Teaching biology outside the classroom

A report on biology fieldwork in the 14-19 curriculum

Compiled by
Susan Barker (University of Warwick)
David Slingsby (British Ecological Society)
Stephen Tilling (Field Studies Council)

Based on discussions from a focus group meeting held at Malham Tarn Field Study Centre, North Yorkshire, May 2002, jointly sponsored by the Field Studies Council and the British Ecological Society

FSC
Bringing Environmental Understanding To All

British Ecological Society

Teaching biology outside the classroom Is it heading for extinction?

"It is really, really important that citizens learn to value their environment and to understand the science behind the great ecological dilemmas which face all of us. Never before has there been so much talk of education about sustainability, about biodiversity, and for citizenship.

All these aspirations remain 'pie in the sky' unless every pupil has an entitlement to extend his or her study of science out of the classroom. It is in the field that science becomes alive and where acting locally becomes thinking globally. Our young people are being let down if their science education does not include field experience. I have no hesitation in endorsing this report and urge its stark message be taken very seriously."

Professor Lord May of Oxford AC Kt,
President of the Royal Society,
Former Chief Scientific Adviser to UK Government

Nearly 60 years ago the founders of the FSC foresaw a world where all young people would have an opportunity to have 'hands on' experiences outside the classroom. In many ways there have been environmental and social changes which would have delighted – and perhaps even astounded – that visionary group but balanced against this is the almost imperceptible trend which is now threatening a critical educational entitlement for a whole generation of scientists in our schools and universities – the demise of biology fieldwork. Quite simply, the 'science of life' is in danger of losing its soul. The need to reverse this insidious trend is now urgent and I believe that the actions recommended in this report provide a strong foundation from which to start. I urge all readers to take them up.

Anthony Thomas
Chief Executive, Field Studies Council

Almost all of us who profess to be ecologists or biologists were 'turned on' to the subject by fieldwork at school. Even for the rest of society who may remember very little biology from school, it is often the fieldwork aspect that is first recalled. It seems that we all remember what we saw and what we did more vividly than what we merely read in a textbook. Indeed, for all science, the important thing is to do it, not just to read about it. Today, there are signs that the fieldwork component of biology may be declining. I agree wholeheartedly with the authors of this report that we must fight against this; we must start at school and continue at university, so that as many young people as possible, even those who will not become biologists, will have the chance to be inspired by the study of biology in the natural environment and take an active part in the conservation of vital natural resources.

John Grace FRSE
President, British Ecological Society

Executive summary

Fieldwork provision in biology is declining in our schools despite the very clear educational and personal development strengths that it offers. This is happening at a time when there is increasing demand for students with the skills and confidence to practise outdoor biology and to be aware of their impacts on the world around them. There are many reasons for the decline but it should be reversed by:

- making fieldwork a requirement rather than an option in the biology curriculum;
- developing and presenting a strong case for biology fieldwork;
- supporting innovative curriculum development;
- providing support for trainee and experienced teachers;
- encouraging scientists to take a much broader view of the world around them.

fewer pupils are being given the opportunity for first-hand experience of the living world ... the demise of fieldwork is happening at a time when an environmentally literate society is essential

1 Introduction

For some time there have been growing concerns about the delivery of 14-19 science education in UK schools. One result has been the recent publication of a House of Commons report which identifies the need for more practical teaching approaches including fieldwork in 14-19 science education (House of Commons, 2002). One of the fears underpinning these recommendations was a critical shortage of biologists with the academic and professional skills to support work in conservation and sustainable development fields both in the UK and overseas (*eg*. Heywood, 1995; House of Lords, 2002). Reports such as these are sporadic but they highlight real concerns and a need for consideration of all the evidence and issues.

This report presents the main conclusions of a two-day focus group meeting held in May 2002, to discuss the role and importance of teaching outdoor biology in UK schools. Twelve participants represented a range of stakeholders including teachers in schools, examination boards, specialist associations, fieldwork providers and teacher trainers. The discussions focused specifically on out-of-classroom activities, including practical work in the school grounds, as well as more extensive residential field course experiences. We refer to all of these activities as *fieldwork* and exclude adventure and holiday visits in the definition for the purpose of this report. The outcomes of the meeting indicated that fewer pupils are being given the opportunity for first-hand experience of the living world outside the classroom and that a range of complex and interrelated factors are involved. The demise of biology fieldwork is happening at a time when an environmentally literate society is essential if we are going to make any appreciable move towards sustainable development in the UK and overseas. Strategies for addressing the problem are presented.

2

The case for fieldwork in biology teaching – why it matters

To students

The evidence in support of the educational impacts of fieldwork on children is conclusive (*eg*. Bogner, 1998; Nundy, 2001), but is largely focused on younger children. There is also clear evidence in other areas of education that a mix of teaching and learning approaches – including 'hands-on' and differentiated learning, which characterises much outdoor teaching – does help to meet the needs of the whole class. It also helps to motivate and inspire children who may otherwise be sidelined by a more formal classroom situation (Nundy, 2001). As well as covering curriculum content, ecological fieldwork – where living animals and plants are encountered in real habitats – can help to put the fun and enjoyment back into a content dominated curriculum. Fieldwork fulfils a number of worthwhile educational objectives in an incidental way. Scientific fieldwork provides an excellent opportunity for students to work as a team, which is in itself an important part of personal and social education. It also helps to discover what it is like to work purposefully out-of-doors in varying weather conditions, to learn to appreciate natural history and to link theory and observation.

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The wider benefits of fieldwork can have lifelong impacts. Outdoor biology teaching can introduce students to unfamiliar environments, which they may not otherwise see. This exposure could be the only opportunity they have to see a world which is remote from their everyday lives. This can help to engender attitudes and values that can integrate communities, and overcome mutual ignorance and misunderstandings (such as those between rural and urban areas, which were highlighted during the 2001 Foot and Mouth Crisis). Indeed, Palmer and Suggate (1996) indicate that 60% of adults that they sampled identified fieldwork at school as having a crucial role in their adult pro-environmental behaviour.

To teachers

Fieldwork provides an opportunity for teachers to develop a different and, potentially, more positive and productive relationship with their students. It often involves students working together with peers; the dynamics and inter-relationships developed whilst working in groups can have a huge influence on how students develop socially. This is particularly true for residential experiences.

Fieldwork can deliver joined-up teaching at its best. A field course, particularly a residential one, often takes the form of an effective teaching model which differs markedly from the usual school timetable. For a few days pupils get used to unfamiliar surroundings and become immersed in a single topic looked at in a multifaceted way. Theory can be taught through motivating practical experiences and placed in a wider context of enjoying field biology. Students returning from such experiences often indicate that it was one of the most enjoyable but also a deeply satisfying aspect of their A level studies. They are often surprised how much they learnt in a short time. In a quality field course, intellectual activity and fun go hand in hand.

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To biology

All science is rooted in observation of the real world, leading to questions, hypotheses, predictions and experiments. Biological fieldwork provides one of the few places in a science curriculum where students quite literally observe the real world and use it as the basis for scientific enquiry. Nor need this be restricted to the biological component of science. Science in the environment is one of the places where science can be truly integrated and holistic.

Biology is a broad and diverse subject, which is becoming more fragmented as new disciplines emerge. Over the past few years there has been a steady and accelerating trend for biologists to become increasingly specialised to the point where a molecular biologist may be isolated from an ecologist and *vice versa*. This fragmentation is now being repeated in school biology teaching where students learn 'bits' of biology in modular boxes isolated from each other. Fieldwork, where whole organisms are studied, enables integration of different elements of biology showing how the biological jigsaw functions. Biology is an experimental subject, and whole-organism ecological studies provide an opportunity to investigate and collect data on a topic – often intensively, over prolonged periods, in great breadth and depth. Fieldwork offers students a particularly good opportunity to collect numerical data on a large scale, either working individually or in groups, and to subject the data to statistical analysis in an open-ended manner. This can rarely be achieved in the laboratory where the tendency is for most practical investigations to be simplified or 'sanitised'.

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Charles Darwin, when analysing his own strengths highlighted his ability to 'grind general laws out of a large collection of facts' (Jones, 2000). Most of his facts were observations made outdoors, but founded on interests kindled in his earlier childhood. It is unlikely that a new Charles Darwin could emerge from our schools at present.

the outdoor classroom... can help to develop understanding, attitudes and values, and lead to a more enlightened commitment

To the wider community

Fieldwork often leaves a lasting impression and promotes a deeper understanding of the experimental, analytical and interpretative approaches that underpin the whole of science and the way in which the world around us really works. The outdoor classroom provides a link between theoretical aspects of biology and issues which affect our homes, communities and the world around us. Fieldwork can help to develop understanding, attitudes and values, and lead to a more enlightened commitment and action in areas such as citizenship, conservation, animal welfare, genetic engineering, biodiversity and sustainable development. The majority of students learning about the need to conserve rainforest biodiversity or to evaluate the Kyoto Protocol will do so through abstraction without hands-on experience of real habitats. Yet, first hand science-based experience of local habitats is a key part of acting locally that is as the pre-requisite to thinking globally (World Commission on Environment and Development, 1987).

Teaching biology outside the classroom. Is it heading for extinction?

3

Issues to be tackled

The situation today

Biology as a discipline has deep roots in fieldwork and natural history. Indeed a long and distinguished line of British biologists such as the Reverend Gilbert White (1720-1793), John Ray (1628-1705) and Charles Darwin (1809-1882) used fieldwork as an essential tool to observe, collect and process data on species and habitats. Until quite recently, this tradition continued where looking at, and working with, whole animals and plants in their natural environment was an important part of being a 'biologist'. Today we see quite a different picture.

In our schools

There is relatively little comprehensive or comparable information about the extent of fieldwork being taught in UK schools; no regular surveys are carried out against which changes can be measured. Most accounts published in national media are based on personal evidence and anecdotes (*eg*. Barnes, 2002).

In the 14-16 age range the surveys of Fido and Gayford (1981), Kinchin (1993) and Fisher (2001) do provide valuable data on a local scale and they are supported by independent surveys (Lock and Tilling, 2002, personal communication). In 1993, Kinchin found that 73% of science teachers who were biology teachers believed that fieldwork was an essential tool for the teaching at 14-16 level. Fisher (2001), however, found that eight years later only 10% of schools sampled carried out environmental work outside the laboratory at 14-16.

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In the 16-19 age range there is even less published evidence available. Personal communication with a number of teachers and providers suggests that as many as one in three A level pupils do not do any fieldwork and amongst those that do there is a trend towards shorter and more local courses (Lock and Tilling, 2002, personal communication). Fewer students experience residential fieldwork despite the fact that these experiences may have a considerable impact on their personal and social development.

one in three A level pupils do not do any fieldwork

Where fieldwork is used as a teaching/learning tool the content too has changed quite remarkably, particularly over the last five years (Field Studies Council, 2002, personal communication). The syllabus requirements of techniques, coursework and doing individual investigations now takes precedence; little time is left for developing a sense of place – an appreciation of simply being somewhere different or special.

Compared to other sciences, recruitment to A level biology remains reasonably healthy. However, evidence from a recent Science Museum survey (Science Museum, 2002) suggests that it could be even higher if teaching outdoor biology is maintained. Eight out of 10 students highlighted 'trips and excursions' as the most popular activity that they do in the whole science curriculum (although the nature of these trips was not defined).

a minority of trainee science teachers with a specialism in biology had biological fieldwork experiences ... some of the largest providers of training do not include fieldwork training in their courses

In teacher education

The trend for a decline in fieldwork is also evident in initial teacher training; surveys of some courses have shown that a minority of trainee science teachers with a specialism in biology had biological fieldwork experiences (Lock and Dillon, 2002, personal communication). Currently, there is no clear entitlement or even recommendation for outdoor teaching experience within the National Curriculum for Teacher Training in science (Teacher Training Agency, 2000) and, therefore, it is not surprising that some of the largest providers of training do not include fieldwork training in their courses and overall the provision of such training is highly variable. As teacher training is now largely school based, trainees might be expected to rely on schools in which they are placed to provide them with such skills and knowledge. This, however, will only happen if the school has its own enthusiastic and competent staff. As the outdoor teaching tradition declines in our schools this in-service experience is becoming less likely (Fisher, 2001). The downward spiral is thus likely to perpetuate itself and accelerate. However, new guidelines for achieving Qualified Teacher Status (QTS) (Teacher Training Agency, 2002) are not subject-specific and do allow a greater amount of flexibility for teacher training providers; this provides opportunities to promote and develop fieldwork amongst teacher trainers.

4

Key factors at work

The few published peer reviewed papers in this field vary considerably with regard to sample size, region and age phases, thus making it difficult to make quantitative comparisons. However, a crude qualitative comparison of the factors influencing the decline in fieldwork is possible and this demonstrates a clear trend in the changing nature of these factors (Table 1).

Table 1: A Comparison of principal factors judged by authors to be influencing the lack of fieldwork in schools from 1982-2001.

Factor influencing decisions not to do fieldwork in biology 14-19	Fido & Gayford 1982	Kinchin 1993	Fisher 2001
Large Class sizes	✔	✔	
Time/timetable	✔	✔	✔
Transport	✔	✔	
Enjoyment/Interest of teacher		✔	✔
Cost	✔		✔
Availability of suitable sites			✔
Lack of curriculum specification			✔
Requirements of National Curriculum for practical work too complicated for fieldwork			✔
Risk of accidents			✔
Students don't see the need			✔
Teacher career progression does not include fieldwork			✔

Changes in the 16-19 curriculum

Ecology – the topic which is most associated with biological fieldwork – is included in the revised Common Core for Curriculum 2000 (Qualifications and Curriculum Authority, 2000) and, therefore, it can no longer be treated as an optional topic in any of the new (September 2000 onwards) A level Biology specifications (syllabuses). Consequently, this should not be a critical factor contributing to the decline of fieldwork. More general changes in the A level framework may be more influential. In the current specifications, awarding bodies are free to choose how to distribute ecology between A/S (1st year) and A level (2nd year) and in most cases the topics which lend themselves to fieldwork are in the latter. In practice, this has dramatically narrowed the window of opportunity for fieldwork, which is now being squeezed into short periods of the year (see Figure 1). This situation is worsened further by the fact that much of the curriculum content is now boxed into neat compartments or modules that reduce flexibility within the teaching programme.

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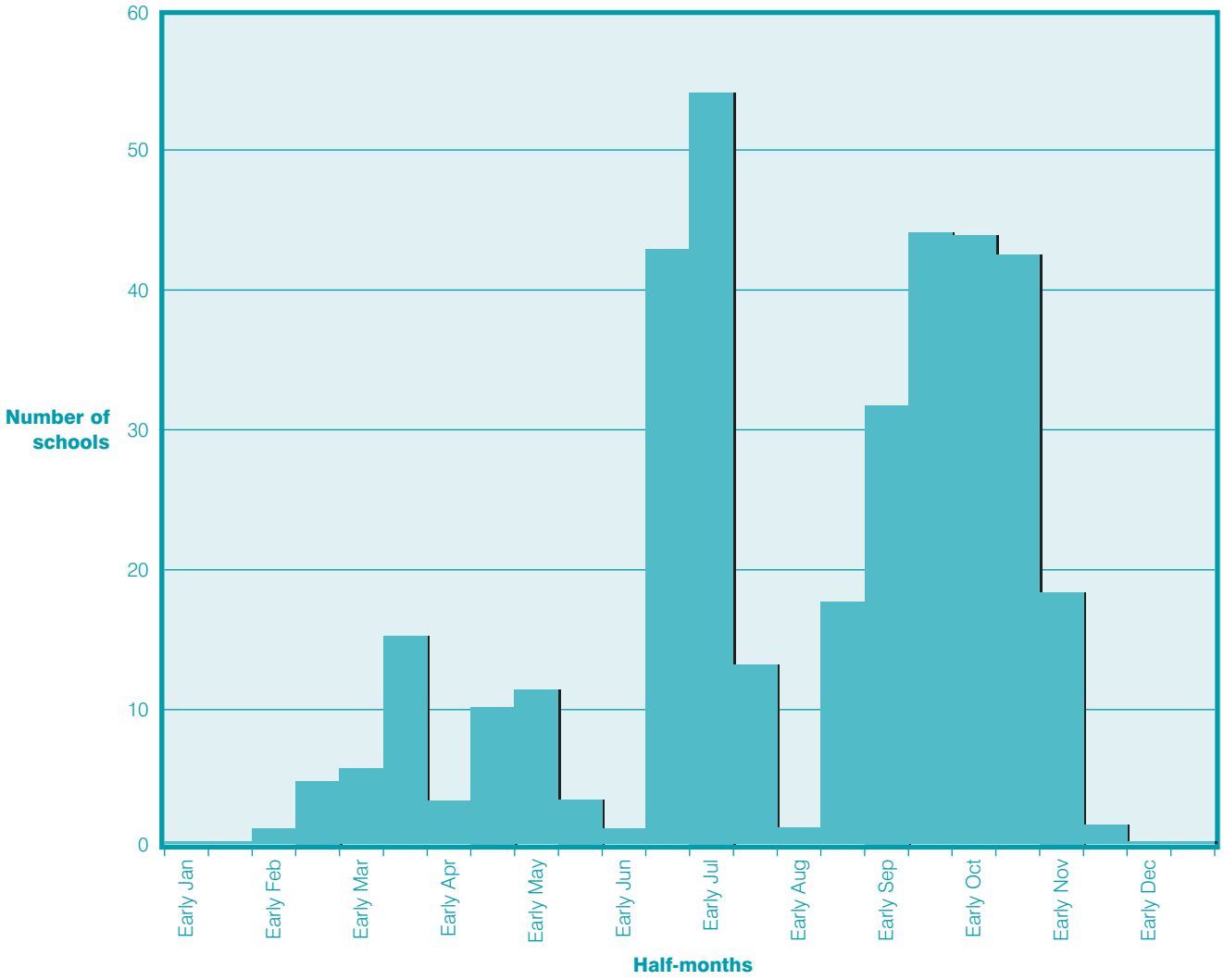
Figure 1:
A Level Biology Field Courses at FSC Field Centres in 2001.



Changes in practical assessment

At A level, there has been a reduction in items of work required for submission for assessment by students. The convenience of fieldwork for generating contributions to assessment portfolios used to be used by some schools as justification for fieldwork. The present trend is towards fewer items, which, although could still be done very effectively through fieldwork, are easier to do as laboratory-based investigations.

2

Changes in school management

Schools are now responsible for their own budget and the role of the local authority has been greatly reduced. There has been a reduction in the number of science advisors and in the degree of influence of those that remain. There has also been a reduction in Local Education Authority (LEA) subsidised field centres. These changes may affect field studies in a number of ways:

- *subsidy of field studies has to come from the school budget* and compete with many other demands – no longer is there any external support from the LEA;
- *there are fewer science advisors promoting what they see as good practice* as part of a bigger picture and able to offer support. It may have been easier to get the support of the LEA advisor than off a beleaguered head teacher;
- increasingly teachers who are off timetable to do fieldwork need to replaced with *supply cover* adding further expense;
- *teachers and students alike are less willing to give up school holidays or weekends*. Many students have jobs which are essential to maintain the life-style of the modern teenager and are reluctant to do fieldwork and lose income. Some excursions also rely on a parental financial contribution and, therefore, there is the potential for some students to be excluded if they cannot afford to pay. This creates a potential for discrimination which awarding bodies and teachers are sensitive to; whilst this has always been an issue 'inclusivity' now has a political dimension and anecdotal evidence suggests that out-of-classroom activities, including fieldwork, are now being reduced or withdrawn (Lock, 1998 a, b; Lock and Tilling, 2002, personal communication);
- *increasing demands of an ever more complicated timetable* and out-of-classroom activity in a range of other subjects make it harder to take students out of classroom for more than a short time. The biology teacher is competing not only for a slice of the financial cake but for days out-of-classroom and off timetable.

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Health and Safety issues

Recently there have been a number of well-publicised incidents involving out-of-classroom activities in which death and injury have taken place. Most of these incidents have not involved fieldwork but have highlighted:

- that taking students out of doors can be hazardous;
- the need for teachers to be adequately trained;
- the readiness of the media and the general public to blame the school and teacher even when there is no particular reason to regard the incident as anything more than an accident;
- the way the enthusiasm and dedication of teachers who organise out of school activities often in their own time (almost always without incident) is taken for granted.

teachers who organise out-of-classroom enrich the education of young people immeasurably and yet their contribution often goes unnoticed until something goes wrong

Teachers who organise out-of-classroom activities enrich the education of young people immeasurably and yet their contribution often goes unnoticed until something goes wrong. And yet if there were no such salt-of-the-earth teachers our education system would be greatly impoverished. The recent Health and Safety issues must make many dedicated teachers feel that the risk is not worth it and many a supportive school head teacher will feel the same. Fear of accidents is not confined to fieldwork; laboratory science has now become so 'risk free' that it has become bland, pedestrian and dull (Fisher, 2001; House of Commons, 2002).

Teacher expertise and enthusiasm

Teacher enthusiasm is one of the most important factors in determining the amount of fieldwork. Where a school has a good tradition of motivating fieldwork it is usually because an individual teacher has promoted it. This is true whether the teacher runs the course his or herself or takes the class away to a field centre. The decline in fieldwork in schools means that trainee science teachers are less likely to have experience outside the classroom at the outset of their training. This problem is further confounded by the fact many biology teachers enter the profession from a degree background in a discipline such as microbiology, biochemistry or physiology with very little experience not only of fieldwork but also of ecology, whole organism biology and biodiversity. Little fieldwork in teacher training exacerbates this further. As fewer teachers have outdoor experience and training themselves, they are less likely to venture outside and so the cycle continues.

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A lack of profile

Fieldwork, although of great historical significance in biology, is rather overshadowed by the massive developments in genomics. Biology has expanded hugely as a discipline with many areas competing for time, space and finance. The commercial applications of the 'new biology' brings huge financial revenue of which some is used for educational purposes – for example, the production of free resources for the classroom. Therefore, there are frequent and powerful messages extolling the importance of these areas whereas fieldwork receives a much lower status.

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5

Action for the future

The case for fieldwork needs to be built

"Why should we bother with looking at plants and animals outside?" When confronted with this question, teachers need to be able to respond with more than indignation. There needs to be an explicit cost-benefit analysis. The costs – financial, physical, emotional – need to be acknowledged but the educational and social benefits of outdoor biology do outweigh the costs even if some can not be measured directly. We should be able to turn the question upside-down and ask *"how can we afford not to do it?"*

field biologists need to be able to respond with more than indignation

The case for field work needs to be presented

The content of A level and GCSE/O level syllabuses used to be largely determined by Awarding Bodies (previously known as Examination Boards) but over the past 30 years UK government agencies, such as the present-day Qualifications and Curriculum Authority (QCA), have assumed increasing control. It is, therefore, essential to present the case for fieldwork to the QCA in the strongest way possible, and with the support of organisations such as the Royal Society, Association for Science Education, Institute of Biology, British Ecological Society (BES) and Field Studies Council (FSC). The effectiveness of doing this is illustrated with a comparison to another subject. Many of the 'key factors' contributing to the decline of biological fieldwork also apply to geography and yet there is still plenty of fieldwork being carried out in geography both at GCSE and at A level. The demand for FSC geography field courses (the FSC is the UK's largest independent provider of geography and biology field courses) has not declined to anything like the extent that has happened in biology. To a geographer, a course without fieldwork verges on the unthinkable. This is, at least in part, because there is a clear consensus amongst geography teachers at school and university supported by the Geographical Association (GA) and the Royal Geographical Society (RGS). There is no such clear consensus about the nature of biology at school level. Biologists with a cell biology or human physiology background may feel that ecology, especially field ecology, is very peripheral. The equivalent of the GA and RGS, the Institute of Biology, does not regard promoting fieldwork as a priority. This needs to change.

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Teachers need to be supported

In one specific school in 2002, an A level student went on a geography field course to Scotland, a history course to France and one day of local biology fieldwork. '*Why was the biology course so short?*' It can't have been because of school policy (which permitted the geography and history trips off timetable in term time), nor the unwillingness of the parents to pay (as they did for the other trips), nor even the examination specifications (there was no requirement for a trip to France in the history specification). The reason must be that less priority was attached to out-of-classroom activity in biology compared to geography and history.

At least some training in fieldwork should be a requirement of any newly trained secondary science teacher, particularly biology specialists. Those with no experience in their school and undergraduate course need extra input. To achieve this a clear signal needs to be given that it matters and that teachers with such skills are valued. Action should include:

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- the issuing of a clear statement by the Teacher Training Agency (TTA) that fieldwork experience is an important part of science teacher training;
- the provision of a professional development short course leading to accreditation in fieldwork teaching skills designed to enhance a teacher's employment and promotion prospects. Designated funding would not only help in practical terms but add necessary credibility;
- the provision of Inservice Training (INSET) courses for existing teachers;
- the provision of advanced skills ecology teachers to advise and assist schools on how to organise fieldwork.

Training on its own will not be enough. Good case studies are needed, as are resources that have an effective outdoor-biology focus. These need not focus wholly on 'traditional' fieldwork; there are many alternatives that could be developed depending on experience and resources available. The establishment of specialist schools or 'Science Centres of Excellence' could help to promote good practice.

We need to address Health and Safety – it needs to be an essential component of fieldwork training and would be included in any accreditation process during training. However, once a teacher has done the training, the risk assessment and planned safe procedures, schools, LEAs, the government, parents' associations and the like should accept that accidents can happen and be prepared to support the good practitioner.

We need to support curriculum development in the field

Results matter. Teachers are clearly driven by the content of the National Curriculum and Awarding Body specifications and changes in syllabus content and guidance will have the biggest influence on the amount of fieldwork which is carried out. The value of fieldwork is such that it needs to be specified as a requirement so that no teacher or student can opt out of including it in their curriculum. This can only be achieved by determined lobbying, and influencing the government's own curriculum advisers – the QCA – either directly or through the government and its ministers. The messages can be subliminal and/or direct, but they need to be designed and targeted with particular audiences in mind. The time for deference has passed; fieldwork is clearly justified and needs to force its way to the front of the queue.

The exponents of fieldwork may already be pushing against a partly open door. The QCA recognises the importance of fieldwork in its Key Stage 3 (11-14) *Schemes of Work*. The 2002 *Key Stage 3 National Science Strategy* (Department for Education and Skills, 2002) emphasises the need for interaction with the natural world and the 'interdependency' within it to enhance learning but there is still no requirement or recommendation for fieldwork whether it be in the school grounds or elsewhere. The endorsement of the *optional* classroom activities means that many schools will opt for them rather than fieldwork. Similarly, although the recent parliamentary report into 14-19 science education emphasised the need for more practical work, there was a very heavy emphasis on laboratory work (House of Commons, 2002).

changes in syllabus content and guidance will have the biggest influence on the amount of fieldwork which is carried out

Working with Awarding Bodies should be a priority

Awarding Bodies will also need support. A revision of the biology subject criteria (Qualifications and Curriculum Authority, 2000) by the QCA, with a shift of emphasis back towards fieldwork, will pave the way. These criteria need to be linked to other curriculum documents and educational initiatives (such as the need for schools to teach *Citizenship*) to create most impact. The ways in which students can progress through fieldwork from 14-19 and the improved results and personal development which occur also need to be publicised. Innovative methods of assessment which provide a consistency across schools and Awarding Bodies should be developed. Even within the present constraints it is possible to improve the fieldwork provision in A level biology. The Salter's-Nuffield A level Biology project, respects the QCA subject criteria for A level biology (see above) and yet achieves the inclusion of practical and fieldwork through a modern treatment of Biodiversity. This is an example of 'good practice', which should be promoted to Awarding Bodies at every opportunity.

innovative methods of assessment which provide a consistency across schools and Awarding Bodies should be developed

Biologists need to see the bigger picture

Scientists excel at looking at detail. Yet, the answer to the fieldwork dilemma may lie in stepping back and viewing the wider world. All around us, children and the general public are being asked to consider their roles in society, as custodians and beneficiaries of the environment for example. Delivering Personal, Social and Health Education (PSHE) and Citizenship (including Education for Sustainable Development) are requirements for schools and fieldwork can make a contribution to meeting these. It provides a very powerful medium for getting beyond simple facts and figures; by being in the real world outside, and working with living things, children can begin to understand how the environment actually works, and develop the attitudes, values and commitments which are needed to support popular and sustainable change, in areas such as biodiversity and conservation.

the answer to the outdoor-biology dilemma may lie in stepping back and viewing the wider world

6

Conclusion

There is a consensus among stakeholders represented at the workshop that the decline in biological fieldwork in 14-19 education is a major concern. The laboratory for the study of life sciences is the 'field'; anywhere else the experience becomes second-hand, out of context and relatively meaningless (Fisher, 2001). We need to work together to ensure that biological fieldwork which is such a memorable learning experience for all is preserved at all costs. We believe that the suggested actions are practical, realistic and achievable. The main demands they place are not on financial or capital resources; rather there will need to be a change in the perceptions, attitudes and values of those working with, and within, biology. Without these changes, the soul of biology – the science of life – may be lost to many children and students.

There is a consensus among stakeholders represented at the workshop that the decline in biological fieldwork in 14-19 education is a major concern

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Participants

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James Hindson	*Field Studies Council*
Roger Lock	*University of Birmingham*
Adrian Pickles	*Field Studies Council*
Gary Skinner	*Bedales School*
David Slingsby	*British Ecological Society*
Mark Smith	*Leeds Grammar School*
Robin Sutton	*Field Studies Council*
Stephen Tilling	*Field Studies Council*
Hugh Willets	*Settle High School*

Observer

Rebecca Edwards	*Qualifications and Curriculum Authority*

"there will need to be a change in the perceptions, attitudes and values of those working with, and within, biology"

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