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Fifty years of the Biological Records Centre

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Abstract

In this special issue of the Biological Journal of the Linnean Society we celebrate fifty years of the Biological Records Centre (BRC) but, more importantly, we celebrate the pioneers of BRC and the volunteer recording community. It is inspiring to consider the many people who have contributed to the rich legacy of biological recording since the 16th Century. The core activity of BRC has remained unchanged since its foundation in 1964: working in partnership with volunteer recording schemes and societies to collate, manage, disseminate and interpret species observations (biological records). However, innovative technologies and the development of statistical approaches are taking biological recording in new and exciting directions. The large spatial coverage and increasingly fine-scale spatial precision of biological records enable ecologists to examine large-scale processes that it would be impossible to address without the voluntary contribution of recorders.

Keywords: Biological recording, volunteer, wildlife observations, large-scale and long-term datasets

What is more we hope .... that others, in emulation of us, may investigate the spontaneous plants, each of his own area, more diligently so that in this way a complete Phytologia Britannica *may finally appear from all their contributions.*

(Ray, 1660, in the Preface to the Cambridge Catalogue; translated by Oswald & Preston, 2011)

Over 350 years ago, John Ray recognised that a complete account of the taxonomy and distribution of British plants could only be achieved by the cooperation of botanists throughout the country. As natural history increased in popularity in the nineteenth and early twentieth centuries, the earlier informal collaboration practised by Ray and his successors became increasingly formalised, either under the leadership of individuals such as H.C. Watson, R.L. Praeger and F. Balfour-Browne, or under the aegis of specialised societies such as the Entomological Club (founded 1826, still active) and the Moss Exchange Club (founded 1896, now the British Bryological Society). By this time, the professionalisation of science which had developed in the 19th century had left botany and zoology amongst the small number of sciences in which amateurs are still able to make a substantial contribution (astronomy is another obvious example). Sir Arthur Tansley (widely considered the founding father of ecology and first chairman of the Nature Conservancy in 1949) acknowledged the importance of amateur experts, stating "acquaintance with their local floras is absolutely unequalled". The launch of the Botanical Society of the British Isles (BSBI) Maps Scheme in 1954 represented a major advance. The resulting publication, the *Atlas of the British Flora* (Perring & Walters, 1962), demonstrated the potential of such coordinated recording and led to the establishment of the Biological Records Centre (BRC) in 1964 (Preston, 2013; Preston, Roy & Roy, 2012; Roy, Harding, Preston & Roy, 2014).

In celebrating fifty years of BRC it is interesting to reflect that the core activity remains unchanged: working in partnership with volunteer recording schemes and societies to collate, manage, disseminate and interpret species observations (biological records). It is also humbling to consider the many people who have contributed to the rich legacy of biological recording. In this special issue of the Biological Journal of the Linnean Society we celebrate fifty years of BRC but more importantly we celebrate the pioneers of BRC and the volunteer recording community. It is an immense privilege to be a part of BRC and exciting to see the large-scale and long-term datasets accrued over centuries supporting conservation and research.

Citizen science, the involvement of volunteers in the scientific process (Roy, Pocock, Preston, Roy, Savage, Tweddle & Robinson, 2012), is a new term. However, Pocock et al. (THIS SI) point out that biological recording has a long history and is undoubtedly leading the way in citizen science, even if this is not always recognised. A recent estimate suggested that 70 000 volunteers annually contribute wildlife observations (Pocock, Roy, Preston & Roy, In press). Biological recording in the UK covers a wide diversity of approaches, from opportunistic recording to systematic monitoring. The number of taxonomic groups covered is extensive, with more than 80 different schemes and societies representing a diverse range of taxa from mosses to mammals. The Water Beetle Recording Scheme for Britain and Ireland is over a hundred years old (Foster, In press) and so can celebrate the accolade of being the oldest insect recording scheme in the world. Foster (THIS SI), in defining a recording scheme, points out that "*The most important requirement of a recording scheme is that it should be motivated by the need to produce something, at least maps but better an overview of the conservation status of a species or, more dangerously, evidence in support of an hypothesis!*".

Most recording schemes and societies focus on the compilation of the records required to develop an atlas documenting the distribution of species. For the less popular groups, this may take many years. Pescott et al. (THIS SI) provide an overview of the distinction between such "atlas projects" and structured monitoring but recognises there can be considerable blurring between the two approaches because recording protocols and support networks for atlas projects can eliminate the distinction between monitoring schemes and atlasfocused fieldwork. It is intriguing to consider the ways in which monitoring schemes evolve and the motivations for developing different approaches. There are many benefits of gathering wildlife observations, whether through systematic or opportunistic approaches, including deriving robust trends and the detection of unexpected ecological change, so called “ecological surprises” (Wintle, Runge & Bekessy, 2010).

Isaac and Pocock (THIS SI) recognise the value of biological records for addressing large-scale questions about biodiversity change but also reflect on the inherent biases: uneven sampling over space and time, uneven sampling effort per visit and uneven detectability. Biological recording is evolving, particularly with the increase in mass participation citizen science (Pocock et al., In press), and there are both new challenges and opportunities arising (Isaac & Pocock, In press). Increased understanding of the various sources of bias and information associated with records will be needed to ensure that biological records remain one of the most important sources of data for policy, conservation and science. Powney and Isaac (THIS SI) review the application of biological records, focussing on four areas of biodiversity research: biogeography, trend assessments, conservation biology and climate change ecology. Phenology is widely seen as one of the clearest ways of documenting ecological responses to climate change. Therefore, it is timely to consider analytical methods to study phenological change using biological records. Chapman et al. (THIS SI) conclude that biological recording will capture data on a broader range of taxa and from a wider area than has been the case with traditional, direct long-term phenological monitoring. Indeed the large spatial coverage and fine-scale spatial precision of biological records enable ecologists to examine large-scale processes that would be impossible to address without the voluntary contribution of recorders.

The contributions within this special issue highlight the breadth and value of biological records to advancing knowledge. However, even within well-studied taxa there are neglected groups, and vascular plant hybrids are one of these. Biologists have wrestled with the species concept for centuries; as Darwin acknowledged “*no one definition (of species) has as yet satisfied all naturalists; yet every naturalist knows vaguely what he means when he speaks of a species*”. Hybridisation is known to have been involved in the origin of many plant species and biological records have been informative in enhancing understanding of the biology of hybrids (Preston & Pearman, In press).

The way in which wildlife is changing is evident both in the short and long-term (Gurney, In press). Gurney (This SI) considers a total of 7,420 species in a wide range of taxonomic groups and, perhaps surprisingly, notes that there have been a similar number of species lost and gained, 125 and 126 respectively. However, the functional traits of the species colonising differ from those species prone to extinction. Gurney therefore concludes that “*If we want to maintain the richness of our flora and fauna, we need to hold on to as much as we can and not just see one species as replaceable by another*.” Mason et al. (THIS SI) continues the theme of change by exploring range expansions of 1,573 southerly-distributed species from 21 animal groups. They confirm the conclusion of a previous study (Hickling, Roy, Hill, Fox & Thomas, 2006) that the northern range margins of many species have moved northwards, but they demonstrate an acceleration in this expansion, especially for Lepidoptera. In contrast, Hill & Preston (In press) consider Boreal species of vascular plants and bryophytes at the southern edges of their range, and show that many have declined markedly in southern Britain (Hill & Preston, In press). Both climate change and habitat loss is affecting boreal vascular plants but only habitat loss is implicated in the decline of boreal bryophytes.

The richness of the invertebrate datasets is one of the most notable features of biological recording in Britain; the invertebrate recording schemes and societies provide unprecedented sources of data on fauna which are otherwise often neglected. The value of these datasets is particularly demonstrated through two papers in this special issue (Stewart, Bantock, Beckmann, Botham, Hubble & Roy, In press; Thomas, Edwards, Simcox, Powney, August & Isaac, In press). Thomas et al. (THIS SI) explore the status of 299 invertebrates representing ten taxonomic groups that exploit early seral stages in a variety of habitats. They concluded that woodland species are particularly vulnerable when contrasted with those of semi-natural grasslands and lowland heaths, which appear to have benefited from agri-environment schemes. Stewart et al. (THIS SI) examine the relationship between the distributions of 1,265 phytophagous insects and their associated food plants, representing an impressive 9,128 interactions. Phytophagous insects rarely exploit the full distribution extent of their host plants; the relationship between the distribution of insects and their food plants is not linear. However, Stewart et al. (This SI) suggest that in a changing environment there will be opportunities for novel interactions and consequently changes in distributions that will be hard to predict. Clearly there is an exciting future for biological recording to document such changes, particularly through a focus on interactions between species.

Pescott et al. (THIS SI-a) highlight another interaction by examining the changes in the distribution of bryophytes and lichens in response to airborne pollutants and associated changes in lichenivorous moths. It is apparent that the effects of environmental change cascade between trophic levels and that reductions in pollutants have led to the recovery of species in all three groups (Pescott, Simkin, August, Randle, Dore & Botham, In press). One of the most intimate forms of interaction is that of a parasite with its host. Purse and Golding (THIS SI) consider the role of biological records in providing evidence to underpin models of disease. Species distribution models are widely used to analyse spatial patterns of pathogens and vectors of disease and thus to develop risk maps to inform policy (Purse & Golding, In press).

The applied value of biological records to inform conservation is the central theme of a number of the contributions in this special issue (Gillingham, Bradbury, Roy, Anderson, Baxter, Bourn, Crick, Findon, Fox, Franco, Hill, Hodgson, Holt, Morecroft, O'Hanlon, Oliver, Pearce-Higgins, Procter, Thomas, Walker, Walmsley, Wilson & Thomas, In press; Maes, Isaac, Harrower, Collen, van Strien & Roy, In press). Roy et al. (THIS SI) celebrate the role of the volunteer recording community in contributing to the understanding of invasion biology, reflecting that their expertise and commitment will continue to be invaluable with the desire to increase understanding of community and ecosystem-level effects of invasions. Detailed field observations, through biological recording, will provide the spatial, temporal and taxonomic breadth required for such research. Biological records are increasingly used for estimating trends and so have an application for the development of IUCN Red Lists (Maes et al., In press). However, IUCN criteria have not been used consistently across regions or taxonomic groups. Maes et al. (THIS SI) provide recommendations for a uniform approach to decision-making for threat assessments. The designation and management of protected species and areas is a pivotal component of conservation action. However, environmental change could render existing protected areas climatically unsuitable for the very species they are supposed to protect. Gillingham et al. (THIS SI) use occurrence data to demonstrate the value of protected areas in promoting colonisation and preventing extinctions of butterflies and birds. Thomas et al. (THIS SI) further highlight the role of protected areas in mitigating climate change. Indeed protected area networks act "*as stepping-stones of suitable breeding conditions and facilitating range shifts, with many species remaining protected across protected area networks as a whole*." Shifts in the ranges of species as a consequence of environmental change are most dramatically seen with the arrival of non-native species, often originating from far-flung native ranges.

Technological advances have revolutionised biological recording (August, Harvey, Lightfoot, Kilbey, Papadopoulos & Jepson, In press). From the use of punched record cards in the early days of computing to the recent development of on-line databases, BRC has developed by embracing new opportunities offered by developments in computational and communication technology. The possibilities offered by modern computing have allowed the development of analytical techniques which maximise the use of the largely unstructured datasets accrued through biological recording (Chapman et al., In press; Isaac & Pocock, In press; Powney & Isaac, In press; Thomas et al., In press). Automated capture of images and sound are set to add new dimensions to biological recording (August et al., In press). August et al. (THIS SI) outline the exciting possibilities, stating "*Technological advances are also changing the landscape of biological recording: websites and mobile technologies are streamlining data gathering, ensuring data quality and engaging a wider audience with nature; automation and crowd-sourcing are improving verification and meaningful analyses at policy relevant scales; and data contributors are being rewarded with data visualisation tools, feedback and game like elements*." The molecular revolution is also providing alternative approaches to monitoring biodiversity (Lawson Handley, In press). Lawson Handley (THIS SI) highlights the potential of molecular techniques to describe entire communities as well as detecting rare or elusive species. Already molecular techniques have been used for the detection of invasive non-native species, trophic interactions and monitoring of biodiversity. The "*soaring throughput, plummeting costs and increased sensitivity* for *assaying degraded or low concentration DNA*" will increase the potential for embracing molecular techniques within biological recording. The challenge will be to manage and integrate the vast molecular datasets alongside conventional biological records.

Biological records have been widely used to predict the changes in species distribution as a consequence of projected climate change (Hill, Thomas, Fox, Telfer, Willis, Asher & Huntley, 2002; Hill, Thomas & Huntley, 1999; Mason, Palmer, Fox, Gillings, Hill, Thomas & Oliver, In press; Thomas & Gillingham, In press). However, the potential use of records for forecasting extends beyond climate change (Oliver & Roy, In press) to inform environmental management. Sutherland et al. (THIS SI) conclude this special issue with a ten-point plan for BRC over the next decade. Development (for example, encouraging the collection of associated data on species and combining different types of data) and reflection (for example, identifying the interests, motivations and skills of recorders) will be critical to the future of biological recording (Sutherland, Roy & Amano, In press).

The 22 manuscripts within this special issue represent more than 80 authors involved with biological recording as volunteers and professional ecologists. However, this is only a small number in comparison to the tens of thousands of people involved in biological recording across the UK (Pocock et al., In press). Biological recording has engaged people through the centuries. The value of the inspiring contributions made by volunteers meticulously documenting our wildlife to inform conservation and research will undoubtedly ensure an exciting future for biological recording.

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