fact finding

ALBERT FRONEMAN (2)

The IOC and big data

Like the Olympics and the World Cup, the International Ornithological Congress (IOC) only comes around every four years. Unlike more narrowly themed conferences, it exposes professionals and amateurs alike to the latest trends across the full spectrum of ornithological research. The 27th IOC, held in Vancouver at the end of August 2018, attracted some 1700 delegates from around the world. The main congress ran for five days, with satellite meetings and a bird fair held in conjunction with it. Delegates were kept occupied by two plenary talks and two symposium sessions per day, as well as poster presentations and round-table discussions in the evenings. With eight symposia running in parallel, it was difficult to choose which to attend.

The Fitztitute was well represented, with most of the academic staff and 10 students and post-doctoral fellows present. Arjun Amar and Petra Sumasgutner presented in their symposium on 'Human–raptor Interactions: from Conservation Priorities to Conflict Mitigation'; Susie Cunningham contributed to one entitled 'Towards a Mechanistic Understanding of Avian Responses to Climate Change'; Robert Thomson highlighted how birds can share nests in a session on 'The Form and Function of Birds' Nests'; Megan Murgatroyd talked about senescence in raptors in the symposium 'Population and Individual Ecology: Population Dynamics'; and Centre of Excellence member Andrew McKechnie highlighted the challenges of keeping cool in a symposium on 'Avian Energetics in a Changing World'. Several students gave speed talks to accompany their poster presentations, and I was accorded the singular honour of delivering a plenary talk on 'Seabird Conservation – a Southern Hemisphere Perspective'.

The Arctic Tern still holds the long-distance migration record.

It's impossible to do justice here to the range of topics covered in such a large, diverse meeting. Movement and migration remained a hot topic, not least because of the parlous conservation status of migrants in general. But it is the incredible feats that these birds achieve that really catch the attention. The continued miniaturisation of geolocators allows tracking of ever-smaller birds. Particularly impressive are the 12-gram Blackpoll Warblers that leave their breeding grounds in western Alaska on a trans-continental flight that ends with a three-day, non-stop flight over the Atlantic, from the east coast of the USA to their wintering grounds in the Lesser Antilles and northern South America.

A more peculiar migratory feat is performed by Common Cuckoos breeding on the Kamchatka Peninsula, north of Japan. In autumn, these birds migrate west across Asia before heading south into Africa to reach northern Namibia, 16 000 kilometres from their breeding grounds. Quite why the cuckoos don't winter in south-east Asia or India is open to speculation, but this is claimed to be the longest known land-bird migration.

Arctic Terns remain the long-distance migrant champions, however, with terns from the Farne Islands in the UK migrating over the Atlantic Ocean to Antarctic waters, where some individuals disperse as far east as the Antarctic Peninsula. From there it is a short hop around the peninsula back into the Atlantic, but instead they return all the way west, south of Australia and Africa, before heading north – a total distance of at least 147 000 kilometres in a year for one bird! This peculiar behaviour prompted arguably the best title of the congress: 'Are Arctic Terns Members of the Flat Earth Society?'

In addition to getting smaller, some of the geolocators used to track these epic movements now have additional sensors. A study of Red-backed Shrike migration from Denmark to Namibia and Botswana used accelerometer data to reconstruct the time spent flying each night and the duration of the two longer stopovers en route. The total flight time on the southbound migration, via Greece and Sudan, averaged 187 hours, whereas the return migration flights were longer, nearly 250 hours, because the birds followed a more easterly route through Ethiopia, the Arabian Peninsula and Turkey (probably to avoid a second Sahara crossing). The shrikes only depart after dark each night, but the time of departure is earlier on nights when they fly for longer, suggesting that they somehow anticipate a long flight ahead. A pressure sensor showed how the shrikes flew higher when crossing major barriers such as the Sahara, sometimes up to 2000 metres above the ground.

It has long been known that migrating birds can use magnetic fields to orient at night if they can't see the stars, but until recently the actual mechanism behind this ability was unknown. Henrik Mouritsen's plenary talk explained how migrant birds appear to have not one but two built-in compasses. Cryptochrome 4 molecules in their retinal cones respond to light differentially depending on the magnetic field, enabling migrants to literally 'see' the earth's magnetic field. However, this probably only works at night, when light levels are too low to stimulate the much more abundant visual pigments in the cone cells. The other magnetic receptor is a cluster of iron-rich cells at the base of the bill, which appears to be important in perceiving a magnetic 'map' of the landscape, allowing migrants to fine-tune their position.

Concern about ongoing climate change was the theme of several symposia. One of the more telling impacts is the increasing amplitude of high-tide events in coastal saltmarshes, which far exceed the average increase in sea level. One video clip showed a Saltmarsh Sparrow leave her nest as the water rose, floating the eggs, and then return to continue incubating as the water subsided. But most nests are less fortunate, with eggs being washed out of nests or chicks drowning. Chris Elphick predicted that this sparrow, which is confined to saltmarshes along the US east coast, will be extinct by the end of the century if sea levels continue to rise. An unexpected impact of warming temperatures in boreal forests is that it might preclude jays and nutcrackers from caching seeds over winter, with significant impacts on their reproduction the following year.

Unsurprisingly, there were numerous sessions on evolution and systematics, physiology, ecology and behaviour. One highlight was a fascinating plenary by Juan Reboreda on the strikingly different strategies adopted by the obligate brood >

below *Common Cuckoos breeding on the Kamchatka Peninsula apparently undertake the longest migration of any land-bird.*

below, left *Miniature accelerometers can now reconstruct the migration flights of birds as small as Red-backed Shrikes.*

WARWICK TARBOTON

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parasitic Shiny and Screaming cowbirds. But perhaps the main reason to attend meetings like the IOC is to find out what new fields and techniques are emerging. Several studies are using genomic screening tools to investigate the gut biota of birds and how these change with habitat, diet, stress levels, etc., while a newly developed imaging dye intended for veterinary medicine elucidates very complex cellular structures. However, for me the most striking new research resulted from 'big data' analyses.

Ben Sheldon gave a plenary on the social structure of bird populations in Wytham Wood, near Oxford, where researchers from the Edward Grey Institute have been studying birds for more than 50 years. For the past decade, most of the tits and nuthatches in the study area have been fitted with PIT tags, which allow them to be identified using an active 'reader'. The readers were installed at a network of feeding stations scattered around the study area and recorded which birds tended to visit feeders at the same time. The automated nature of the system allowed hundreds of thousands of events to be logged over several years, and these were used to estimate measures of association and connectedness among individuals and species. Having an idea of the social structure, the researchers were able to conduct fascinating experiments into cultural transmission of novel feeding behaviours among populations.

But this pales into insignificance compared to the analysis of bird migrations using the NEXRAD weather radar data across the United States. More than 13 million radar scans from 143 radar stations have been archived during the past 25 years. A team of researchers, aided by computing power from Amazon, analysed these images to track bird migrations. Clouds of birds can be seen taking off each evening and landing before dawn. Coverage is fairly comprehensive across the country, so you can see how migrating birds time their departures in relation to the movement of frontal systems sweeping across the US.

The radar images can also be used to estimate the numbers of birds migrating through the US each year – and the results are impressive: some 3.5 billion cross into the US from Central America each spring, with 2.5 billion leaving the US to head into Canada. In autumn, the numbers are higher, swelled by the year's production of juveniles: 4 billion enter from Canada and 4.7 billion leave the southern US. The difference between spring and autumn numbers is less than you might expect given the large clutch sizes of most North American birds, which suggests that many juveniles die before getting very far on their first migration.

Another big data project that caught my attention used satellite imagery to produce a global inventory of intertidal mudflats. This proved to be extremely challenging and Google had to resort to running some of the analyses on the servers that support YouTube, which are their most powerful computers. The result – a series of 11 coverage files averaged over three years from 1984 to 2017 – will be made available by the end of 2018.

WOLFGANG WANDER/WIKIMEDIA COMMONS

above *Extreme high-tide events along the eastern seaboard of the US are threatening Saltmarsh Sparrows by flooding their nests.*

above, left *The tiny Blackpoll Warbler migrates from Alaska to South America, including a three-day, non-stop flight off the east coast of the US.*

As you might expect, the data paint a gloomy picture for shorebirds, with a 17 per cent loss of mudflats globally over the study period and a 28 per cent loss in the Yellow Sea. Fortunately, China has identified 14 sites for nomination as World Heritage Sites and much of the coastal reclamation has been halted as part of Xi Jinping's 'Ecological Civilisation' policy, announced in October 2017. Hopefully the Chinese will conserve these wetlands, which are so crucial for the East Asian Flyway, and there will be some shorebirds left for the delegates to see at the next IOC, in Melbourne in 2022.

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