

THE TEACHING OF ECOLOGY AT UNIVERSITY LEVEL

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The title I was given for my contribution to this symposium is indeed broad. As it stands, lacking any qualification, it is meaningless. Ecology, by whatever definition you choose, involves many disciplines; and the whole question of the training of ecologists is important and fraught with problems. That university course structures in ecology have been exercising the minds of academics and administrators increasingly over recent years may be inferred from the growing literature on the subject—see the recent volume, *The teaching of ecology*, Lambert (1967) and a paper by Harrison (1967), to mention but two contributions.

The fact that ecology must embrace the physical environment as well as the organisms themselves means that other complementary subjects should be taught, many of which lie outside the traditional science course. Few would disagree with this statement; but from this point on the road is cluttered with arguments, some of which seem incapable of solution. For instance, we immediately come up against the age-old controversy between the advocates of general studies and those recommending early specialisation. In terms of ecology this means the choice between training people first as biologists before exposing them to the theories, philosophies and techniques of ecology; or streaming students after the first year of the traditional zoology, botany, chemistry and mathematics/physics courses into special fields, one of which might be ecology. Both systems I feel have their place.

Again, there are those who consider that the fully equipped ecologist needs not only the traditional subjects mentioned above (with zoology or botany—or both—to a degree level), but also an insight into geology, pedology, climatology, cartography, physiography and so on. Because this is so often impracticable at both secondary and tertiary institutions, it is better to omit ecology altogether rather than give a partial training. This is an extreme view, but so is that held by those who advocate that all biology should be taught with an ecological bias.

These are but a few of the major differences of opinion about what should be taught, when it should be taught, or indeed if it should be taught

at all. If we superimpose the equally controversial arguments about the function of education in general and the function of universities in particular, we are bound to get bogged down in a sterile exercise. The point I wish to make (and this is by no means original) is that as the need for ecologists in government, local government, river authorities, fish and game management agencies, etc. becomes better recognised, so it is realised that students with different backgrounds and outlook are required. We will need specialists in research and people with a general background but without detailed knowledge or experience in any particular field of research. To restate the case: it is pointless to think in terms of teaching in a subject such as ecology without due regard to the end product, the growing and pressing needs of society and the types of careers available to graduates.

During a recent study-leave in Britain I was able to see briefly how the teaching of ecology is being tackled at several universities whose aims and functions are quite different. Lack of space dictates that I should err on the side of over-simplification and generalisation.

As an example of early specialisation aimed at training people in the broad field of management of natural resources, I will cite the courses offered by the recently established Department of Forestry and Natural Resources in the University of Edinburgh.* Here, a pass degree of B.Sc. (Ecological Science) is taken after three years' study, or the Honours degree after four. The first year of the course covers the basic subjects common to all biology students—biology, chemistry and physics/mathematics. For students intending to study ecology, forestry, wildlife management or land-use ecology, the second and third-year courses are in ecology and resource management. (In the third year there is some specialisation in resource management towards the proposed Honours subject—ecology, forestry, wildlife management or land-use ecology.) Time throughout is divided between

* So far as I am aware no British university has a Department of Ecology. The nearest to approach to this, I feel, would be the Department of Forestry and Natural Resources, University of Edinburgh.

elements of ecosystems (including aerial and land survey and cartography), hydrology and water management, statistical techniques and the ecology of different land use systems. The practical aspect of the degree structure is further emphasised by the vacation courses which are tailored to the students' interests. Typical examples would be tours to study management systems in relation to land use in Britain or on the Continent, or to assess populations of mammals or fish, or a three-month attachment to a special laboratory.

One of the features of the Department, which may be seen in many British universities and which must impress anyone coming from New Zealand where we foster the "jack-of-all-trades" attitude, is the number of staff involved in the course. For instance, in 1968 the student population consisted of approximately 75 undergraduates and 20 graduates. These were the responsibility of 14 staff members whose special interests covered the entire range of biological systems from fresh-water fisheries to forests. In addition, the Departments of Agriculture, Statistics and Geology within the University, and staff of scientific agencies and institutions (e.g. the Nature Conservancy) outside the University all bring their specialist knowledge to the teaching, and in some instances to the supervision, of research.

There is obviously a great and growing need for people trained in this way. Admittedly, some will maintain that these students do not have the biological background on which to build ecology. The argument about whether the omission of a traditional detailed background of courses in zoology and botany is desirable or not will never be settled. In the meantime Edinburgh has established a pattern that will provide a pool of trained practical graduates who, through sound management practices, can enable the production of natural renewable resources to be maintained at the highest possible level.

For those who believe in approaching ecology through general studies, the recent development in Britain of the one-year post-graduate course in ecology is relevant. University College, London, was the first in the field and offers the M.Sc. degree

principles and techniques. The courses in resource management include such aspects as the objectives of resource management, economic analysis, the measurement of the biological and physical

(Conservation), whereas Aberdeen and Durham Universities and the University College of North Wales, Bangor, all offer the M.Sc. degree (Ecology) by examination. At University College, London, applicants with backgrounds other than biology (such as geography, geology, civil engineering and economics) are accepted and the Diploma in Conservation is awarded to those not eligible for the degree of M.Sc. Here the aim is to develop in people interested in such fields as conservation, park management and regional planning an appreciation of ecological principles and outlook so that they may apply these to practical problems in the broad field of conservation. Or as a University College circular puts it, "the course is essentially a training in the application of physical geography and ecology to problems of land-use and management of natural resources."

In the other three universities the aim is to take biologists and offer them additional training in ecological theory and technique. The aim is to get a more specialised and integrated approach to ecology. In Britain until quite recently most potential ecologists graduated with a specialised training in either zoology or botany. Frequently, lacking training in one of these subjects, they have not had the integrated view which is desirable, if not essential. The same situation in general holds true for New Zealand. At University College, London, and at Aberdeen, the emphasis is towards a broadening curriculum (with other departments involved), whereas at Durham and Bangor the emphasis is towards specialist training with instruction largely confined to the biology departments.

As an example of the training of a research ecologist, the pattern at Aberdeen may be cited briefly. Here the attitude is different from Edinburgh which advocates early specialisation. At Aberdeen it is felt that "too much integration of ecological subjects at undergraduate level tends to produce 'jack-of-all-trades' ecologists without firm foundations in either of the main subjects of zoology or botany". Students, in the main, with first or upper second-class Honours degrees in biology, botany, zoology, forestry, geography or agriculture are admitted to the course with its wide-ranging curriculum, the aim of which is to equip the potential research ecologist with the technical and theoretical training necessary for posts demanding a broad ecological approach (e.g. research on general ecological problems, or applied work in the spheres of land-management or conservation).

Another aim is to provide better background experience for Ph.D.s involving specialisation in, for example, animal, plant or soil ecology. Great stress is placed on the ancillary sciences, and an Institute of Ecology has been established linking the University departments and the research institutions in and around the city. This Institute has set up a number of working groups, one of which is responsible for the M.Sc. course in ecology. Great use is thus made of the wide range of specialist teachers and research workers available both within the University and outside. The course is an interdepartmental effort, organised and run by Zoology and Botany, but with assistance from Soil Science, Statistics, Geography (geomorphology, land-use, aerial photo interpretation, survey methods, etc.) and Forestry. Lectures are also given by staff from the Marine Laboratory of the Department of Agriculture and Fisheries for Scotland (the conservation and exploitation of fish), the Macaulay Institute for Soil Research and the Nature Conservancy. Other institutions which cooperate are the Hill Farming Research Organisation (land-use problems), the Rowett Research Institute (animal nutrition) and the Torry Research Station of the Science Research Council.

The value to the graduate of this exposure to specialists over a wide field of ancillary subjects may readily be appreciated. He is given a broad training in research and management which would not be remotely possible if the teaching were confined to one department or even to one school of studies. The broad background and training is equally important for the administrator who must be able to appreciate and apply the results of research.

I do not intend to discuss at any length the teaching of practical work as I saw it in Britain. Briefly, it may be said that there are as many approaches to this as there would be to the teaching of theory. Again at the risk of over-simplification, the range includes field-trips of a few hours to communities adjacent to the university, followed by laboratory periods to work up the results of field collections (as at Oxford), residence for several weeks at a field station attached to the department (as at Glasgow), laboratory teaching plus vacation courses consisting of field work or attachment to a research or management agency for several weeks or months (as at Edinburgh), and the experimental approach in the laboratory

and university field station (as at Imperial College, London). Naturally, each approach must inevitably be dictated largely by the situation of the university and the facilities available.

The universities offering the one-year post-graduate courses all award the degree on the basis of examination. However, individual investigations are undertaken at University College, London, and at Durham and Bangor as part of the practical training. At University College students also engage in group projects. Individual dissertations are not required at Aberdeen where it is felt that, because of the short time available, a disproportionate amount could be spent studying a very limited field. Instead, students are required to undertake limited investigations, usually related to some long-term research, to prepare field reports and to visit places and establishments where research may be seen and discussed.

In the three models I have discussed, the essence of the teaching is on inter- and intra-departmental participation. Let us now transfer our thoughts to the Antipodes, where we are literally poles apart in our attitudes. My remarks will be confined to the university of which I have first-hand knowledge — Victoria University of Wellington. The situation is, however, not very different in the other universities.

If we accept the fact that ecology involves many disciplines then we should think in terms of teamwork, whether it be in teaching or research. However, it is not generally accepted here that the specialist team approach is necessarily desirable. The "jack-of-all-trades" attitude, which seems to be a proud part of our national character, may be highly desirable in times of national emergency or during service in the Antarctic when initiative and versatility could mean the difference between life or death, but it is not necessarily desirable in university teaching. Perhaps we have still not emerged from the pioneer stage of national succession when a good man had to master many crafts or go under.

At Victoria, animal ecology and behaviour is taught in the Department of Zoology as a half-unit (13 weeks' duration) at the undergraduate level.* The teaching of ecology and the half-unit system has been operating for only three years and, largely as a result of the choice of subjects now offered by the Department, the numbers of students, both undergraduate and graduate, have risen sharply in certain fields. One of these is ecology. We are now

faced with a most unfavourable ratio of staff to student. I hasten to add that this situation is imposed from outside the University — by government, which controls the purse-strings.

It is the responsibility of one staff member (who happens to be me) to take charge of virtually all the ecology teaching (including elementary statistics) and the supervision of the practical course and Honours research. This year I am responsible for moulding 38 undergraduates and eight gradu-

ates who are doing dissertations at all levels up to that of the Ph.D. Naturally, under these conditions, and with the best will in the world to expose students to as wide a spectrum of ecological thought as possible, what is taught will depend largely on the interests and areas of proficiency of the lecturer concerned. However, we are in the process of evolving and should be able to look forward to improvements in the course structure, teaching facilities, staff/student ratios and so on. Nevertheless, I feel it will be a long time before we change our attitude towards the integrated team approach or have the money for staffing to implement a change. Critics of the need for or desirability of the integrated approach will point to the fact that New Zealanders so often make a name for themselves overseas. Perhaps our deep-grained non-specialist attitude has merit after all.

* The B.Sc. consists of 8 units, each unit being one year's work. Students majoring in zoology usually take Zoology I, Botany I and Chemistry I in the first year. They must then take at least four half-units chosen from Invertebrate Zoology, Vertebrate Zoology, Physiology, Developmental Zoology, Animal Ecology and Behaviour, Genetics, and Entomology, of which one should be either the invertebrate or vertebrate option. The remaining half-units to make a total of 8 may be taken in Physics, Chemistry, Geology, Pedology, Geography or Mathematics. An innovation this year is a terminating unit in mathematical and statistical techniques for students advancing in other subjects, such as natural or social sciences. This is not mandatory, but will be a vast improvement on the situation as it now exists, in which few students have done any mathematics since leaving secondary school.

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