to be worked out.

Final terms for training programmes of professional environmental biologists

In the first place, an environmental biologist should be a good biologist. He should have a good basic knowledge in general biology, research skills, a good insight and judgement on research of other biological disciplines and knowledge of biological ethics. In general, a biologist, who wishes to get specialized in environmental fields should have a common basic training period in biology, usually of 4 years, as it was agreed on by ECBA with its biology core programme (see ECBA-Workshop Report I: Biology Curricula at Universities, Amsterdam, 1976). In summary, this basic core programme provides every biologist with biological topics, topics related to biology and skills and attitudes, which are obligatory to each modern biologist (Tab. 2). An environmental biologist has a vision and perspective on environmental problems. which he can build up from a system approach to problem fields. He should be able to

Tab. 1 Professional Fields and Professional Needs for Environmental Biologists

Professional Fields	Instrumentation	Professional Needs Methodologies	Positional Requirements	Capabilities
LAND USE PLANNING	Legislation	Scientific/ Technical Inventions Evaluations Planifications Measurements	Tasks Research Advising Management Education Public Relations	Professional Credibility
POLLUTION CONTROL	Planning Environmental Standardization	Social Cooperation Coordination Projecting	Levels International	Professional Approach
	Environmental Impact Assessment (E.I.A.) Administration	Terminology/ Language Cost-Relevance Social-Relevance	Local Positions Public Service Economy Consulting Agencies	Work Management Communication Administration
CONSERVATION	Non-governmental Organizations	Management/ Leadership	Private Industry Mass Media Political Parties Voluntary organizations	Bio-ethical Motivation Bio-political Interpretation

recognize environmental problems and fields and predict environmental developments from analytical factors. He should be aware that during the process of recognizing and predicting, most environmental problems cannot be solved by biologists alone, but need an inter - and multidisciplinary approach. He should build up a flexible approach towards managing and solving environmental matters by communication with others. Therefore he should be able to work and communicate with people from other disciplines (e.g. lawyers, engineers, economists, politicians, etc.) and he should have — in order to judge the contribution of each team member — insight in different working fields, the specific techniques used and the special professional problems of other disciplines.

An environmental biologist should have the ability to manage, to cooperate and to coordinate an environmental project, especially when biological issues are dominating like in most fields of nature conservation or wild life management. He also should know where his responsibilities as a biologist are established within the structured society and he should have the ability to bring over his professional views and philosophy to the general public by sound and clear arguments in scientific, ethical and political terms.

Elements and course components in environmental training programmes

According to the final terms for training programmes of environmental professionalists mentioned in the previous chapter, an environmental biologist must have a thorough basis in biology and he should receive a specialization in theoretical and experimental ecology including applied aspects in both cases. This specialization on environmental issues should be used on a clear exposition of key concepts and objectives and should include

- the major principles of terrestrial, limnological and marine ecology (especially syncology)
- the principles of applied ecology (oriented on environmental issues)
- ecological resource management and use
- the central themes of population management, natural area planning and conservation philosophy
- an understanding of man's environment as an integrated unit
- a training of critical approach to use biological and chemical and engineering methodologies to assess its state
- knowledge of the impact of man's waste on land, water and air and an understanding of waste management
- a basic insight into environmental decision making
- and a short period of practical skill in fields with industry, government departments or other environmental bodies.

Additionally, whilst the transmission of knowledge is an important aspect within environmental biology, the development of attitudes, the skills of analysis and synthesis,

Tab. 2 Basic Training of Biologists Prior to Specialization

Biological Topics	Topics related to Biology	Skills	Attitudes
<ul style="list-style-type: none"> ● Systematics of organisms ● Biology and biochemistry of cells and subcellular systems of pro-and eukaryotes ● physiology and developmental biology ● Ethology ● Genetics and the process mechanisms and pattern of evolution ● Ecology 	<ul style="list-style-type: none"> ● Physics ● Chemistry ● Geosciences ● Mathematics ● History of Biology ● Philosophy of Science ● Foreign languages 	<ul style="list-style-type: none"> ● Basic Skills ● classical & advanced instrumental techniques ● experimental skills ● mathematical skills ● verbal & reporting skills ● bibliographic skills ● observation techniques ● hypothesis techniques ● Desirable Skills ● drawing ● conservation & dissection ● breeding & maintenance 	<ul style="list-style-type: none"> ● Basic Attitudes ● tendency towards empirical proof ● readiness to test formal theories ● awareness ● openness ● cautiousness ● cooperation ● Desirable Attitudes ● engagement in promotions

and the abilities of problem-solving, decision-making and public relations are even more important than theoretical knowledge. Therefore, environmental education should involve a significant element of practical study, preferentially in form of *case studies* or of problem oriented *projects studies*.

This would implement that programmes should be developed by teams rather than by specified persons or chairs, including biologists and other scientists, social and economic experts and educators, and includes experiences outside universities, mainly field-studies, as well.

Biologists must have a significant role as well in structuring educational programmes for other environmental scientists, since the strict way of scientific thinking by natural scientists (physicists, mathematicians, chemists a.s.o.) often resulting in a monocausal relation, is widened by biologists, because they are trained in a more complex way of thinking ("inclusive thinking", see workshop report of meeting on "Biology in Secondary Schools" held by ECBA at Salzburg, 1980). Biologists should also be able to convey biological, (especially ecological) thinking, but also bio-ethical attitudes to colleagues from engineering, social and political sciences collaborating with them in environmental work.

The training of biologists should therefore enable them to train and teach colleagues and students of other disciplines as well.

This "inclusive thinking" enables biologists to contribute effectively in teams of multi-disciplines and provides an interdisciplinary connection with professional credibility. Essential elements for a specialization phase of environmental biologists are summarized in Table 3.

*BIOLOGY CURRICULUM WITH SPECIALIZATION
TOWARDS 'ENVIRONMENTAL BIOLOGY'*

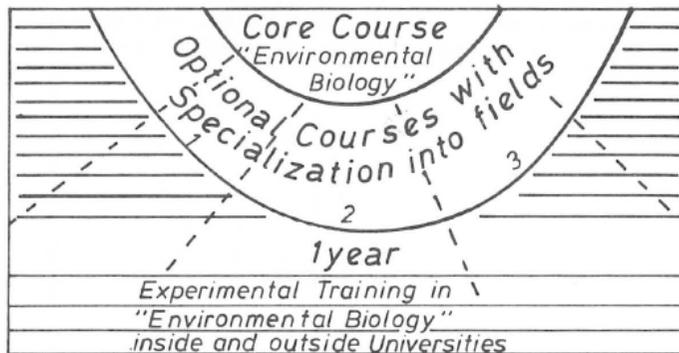
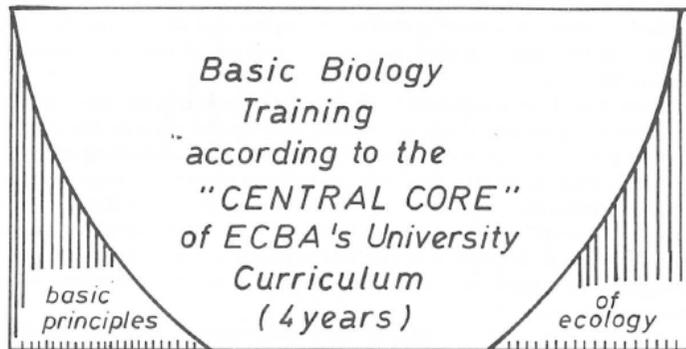


Table 3 Elements for a Core-Course of a Training Curriculum towards an Environmental Biologist during a Phase of Specialization

Knowledge

biology: the ordering and systematic relationship (of living systems of all levels of complexity) that they have with their physical environment

ecology: ecosystem structure and function and their evaluation; appraisal of utilization; ecological and planning

bio-ethics: conservation and life ethics

resource economics (ecological economy) and environmental policy, system theory

basics of administrative sciences: law, political sciences (incl. policy-making theory)

public administration, democratic control of environmental planning processes.

operational research: decision making, programming, simulation; case study techniques and application

choices of technology: ranges of technology, their evaluation and choice; social policy implications; alternative technological choices

social-psychology: interaction processes

Abilities and Skills

communication: writing, speaking, negotiation, use of media

team-work

management

Attitudes

flexibility responsibility,

assertentny ("back-bone")

"professional ethics"

The design of a training programme

With all the elements listed in the previous chapter a training programme can be designed, for biologists who enter the phase of specialization towards an environmental biologist. All biology courses and other training elements are now related to environmental problems.

Since environmental problems arise in a social context within the society and solutions have to be found within the society, a pure academic training programme will not be adequate.

It is strongly advised to set up a programme focused on practical problem-solving of environmental issues, which contains elements of practical training and training in team work. This can best be done in problem oriented project studies or case studies.

Preferentially this should combine training in university courses with practical studies outside university (field work).

Case studies and projects are suitable didactical designs for teamwork training: skills and attitudes are directly integrated with the teaching of knowledge and facts.

The phase of specialization towards a professional environmental biologist should be arranged as a training programme in two steps:

- (1) A first step, which is a core programme of key issues in environmental education, should present a progressively more complicated and sophisticated understanding of the human environment, a history of Man's interaction with the Environment, the hazards of the physical world, the organization of the natural environment, structure and function relationships of ecosystems. The core programme should also obligatorily contain an introduction to environmental planning and environmental technology (energy resources, mineral production, urban technology, resource economics), cost-benefit analysis, administrative structures in environmental management, environmental economics and environmental legislation, and should stress the organization of a democratic society with its elements and techniques of decision making, including public involvement.
- (2) The second step, which offers the opportunity of a further specialization, should include optional courses with direct relations to practical work related subjects.

V. CONCLUSIONS AND RECOMMENDATIONS

- All biologists should have, prior to any specialization, a common basic training period in biology usually of 4 years resulting in a level of knowledge, skills and attitudes comparable in all countries.
- A specialization in environmental biology should be based on a clear exposition of key concepts and objectives in major ecological principles (of pure and applied ecology); the central themes of ecosystem and special resources management; homeostasis theory, the conservation philosophy and ethics of life.
- Environmental training should involve a significant phase of practical study.
- Social and ecological concepts arising from the interaction of human social systems with natural systems should be integrated in teaching environmental biology.
- It is important to extent the development of knowledge in environmental biology by skills of analysis and synthesis and by the abilities of problem-solving and decision making. Environmental biology programmes should include methods for encouraging these attributes.
- Graduates should be aware of the necessity and importance of multidisciplinary approaches by team projects.
- Environmental biologists should be trained to communicate by using different methods at different levels to different kinds of people.
- Postgraduate courses including all elements mentioned should be offered to biologists for specialization in environmental biology.
- The governments of the European communities should introduce Environmental Impact Assessment Studies (EIA) into their administrative structure as a valid tool to prevent environmental detonation due to non ecological sounded development as technology, and should provide special training programmes at national and multi-national level for proper E.I.A. implementation.

VI. ACKNOWLEDGEMENTS

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Annex 1

Published Reports of ECBA

1. Biology Curricula at Universities (1977).
2. Biologists in European Society (1979).
3. School Biology for Child and Society (1981).
4. Health Education and School Biology (1984).
5. Biologists and the Environment - The Role of the Professional in a Changing World (1984).

Annex 2

EUROPEAN COMMUNITIES BIOLOGISTS ASSOCIATION (ECBA) - Adress list

FULL MEMBERS

Belgium

National Body: Vlaamse Vereniging voor Biologie

c/o Prof. Dr. Hendrik Gysels

Onderzoekscentrum voor Landschapsekologie en Milieuplanning

Rijksuniversiteit Gent

Coupure 168

B-9000 Gent

National Body: Association des Biologistes Beiges d' Expression Francaise (ABEF) c/o

Prof. A. Danguy

Avenue de la Reforme 83

B 1080 Brussels

Denmark

National Body: Foreningen af danske biologer c/o

Lektor Per Rosenkilde

Zoophysiological Laboratory A

Universitetsparken 13

DK-2100 Copenhagen O

France

National Body: Association des Professeurs de Biologie et Geologic c/o

Professor Jean Ulysse

12 Rue Beccaria

F-15012 Paris

Federal Republic of Germany

National Body: Verband Deutscher Biologen

c/o Prof. Dr. L. H. Grimme

FB 2 Biologie/Chemie der Universitat Bremen

Postfach 330440

D-2800 Bremen 33

Greece

National Body: Panhellenic Union of Biologists

c/o Ms. Lia Tsakalia

Panhellenic Union of Biologists

79-81 Socratous Street

Athens 102

Ireland

National Body: Institute of Biology of Ireland

c/o Professor J. A. Kavanagh

Royal Dublin Society

Ballsbridge

Dublin 4

Italy

National Body: Ordine Nazionale dei Bioiogi c/o

Professor Giorgio F. Moretti

Via S Anselmo II

00153 Rome Luxembourg

National Body: Association des Biologistes Luxembourgeois

c/o Mr. Paul Kintziger

24 rue du Gymnase

Diekirch

Netherlands

National Body: Biologische Raad c/o

Koninklijke' Nederlandse

Akadcmie van Wetenschappen

Kloveniersburgwal 29

1011 JV Amsterdam

United Kingdom

National Body: Institute of Biology

c/o Prof. J. A. Beardmore

20 Qucensberry Place

London SW 7 2DZ ASSOCIATE

MEMBERS Norway Biologencs Interesse

Organisajion c/o Dept. of Biology

The University of Oslo

P.O. Box 1050

Blindern - Oslo 3

Spain
National Body: Colegio Oficial de Biologos
c/o Colegio Oficial de Biologos
Plaza de Chamberi 9,4°, lat izqdo
Madrid 10

Sweden
National Body: Biologsamfundet
c/o Dr. Jan-Eric Tillberg
Botaniska institutionen
Stockholm* universitet S-106 91
Stockholm

Annex 3
LIST OF PARTICIPANTS

BELGIUM
Dr. Rudy Nys
Seminaric voor Biologic i.v.m.
de Mcnswetenschappcn
State University of Gent
Vakdidaktiek Biologic
Coupure 168
B-9000 Gent

DENMARK
Dr. Hans Ulrick Riisgiird
Biologisk Institute
Odense University
Camusvcj 55
DK-5200 Odense M
Dr. Vibeke Brock
Institute of Genetics and Ecology
Ny Munkegade, Arhus University
DK-8000 Arhus C
Mr. Torben Sifnrichsen
Solsortvej 19
DK-4300 Holbaek

FEDERAL REPUBLIC OF GERMANY
Prof. Dr. Wolfgang Erz
Federal Research Centre for
Nature Conservation &
Landscape Ecology
Konstantinstr. 110
D-5300 Bonn 2
Prof. Dr. L. Horst Grimme
FB Biologie/Chemie
University of Bremen
PO Box 330440
D-2800 Bremen 33

NORWAY
Dr. Dag Olav Hcssen
Zoologisk Institutt
Universitet 1 Oslo
Postboks 1050
Blindern - Oslo 3

GREECE
Prof. Dr. Dinos Christodoulou
School of Sciences
University of Patras
Patras
Dr. Anastassios Legakis
Department of Biology
University of Athens
Athens

IRELAND
Dr. John J. Bracken
Zoology Department
University College, Dublin
Belfield
Dublin 4

ITALY
Prof. Dr. Giorgio Moretti
University of Padova
Padova
Dr. L. Zuzzi
University of Padova
Padova

THE NETHERLANDS
Dr. V. van Ry
Subfacultcitsbureau biologic
Kruislaan 318
NL 1098 SM Amsterdam
Dr. Angelique van der Schraaf
Rooysestraat 7
NL-6621 Ah Dreumel
Prof. Dr. Bert Vlijm
University Council
Vrije Universiteit
De Boelelaan 1105
NL-Amsterdam

SPAIN
Dr. Antonio Machado
Vivero Forestal ICONA
La Laguna
Tenerife/Canary Islands

UNITED KINGDOM

Dr. Michael Chadwick
Department of Biology
University of York
Hcslington
York, Y01 5DD

Prof. John Beardmore
Department of Genetics
University College of Swansea
Singleton Park
Swansea, Sa2 8PP

Dr. S.A. Peachey
Centre for Environmental
Technology
Imperial College
London, SW7

Prof. Sir Richard Southwood
Department of Zoology
University of Oxford

South Parks Road
Oxford

Mrs. Pauline Marstrand
21 Maplewell Road
Woodhouse Evans
Leicestershire

Mr. Philip Oswald
Nature Conservancy Council
Po Box 6
Godwin House
Huntington, PE18 6BU

Mr. D.J.B. Copp
Undcrhill Farmhouse
Wittersham
Near Tcnderden
Kent, UK

Mrs. Pamela Kendal! Insitute of Biology 20 Queenberry Place London SW7 2DZ