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Tomorrow's Biodiversity Consultation

Collated views and ideas from the 2014 consultation

BRINGING ENVIRONMENTAL UNDERSTANDING TO ALL

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1 Contents

2 Introduction

The Field Studies Council (FSC) has a 70 year tradition of training and resource development for taxonomic identification skills. FSC plant, animal and fungi training courses, delivered from our nationwide network of learning centres by leading experts, are highly regarded in the environmental sector. Our dedicated Publications Unit includes in its portfolio the widely used 'fold-out chart' guides and the AIDGAP series (Aids to Identification in Difficult Groups of Animals and Plants) which has established itself as a very strong brand and a mark of excellent quality.

FSC 's Tomorrow's Biodiversity project is funded by Esmée Fairbairn for five years (2013-2017 inclusive). The major objective of the project is to look strategically at FSC's provision of training and ID resources and increase our operational contribution to facilitating biodiversity surveillance & monitoring in the UK. The project will explore ways for FSC to focus development of new and more effective resources, training and support on taxa and/or habitats that are currently under-resourced but which have the potential to make a valuable contribution to our understanding of how biodiversity fares over the coming decades in the face of rapid environmental change.

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In the delivery phase of Tomorrow's Biodiversity (2015-2017 inclusive) we will develop several exemplar projects to model new operational approaches, techniques and partnerships that help us meet our major objective. To help us develop those projects effectively, we conducted a wide-ranging consultation with the UK biological recording and biodiversity surveillance & monitoring community. This was accomplished over a series of open workshops covering a wide geographic area in the UK plus targeted meetings and formal telephone consultations (see appendix A). Almost 100 people took part in these personal consultations (see appendix B).

During the consultations, we tried to identify where FSC could develop new training and resources, or modify its existing portfolio or practices, to provide greater facilitation of biodiversity surveillance & monitoring in the UK. Themes covered included:

- gaps in taxonomic coverage,
- habitat recording/monitoring,
- supporting surveillance & monitoring protocols,
- overcoming barriers to learning,
- overcoming barriers to contributing to surveillance & monitoring,
- supporting people outside the classroom, and
- identification resources (including new media) and techniques.

This document distils many of the views and ideas expressed over the entire consultation. In particular we have looked to identify views and ideas that had widespread support or which were otherwise innovative or interesting. The views and ideas have been brigaded under major headings relating to the major discussion themes. Under these are sub-headings grouping those which have a lot in common. The interpretation of the views and ideas expressed, and the tenor of this synthesis,

is necessarily influenced by the perceptions of the author, but we have endeavoured to convey as many of the major views expressed during the consultation as possible.

A list of 'key points', 'learning points' or 'next steps' is not included since identifying these depends on the particular prism through which the document is viewed. Learning points for the Tomorrow's Biodiversity project will not necessarily be the same as those for FSC as a whole and people outside the FSC will draw their own context-specific learning points. For the Tomorrow's Biodiversity, the next step is to identify a number of projects that will comprise the delivery phase of the overarching project between 2015 and 2017 inclusive. The consultation and this document will inform the selection of these projects.

In the interests of readability, the term 'surveillance & monitoring' is, for the most part, replaced with 'monitoring' in this report.

3 Addressing gaps in biodiversity surveillance & monitoring

3.1 Identifying focal taxa

When identifying taxonomic groups for which FSC could play a role in providing more training and/or resources, a very wide range of different factors affected people's suggestions including:

- lack of existing resources and/or training;
- quality of existing resources;
- gaps in the taxonomic coverage of monitoring;
- ecological and 'indicator' value (including links to drivers of biodiversity change);
- practical considerations; and
- synergistic opportunities.

A wide range of taxa were suggested as being worthy of more support, from birds to hydroids, but there were a few which were consistently suggested across the workshops including:

- fungi;
- lichens;
- bryophytes;
- earthworms;
- freshwater invertebrates;
- bees (and other aculeate hymenoptera); and
- springtails.

But it should be noted that there wasn't, by and large, a great deal of enthusiasm for identifying specific taxa for the focus of attention. This probably reflects a widespread view that there are huge gaps at all levels of biodiversity monitoring and that better monitoring of almost any taxonomic group could make a valuable contribution to our understanding of how biodiversity is faring. People

were more interested, for the most part, in identifying the barriers inhibiting effective monitoring that are common across a wide range of taxa.

Within the context of identifying focal taxa, people sometimes suggested grouping them by habitat rather than taxonomic relationships. Interestingly, it was almost always marine habitats that were identified in this way, for example:

- intertidal rocky shores; and
- intertidal soft sediments.

This probably reflects the greater focus on habitat-based cross-taxa recording and monitoring in the marine environment. It was noted that many benthic species are responding rapidly to climate change suggesting a very direct link with that driver and the utility of monitoring benthic species. Cross-taxa monitoring of the near-shore benthic zone is well-organised under the Seasearch project. The intertidal zone has its own initiatives such as Shore Thing and Shore Search which are often implemented and coordinated locally (see '5.2 Supporting protocols').

People identified many reasons for taxonomic gaps in monitoring. Some of these are outlined below.

- Limits to our own understanding of the ecology of some taxa and our ability to develop meaningful measures of their abundance and distribution. Fungi were frequently cited as an example of such a taxonomic group.
- Some groups of cryptic taxa which are not particularly amenable to traditional monitoring techniques may be better subjects for rapidly developing new techniques like eDNA collection and analyses.
- For some taxa, a lack of baseline data needs to be overcome before meaningful monitoring can occur.
- There is very little strategic spend on biodiversity monitoring by UK government. This hinders development of new monitoring.
- Existing biological recorders are often reluctant to adopt monitoring protocols (see '5.1 The perception of protocols').

It was pointed out that turning the reluctance of some biological recorders to adopt new monitoring protocols on its head can identify opportunities. One example is to encourage moth trappers to cover other taxa that occur in their traps. Rather than entailing a change in recording practice or protocol, the main barrier to overcome here is one of taxonomic ID skills (which most biological recorders are willing to expand).

With respect to new techniques for environmental monitoring, such as eDNA, and more traditional ones like biological recording, it is important to recognised the strengths and weaknesses of them all and develop an integrated approach to biodiversity monitoring that maximises the potential of all the tools at our disposal.

3.2 Under the strategic radar

The contribution that FSC can make to monitoring of biodiversity will often be at a point far removed from operational indicators. The fact that some groups, like fungi, are still poorly understood,

despite their vital role in ecological systems and services, points to a need for more fundamental research and education.

FSC has an important role to play in this, particularly in education. Stimulating more interest in these taxonomic groups and teaching ID and recording skills outside context of monitoring has great value and can help us reach a point where the UK can implement informed monitoring of such taxa. FSC should be careful not to lose sight of this 'long view' when considering the contribution it can make to monitoring in the UK.

Fungi, lichens and other taxa that are poorly understood and difficult to monitor can, and do, contribute to our understanding of how biodiversity is faring in ways other than through formal monitoring programmes. Signals of change can be detected through smaller-scale studies, for example at academic institutions or by amateur expert naturalists, and syntheses of such studies and the signals they produce remains a valuable way of understanding biodiversity change.

Studying and understanding the ecology and dynamics of taxonomic groups that do not contribute to strategic biodiversity monitoring is also vital in our efforts to understand the *reasons* behind observed trends in better monitored taxa. We must recognise the importance of work done by amateur naturalists and schemes & societies on less 'strategic' taxa in this respect and FSC should support this work. As one person put it, sometimes people have their enthusiasm for less strategic taxa "*knocked out of them*" because their experience does not attract strategic, planning or legal attention and is not otherwise valued; FSC can help people to "*stake a claim on the unloved bits of taxonomy*"!

4 Habitats

4.1 Habitats as a framework for studying natural history

There was a striking range of attitudes towards habitats across those consulted. Some had "*no use for habitats*" whilst others (the clear majority) regarded habitat as a useful framework within which to study and make sense of natural history. In the latter group, some people like to use habitat information to contextualise biological records. The Spider Recording Scheme and British Bryological Society have gone as far as formalising the collection of some broad habitat and micro-habitat data along with the basic 'who, what, where & when' of records.

A factor contributing to this diversity of attitude is the difficult nature of the very concept of habitat. It was pointed out that this concept goes beyond phytosociology, but our classification systems (taxonomies) and tools for describing them are primarily phytosociological in nature. The plethora of habitat taxonomies and complexities introduced by scale (e.g. broad vs micro-habitats) add to the confusion. The diverse attitudes towards habitats almost certainly reflect diverse individual concepts of them.

Among the majority who valued the concept of habitats, there was a lot of interest in using them to frame ID training and resources as a way of incorporating more ecology and natural history learning (already common practice for some taxa, e.g. vascular plants). By promoting this approach further, FSC could play a role in raising awareness of habitat concepts, including ecosystem services. One suggestion was that courses with a habitat focus, such as 'understanding woods', might be more

attractive to many than those with a taxonomic focus, such as 'identifying trees'. There was considerable support for habitat-based species ID guides (something FSC already does with fold-out charts) but there was also interest in specific 'habitat identification' resources, for example incorporating indicator species.

People are interested in associations between organisms and there was widespread support for the idea of identification/ecology courses that cover two or more different, but ecologically related, taxonomic groups.

4.2 Recording habitat extent & condition

By contrast to the generally held view that habitat is a valuable concept within which to learn and conduct biological recording (including monitoring), there was less enthusiasm about the role of volunteers in direct recording of habitat extent and condition. But even here there was a divergence of opinions with many of those in Scotland being more positive. The geographic split is telling. In Scotland SNH have made a decision to standardise on the EUNIS habitat classification for a major baseline habitat mapping project – with the first edition due in 2019 – and this could eliminate some of the confusion around the habitat concept and provided a focal project around which ideas and innovations around recording habitat can coalesce. There are opportunities here for FSC to develop and deliver training and resources in support of this major project.

In the rest of the UK there is currently less focus. In England there are, potentially, projects that could engage volunteers who are interested in recording habitats – for example ground-truthing Natural England's national habitat inventory or surveying Local Wildlife Sites, but many of these need more work before they are formally ready to start engaging volunteers. Volunteers involved in habitat mapping in the UK at present often work through local groups and initiatives such as Local Record Centres or Local Sites Partnerships. An exception is the marine environment where habitat and species recording are more joined up for various reasons.

Although one or two people could see a role for casual habitat recording, more suggested that volunteers need a purpose to record habitats – they don't just do it for their own enjoyment. Outside of specific projects, there's "*nowhere for habitat records to go*".

There was recognition that the practice of recording habitats is changing thanks to improvements in remote sensing and the increasing availability of hand-held technology. Barriers to involvement in habitat recording could be of two kinds:

- technical knowledge of habitats (e.g. habitat ID skills); and
- skills in using (and perhaps accessing) the technology.

Despite the changing face of habitat recording and the uncertainty about habitat taxonomies, Phase 1 habitat mapping – both the taxonomy and the practice of undertaking it – is still generally held to have value. This may be due, in part, to the large legacy of Phase 1 habitat information. It is also probably the most widely understood taxonomy. For this reason people still see value in developing resources and training for Phase 1 habitat mapping. Too often in the past, volunteers have been assigned to habitat mapping projects as something to cut their teeth on without first having sufficient training or being given the chance to make mistakes in a safe environment. Even in the

hands of professionals, objective scientific studies have shown huge inconsistencies in the way taxonomies are applied and the resulting habitat maps produced.

There was general recognition that recording habitat condition is a completely separate, and even more difficult, issue from recording habitat type and extent. Tools such as Common Standards Monitoring (CSM) may seem fairly straight forward, but most are only really effective in the hands of ecologists with years of experience of particular habitats. Another view was expressed was that CSM was "*designed for people who lack ID skills and as a result tells us little or nothing about the condition of a habitat*". In any case, in general, people could only see a very limited role for volunteers in the area of habitat condition monitoring.

5 Surveillance & monitoring protocols

5.1 The perception of protocols

Monitoring protocols were often discussed with some caution by biological recorders during the consultation. Some practising biological recorders are reluctant to adopt monitoring protocols that require them to record in different ways or in different places. There is a perception that following a monitoring protocol can detract from the enjoyment of natural history and turn potential newcomers off. An interesting observation is that the ladybird recording scheme has an *optional* protocol for contributors but recorders that use it are very much the exception rather than the rule.

On the other hand there are some widely adopted and successful recording protocols out there, generally supported by the larger national recording schemes and societies, for example the BTO's bird surveys. And even the smaller schemes and societies have had some success, at one time or another, in asking recorders to follow a protocol (e.g. for woodlice recording).

Wider discussion of protocols, and other practices that support production of more useful records (see '5.3 The value of recording outside strict protocols'), between and amongst biological recorders, schemes and societies and users of biological records would help improve the perception and understanding of recording protocols and what does and doesn't work when engaging new and existing biological recorders. There is scope for exploring the subject of protocols more frequently in training and ID resources to promote this understanding and discussion. In doing so, there is a fine line to tread in order to explain why protocols enable the scientific method without overwhelming newcomers with detail of the scientific method itself. The growing citizen science movement is developing an understanding of these issues.

5.2 Supporting protocols

The National Plant Monitoring Scheme (NPMS), trialled in 2014 and due to be officially launched in 2015, has the potential to make a major contribution to vascular plant monitoring in the UK. The scheme is designed to accommodate both beginners and expert botanists which it does by incorporating four different, but related, protocols with a clear progression path between them. Participants can choose the protocol which best suits their level of expertise and confidence with the potential to move to a higher level protocol (within the same survey square) as their expertise and confidence grows. This is an innovative approach to engagement and technical development of participants within a single scheme. The focus of the scheme is vascular plants but another

interesting feature is that all four protocols operate, to some extent, within a formal habitat framework (see also '4.1 Habitats as a framework for studying natural history').

There are several well-established taxonomically-based monitoring protocols, mostly established by the larger national schemes and societies such as the British Trust for Ornithology, Butterfly Conservation and the Bat Conservation Trust. Although they are well-established, it is normally the case that even these recording schemes want to recruit new participants.

There is a significant number of biological recorders (and perhaps an even more significant number of potential recorders) who are interested in particular places rather than particular taxonomic groups. Capturing participation from this audience has been one of the aims of cross-taxa monitoring protocols like PondNet and others trialled for heathland, ancient woodland and other habitats (for example Defra pilot projects run by LRCs in Norfolk and Greater Manchester). Recording in marine environments lends itself to cross-taxa recording and monitoring. Seasearch, in particular, has a well-established protocol supported by a national network of coordinators and a growing base of resources. Protocols for the intertidal zone include Shore Thing and Shore Search which are often implemented and coordinated locally.

FSC has traditionally carried out and facilitated training in ID and survey skills across many taxa and produced a large number of related ID resources. Future FSC training and ID resources could make a greater contribution to monitoring in the UK if FSC is mindful about how they relate to the monitoring protocols such as NPMS (and others mentioned above) and people's participation in them.

5.3 The value of recording outside strict protocols

When the subject of protocols was discussed during the consultation workshops there were usually people that wanted to balance this by emphasising the potential of making more of 'ordinary' biological records by incorporating measures of:

- abundance; and/or
- recording effort.

People were clear that recording within the context of a monitoring protocol generally provides that kind of information but there was an acknowledgement that much biological recording takes place outside of the context of these strict protocols (and probably always will). There was a generally held feeling that these records would be more amenable to interpretation and analyses if accompanied by data relating to abundance and/or recording effort.

Some taxa are more amenable to recording abundance than others. For example DAFOR and SACFOR scales can provide standardisation of abundance measures for casual records of vascular plants (notwithstanding problems associated with these such as people modifying them to suit local conditions). Applying the same sort of scales to other taxa can be problematic, for example weather conditions can have an overwhelming effect on abundance and/or detectability of invertebrates and scales of abundance can themselves only be meaningfully interpreted if accompanied by information on weather conditions. There are even fewer meaningful ways of recording recorder effort (which can itself be split into time and intensity).

Often a feeling was expressed that biological recording culture in the UK undervalues biological recording at levels other than the species level, for example higher taxonomic levels, aggregated species and morpho-species. And yet experience has shown – for example in the academic world and for freshwater invertebrates – that recording at these levels can yield important signals of biodiversity change.

One consequence of undervaluing recording at higher levels is that biological recorders, under pressure to name the species, may guess or make otherwise unsafe determinations that exceed their technical ability or confidence. Our biological recording culture is not strong with the message that high quality biological recording can mean saying "I don't know" or "I can only identify it with certainty to this level, but that is still valuable". By undervaluing records which are not made to species level, we are also undermining routes of secure progression in taxonomic identification learning.

Several people made the point that there is a very important role for casual recording outside of the context of protocols and that it remains the greatest source of data for many taxa including the majority of invertebrates. Casual recording of invasive species has great value, often alerting us to the extents of their expanding distributions. One consultee expressed their sense of the value of casual recording by saying that it adds important "*colour and context*" to data obtained from structured recording.

FSC cannot address some of the issues described in this section directly – that is more the realm of the recording schemes & societies, the BRC, the NBN, the NFBR etc – but it can play its part by keeping abreast of any developments and paying heed to them in the development of resources and the provision of training.

6 Promoting engagement and effective learning

6.1 Progression through a 'pyramid of engagement'

We talked a lot about a 'pyramid of engagement' at several consultation workshops. In the context of biological recording and monitoring, the width of the pyramid base represents the reach of engagement activities that introduce people to natural history and biological recording. Although the top half of the pyramid represents fewer people, these people can are relatively extremely productive. It has been estimated that for an average taxonomic group, 80% of the records come from 20% of the recorders. The very top of the pyramid represents people like scheme organisers and verifiers – the kind of people that have progressed and earned their stripes through "*many years spent staring down a microscope*". The ideal situation is for a very broad-based pyramid with strong progression pathways for people to move up as they become more skilled, confident and connected.

At the moment the base of the pyramid is considered by many to be too narrow and, consequently, the top too fragile. Currently many apparently successful schemes are, in fact, highly dependent on relatively few people. We need to broaden the base of the pyramid, for example through more engagement, but this is largely ineffectual if we don't also develop and maintain strong paths for progression up the pyramid in order to make the top more resilient. It's relatively easy to broaden the base of the pyramid but harder to strengthen the technical skills, networking and progression in the middle of it. Really successful monitoring programs deal with both recruitment and progression.

Some people found it useful to identify two key steps: step 1 from base to intermediate and step 2 from intermediate to top of the pyramid.

Occasionally views were expressed which warned against conflating engagement with recording – that we should be very clear about what to expect from people at different parts of the pyramid and how their data can be used. However there was also recognition that finding ways to introduce people to recording "*softly*", so that they can make some sort of contribution at a low level, is an important part of the progression path in the lower part of the pyramid.

Ideas for widening the base of the pyramid included:

- converting naturalists that don't currently actively record – we can often reach such people through social media;
- drawing in the growing number of people who are primarily interested in taking photos but are using social media to learn more about their subjects and obtaining identifications;
- considering opportunities offered by 'gamification' –engaging people (especially young people) in recording through making it more entertaining;
- engaging community groups may produce new recorders and self-supporting communities;
- searching for effective ways of engaging inner-city and immigrant communities – those that generally feel disconnected from the countryside; and
- supporting initiatives such as iSpot which provide effective self-help communities and a non-threatening access to biological identification for newcomers.

One person warned that we need to guard against 'volunteer burnout' if we keep hitting the same people again and again with engagement projects.

There was an often-expressed view that we need to think more about providing a greater range of training within specific taxonomic groups to cater for a greater range of abilities. Beginner's courses are often too hard and off-putting and we should provide more *very* simple introductory courses. Difficult taxonomic groups (e.g. fungi) may be more effectively taught by concentrating courses on smaller taxonomic units (e.g. waxcaps). All in all, we need to think more about training programmes, rather than individual training courses, considering what content is appropriate at what level and thinking about how the programmes and constituent courses provide paths for progression up the pyramid of engagement.

6.2 Motivation and encouraging participation

Many people at the workshops were keen to identify things which either motivated people or acted as barriers to participation in training, recording and monitoring schemes. Here are some of those commonly identified.

- People need feedback as soon as possible after they have made a contribution such as submitting a record (one person called it "*instant gratification*"). The more contextualised that feedback can be, the more motivating it is (e.g. 'first record of this species for 30 years'). But feedback can be tremendously time-consuming for scheme organisers, verifiers and administrators and not all are prepared to do it.
- It was noted that "*people like to see their name in print*"!

- Definite project endpoints, with interesting outputs like distribution atlases, can act as a major incentive to greater levels of participation - even to existing recorders. Many schemes & societies notice that participation from members waxes and wanes under the influence of such projects.
- Capitalising on developments in new technology can boost participation. Marine recording has benefitted greatly from new technology.
- Lack of confidence can be a barrier to engagement. This may be exacerbated by courses which are marketed for 'beginners' actually being pitched at too high a level.
- Lack of access to specialist equipment like microscopes and even consumables like alcohol can be a barrier to participation
- Lack of access to training because of cost can be a barrier to participation (four-day residential courses were described as "*prohibitively expensive*" for many). For working people, access to training courses which take place during working hours can be difficult.
- Lack of confidence in, and clarity about, dataflow and verification was identified again and again as a major dis-incentive to participation for many. It was suggested that sometimes submitting records can feel like putting them into a "*box*" or a "*black hole*". The problem often has its roots in the lack of verification expertise available to recording initiatives (such as iRecord).
- A perceived lack of coordination between recording schemes & societies, conservation NGOs and government agencies can dis-incentivise participation. A contrast was drawn between terrestrial recording – where this was seen as a problem – and marine recording which has proceeded in a more joined-up fashion since the Marine Conservation review in 1988.
- Among some biological recorders – particularly the more established ones – there is sometimes resistance to the 'citizen science' epithet. For some it may be distaste for the name itself. Others perceive citizen science as a threat to professional ecology. It would be wise to be sensitive to these reservations otherwise the way a scheme or project is labelled and marketed may be a barrier to the involvement of an important audience.
- A declining number of field meetings is reducing opportunities for informal mentoring.

6.3 Demographic issues

A very common theme was the need to inspire and educate children. A lack of opportunities for young children to engage with nature and develop natural history skills was identified again and again. FSC was widely recognised as having a very fundamental role in addressing this.

The demise of the school 'nature table' and fewer opportunities for children to experience nature formally and informally out of doors has affected children for more than a generation resulting now in a generation of children's teachers who are disengaged with nature. The BTO now has to train people in bird-nesting skills when previously they would have been self-taught as children! There's no lack of appetite amongst the very young for wildlife and natural history, but there are now fewer opportunities to fan the flames (e.g. through school). To overcome these lack of everyday opportunities , NGOs and schemes & societies are having to do more direct engagement of the young themselves which can stretch their resources.

At one of the workshops, a twenty-something volunteer biological recorder just embarking on a career as an ecologist suggested that almost none of his peers get involved in natural history purely

as a pastime. Those that do engage with natural history want a career in ecology. For the rest, the normal way to experience the outdoors is through sport.

The same person had experience in organising Shore Search groups for a Local Wildlife Trust and noted that almost all volunteers were in the 50+ age bracket. Many people in their 50s and 60s – a very productive demographic in terms of recruiting new recorders and participants in monitoring – take up an active interest in natural history when a dormant interest that they've had from a young age is re-ignited at a time in their lives when they are looking for a change. A worry is that the middle-aged demographic of tomorrow will have no flame from their younger days to re-ignite. There was also a point of view, expressed several times, that we could do more to specifically target this older age bracket when trying to recruit new biological recorders for monitoring.

Engaging children and young people with the outdoors and natural history is a major part of FSC's work but it does not feature directly in the Tomorrow's Biodiversity project. Nevertheless, when considering building broad-based engagement pyramids to support biological recording and monitoring, we would be wise to be mindful of these issues.

6.4 Adding value to courses

Ideas for increasing the efficacy of courses included the following.

- Provide more information to people before they come on a course on what to expect. This could help them to formulate questions and could also help to ensure that the tutor(s) cover all the areas expected of them.
- Consider, in some circumstances, giving people a task to complete before coming on a course. This might be especially useful for intermediate level courses where participants are expected to have some basic knowledge.
- Link training to some sort of follow-up activity. Follow-up meetings (either physical or through communications technology) can be effective.
- Ensure that courses, where appropriate, include relevant information (or pointers to relevant information) on making and submitting biological records and the relevant schemes & societies.
- Where effective, consider using more than one trainer, or providing support to the main trainer, if this will significantly enhance the learning experience of the participants. An example of where this approach might be useful is where a taxonomic expert who lacks teaching skills or experience is supported by someone else who acts as primary facilitator of the teaching sessions.
- Consider providing certificates of attendance. These are often highly valued – both in themselves and, increasingly, as evidence of CPD.

Although not strictly related to courses *per se*, there is a good appetite for accreditation schemes like FISC though some people noted that some previous schemes such as IDQs met with limited success. One person suggested that there may be a demographic split in the appetite for formal accreditation with many older recorders being unwilling to undergo formal assessment.

Ideas for ancillary courses, outside of taxonomic ID, that facilitate progressions through the engagement pyramid included the following.

- Training on the technical aspects of making biological records and the technical disciplines of identification – outside the context of particular taxonomic groups.
- Specialists develop, beyond a certain point, largely by teaching themselves. There may be scope for thinking about teaching people how to school themselves and obtain technical support as they do so.
- More courses like 'Wildlife in the Cloud' which enable biological recorders to leverage the technical tools available to them.
- Training on the use of GIS, enabling 'high-level' biological recorders to learn more from their own records.
- Something on enabling verifiers, e.g. identifying and exploring progression paths for people to move towards becoming verifiers.
- There may be scope for courses on things like 'how to conduct an invertebrate survey' for the consultancy market.
- Training for trainers (see '6.5 Training trainers').

A theme that cropped up more than once was based on the idea of partnerships between FSC and schemes & societies that go beyond the usual FSC Associate Tutor model. FSC could work in partnership with schemes & societies to develop and deliver programmes of courses that facilitate progression through the engagement pyramid. One model advocated had the scheme/society as the prime developer and provider of the programme and FSC as the host and administrator of bookings etc. But there is scope for FSC provide more than this including the facilitation of networking, mentoring and support.

It was noted that FSC-facilitated courses should not be designed or evaluated in isolation; rather we should consider them within the context of the entire provision of courses incorporating those of other training providers like LRCs, Wildlife Trusts and schemes & societies and accommodate local expertise and experience where appropriate. This would be facilitated by a central catalogue of training provision (see '7.5 Electronic resource hubs').

There was agreement amongst those with experience of running day courses that putting a monetary value on them was a good idea. A nominal charge (e.g. £20) can encourage people to value a course more and help avoid the problem of people booking and not turning up. When a charge is not levied, another effective approach is to gently 'harass' people – ensuring that the course is kept in mind and in their diaries! Online booking forms for a free course are fatal – it's too easy for people to book and not turn up.

6.5 Training trainers

There was a lot of interest in the idea of providing training in teaching skills to people who run natural history courses. Several noted that good natural history teachers need both natural history skills and teaching skills. The best mentors and teachers want to "*communicate rather than demonstrate their knowledge*", but demonstrating often comes more naturally that communicating. It was pointed out that the Environment Agency provides coaching in training skills to staff that provide internal training in the organisation.

A number of people saw value in the idea of a one-day course on 'teaching skills' aimed at natural historians who already have taxonomic ID expertise, covering, for example, structured learning, using breaks, working at different paces etc . The BSBI runs an annual 'Training the Trainers' workshop for BSBI staff and members involved in training and education. Others felt that much of value could be provided through instructive videos. Such courses and/or resources could have value to a large number of people including individual natural historians that do (or would like to do) some teaching, schemes & societies, rangers and community groups.

Although not related directly to the Tomorrow's Biodiversity project, many people expressed concern about the lack of natural history skills and confidence amongst school teachers and saw this as being at the root of the decline in natural history skills. They want FSC to think about ways of up-skilling teachers (as well as teaching children directly), though it was generally agreed that we should train primarily about ecological function – not taxonomy *per se*. People were also at pains to say that they valued (and even *expected*) FSC to be involved in lobbying government to ensure that the curriculum is broad-based enough to embrace fieldwork and natural history.

6.6 Support outside the classroom

There was universal recognition of the value of follow-up support to learners once a course is over. But achieving this can be problematic. Some of the best examples of natural history teaching programmes – e.g. the Cyril Diver project, TCV's Natural Talent Project and FSC's Invertebrate Challenge project – have provided a high degree of support outside the classroom. Support outside the classroom is not limited to relationships between tutors and students, but includes self-help and peer support, all of which is more effective when explicitly facilitated.

It was noted that what many successful projects have in common is a *funded project officer*. A big problem is maintaining levels of support once funding for a project comes to an end and resources disappear.

Mentoring – where a learner can call on advice and support from a more experienced practitioner – is seen as a very valuable mechanism for learning and, of course, has been part of the tradition of teaching natural history for generations. Mentoring (and other 'after-course support') is often independent of teaching; teachers needn't be mentors, nor *visa versa*, but the two roles often go hand-in-hand.

It was suggested that many experienced recorders are willing to act as mentors, but are under-used as such. Many schemes & societies and other organisations, such as Local Record Centres, do operate mentoring schemes (with various degrees of formality) where mentors and learners are matched up but, probably more often, mentoring relationships are built by chance or circumstance and it's a thing that can't be forced. Nevertheless, more could probably be done to facilitate chance and create the right circumstances! The number of mentoring relationships which don't work out is probably orders of magnitudes higher than those that succeed. But the benefits to the learner and to biological recording of those that succeed can be incalculable, so we shouldn't be put off by seemingly low success rates.

Multi-media communications technology could help to re-invigorate mentoring and support outside the classroom. Technologies like webinars, Skype and Google Hangouts could allow cost-effective

and accessible post-course follow-up sessions and mentoring to people that are physically hard to bring together.

Social media such as iSpot, Facebook, Twitter and Yahoo mail-groups can provide access to communities of expertise spread over dozens or hundreds of people that would never physically meet together in one place. Many examples of useful social media groups were cited. Factors common to the best among them include:

- fast response times to queries;
- top-level expertise amongst the contributors; and
- an inclusive and friendly ethos.

People can see a role for groups in supporting learners beyond the classroom and it was suggested that the 'drop-off rate' was lower when such support was available. It was noted that social media groups aimed primarily at identification (e.g. iSpot and some Facebook groups) are great at pointing to the common ID problems that people encounter and are an excellent source of such knowledge for those producing new ID resources.

People also pointed out some potential problems with social media groups that we should be mindful of:

- when non-biological recorders submit a picture for identification, they often suppose that they have 'submitted a record';
- social media sites need a certain amount of 'policing' and the resources involved for a very active site are not inconsiderable; and
- not everyone has access – or wants to be involved with – social media, so social media should only form part of a wider communications and support strategy.

An advantage of social media over traditional websites is that content is dynamic for a well-subscribed group because it is naturally generated by the entire community of users rather than the 'webmaster'. A good tried-and-tested model for a natural history group to maintain a web presence is to use a simple website – e.g. one based around a blog – to act as a home for regularly contributed content-rich articles and information relevant to the group and connect social media to this. It is as well to use more than one social media tool (and be open to new ones) since each tends to reach a different audience (and the actual audience of each changes rapidly).

It was noted that we must avoid the temptation to see new media as a 'magic bullet' – there is still a lot of value in getting people in a room together and there's still a very important role for field meetings. Experience suggests that social media works best when a group of people have the chance to meet face to face periodically. The Earthworm Society have had some success with two-day field meetings with the twin purposes of 1) getting existing members together and 2) attracting new members. Sometimes a physical meeting place can be an important ingredient in giving people a sense of belonging and can also act as important physical hubs for housing resources such as microscopes and ID resources. The NHM's Angela Marmont Centre is an outstanding example of one such national hub, but FSC, Museums, Local Record Centres and others could play important roles in providing local facilities.

7 Identification resources

7.1 General comments about existing ID resources & their creation

FSC paper ID resources are highly valued across their range, from fold-out charts through AIDGAP guides to resources produced in association with partners (e.g. the Linnean Society synopses).

The technical value of the information on the back of FSC charts was often commended. Some said this information was often valued as much, if not more so, than the ID guides on the front (an example cited was the bats chart). People really valued the charts as a great way to engage new comers ("*people love to gather around charts in the field*"), but their value was often seen as going far beyond that. Even experienced recorders find utility in some of the fold-out charts in the field.

There was quite a bit of discussion around ID guides that bridge a gap between fold-out charts and the much more technical material. Some people considered that AIDGAP filled that role whilst others regarded AIDGAP as part of the more technical literature and considered resources like the British Wildlife ID guides to be in the middle. People considered that this 'middle literature' was often responsible for really opening up taxonomic groups to people. However, a common concern was that middle literature that is not comprehensive should come with a health warning to avoid the "*Chinery Effect*" – that is the tendency for people to identify their specimen as the one that most closely matches it in the resource in front of them. It was noted that we need to do more work on how beginners identify and misidentify specimens in order to create more effective ID resources (see also '6.6 Support outside the classroom').

Discussion of ID resources covered several interesting points including:

- learning is most effective if people have access to a range of ID resources, sometimes approaching the same subject in different ways;
- text-heavy resources put many people off;
- we shouldn't dogmatic about using either photos, paintings or line drawings and should use each – or a mixture – as appropriate; and
- there is very widespread support for *annotated photos*, including side-by-side comparisons of confusing species.

There was some discussion about barriers to production of identification resources and pinch-points in the process – one of the major problems identified was the difficulty in sourcing or creating illustrations which often require a professional illustrator or microscopist. Many keys exist as drafts for years – often while people write a book around them. Moves to make draft keys more widely available, which would also facilitate testing, would be useful.

7.2 Ideas for new resources

There was a lot of interest in the idea of very simple identification resources that help widen the base of the engagement pyramid, for example online entry-level guides and even things as simple as "*six you're most likely to see*" and "*what's in my pond?*". With modern versatile techniques for resource production and delivery, people also saw more scope for tailoring resources, for example to local geographical areas or for specific habitats.

In general, people felt that ID guides themed on particular habitats or micro-habitats is a good idea (see also '4.1 Habitats as a framework for studying natural history') for example along the lines of the Naturalists' Handbook series. Many could also see the value in more resources to explicitly explore habitats in themselves, for example "*what habitat am I in*?" or something to support specific classifications as used by the NPMS, Phase 1 or EUNIS.

Several people talked about 'crib-sheets' in support of other resources or to tackle specific commonly encountered ID problems. For example crib-sheets that can be used with existing published keys to help users cope with things like changes in taxonomy and problems that emerge with using the key after publication. These kinds of resources could be produced as PDFs and published online. Existing examples include the BSBI 'plant crib' and the Spider Recording Scheme's 'difficult species' information sheets.

7.3 New media resources

In general there was a great appetite for online, free PDF resources (unsurprisingly!) and also a lot of interest in other online resources, such as online keys, photographic libraries, and mobile apps which were often perceived as being easily updatable and able to cope with rapidly changing situations such as those presented by invasive species. Another big advantage of apps, for many, was their portability, enabling people to carry far more resources in the field without the weight burden of traditional books. It was noted, in particular, that younger people favour using apps and mobile resources in the field. Gaps in internet coverage at remote and coastal sites mean that mobile applications must be capable of functioning without an internet or, at least, 'degrade gracefully'.

There was almost universal enthusiasm for the idea of short education videos (of the kind that appear on YouTube) with some people stating that watching such videos was their preferred way of learning a new practical skill. Ideas for subjects of short videos included:

- a series on using and maintaining microscopes;
- a series on identifying plant families;
- a series with to accompany fold-out charts, with each one explaining how to get the most out of a particular fold-out chart;
- a series on elements of fieldcraft (could be especially useful when there aren't opportunities to cover all relevant elements on a particular field course);
- a series on taking photographs for invertebrates to enable photographic ID; and
- a series on biological recording.

There was discussion around the problems associated with the developing digital revolution in ID resources. Some people thought that there were already too many apps, but others felt that we just needed better information on what is available (see '7.5 Electronic resource hubs'). There is a real tension between the very low margin market developing for electronic resources and the need to continue support for the specialists who produce them. As demand for low-cost electronic resources continues to grow, there may be less investment in quality resources. How will we incentivise people to produce resources when there is very little prospect of any real financial return? People cannot always afford to spend time on producing resources and this is especially true if there is no financial reward for doing so.

Many felt that we will always require an option to produce ID resources in paper. One participant noted that recipe books are still far more popular than recipe apps. Under many circumstances, paper is still the best technology to deliver information and resources. One person noted that they pursue field natural history, in part, to get away from modern technology.

7.4 Multi-access keys

Not everyone was aware of computer-based multi-access keys and how these differed from traditional dichotomous keys. Those that were aware of the technology were generally enthusiastic about their potential and there were a number of interesting suggestions of subjects for the multi-access key treatment including difficult taxa such as Waxcap fungi and, more innovatively, habitats.

A potential feature of online keys (whether multi-access or dichotomous) that captured the imagination of a number of people was the potential to keep them up-to-date with changes in taxonomic knowledge etc, but someone also made the interesting point that it is sometimes important for a verifier to know the identification resource, including the exact version, used in the original determination in order to assess whether or not it is likely to be correct. This could be harder to keep track of with rapidly changing online keys.

There are still many advocates of traditional dichotomous keys and universal recognition of their importance as ID resources.

The comments in the previous section regarding the difficulties in finding a market model which adequately supports the development new media resources applies equally to multi-access keys. In the development of paper-based keys, authors are generally rewarded reputationally and, often, financially. We are only likely to see a really vibrant movement in the development of multi-access keys if commensurate reward systems develop alongside them.

7.5 Electronic resource hubs

A theme which generated a lot of traction at all the workshops was that of central collation resources – one-stop-shops where people can get a handle on what training, ID and other biological recording resources are available and how to find them. Existing and emerging facilities along these lines include the NHM's 'Nature Groups Near You', NatSCA's 'Natural History Near You', the Linnean Society's catalogue of training providers and those available on the Countryside Jobs Service website. The sorts of resources that could usefully be collated by such facilities include:

- training providers;
- courses;
- identification resources;
- biological recording software;
- outlets for studies and nature notes; and
- personal nature blogs.

It was suggested that by tracking use of such collation facilities, and the most common queries made against them, it would be possible to gauge the demand for training and resources for given taxa.

There are many partners with an interest in the provision of these kind of resource collation facilities and it is important that efforts to provide them are made collaboratively. The technical challenges of

providing such facilities are not as great as the challenges of resourcing their upkeep and development.

8 Next steps

This document will be one source of information used by FSC to inform the future direction of its biodiversity training and ID resource portfolio. More specifically it will be used during the latter part of 2014 to inform the design of a number of exemplar projects for the delivery phase of the Tomorrow's Biodiversity Project between 2015 and 2017 inclusive. Some of those projects may focus on taxonomic gaps in surveillance & monitoring, whilst others may explore ways of addressing some of the barriers to participation in surveillance & monitoring that are common across a range or taxonomic groups.

An initial list of exemplar projects and their objectives will be published on the Tomorrow's Biodiversity scratchpad during Autumn 2014 (http://tombio.myspecies.info/).

9 Appendix A: Consultation programme

A series on nine workshops were held over the UK as indicated below. A number of people were invited to these consultations and an open invitation was also issued to the biological recording community in the UK.

- Royal Botanic Gardens Edinburgh (24th April)
- FSC Margam, South Wales (8th May)
- FSC Belfast, Northern Ireland (15th May)
- FSC Blencathra, Cumbria (22nd May)
- FSC Slapton Ley, Devon (29th May)
- FSC Preston Montford, Shropshire (3rd June)
- Attenborough Nature Centre, Nottingham (5th June)
- Natural History Museum, London (11th June)
- Natural History Museum, London (12th June)

In addition to these workshops, consultation meetings were also held with Scottish Natural Heritage (which included some external partners) in Inverness on 25th April, the Biological Records Centre (including some partner organisation) in Wallingford on 2nd May and Natural England in Peterborough on 20th June. A number of formal telephone consultations were also undertaken.

10 Appendix B: Consultees & affiliations

People who took part in consultation workshops, meetings or telephone conversations are listed below. Please note that affiliations can be any organisation, or entity, that a consultee associated themselves with *in any capacity* (e.g. as an employee, student, volunteer, member, associate, committee member etc). The affiliations are listed in order to give an idea of the range of experience and expertise that informed this consultation. In the interests of brevity and simplicity, the nature of each affiliation is not given. ***The listing of an organisation as an affiliation for any individual does not infer that the individual represented that organisation in an official capacity*** (although in many cases, they did). Some people listed only their main, or most relevant, affiliation, whilst others listed more.

Consultee	**Affiliation** *(see notes above on interpreting affiliations)*
Austen-Price, Gail	University of Kent, Kent Reptile & Amphibian Group
Beckmann, Björn	Biological Records Centre
Bee, Lawrence	British Arachnological Society
Bertrand, Catherine	Butterfly Conservation (Northern Ireland), Northern Ireland Environmental Recorders Group
Bicker, Adrian	Living Record, British Dragonfly Society, Dorset Wildlife Trust, National Trust
Birch, Jane	Environment Agency
Boardman, Pete	Field Studies Council
Boxshall, Geoff	Zoology Society of London, World Register of Marine Species
Brotherton, Pete	Natural England
Brown, Keiron	Earthworm Society of Britain, Bat Conservation Trust, Soil Biodiversity Research Group (Natural History Museum)
Campbell, Pauline	The Centre for Environmental Data and Recording
Charlton, Jim	Manchester Metropolitan University
Cheesman, Oliver	Invertebrate Link (JCCBI), Reading University
Coppins, Brian	Royal Botanic Garden Edinburgh, British Lichen Society
Coventry, Laura	
Creedy, John	Natural England
Duffell, Mark	Arvensis Ecology, Manchester Metropolitan University, Field Studies Council, Botanical Society of Britain & Ireland
Eastwood , Dan	Swansea University
Fergusson-Smyth, Claudia	Botanical Society of Britain & Ireland, Royal Botanic Garden Edinburgh
Finlay, Catherine	The Centre for Environmental Data and Recording, National Museums Northern Ireland, British Trust for Ornithology, National Trust, Keep Northern Ireland Beautiful (Eco-schools Programme)
Foster, Andy	National Trust
Frost, Teresa	Cumbria Biodiversity Data Centre, Carlisle Natural History Society, Association of Local Record Centres, National Biodiversity Network Trust
Godfrey, Martin	British Bryological Society, Manchester Metropolitan University, Field Studies Council
Gough, Su	British Trust for Ornithology
Gowing, David	Open University, Floodplain Meadows Partnership, Wildlife Trust for Beds, Cambs and Northants
Handley, John	Arvensis Ecology
Harding, Brian	British Entomological and Natural History Society, the Dipterists Forum
Harding, Paul	British Myriapod & Isopod Group, National Biodiversity Network Trust, British Entomological and Natural History Society, Biological Records Centre
Harris, Felicity	Plantlife
Harvey, Martin	iSpot (Open University), Soldierflies and Allies Recording Scheme, Field Studies Council, National Forum for Biological Recording

Hedges, Gary	Cumbria Biodiversity Data Centre, Manchester Metropolitan University, Carlisle Natural History Society
Heeley, Lyn	Joint Nature Conservation Committee
Hewitt, Steve	Tullie House Museum, Carlisle Natural History Society, Dipterists Forum
Hind, Martin	Highlands Council Ranger Service
Holden, Liz	Scottish Fungi website, British Mycological Society, Grampian Fungus Group
Houldsworth, Jane	Botanical Society of Britain & Ireland
Hunt, Tom	Association of Local Record Centres
Ikin, Helen	Leicestershire & Rutland County Recorders Network, Loughborough Naturalists' Club, Leics Entomological Society, Leicestershire & Rutland Wildlife Trust, Bees Wasps & Ants Recording Society, British Myriapod & Isopod Group, Dipterists Forum, Mammal Society
Imlach, Janet	Biodiversity Information Service for Powys and Brecon Beacons National Park
John, Tony	British Trust for Ornithology
Johnson, Christine	Scottish Biodiversity Information Forum
Kendall, Mike	Highland Seashore Biodiversity Project, Plymouth Marine Laboratory
Kipling, David	Marine Conservation Society
Knowles, Chris	Royal Society for the Protection of Birds
Lavery, Anna	Field Studies Council, Open Air Laboratories
Leather, Simon	Harper Adams University
Lee, Paul	Arachne Ecology Ltd
Lightfoot, Paula	Seasearch, Newcastle University, Yorkshire Naturalists Union, National Forum for Biological Recording
MacCana, Pol	Northern Ireland Environment Agency
Macdonald, Iain	Scottish Natural Heritage
Macdonald, Murdo	Highland Biological Recording Group
MacGowan, Ian	Scottish Natural Heritage
Mantell, Adam	
Marrs, Sue	Scottish Natural Heritage
McCullagh, Frances	Natural England
McFarlane, John	The Conservation Volunteers, Natural Talent Project
McHugh, Sean	Wales Biodiversity Partnership
McSorley, Claire	Scottish Natural Heritage
Millar, John	UNESCO Man and the Biosphere's UK Urban Forum, Linnean Society of London, Nature Conservation Working Party of UK Environmental Law Association, Open Air Laboratories, British Ecological Society's Citizen Science Special Interest Group, Amateur Entomologists' Society, Field Studies Council
Miller, Russell	Manchester Metropolitan University
Mottram, Keir	London Natural History Society
Mulholland, Rosemary	Craigavon Borough Council
Newbould, John	Yorkshire Naturalists Union, National Forum for Biological Recording, National Trust, Diver Project
Nobel, Martin	Manchester Metropolitan University
O'Brian, David	Scottish Natural Heritage
O'Hara, Rebecca	Scottish Natural Heritage
Palmer, Matt	Devon Wildlife Trust
Perry, Franki	Seasearch, Marine Eco-Sol
Pescott, Oliver	Biological Records Centre
Picton, Bernard	Ulster Museum
Pilcher, Katherine	Environment Agency

Pocock, Michael	Biological Records Centre
Porter, Keith	Natural England
Porteus, Hilary	Manchester Metropolitan University, North Pennines Area of Outstanding Natural Beauty, Wildwatch, Nectarworks
Proudlove, Graham	Manchester Museum, The University of Manchester
Raper, Chris	Natural History Museum, Tachinid Recording Scheme
Rowe, Adam	South East Wales Biodiversity Records Centre
Roy, David	Biological Records Centre
Roy, Helen	Biological Records Centre, Ladybird Recording Scheme
Sazer, Deborah	
Skingsley, Dave	Staffordshire University, Cheshire Active Naturalists
Sterling, Bertie	Arocha UK, The Presbyterian Church in Ireland - Environmental Panel
Stewart, Alan	Sussex University, Auchenorrhyncha Recording Scheme
Stone, Dave	Natural England
Thomas, Peter	Keele University, Staffordshire Wildlife Trust
Thompson, David	National Trust for Northern Ireland
Townsend, Sue	Field Studies Council, Botanical Society of Britain & Ireland
Tweddle, John	Natural History Museum
Viscardi, Paolo	Horniman Museum and Gardens, Natural Science Collections Association, Linnean Society of London
Walker, Kevin	Botanical Society of Britain & Ireland
Warren, John	Aberystwyth University
Whild, Sarah	Manchester Metropolitan University, Botanical Society of Britain & Ireland, Field Studies Council
Whitbread, Steve	Northamptonshire Biodiversity Records Centre, National Forum for Biological Recording
Wilkinson, John	Amphibian and Reptile Conservation
Wilson, Michael	National Museum of Wales, Open Air Laboratories
Wolsey, Shane	British Trust for Ornithology
Woodward, Steve	Leicestershire & Rutland County Recorders Network, Loughborough Naturalists' Club , Leics Entomological Society, Leicestershire & Rutland Wildlife Trust, Bees Wasps & Ants Recording Society, British Myriapod & Isopod Group, Dipterists Forum, Botanical Society of Britain & Ireland
Wright, Mark	Northern Ireland Environment Agency
Yahr, Rebecca	Royal Botanic Garden Edinburgh, British Lichen Society