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LEARNING MORE THAN ECOLOGY: POST GRADUATE CERTIFICATE IN EDUCATION BIOLOGIST FIELD COURSES

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ABSTRACT

Trainee teachers at a field centre are more challenging than any other group of students, for they are always working at two levels—the overt exercise upon which they are engaged and the covert analysis of the leaders' teaching styles as models to emulate (or not!). For some twenty years, we have used the PGCE field course to teach some field biology and techniques, as well as meeting our prime objective of developing skills in working safely and effectively with pupils. The issues that we address in this paper are not all unique to field teaching, but field work has contributed to our students' ability and our awareness. The paper describes how a series of field investigations, sometimes with young children as guinea pigs, are built together to achieve the objective.

INTRODUCTION

Trainee teachers at a Field Centre are, at first sight, no more than another group who use the Centre's facilities, and with luck get enthused and bring their own pupils back later. Experience of working with them changes that view. They are more challenging, for they are always working at two levels—the overt exercise upon which they are engaged and the covert analysis of the leaders' teaching styles as models to emulate (or not!).

For over twenty years, all biologists on the PGCE initial teacher education course at Chelsea College and later, after the Colleges' amalgamation, at King's College, have spent their final teaching week at Nettlecombe Court, the FSC Centre in Somerset. Many incidents, planned and unplanned, enrich our memories of working with these students, and here we use some vignettes, presented in the boxed text, to raise issues concerning the opportunities field courses present for beginning biology teachers, and others that they have wittingly (or unwittingly) raised with us as we re-evaluate our approaches to teaching and to fieldwork. Such continual re-evaluation is needed not just so that we learn and improve the experience for students, but also because the school curriculum changes, along with assumptions about the role of science teachers within it.

The ability of many beginning teachers to cope with field work has remained very limited, and a one-week course is only a very short time in which to cover a great deal. This is especially true with a mixed-experience group containing those whose degree course contained little or no ecology teaching. Records of the fieldwork background of students over the last 15 years show that around 25% had not attended a field course at

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school. Further, of those who *had* attended a field course, for some 10 to 15% it was a one or two day event. During their degree course, around 15% had not carried out any field work. Overall, between 5 and 20% had never been on a field course at any time during their biological education. For example, of the 1992–93 group of twenty; seven never went on a field course during their schooldays and seven did not go on one during their degree programme: two of these had never been on a field course but the rest had attended courses whilst at school and later.

Of course, a few students have always been very well equipped to cope with field ecology, at least academically. We have been fortunate on a couple of occasions, over the years, to have had ex-FSC staff as students on the course. Thus we have had a group ranging from the virtually ignorant, who wouldn't know or recognise a quadrat if it hit them, to the very experienced field worker.

We have, therefore, used the PGCE field course to teach some field biology and techniques, as well as meeting our prime objective of developing skills in working safely and effectively with pupils. The issues that we wish to address in this essay are not all unique to field teaching, but field work has contributed to our students' ability and our awareness.

We do not consider, in any detail, the obvious opportunities that arise to overtly comment on the nature of a field trip and on its organisation—including the utility of the journey itself. At one time, we visited Philip Harris Biological at Weston-super-Mare, *en route* from London to Somerset. This was an excellent opportunity to find out how a biological supplier operated, meet the people with whom they would probably be dealing in the future, and to learn a great deal about biology in the process. Then, one year, due to rebuilding work at Philip Harris, the traditional visit was not possible and a new venue was found—Stourhead garden (See Fig. 1). This has proved an excellent alternative; in fact, so useful that we have kept on going there. It provides quite a bit of interesting history, broadening students' ideas. But, apart from just a tramp around one of the most beautiful gardens in England, they are also engaged in a tree-naming game, as an introduction to identification, for we have found that knowledge of the names of even very common organisms is almost a total blank at this stage—common trees, such as oak and ash are just not known. In addition a few awkward problem oddities, like identifying the morphological structure of Butcher's Broom cladodes are thrown in for luck!

PROBLEM RECOGNITION AND THE PITCH OF A TOPIC

One of the problems that most beginning graduate teachers have with their classes is bringing the subject matter down to an appropriate level for their students. Indeed, biology student teachers have said that, in one sense, they find teaching the physical part of a balanced science course easier to cope with than biology—because their background knowledge is more limited and thus the difficulty of selection is less. Thus, in view of the mixed background of our groups, an early aspect of each course must be to attack the problem of bringing subject matter down to a level that the students can appreciate.

At one time we would take quadrats up onto a moorland area of the Quantock Hills and survey the difference between a newly-burnt heather and an old heather area. We have now abandoned this in favour of a more 'natural history' approach which has many advantages, as an introductory exercise, over highly quantified investigations, especially if it is used to set a real problem of explanation and interpretation that can be tackled by the inexperienced and experienced alike.

FIG. 1.
A general view of Stourhead Gardens.

Early in our course we visit the Quantocks. A perennial stopping place on the climb to the top of Dowsborough is a small area of some hundred square metres of mainly bracken and heather—and a large population of wood ants—otherwise surrounded by an oak wood. The effects of burning are still visible today, twenty-five years after the event. The students are asked to devise hypotheses and to present supporting evidence as to why this area is tree-less, yet it is surrounded by oaks. Some interesting suggestions are made: the ants prevent trees from growing; the trees have been cut down; disease, and even the effects of fire. But it is interesting that, even in early years when evidence was much more clearly visible, the students very seldom notice the burn scars on the sides of the boles of trees, all facing directly into the treeless area (See Fig. 2).

They need to first recognise a problem, make some hypothesis to explain it, predict consequences of their tentative interpretations, and seek evidence, on site, to test and refine their interpretation. Little detailed field knowledge is needed, but the site provides an opportunity to emphasise that observation of the total environment is of importance on a field excursion.

FIG. 2.
A clearing in Dowsborough Wood . . . what caused it? Problem-solving on this scale can throw up some interesting ideas—one way of introducing students to the scientific process.

These aspects are later emphasised when the group is quizzed regarding the nature of the oak trees on the hill. Very few people have observed that the oaks are coppiced. They will have noticed that the trees are dwarf, and usually put this down to climatic conditions. Here, we have the opportunity to point out to the students that they do need some background knowledge to notice that the oaks are different. Few will have noticed that there are a number of main branches growing up from near the ground instead of a single bole, and even those who *do* make the, reasonable, assumption that the differences from other oaks with single trunks that they have seen in the fields around Nettlecombe Court are just taxonomic (so there is nothing to be remarked upon, and nothing further to explain). Identification of the species and comments about the normal range of variation within the habit of *Quercus petraea* thus become tools to make the point that one way that problems are recognised depends upon the violation of expectations derived from detailed knowledge. As well as an opportunity to learn some specific 'facts', for most of our students this is a gentle introduction to issues of philosophy of science, dealing with the interaction between theory, observation, and the 'truth' of interpretations.

CROSS CURRICULAR ISSUES AND HUMAN INTERACTIONS WITH HABITATS

Standing on the summit of Dowsborough, within the ramparts of the ancient fort, we read a few appropriate lines from 'Kubla Kahn' and the 'Ancient Mariner' to

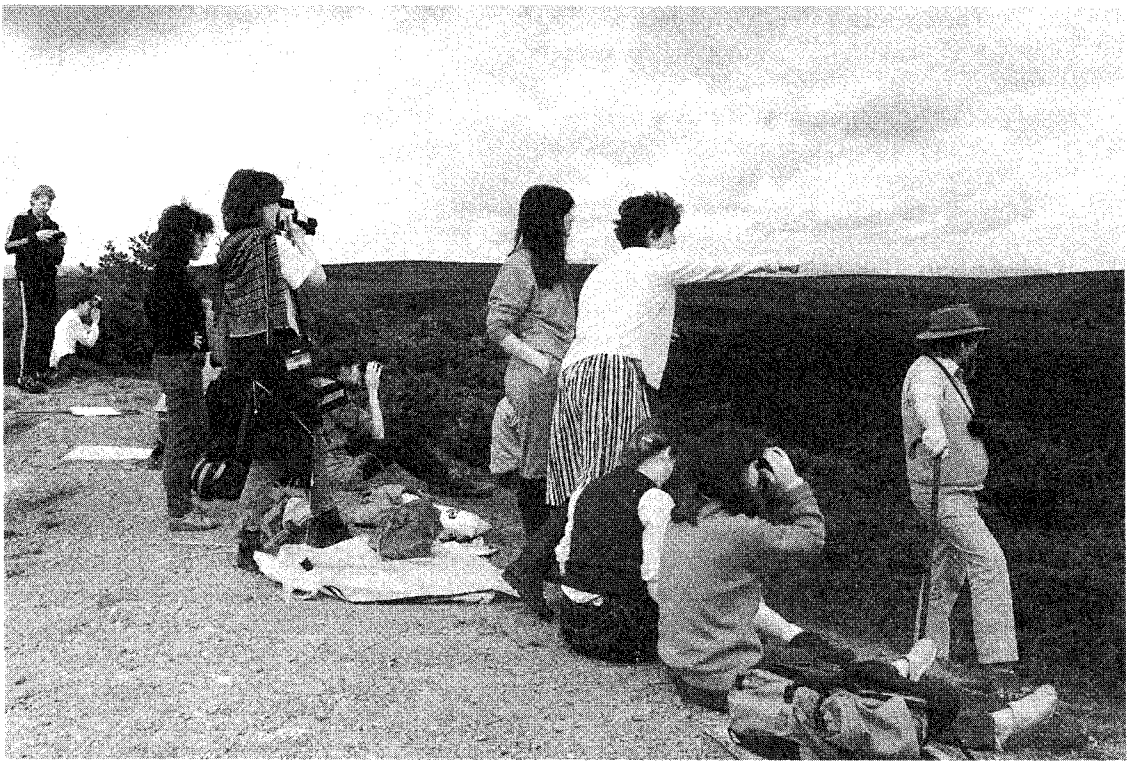

FIG. 3.
The summit of Dowsborough. An ancient site providing opportunities to bring historical influences into life. All too often these past events are presented as 'abstract' information. Professor Lucas holds the walking stick.

link to the story of Coleridge and Wordsworth and the activities of the Home Office spy following their jaunts on the Quantocks, fearing they were French spies planning an invasion! The spy reported:

'The man has Camp Stools, which he and his visitors take with them when they go about the country upon their nocturnal or diurnal excursions, and have also a Portfolio in which they enter their observations, which they have been heard to say were almost finished. They have been heard to say that they should be rewarded for them, and were very attentive to the River near them'—probably the river coming with a mile or two of Alfoxton from Bridgwater.

With hindsight, it is easy to understand how the agent mistook Coleridge's activities, 'making studies, as the artists call them, and often moulding my thoughts into verse, with the objects and imagery immediately before my senses'. The notes on river patterns mistaken as guidance to the French invaders, led to lines such as

> But O, that deep romantic chasm which slanted
> Down the green hill athwart a cedarn cover!
> ...
> Five miles meandering with a mazy motion
> Through wood and dale the sacred river ran,

Then reached the caverns measureless to man,
And sank in tumult to a lifeless ocean

and

Oh! dream of joy! is this indeed
The light-house top I see?
Is this the hill? is this the kirk?
Is this mine own countree?
...
The rock shone bright, the kirk no less,
that stands above the rock:
the moonlight steeped in silentness
the steady weathercock

(See Holmes, 1989, Chapter 7) (See Fig. 3).

The point of the exercise is to try to bring to life our forbears interacting with the environment. As well as serving as a hook to hang this point on, Coleridge's case also serves to reinforce the general point of the problem of interpretation of evidence when the framework of theory from which observations come is not understood. More importantly, the iron age fort, the heathland, the pattern of land-use visible from the summit, the coppiced oak (for charcoal burning) and the nuclear power station at Hinkley Point all serve as an introduction to a discussion of the shaping of the landscape, and the changing ways in which humans have interacted with organisms.

To further develop the nature of interaction between humans and plants, before setting out to the Quantocks each pair of students is allocated a plant, such as ling, cow-wheat, bilberry, bed-straw, etc. First they need to find an example of 'their' species, and then after studying its occurrence on the Quantocks and later using library resources, find out as much as they can about its biology and natural history, including aspects such as economic values, the origin of its name and any folklore attached to the plant. The result of this activity is a five minute presentation to the group that evening. The exercise gets students to look at plants in something of a new light and to see ways of making plants become 'alive' to the audience. This is important, for most have little botany and, as is typical of their future pupils, have found plants much less interesting organisms than animals (see Honey, 1987). Evidence of the success of this work can be seen amongst the plaques designed by students to decorate the Nettlecombe bar, almost all of which make some reference to interpretations of plants since this exercise was introduced.

VALIDATING THE OBVIOUS VERSUS REVEALING THE OBSCURE

It is usual for the students to link up with a school group and join with them for work at Gore Point, Porlock Weir in a survey of a special part of the rocky sea shore, just where a freshwater stream enters the beach. In this exercise, the student teachers act as demonstrators and general helpers, the exercise being run by the field centre staff. In fact, of course, many of them are taking a close look at sea-shore animals and plants for the first time. A series of parallel transects are made across the shore, forming a grid. The pupils record the abundances of a select range of organisms at five metre intervals along their transect line. Little pattern is

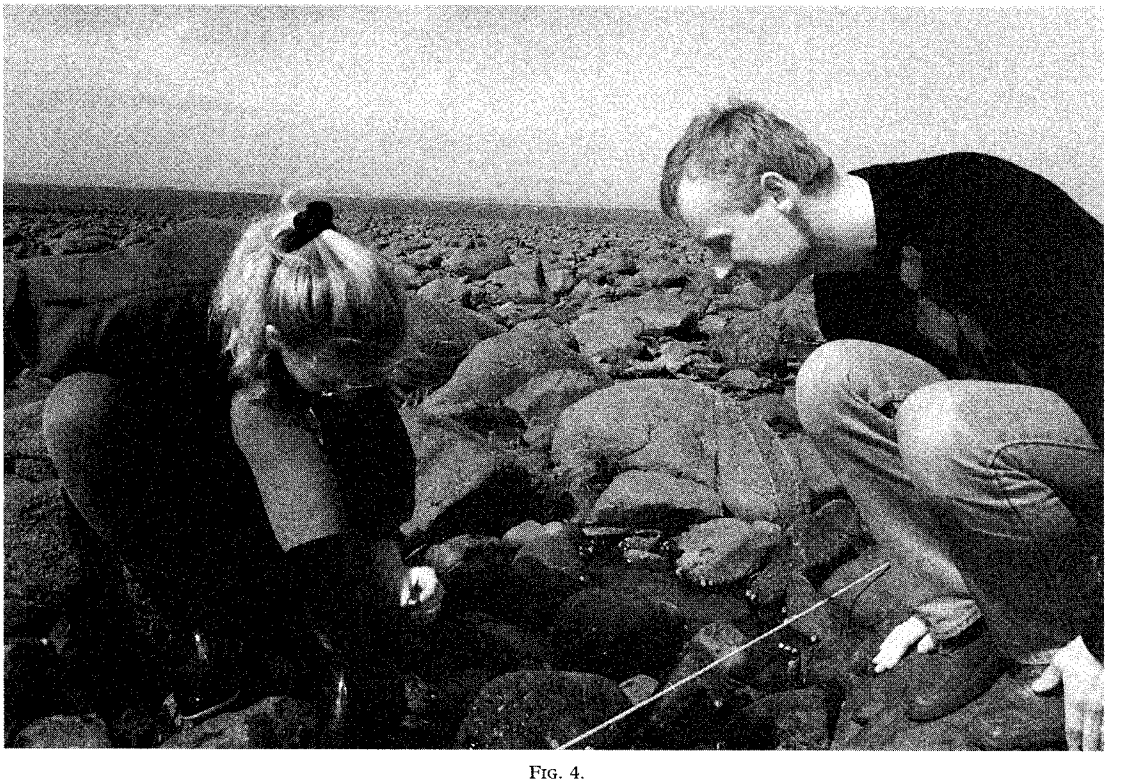

FIG. 4.
"Is it a common topshell or an edible winkle?" Student asks Student Teacher on the seashore at Gore Point. Superficially, the individual 'traditional' activities such as identification may seem to lack a purpose, but when viewed on a wider scale, the sum of all activities reveal patterns which were previously disguised. An important introduction to the nature of scientific identification.

discernible in the results at this stage. A usual comment from the students on the way back from the beach is on the lines of "the kids have got no idea on what the exercise is supposed to be finding out". (See Fig. 4).

The Gore Point exercise (see Wilson, Crothers and Oldham, 1983) initially seems to students, experienced in rocky shore field courses, to be a retrograde break with the classic tradition of carrying out a rocky shore transect—which often only shows up what is blindly obvious at one glance. Thus, after several hours hard work, often in inclement weather, the results often show little more than the eye can see, with a photograph of the beach being replicated by a map drawn after hours of work. (It is the 'using the light meter to show that there is less light in the shade of the tree' syndrome: quantification becomes the end, rather than a means to an end.) At Gore Point the distribution of organisms on the shore is by no means accessible to even close visual scrutiny: patterns are not revealed until the data are mapped collaboratively. After seeing the results of the plot, and the physiological laboratory experiments designed to investigate response to salinity levels, the student teachers are forced to reconsider what makes a good field work

FIG. 5.
Demonstrating the 'obvious' can illustrate how dangerous 'self-evident' can be in fieldwork; unpredictable cycles, cryptic trends and hidden influences may all lurk in the background. Collecting data from the Nettlecombe Grassland Experiment.

problem-solving exercise, and thus begin to broaden their perceptions about the nature of field work, and the nature of scientific investigation in general. In addition, the students get the opportunity to see how an experienced tutor deals with a complex field exercise.

LEARNING THE DIFFERENCE BETWEEN FIELD DATA AND ARM-CHAIR BIOLOGY

> 'It is obvious, from first principles, that mowing will discourage annual plants that reproduce by seeds. Why go to all this trouble with point quadrats to show that?' (See Fig. 5).

We had clearly made the point in the Gore Point exercise: it is counter productive to demonstrate the 'obvious'. But equally we had failed to make the point that what is 'self evident' may not be so. The student was complaining about the tedium of 'reading' one hundred point quadrats in the grassland plots, where four treatment regimes have been established (see Crothers & Lucas 1982, Crothers 1991). The Nettlecombe grassplot experiment has been a 'must' on every one of our visits come rain, snow or hail. Originally, the emphasis was very much on the collection of data and manual processing

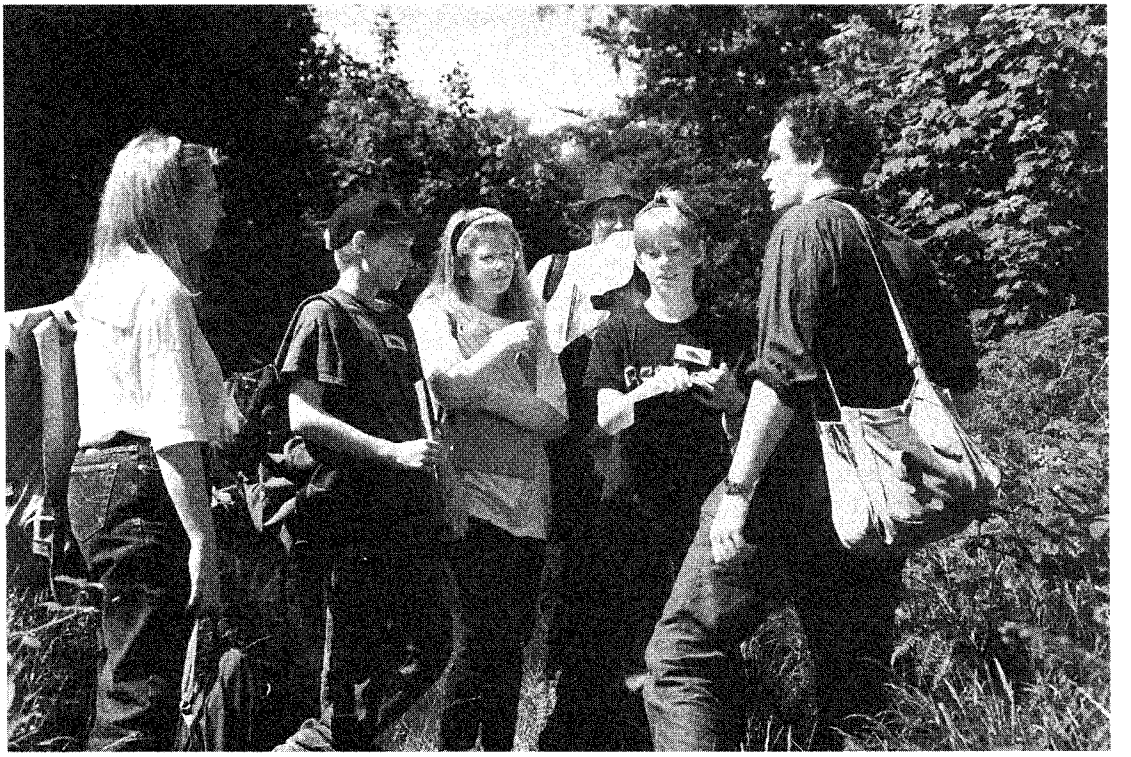

FIG. 6.
With pupils in Pooke Wood.

of it. Nowadays, with the introduction of computing facilities, more emphasis is placed on data processing to examine alternative interpretations and discussion of the nature of the experiment.

We put special emphasis on utilising ecological results obtained over a long period, for which the grass plots experiment provides an excellent exemplar. The use of data collected from many groups also emerges in relation to the work at Embercombe (Crothers, 1989). We emphasise that, on a field course, we are sampling the environment at one particular season, at one particular time. Thus working with a school group as they carry out a 24 hour drift survey in the stream provides an additional viewpoint by exploring the night life of a stream, and provides a useful reminder that fair-weather, day-time ecologists can give a distorted view of reality.

Equally importantly, the self-evident can be shown to be not so self-evident, as cycles appear in the long term data that are independent of the treatment regime. We can use the example to make points that go well beyond the specific case, and raise a number of questions about the nature of arguments based on adaptation (see, for example, Lucas 1971).

LEARNING MORE ABOUT THE NATURE OF TEACHING

'How is it that the Field Centre staff don't seem to get bored with teaching the same thing over and over again?' (See Fig. 6).

The very common comment made by both experienced teachers accompanying groups and by our own students about the potential boredom of teaching the same exercise weekly initially surprised us, but it reveals a great deal about the perception of teaching as subject centred, ignoring the variation between groups of pupils who undertake the exercise. When it is coupled with observing how experienced staff get a rapport with a group that they will only see for a very short time—for example one tutor could line up a new group in height order, get their personal names, and instantly recall them—the point that teaching is an interpersonal activity more than it is a transfer of knowledge becomes blindlingly obvious at an empathetic level, despite the number of times it has been emphasised, and accepted intellectually, in College classes and during teaching practice in schools. The context of the Field Centre has allowed the act of teaching to be examined from a different perspective.

It is not only the Centre staff tutors, and us as their own tutors, who are observed.

> Some teachers accompanying pupils get stuck into the work with the centre tutors as a combined effort, each reinforcing the other. Others, ostentatiously have a holiday while they devolve all responsibility onto the staff of the Centre and basically play no active role. One year, a teacher of the latter kind laid in wait for some miscreants from his group who had illegally visited the local pub. On their return, he jumped out on them as they were going up the main staircase. The teacher, at breakfast the very next morning, asked the deputy warden to discipline the boys for their misdemeanour—you may guess the reply he got!

Issues of professionalism, and the nature of responsibility cannot be brought home as easily as this in any other way.

LEARNING MORE ABOUT PUPILS

> The mini-bus is going back to Nettlecombe. After four hours hard work in the woodland, five small boys are talking in the back, while half a dozen student teachers casually listen in. The conversation is about black holes—the astronomical sorts. The conversation is knowledgeable, showing up-to-date ideas of the theories associated with black holes. After some five minutes discussion one eleven year-old finishes the debate with the words 'that's enough, I don't think we know anything more about black holes'. The student teachers refrain from comment until later.

Most of our students have been working at inner London schools, often with classes of low ability and almost always with mixed ability groups in the lower secondary school. It is therefore, to say the least, a considerable contrast to work with a different range of children.

In our first years of visiting the Centre, it was difficult for us to ensure that the points we were making incidentally about the organisation of field work were being absorbed: we could give students no opportunity to learn from supervised experience of field work with pupils, nor to put into practice what we had been illustrating. One year we coincided, by accident, with a group of young pupils, whose teachers were only too happy to have additional adult supervision in the field. So, for the last ten years, we have

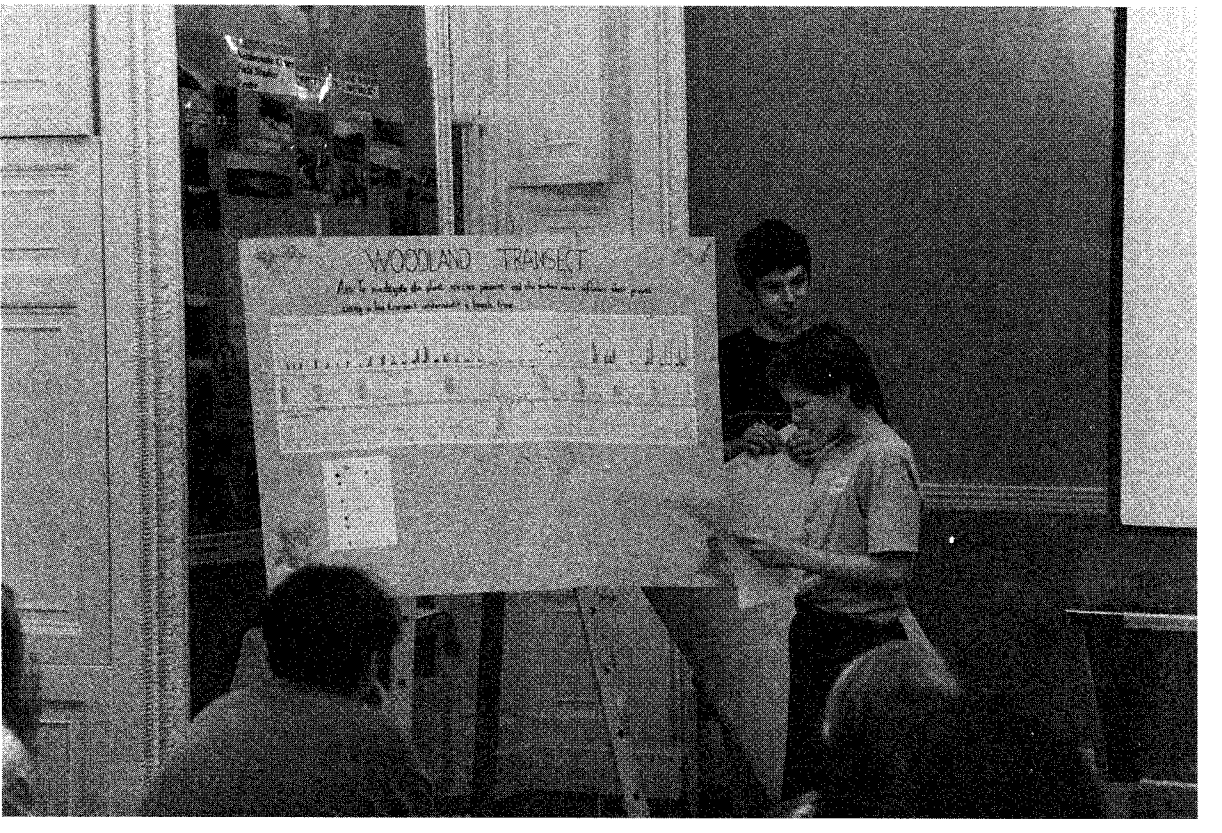

FIG. 7.
Project presentation can focus the mind, but also highlights the value of group discussion and exchange of ideas.

organised the course so that we can work with a school group. Malcolm Mogford, a senior teacher from the Selwood Middle School at Frome, arranges the timing of the school visit to coincide with our own. The school's summer environmental course is an enrichment course for all pupils, but the group of up to twenty four children who are chosen to spend the time at Nettlecombe are considered able to cope with introductory quantitative field work. They are thus an atypically high ability selected group. The experience has proved so successful that most children return for a 'repeater's course the next year and a few even for a third year. We work with those attending for the first time (ten to eleven year olds). The student teachers are involved in two activities. First they are required to organise and teach a complete day's programme from 0900 to 2100 to teach the group something of the ecology in a local wood. Second, an important part of the children's work is to develop a field project, and the students are involved in acting as mentors to small groups or individual children.

Normally, before we start the students on thinking out how they will plan the day's activities, we have a session to look at the problems in organising field work. This takes the form of a brain-storming followed by the development of a coherent list of pointers to be taken into account. This evening activity is followed up the next

FIG. 8
The effects of fieldwork on animals and plants may be obvious in some cases but it is advisable to consider all of the possible impacts on the environment. This mink was mistaken (by some) for an otter!

afternoon when they are actively involved in the planning for the day. Responsibility is forced upon the student group. Having given the group certain parameters within which they must work, and appointed a chair, all staff withdraw and leave them to it. In some years the discussion that follows has almost led to blows, certainly to much debate and some frustration, but eventually a clear plan emerges.

It is difficult to resist the temptation not to give direct advice, especially when you realise that the group is involved in a long process that will reinvent the wheel as well as several other ancient devices. But intervention and censorship by staff is out, unless the proposed activity is unsafe or illegal. 'Why throw us in at the deep end,' we are asked? The answer is clear, although not always accepted ungrudgingly. Students learn three things in the organisational afternoon:

- how to manage the dynamic of a professionally oriented debate, where there is no single unambiguously correct solution;
- how to translate ideas into concrete plans, where they have to take seriously the general message of providing alternative activities if something, such as the weather, does not go as anticipated;

- how to translate general exhortations to provide for safety into an analysis of potential danger.

After working with the pupils for a day, and while they recover from their exhaustion, the students learn that they have probably under-estimated the ability of bright eleven year-olds to understand complex issues. On the best occasions, they can also reflect on how they adapted their plans within the overall aims to cope with the pressure to learn that comes from the most able of an able group. At least some leave the day reflecting upon the ways that they will ensure that they are aware of the range of ability in their normal mixed ability classes in future.

> The last morning of the school group's course is devoted to presenting their projects to an audience of both centre staff, our students and to parents who have come to collect their offspring for return to Frome. The standard of some presentations is extremely high, although some children concentrate far more on themselves than on the subject of the project. Witness one small boy who constructed an elaborate hide from which to observe rabbits—which he successfully did, but unfortunately the talk was very much more about what he did and rather less about what the rabbits did! (See Fig. 7).

The lesson is soon learned that, even in open-ended activities, careful work by the teacher is needed to ensure that an effective plan of campaign is laid out before the project starts, and a discussion before any presentation is finalised—skills to reflect back onto how the student teacher works.

Concluding Comments

After a quarter of a century, as we each decrease our active interaction with student teachers at Nettlecombe, by what terms should we measure the success, or otherwise, of our efforts? We have no objective data on how many of our teachers go on to use field centres during their careers. We do know of a number who have returned to Nettlecombe and doubtless other FSC centres are used as well. But we cannot tell whether our principles have taken hold, or whether the teachers will just slavishly copy the activities to which they have been introduced: we hope they generalise, and don't put excessive pressure on the habitats we have used as examples.

> 'You are very keen to ensure that, when we have finished with animals caught in the stream, we return them. Yet, when we went down to Watchet, everyone was happily chipping bits out of the cliff to find fossils—aren't you being inconsistent about conservation ?' (Comment from a student teacher)

The case above is one of the more embarrassing realisations forced upon us, and requires no comment. There are many times when we are made to realise that we have much still to learn. We shall miss the opportunities to learn from our students in the setting provided by the FSC.

What then of the future? From 1994, the whole nature of PGCE courses changes to be in line with new government regulations, one result of which will inevitably be less finance

available for activities such as field courses. Even if finance is forthcoming, can the activity be accommodated into the new programme where students have to spend the majority of the course in schools? We hope that the values of this activity are not lost, for it is essential that new biology teachers are capable not only of developing field activities themselves, but also of helping staff of other science disciplines work in the field as well.

ACKNOWLEDGEMENTS

Both of us have been fortunate to benefit from the developing experience of Nettlecombe's Warden, John Crothers, and his staff, many of whom became close personal friends as we made our annual pilgrimages. We have also had the benefit of the knowledge, experience and field skills of Malcolm Fraser, our senior biology technician, who could certainly use a different set of vignettes to illustrate how to cope with staff who teach about general principles but who couldn't distinguish between an otter and a mink at 10 paces! We also have much to thank Malcolm Mogford, now Assistant Head Teacher at Selwood Middle School, Frome, for his very willing co-operation over the past decade.

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APPENDIX

Current stated aims of the course, as given to student teachers:

Aims

We hope that by the end of the course you will have:

1. Had the opportunity of developing in children a wider appreciation of the environment.
2. Considered ways of introducing children to the diversity of life through field studies.
3. Had experience of using a variety of field techniques and helped children to use them.
4. Experienced a range of sampling techniques and considered ways of analysing the resulting data for a level suitable to your students.
5. Identified those aspects of the 'Programmes of Study' and 'Attainment Targets' that can be most profitably achieved through field studies
6. Had experience of developing and implementing field teaching to deliver aspects of the National Curriculum.
7. Been able to identify the common organisms in at least two major habitats.
8. Developed problem solving techniques for use in field work.
9. Have used IT in connection with field studies and evaluated its potential.
10. Discussed the design, interpretation and value of long-term ecological investigations.
11. Demonstrated that you can orientate yourself, using a map.
12. Discussed the problems, hazards and misfortunes that can befall the field course organiser, and identified ways to minimise their detrimental effects.