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Natural history: Restore our sense of species

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DAVID ATTENBOROUGH/BBC

David Attenborough in one of his early natural-history documentaries, *Zoo Quest*, more than 60 years ago.

Restore our sense of species

Klaas-Douwe B. Dijkstra has named a new dragonfly after David Attenborough to mark the broadcaster's 90th birthday — and to honour the importance of knowing the natural world.

Many of the greatest communicators have been naturalists. E. O. Wilson has his ants and Jared Diamond his birds. Oliver Sacks studied ferns as well as brains. The views of these thinkers were opened up by their exploration of the biosphere, enabling them to expose that vision to the world. One of the greatest naturalists of all is not a scholar in the traditional sense, but a broadcaster. To mark the 90th birthday on 8 May of documentary pioneer David Attenborough, I was given the honour of naming a new species of dragonfly — his favourite insect — for him (see 'David's dragonfly').

Attenborough's many hundreds of hours of exquisite television are a reminder that a primary reason to study nature is enlightenment. I am, of course, not the first to name a species for him — at least 15 animals and plants now bear his name. But doing so has led me to reflect on why we need naturalists like Attenborough today more than ever.

Although the impact of humans on all other life is beyond apocalyptic, our consciousness of its diversity is medieval. Almost 3 centuries since Carl Linnaeus came up with his naming system, perhaps only 1.2 million of an estimated 8.7 million extant eukaryote species (animals, plants, fungi and protists) are named, and more than half of them are insects such as dragonflies[1]. Even worse than this taxonomic deficit is our grasp of natural history. The basic ecology, distribution and status of only 80,000 species are known well enough to assess their extinction risk, and about 29% are in danger (www.iucnredlist.org).

The scale of this incredible richness, ignorance and destruction is hard to fathom. Imagine for a second that each of the estimated 6.5 million terrestrial species had an equal share of the total available land on Earth. Each species' plot would cover an area only one-quarter the size of Manhattan, so the human plot could be walked around in just three hours. The 80,000 species we are familiar with would only cover an area equal to Spain, France and Turkey; and we would not even know the natural world beyond the combined areas of Europe, India and China. Yet we are set to void of life an area equivalent to the New World. The biosphere has been charted as well today as the globe was in Christopher Columbus's day, yet the biological apocalypse is already complete.

After spending 32 of my 41 years in the field, I'm still agog at life's splendour. The beauty I see as I search for dragonflies on expeditions in Gabon or watch birds around Stellenbosch on my way to work can be so absurd it makes me laugh, so diverse it makes me gasp for air, so intense that I binge-watch as if there is a

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cliff-hanger in every impression.

Last year, my colleagues and I described 60 new dragonfly species at once, adding 1 species to every 12 known in Africa[2]. Why? To show that most of what is unknown, however conspicuous, is simply not looked for. The field is empty while the labs are full. A student I know, who is passionate about exploring beetles — the most varied animal group on Earth — has ended up studying the gene expression of one model species in a lab.

Intact biodiversity provides undeniable proof that we can inhabit our environment without destroying it. Just when naturalist–taxonomists are needed most to expose the evidence, their position has become weak. We in the field are partly to blame for this marginalization, having too often emphasized the scientific and economic value of what we do, thus losing sight of its impact beyond science and the economy. Our work's greatest justification lies not in biodiversity's enormous direct contribution to human well-being, but in the moral counterweight that we can offer to life's runaway exploitation: biodiversity is the embodiment of sustainability.

CORE VALUES

Attenborough once said that he had "never met a child who was not interested in natural history". For most of our existence, humans were hunter-gatherers who needed to name and know other species to survive. We evolved an affinity with nature — what Wilson calls biophilia. This is probably why observing nature can be so satisfying. If nurtured, this instinct could rapidly transform society[3].

The core value of natural history and taxonomy is species sense. This is a consciousness of the existence and impact of all species, from plankton to cattle and including humankind. Species make each place special and thus worth fighting for. Life is like water, a branching river system literally a genealogy: with a unique history in every separate stream, one human action can erase an irreplaceable ecosystem[4]. Although a hydroelectric dam might seem a sapient energy solution, it can mean ecocide to a 'specient' mind — one with species sense.

Whereas every human relies on this species sense, even if only by reaping the benefits of agriculture and medicine, few in society see it as their primary responsibility. With nature held hostage by our growing demands, environmental consultants and conservationists have little time left to find out who they work for.

Most worryingly, the field of biology itself has lost species sense. Biological research is an interaction between the inventory of life's diversity and the investigation of the forces shaping it. Disciplines shift with the advance of theory and methods (genetics to genomics is one example). Spread across all ranks of life, specializations such as entomology and botany are more stable but also more isolated and introverted. Woven together, information and theory make biology strong.

However, when competition for financial support increased half a century ago, the seemingly static soloists stood weaker. Somehow, the idea that they were old-fashioned and lacked rigour and impact became accepted, thinning the warp of expertise that bore the weft of disciplines in biology's fabric[5]. The strongest 'despeciation' of biology occurred in the 1960s to 1980s. Within a 40-year period in the United States, textbook content related to natural history decreased from two pages of every three to just one page; related PhDs fell from two in five to one in five (even as the total number in biology tripled); and the median number of courses on natural history required for a biology bachelor's degree dropped from two to zero[6].

This unravelling has also affected the ultimate custodians of species sense: natural history museums. With decreasing support, these have often increased emphasis on the separate outcomes of their taxonomic expertise without reinforcing the foundation itself. Public outreach must draw bigger crowds; scientists must chase loftier questions; and collections must focus on preservation. As a result, collections-based research has lost ground[7].

The species expertise from such research may be the most impactful knowledge ▶

DAVID'S DRAGONFLY

Field and museum research reveal Madagascan beauty

Dragonflies do not help to feed us like bees and fish do; they are not feared and persecuted like mosquitoes and snakes; nor are they studied as proxies of human psyche and society like ants and apes. Their beauty and sensitivity stand for the state and needs of nature before our own. We admire dragonflies purely for what they are — the same unconditional love for nature that David Attenborough has taught us.

In few places is the creative force of nature and the destructive force of humankind more apparent than in Madagascar. Fortunately, the dragonfly *Acisoma attenboroughi*[10] (pictured) can be seen easily there. Kai Schütte and I first noticed in the field and in collections that this species had been confused with its African and Asian counterparts for 174 years — a fact confirmed by DNA studies in the molecular labs at the museums of Leiden in the Netherlands and Hamburg in Germany.

The photographer Erland Nielsen joined me on a special tour for dragonfly enthusiasts earlier this year to amass images and raise funds for a booklet introducing these freshwater sentinels to the people of Madagascar for the first time. Like so many species, Madagascar's spectacular dragonflies have been ignored since the European monographs produced in bionomy's heyday in the 1950s. K.-D.B.D.



ERLAND R. NIELSEN

Attenborough's pintail (*Acisoma attenboroughi*).

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of biodiversity, used by enthusiasts and practitioners every day. Moreover, it connects the institutes' legacy, science and public functions. Ultimately, the dissolution of their core tasks can undermine the very survival of museums. Should they keep collections that are not used for research or outreach? Or focus on the type of research conducted at institutes that do not have collections?

Pressed by human indifference and habitat destruction, harried by bureaucracy and regulations, marginalized in education, and spurned by the science and institutes that they founded, many naturalists and taxonomists now have a deep feeling of exasperation. With less species sense, how fit are today's biologists to write research papers, undertake surveys, manage collections and teach our children?

REVIVE BIONOMY

We need one name to acknowledge the elementary and edifying exploration of life, with its own funding mechanisms. Although venerable, 'natural history and taxonomy' can sound clunky, transient and restrictive. I like 'bionomy'. Coined 150 years ago by Ernst Haeckel as an alternative to ecology, bionomy has never been applied widely (although 'bionomics' is used occasionally to describe the natural history of species).

> ***"Each species is a world parallel to our own, invoking a sense of being among equals."***

Like the science from which it is increasingly divorced, bionomy is a human endeavour in its own right. Arguing that biology builds on bionomy and thus owes it support is moot if science's driving force is advance and not consolidation. With independent financing, from a global pot, current indicators of impact — including journal citations and methodological innovation — can be replaced by appropriate ones such as urgency and applicability.

Most habitats will be gone before the most basic surveys are done. Mapping genomes, running models and experiments, perhaps even digging fossils, may just have to wait. Predicting future biodiversity, or studying past extinctions to understand the present, at times seem to be almost fantastical excuses for ignoring the loss itself. In an era of extinction, there are no greater priorities than to accelerate the synthesis of life, salvage knowledge and increase awareness. To do so, we need our strongest familiarity with all species.

Thanks to the technological reinvention of natural history and taxonomy, all imaginable knowledge can now be integrated and analysed[8]. Online repositories and genetic tools released a deluge of valuable information, although dwindling expertise struggles to validate it. Citizen science is a powerful contributing force, because no research is closer to the public's heart, but it also needs authoritative support. We may finally learn the true extent and intricacy of biodiversity, but innovations have increased the need for what they seemed to replace by baring the enormity of the expertise gap.

Bionomers are often criticized for lacking shared and achievable goals[9]. Because enlightenment is even more important than information, we must invest in people before tools. Our target should not be quota of species known or access to passive data, but a volume of active experts. If we can send a probe to search for unlikely life in space, then US$10 billion of global core funding over a decade (roughly Turkey's annual science spending) would be a bargain for humanity to develop a conscience for all life around us.

The biodiversity products needed most today are not patents or papers, but inventories, field guides, Red Lists of threatened species, teaching materials and media campaigns. Whether academics or amateur, good bionomers have initiative and drive, and only need prospects and recognition to deliver these products. Prizes that reward their typically lifelong personal investment may be the best way to double the active expertise worldwide. For instance, if a handbook took three years of funding to complete, similar funding will see more such output.

Astronomers and astronauts discover the Universe; bionomers and bionauts uncover life. Just as we feel an instant sense of our insignificance when we stare into the cosmos, or experience the exhilaration of the expanding landscape as we ascend a mountain, bionomy stretches our horizon. Each species is a world parallel to our own, invoking a sense of being among equals. That, I believe, is what Attenborough has taught us and what we must expand. ■

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