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PULSE

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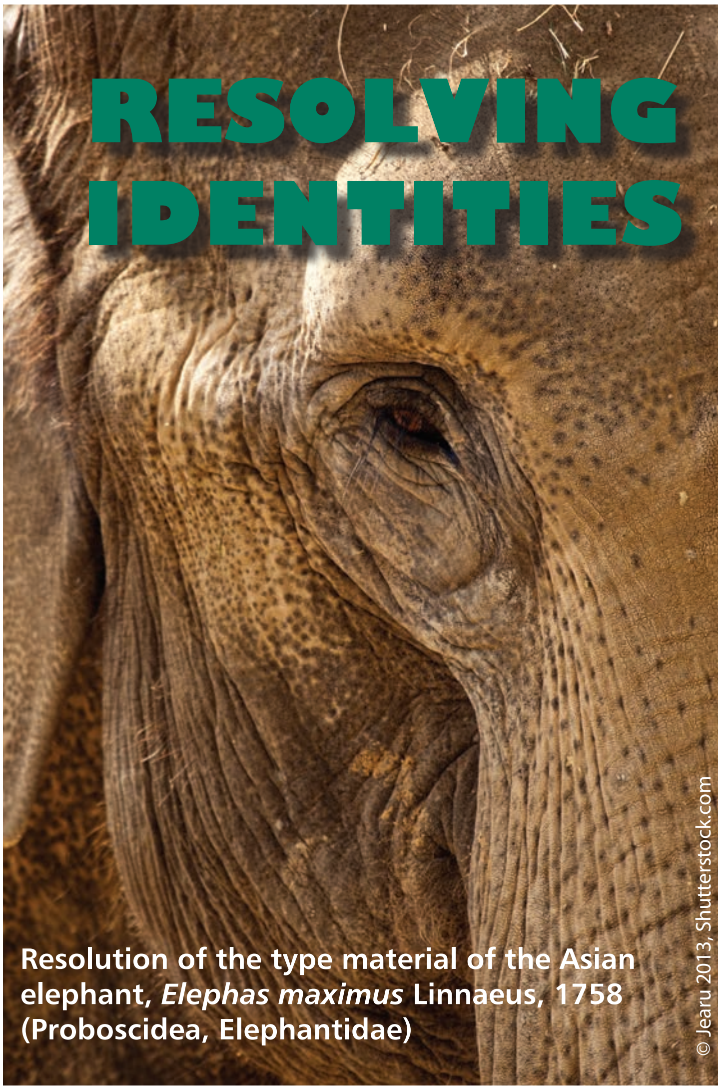
News from the Linnean Society of London – A living forum for biology

RESOLVING IDENTITIES



Resolution of the type material of the Asian elephant, *Elephas maximus* Linnaeus, 1758 (Proboscidea, Elephantidae)

In a world where species are not only being described at an unprecedented rate, but also being lost at a shocking rate, the understanding and preservation of Earth's biodiversity critically depends on the accurate identification and nomenclature of species. Key to this is the concept of 'type' specimens, those that represent the fundamental reference for each described species. Despite their importance, it may come as a surprise to many that in a number of cases, in particular among species described long ago, considerable uncertainty and inconsistency exists. Although this is often linked to rare and perhaps obscure specimens, this is not always so: we address one such example in the *Zoological Journal of the Linnean Society* by looking at one of the most iconic of all animals—the elephant. Specifically, our study uses state of the art genetic and proteogenomic techniques, coupled with 'old-fashioned' sleuthing through historical texts, to resolve a remarkably long running debate with regard to the species-identity of two specimens that hold syntype status for *Elephas maximus*, the Asian elephant, that was first described and named by none other than the father of systematics, Linnaeus, in Edition 10 of *Systema Naturae* (1758).

To achieve this, we used morphological, ancient DNA and high throughput ancient proteomic analyses to demonstrate that the most famous and only complete original syntype specimen for *Elephas*, the remarkably well-preserved body of an elephant foetus in a spirit jar, held today at the Swedish Museum of Natural History (NRM) in Stockholm, is actually an African elephant: Loxodonta. Fortunately, as part of our archival research, we discovered an alternate specimen having syntype status, a sample that furthermore is preserved today as one of the major exhibits at the Natural History Museum of the University of Florence. Morphologically, the skeleton is clearly that of an Asian elephant and mitochondrial ancient DNA analysis of a small bone fragment from its left humerus confirms the skeleton's identity as *E. maximus*. We designate this specimen as the lectotype, thereby fixing the identity of the species.

From the popular point of view, the study combines a fascinating history of science story that took place in an epoch when the philosophical foundations of modern scientific thinking were taking place (namely the introduction of observation, classification and description of nature), with fundamental concepts of modern systematics, and involves several of the fathers of modern biology (including Linnaeus, Seba and Ray) as well as one of the most well-loved animals alive today. Cutting edge techniques have allowed us to implement ancient proteomic tools based on nano-liquid chromatography (nanoLC) coupled with high-resolution tandem mass spectrometry (MS/MS), in combination with proteogenomics methods and high throughput DNA Illumina sequencing. This work is also characterised by the strong integration of current experimental research and historic literature investigation, streamlined by digitisation and online availability of historical texts. Thus, we feel that these aspects make the work we present not only relevant for a wide and interdisciplinary scientific community, but also particularly suitable as rigorous, and at the same time attractive, dissemination material to intrigue the broad audience, both adult and young, about a precise moment of human history at the dawn of scientific thinking.

To read the abstract and full author list in the *Zoological Journal of the Linnean Society* go to: http://onlinelibrary.wiley.com/doi/10.1111/zoj.12084/abstract

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The LINNEAN SOCIETY of London

Broadening our Events: Regional Programme

In order to broaden the reach of our Events Programme, the Society has, in the past year, promoted its engagement with regional meetings. By supporting local events, organised by our Fellows in partnership with their institutions, we have been able to offer scientific lectures outside of London. In addition to enabling more of our Fellows to access our events, this also provides us with an opportunity to increase awareness of the Society. This year, we have supported the School of Earth and Ocean Sciences Lecture Series, organised by Dianne Edwards PLS, at Cardiff University, which has celebrated Alfred Russel Wallace. In March 2014, we are supporting a lecture, organised by Rich Boden FLS, in conjunction with the School of Biosciences at Plymouth University:

Biodiversity and climate change: connecting the past to the future

Professor Camille Parmesan, co-recipient of the Nobel Peace Prize in 2007

Professor Camille Parmesan

With the aim of making great science communicators more accessible to those in the South West, the first Plymouth Linnean Lecture will be held on **Wednesday, 19 March 2014.** Although free, booking is essential:

www1.plymouth.ac.uk/schools/bio/pages/pll.aspx

Image courtesy Plymouth University

BIOLOGICAL SCIENCES WITH PLYMOUTH UNIVERSITY

PLYMOUTH LINNEAN LECTURE

Events at the Linnean Society of London

The Linnean Society aims to hold interesting lectures and day symposia that encompass our overarching remit—the study of natural history in all its branches. Through both individual and collaborative events (like the excellent lecture series organised by the Ecology and Conservation Studies Society at Birkbeck, University of London), the Society's Programmes Committee is keen to capitalise on our high attendance by broadening the involvement of the Fellowship and beyond. The Programmes Committee, Officers and Council have recently taken a strategic look at our events to see what changes can be made to benefit the Fellowship and others who support the Society, mindful of the fact that we are interested in increasing the attendance of younger members of the research community.

While we wish to continue holding events on the history of science, we are keen to attract more early and mid-career researchers in the life sciences, especially those working in systematics, evolutionary biology and biodiversity. This group is the very one that represents the future of the Society. Moreover, encouraging events about current science will help us to realise an attractively balanced programme.

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To facilitate the invitation of leading researchers, and great communicators, Fellows are encouraged to propose topics and speakers via our new proposal forms for evening lectures and day symposia: linnean.org/proposeanevent. Forms submitted now will help the Society to structure our programme for 2015, although, while all proposals will be reviewed, we will not be able to accommodate every one (and self-nomination is discouraged). To extend our reach, the Society is forging links with two networks, the Centre for Ecology and Evolution (CEE) and the London Evolution Research Network (LERN).

We feel that these developments will help us achieve an exciting programme of events, appropriate to the purpose and tenor of the Society.

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Mystery Portrait - Who is it?

While sorting through framed material at the Linnean Society, our Conservator Janet Ashdown came across this pencil/watercolour portrait. The portrait is signed with the artist's name (Olive Smith), but unfortunately there is no other information or paperwork by which to identify the subject. We are keen to know exactly who this distinguished gentleman is! If you have any information please email janet@linnean.org.

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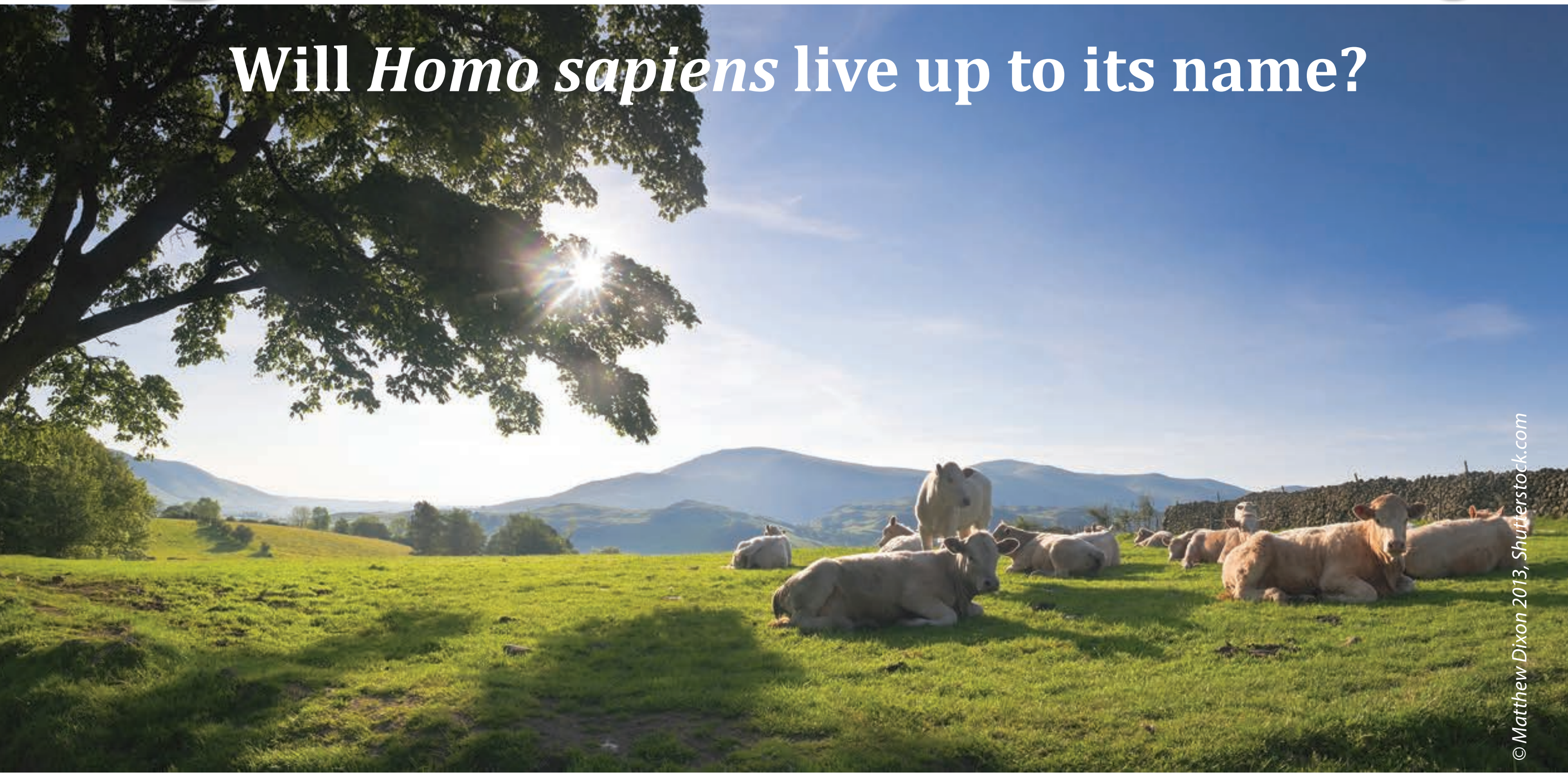
Agricultural Biodiversity

Will *Homo sapiens* live up to its name?



© Matthew Dixon 2013, Shutterstock.com

Agricultural biodiversity* is almost unrecognised and certainly undervalued as a core component of species biodiversity, despite its increasing importance for human food security, ecosystems services and the sustainable management of many priority habitats for wild species. This is all the more perplexing given the vital significance of this biological genetic diversity to the survival of *Homo sapiens* itself, as it would seem that the prospects for seven billion people attempting to sustainably maintain their species into the future by returning to hunter-gathering are not hopeful.

This biodiversity has been included in the deliberations of the Convention on Biological Diversity (CBD) since 1996, and has been mentioned in numerous international and national strategies, yet it rarely appears as a priority for practical implementation measures in agricultural or biodiversity policies (e.g. it is not a key concern in the latest reform of the European Union's (EU's) Common Agricultural Policy for 2014–20).

The CBD's Strategic Plan for Biodiversity 2011–20 states in Aichi Target 13 that:

> *By 2020, the genetic diversity of cultivated plants & farmed & domesticated animals & of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, & strategies have been developed & implemented for minimizing genetic erosion & safeguarding their genetic diversity.*

The EU's Biodiversity Strategy to 2020 comprises at Action 10 "Conserve Europe's agricultural genetic diversity":

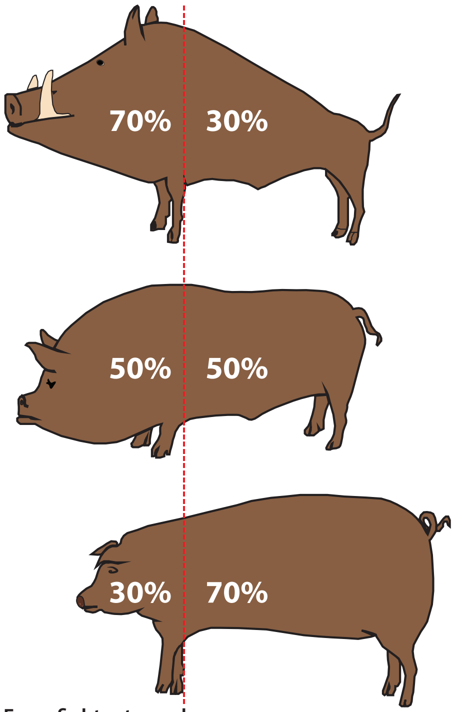
> *The Commission & Member States will encourage the uptake of agri-environmental measures to support genetic diversity in agriculture & explore the scope for developing a strategy for the conservation of genetic diversity.*

The strategy for England's wildlife and ecosystems services ("Biodiversity 2020") (Defra, 2011) correctly asserts that:

> *Conserving and enhancing biodiversity is not just an issue for wild species. It also applies to cultivated plants and farmed animals as well as to their wild relatives. England is relatively rich in wild relatives of crops, landraces of cereal, vegetable and fruit crops, and traditional orchard trees. There are also over two hundred native breeds of farm animals which are often associated with traditional land management required to conserve important habitats. The great genetic diversity which these provide can make an important contribution to the ecosystem provisioning service of food security by offering genes that are important for future crop or livestock breeding.*

The relatively few species that *Homo sapiens* itself depends upon for its food supply should be on any list of "priority species" but most of these lists continue to contain 'wild' species only. *Homo sapiens*, (Latin: 'wise man') is, of course, the species to which all modern human beings belong. *Homo sapiens* is one of several species grouped into the genus *Homo*, but it is the only one that is not extinct. The name *Homo sapiens* was applied by Carl Linnaeus in 1758 in the 10th edition of his work *Systema naturae*. It was well known that human beings physically resemble primates more closely than any other living organisms, but it was a bold act to classify human beings within the same framework. *Homo sapiens* evolved as part of global wild biodiversity, and then selected and adapted several other wild species for domestication and cultivation (agricultural biodiversity) for its own purposes. There is now, potentially, a 'perfect continuum' of dependencies—humans depend on agricultural biodiversity, and agricultural biodiversity depends on wild biodiversity (especially its inherent genetic diversity). Agriculture, and indeed all the other '...cultures' that utilise living organisms, is dependent upon wild biodiversity, which in turn may not survive unsustainable agricultural or other 'cultivation' systems.

An example of the adaptation, firstly by domestication and secondly by selective breeding, of the wild boar is shown in the diagram below. The wild boar shows natural evolutionary adaptations for fighting with large heavy shoulders, a longer, stronger snout and substantial tusks, whereas the modern selectively-bred pigs have proportionately much heavier hindquarters, where the highest value cuts of meat are to be found.



Redrawn from an image © Ing. Juan Luis Uccelli

From fighter to porker

The principal wild relatives of major livestock species include aurochs (extinct), mouflon, bezoar goat, wild boar and red jungle fowl. Currently significant livestock species in the UK are cattle, sheep, goats, pigs, ponies, horses and poultry. The UK is host to approximately 700 breeds of these species which represents more than 9% of the total global number of livestock breeds (Defra, 2013). The key plant species used in arable, horticultural and pastoral systems, including their landraces and varieties are cereals, vegetables, pulses, oilseeds, beets, fruit & nuts, forage crops and their 'crop wild relatives' or CWRs (e.g. in the UK, CWRs of barley, sugar beet, cabbage, radish, asparagus, leek, apple, pear, etc.).

Why should we be disturbed about agricultural biodiversity and its trends? Only 14 of the more than 30 domesticated mammalian and bird species provide 90% of human food supply from livestock (principally cattle, pigs, fowls, sheep and goats). Plants account for over 80% of the human diet; of the 30,000 terrestrial plants that are known to be edible, 7,000 are cultivated or collected by humans for food. However, 30 crops feed the world, and only five cereal crops (rice, wheat, maize, millet and sorghum) provide 60% of the energy intake of the world population (UN Food and Agriculture Organisation, 2013). The trends are virtually universally towards a general 'narrowing' of the use and availability of such biodiversity. We are relying upon ever fewer species, breeds, landraces, varieties, hybrids/crosses/composites, and there are fewer 'owners' of this genetic diversity. The continuing drive towards monoculture production systems at increasing scales is supplanting more traditional mixed and rotational farm enterprises. Many of these changes result from developments in markets, logistics, economics, technology, climate, human diets and societies.

For agricultural biodiversity, unlike the majority of wild biodiversity, prospective losses are not normally at the species level but they can be both swift and extensive at subspecies levels. The conservation and sustainable use of agricultural biodiversity requires vigilant attention to all those distinctive factors which might put it 'at risk'. These factors may consist of one or more of the following:

1) Numerical scarcity or rarity: For farmed animal breeds this is normally measured in terms of the number of registered-pedigree breeding females, although registered-pedigree purebreeding females would be more informative. With the potential future utilisation of cloning techniques, assessments of agricultural biodiversity endangerment based only on 'head counts' could become increasingly unreliable.

2) Geographic concentration (and specific locational density): e.g. Excessive concentration of genetic resources, especially *in situ*, is particularly dangerous in the event of serious outbreaks of exotic diseases in animals which are controlled by compulsory rapid culling programmes (e.g. foot and mouth disease). Large scale monocultures of cultivated plant agricultural biodiversity (including trees) also exacerbate the risk of losses from plant pests and diseases.


Old English Pheasant

© John Green


Oxford Sandy and Black pigs

3) Inbreeding: e.g. Breeding within populations with restricted gene pools which can threaten the viability of animal breeds in terms of their 'genetic health'.

4) Introgression: e.g. Excessive introduction of external genes which can lead to loss of original genes and established characteristics (e.g. local adaptations). A more prudent alternative can be to effectively create and identify a new breed.

5) Lack of within-breed genetic variation (e.g. low 'effective' population), poor management of a breed as a whole and poor structure of a breed (e.g. regarding age, gender ratios, genetic diversity, etc.).

6) Absence of comprehensive, viable and multi-site *ex situ* 'collections' of cultivated plant genetic resources (PGR) and farm animal genetic resources (FAnGR). [N.B. 75% of global cultivated plant genetic resources diversity has been lost in the last 100 years.]

7) Inability to adapt to changing climatic or other environmental conditions, or new pest and/or disease challenges. Cryopreserved genetic resources inevitably cannot adapt or evolve whilst in their deep-frozen state.

8) In some countries, predation by protected wild species (e.g. wolves, bears, lynx).

9) Going out of use in commercial enterprises or simply 'out of fashion' with modern humans. The short-term commercial attractiveness of the latest hybrid and composite breeds, and new plant varieties, can rapidly displace more traditional livestock and crop types and even lead to extinctions.

Agricultural biodiversity in the UK does currently receive some support in a number of ways. These include:

A) A small 'genetic resources for food and agriculture' team in Defra, and expert committees on FAnGR and PGR.

B) Non-governmental organisations which promote and maintain certain elements of agricultural biodiversity, e.g. Rare Breeds Survival Trust, Sheep Trust, Cobthorn Trust, National Trust, Millennium Seed Bank (Royal Botanic Gardens, Kew), Svalbard Global Seed Vault, Global Crop Diversity Trust, National Fruit Collection, Pea Gene Bank and Vegetable Gene Bank.

C) Environmental land management schemes (e.g. Environmental Stewardship in England—grazing with native breeds at risk, and the restoration of traditional orchards; Glastir in Wales; Countryside Management Scheme in Northern Ireland) and the Scottish Landrace Protection Scheme.

D) Identification of those breeds of animals, cultivated plant varieties and crop wild relatives that warrant particular protection, conservation and sustainable management.

As a wise species that wields tremendous control specifically over agricultural biodiversity, *Homo sapiens* should recognise its heavy reliance on all categories of biodiversity. It would, for instance, develop genuinely sustainable and optimised agricultural, horticultural and silvicultural systems where wild and agricultural biodiversity were of equally high priority. It would understand that agricultural biodiversity is a fundamental constituent of overall biodiversity, natural resources, ecosystems services and natural capital, and ensure both its successful conservation (*in situ* and *ex situ*) and its integrated sustainable use. It would guarantee fair and affordable access to agricultural genetic diversity and equitable sharing of its benefits.

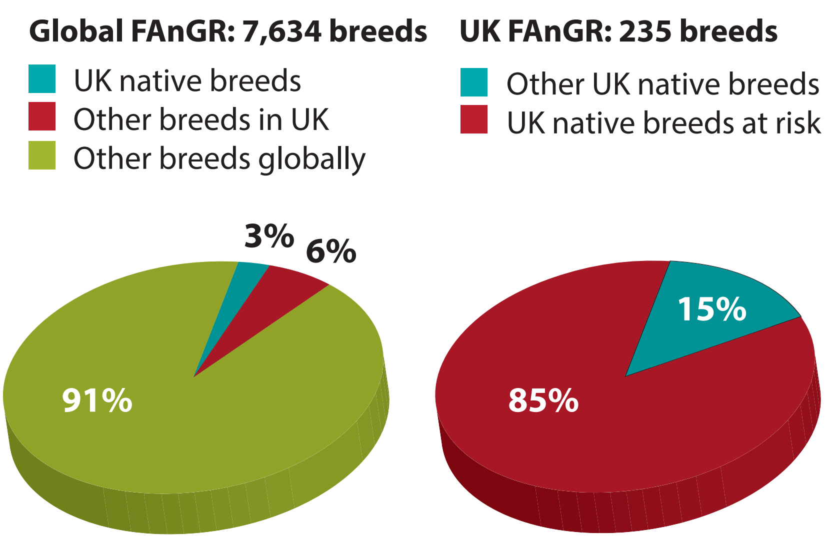
Particularly apposite is the United Nations Conference on Trade and Development's Trade and Environment Review 2013, entitled 'Wake up before it is too late: Make agriculture truly sustainable now for food security in a changing climate'. It contends that:

> *The world needs a paradigm shift in agricultural development: from a "green revolution" to an "ecological intensification approach". This implies a rapid and significant shift from conventional, monoculture-based and high external-input-dependent industrial production towards mosaics of sustainable, regenerative production systems that also considerably improve the productivity of small-scale farmers. We need to see a move from a linear to a holistic approach in agricultural management, which recognises that a farmer is not only a producer of agricultural goods, but also a manager of an agro-ecological system that provides quite a number of public goods and services (e.g. water, soil, landscape, energy, biodiversity, and recreation).*

The widest available range of agricultural biodiversity, and its intrinsic diversity of genetic resources, will be pivotal in achieving such changes.

There are now a myriad of trends in climate, land and water utilisation, disease and pest risks, economics and technological developments that require the greatest wisdom in the sustainable husbandry of agricultural biodiversity—or should our own species name be changed to more accurately reflect its behaviour?

Status of UK FAnGR



[UK Government] Department for Environment, Food and Rural Affairs, 2013

[*For the purposes of this article, "Agricultural biodiversity" includes the full range and genetic diversity of animals, plants and micro-organisms that are used directly or indirectly for food, feed, renewable materials (e.g. for fibres, fuels and pharmaceuticals) agriculture, forestry and aquaculture (including cultivated crops and trees, farmed livestock and fisheries), and their wild relatives.]

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RADICAL CHANGE

Japanese botanical species affected by the 2011 tsunami

Fig 1 *Linaria japonica* Miq./Scrophulariaceae Linaria

Japan has a long history with disasters like the tsunami that struck its coastline in March 2011. With a coastline totalling approximately 34,000km, some areas have seen a line of defence set up (over several hundred years) of around 1,640km^2 of protective forested green belt. Nevertheless, the seashore habitat is continually following a cycle of degeneration and regeneration. Many species have managed to adapt to ocean currents, erosion, longshore drift and low-level disturbances; these environmental changes have in turn perpetuated a wide variety of coexisting species. Yet, the earthquake off the Japanese coast and the resulting tsunami on 11 March 2011 was almost too catastrophic for plant life to recover. Two years after the tsunami, it is apparent that there are two major problems that prohibit full recovery of vegetation in the Sanriku coast line.

The first problem noticed was the scarcity of plant material after the tsunami which hindered the regeneration of species. This was of course largely due to the tsunami itself, but pre-tsunami activities may have also been partially responsible; it can be speculated that many years of landfill and other construction projects have greatly reduced the coastline and have contributed to the decrease in species. Secondly, post-tsunami reconstruction projects like coastal levees and storm surge barriers tend to weaken the natural regenerative capabilities of an ecosystem. These projects have stimulated irreversible changes and altered the local environments. Essentially, it means that along the Sanriku coastline species have been under threat twice over.

Sea shore and tideland areas

The damage to the seaweed bed near Iwate prefecture was less serious with regard to marine algae, including laminar or sea tangle, which were attached to the rocky reef. There are even some areas where such seaweeds are more widely distributed than before. Yet the seabed sediments were severely disturbed: some seagrass beds, held in the sand, were swept away. However, little by little, remaining seed has managed to germinate.

Some tideland areas have been submerged or vanished altogether. Tideland can easily be lost to sites where land reclamation has occurred, and as a consequence endangered tidal plant species such as *Triglochin maritima* L. had accumulated in the remaining areas of tideland before the tsunami. This situation has meant that the recovery of tidal plant species is taking much longer.

Seaside plant species

Many seaside plants were more resistant to the tsunami than expected; we don't know of any species along the Sanriku coast that have been wiped out. Nonetheless, one of the rare plants, *Linaria japonica* Miq., barely managed to survive (Fig 1). This species has decreased in number following the post-tsunami reduction of the natural coast. Along areas of the coast where the natural environment has endured less artificial alteration, it was found that the composition of species did not change drastically after the tsunami. However, seaside environments that had been artificially modified before the disaster showed that the floral species composition had greatly changed, as invasive plant species from abroad colonised the areas where indigenous species had once been (Fig 2). For example, the 'alien' plant *Verbascum thapsus* L. (from Europe) has prospered,

Fig 2 *Verbascum thapsus L.* (Scrophulariaceae Verbascum)

post-tsunami, at a vacant site. The restorative ability of some coastal plant species had not only been compromised by human intervention, but the backrush of the wave dragged out inland soil containing seeds of competing non-coastal species.

Coastal forest

Coastal forest in Takata-matsubara, a government-designated Special Place of Scenic Beauty, was mainly composed of Japanese black pine or Japanese red pine; approximately 70,000 trees previously lined a two kilometre stretch of coast near the city of Rikuzentakata. Pine is a revered species in Japan; for example, stage backdrops for Japanese traditional theatre regularly contain representations of pine trees. Coastal forest pine trees were lodged, ruptured and uprooted by the tsunami and celebrated scenery in places like Takata-matsubara was devastated (Fig 3). Artificial pine forests are found throughout the Japanese coast line, planted to protect people from such disasters, however the sheer scale of the tsunami meant that people were injured by trees uprooted in the flood. Artificially-planted trees have a life span of 100–200 years, with the 2011 tsunami being the biggest threat these forests will have encountered. After the tsunami, some broadleaf tree species showed signs of recovery, the most conspicuous species being the introduced *Robinia pseudoacacia*.

Fig 3 Destroyed forests, in place to control tsunami damage

Japanese cedar

Japanese cedar (*Cryptomeria japonica*) is a native species and has been planted in large numbers throughout the country. The tsunami wave hit the forest of Japanese cedar at the inner shore of the bay around Tonohata village in Iwate Prefecture, where the trees went on to display signs of increased salination, like the reddening of leaves (Fig 4). Scenes of empty, tsunami-ravaged landscapes and reddened forests have been indelibly inked on people's minds. Additionally, the bamboo forest also suffered, turning brown, though luckily many bamboo species had recovered by the summer of 2011.

Fig 4 Increased salination of trees in Tanohata Village

Seawall

After the tsunami, reconstruction of the seawall was greatly debated. Eventually a plan was proposed by the government and accepted at a municipal level: seawalls of 10–15m in height were to be built, essentially blocking out any views of the ocean. However, even this seawall would not be able to defend against waves of 20m plus in height, like those of the 2011 tsunami. During this disaster, the old seawall collapsed easily. In line with the new plan, the base of some of the wall will extend more than 60m so that it will not be so easily breached. The drawback is that such a huge seawall may interrupt the continuity of the border between land and sea, possibly disrupting the transition zones between biomes.

Tsunami and ground settlement

Unexpectedly, the tsunami and subsidence activated the reappearance of previously 'lost' environments. After the disaster some endangered rare plants, like *Monochoria korsakowii* Regel et Maack, were found growing in a residential area in Sanriku; hygrophytes had previously been common in what was once marshland, but had disappeared following the establishment of a housing development. The earthquake radically changed the geomorphology of the area, forcing the emergence of seeds that may have been dormant underground for decades. Perhaps, sooner or later, these species will disappear again as reconstruction of the area is completed.

As the tsunami waves enveloped the Japanese coast, one could be forgiven for saying that the shoreline was almost restored to its Mesolithic state. Six thousand-year-old ruins from this era are located on higher ground, and avoided the assault of the largest waves. Ironically, these areas would also be the best in which to build new towns, but conservation of the ruins would no doubt prohibit this. The Japanese have long lived alongside stunning natural scenery whilst attempting to buffer the threat of natural disaster. However, the tsunami arrived with another, less expected, consequence. Pollutants that had been offloaded into the sea during the post-WWII era of rapid economic growth had accumulated at the bottom of the bay as sludge, only to be deposited by the tsunami onto fields of important crops.

In 2011 the foundation of the Japanese view of nature was shaken. Yet, there has been a movement to re-plant trees as a natural form of defence instead of the construction of the large seawall; people are trying to plant more than 10,000 cherry trees along the coast, at the limit of the latest tsunami's devastation. And yet after the disaster, garden centre managers in the Tōhoku-area of north-eastern Japan expected their businesses to fail, as they felt that those displaced by the tsunami would most likely focus on rebuilding their lives in more basic and concrete ways. However, they were inundated with orders and found themselves much busier than in previous years. They found that, at the very least, the Japanese people were trying to re-establish their relationship with nature.

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Merry Christmas and a Happy New Year

from everyone at The Linnean Society of London

The Society is closed from Friday 20 December until Thursday 2 January. We look forward to welcoming you back in 2014.

4th Polar Marine Diatom Taxonomy and Ecology Workshop

© Jennifer Pike

On 4 August 2013, 36 researchers from 14 countries around the world gathered in Cardiff University to become immersed in polar marine diatoms for a week. The aim of the workshop was to provide a forum for practical, microscope-based taxonomic training and to share latest research results. The group comprised 21 established and early career researchers and 15 postgraduate and Masters students. Workshop presentations consisted of 15 microscope-based taxonomy sessions, 9 talks and 12 poster presentations. Linnean Society sponsorship of the workshop allowed us to award two prizes for student-led microscope taxonomy sessions. Rebecca Totten Minzoni (Rice University, USA) is well established in her postgraduate research and led a taxonomy session on important diatoms that are used as indicators of palaeonvironmental change in the Antarctic Peninsula region. Conversely, Bartłomiej Jerzak (University of Gdansk, Poland) is in the early stages of his research and led a session that asked many questions of the audience regarding the taxonomic concepts used to describe species within his Antarctic diatom assemblages. This session not only help Bartłomiej but re-affirmed for us 'experts' that our taxonomic ideas and concepts are all still aligned! Bartłomiej's session exemplified the strength and value of the Polar Marine Diatom Workshops—presenters can be from any stage in their career and do not have to have all the answers—we learn from each other at the microscope! As well as the Linnean Society, sponsorship was welcomed from The Micropalaeontological Society, the Annals of Botany Company, Beta Analytic, GX Optical and the IGBP-PAGES (Past Global Changes) programme. The next workshop will be held in Salamanca, Spain, in 2015.

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The Linnaeus Link Partners' Meeting in Uppsala

After the successful launch of the new Linnaeus Link Union Catalogue (www.linnaeuslink.org), we had many reasons to celebrate at this year's Partners' Meeting in Uppsala in October. Linnaeus Link now contains almost 10,000 individual bibliographical records from 12 contributing international Partners, and has had nearly 12,000 page views in the last year.

© Elaine Charwat

The Partners examine Linnaean treasures

Warmly welcomed in true Scandinavian style by our Partners at Uppsala University Library, we were even invited to have dinner with the County Governor in Uppsala's pink castle! Visits to the University Library, Linnaeus' house, garden and grave were poignant and informative, as was a visit to the Royal Swedish Academy of Sciences in Stockholm. The group toasted Linnaeus and the future of the project when visiting our most recent Partner, the Hagströmer Library.

This collaborative project is making excellent progress in unlocking and ordering Linnaeus' work and legacy, and would have, we hope, satisfied the high standards of that master of organisation—Linnaeus himself.

Elaine Charwat
Deputy Librarian
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Annual Book Sale

Due to the closure of Burlington House throughout 2013 for building work it has not been possible to collect enough material for a book sale this year. We will put out a call for "previously-loved" book contributions in good time once a date is set for 2014.

Forthcoming Events 2014

16 January **Evening Meeting** **18.00–19.00**	Snapshots in dinosaur evolution: plants, feathers and palaeobiology Speaker: *Dr Paul Barrett, Natural History Museum, London* **No registration required**
20 February **Evening Meeting** **18.00–19.00**	Tracking Plant Trade in the 21st Century Speaker: *Noel McGough, Head of Conventions and Policy, Royal Botanic Gardens, Kew* **No registration required**

For more information about our events go to linnean.org or email events@linnean.org

All articles welcome! Please submit your articles in electronic format to the Editor at pulseeditor@linnean.org
Images are also welcome in high resolution format with appropriate permission and copyright.

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