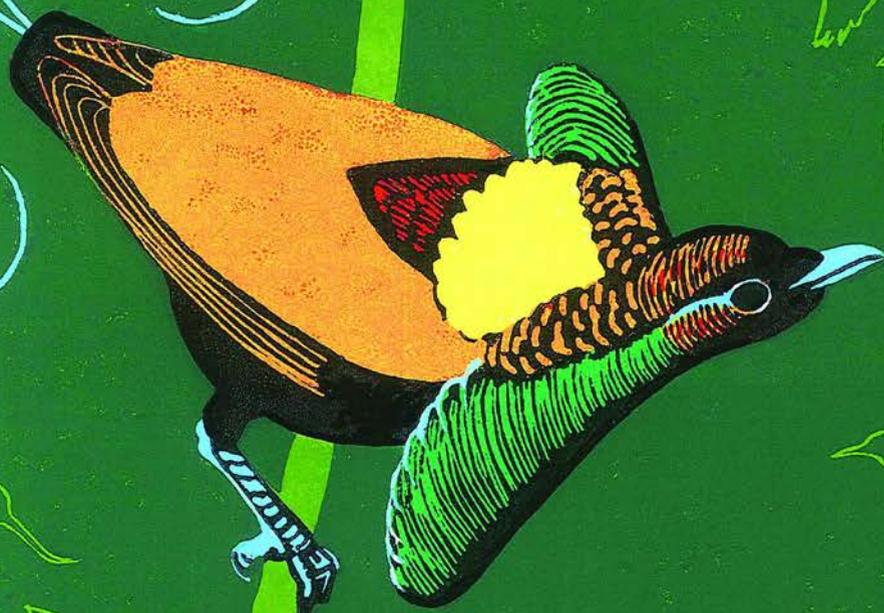


TEN THOUSAND BIRDS



ORNITHOLOGY
SINCE DARWIN

TIM BIRKHEAD
JO WIMPENNY
BOB MONTGOMERIE

TEN
THOUSAND
BIRDS

Ornithology since Darwin

TIM BIRKHEAD JO WIMPENNY BOB MONTGOMERIE

PRINCETON UNIVERSITY PRESS PRINCETON AND OXFORD

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CHAPTER I

Yesterday's Birds

The road from Reptiles to Birds is by way of Dinosauria to the Ratitae.

—THOMAS HENRY HUXLEY, IN A LETTER TO ERNST HAECKEL ON 21 JANUARY 1868¹

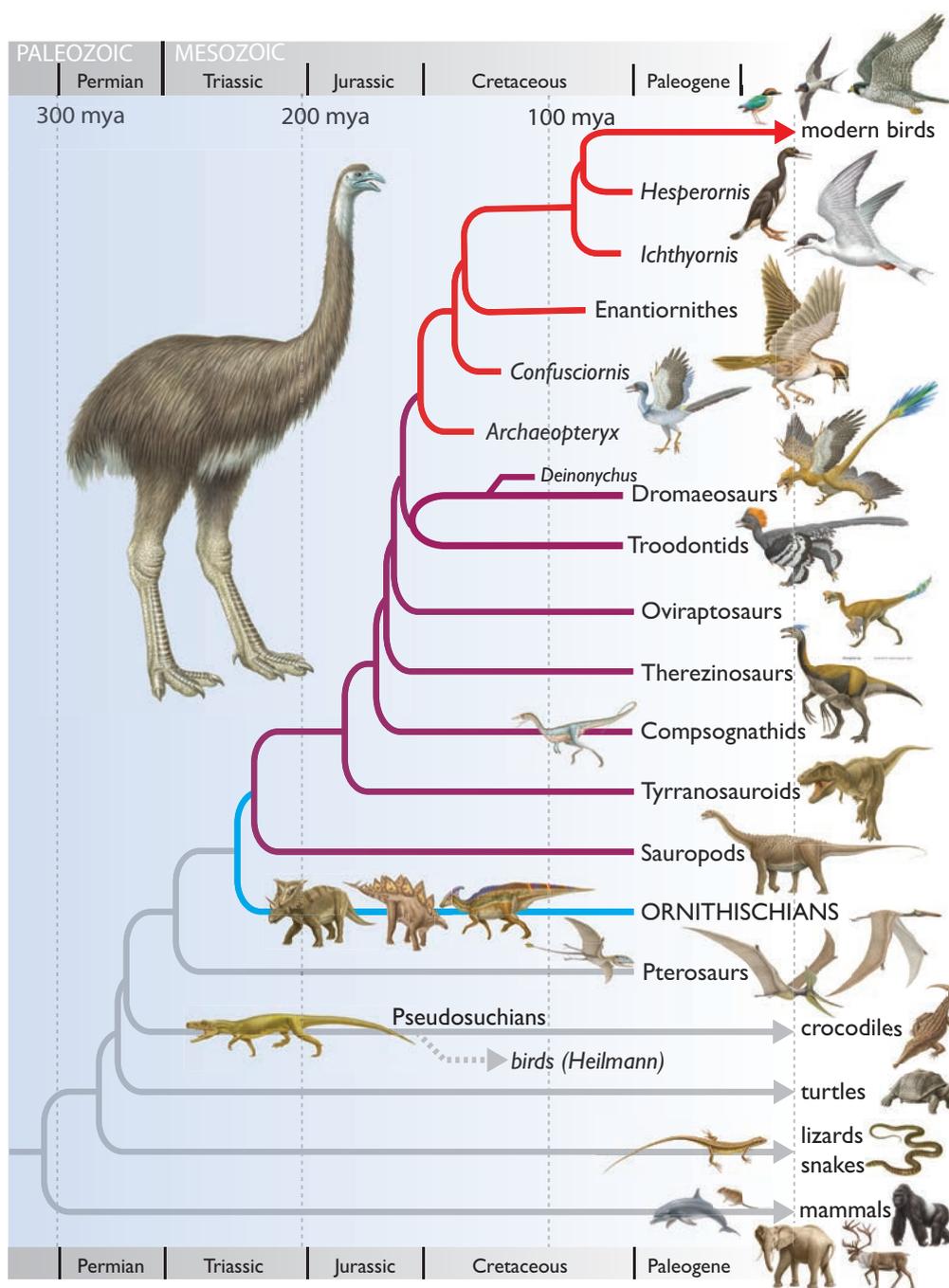
THE TERRIBLE CLAW

LATE ONE HOT AUGUST EVENING IN 1964, near Bridger, Montana, the paleontologist John Ostrom and his assistant, Greg Meyer, made a discovery that revolutionized the study of ancient birds. Toward the end of a hard day in the field, they spotted, in the slanted light, some claws and bones protruding from the reddish-brown soil. Scrambling to the spot, they began digging with the only tools they had at hand—a jackknife, a small paintbrush, and a whisk broom. Rapidly running out of natural light, they marked the location so they could resume work the next morning. Given the fossil's sickle-like claws, Ostrom was convinced this was a carnivorous dinosaur: “I was almost certain, although still wary, that we had discovered something totally new.”² And they had, as the subsequent week of excavation revealed—a

specimen considered by some³ to be the most important dinosaur discovery of the mid-twentieth century, an animal Ostrom called *Deinonychus*, “the terrible claw.” This was a seventy-kilogram bipedal runner with sharp claws on all four feet and an especially outsized retractable claw on the second toe of each hindlimb. *Deinonychus* was a killing machine, and its study revolutionized our understanding of how dinosaurs lived and breathed and how birds evolved. *Deinonychus* was a member of the *Dromaeosauridae*, a family of theropod dinosaurs—including *Velociraptor*, made famous by the movie *Jurassic Park*—that proliferated in the Cretaceous.

Like so many others who influenced ornithology in the early twentieth century, Ostrom started out studying medicine. Growing up in Schenectady, New York, he began his premed studies there at Union

A pair of *Archaeopteryx lithographica*. Painting by Rudolf Freund for an article in *LIFE* magazine on evolution (Barnett 1959). In 1959 nothing was known about the colors of plumages and bare parts of fossil birds, so Freund was guessing (probably incorrectly, as it turns out).



Evolutionary history of the birds (red), a selection of other dinosaurs (purple and blue), and some other groups of vertebrate animals (gray). The dinosaurs comprise two major groups: Ornithischians (blue) and Saurischians (purple and red). Representatives of each named taxon, except *Confusciornis* and *Deinonychus* (see page 2), are shown (not drawn to scale). The large bird in the upper left is a moa (*Dinornis maximus*) from New Zealand, one of an entire genus of birds that was extinct by 1800 due to human activities. Heilmann and others originally thought that birds evolved from Pseudosuchian reptiles (dashed gray line).

BOX 2.1 Peter and Rosemary Grant

ORIGIN AND
DIVERSIFICATION



Rosemary grew up in the Lake District of England. Her choice of career as a biologist is not surprising, as she was strongly influenced by her early experience in the family garden and on the fossil-studded limestone hills. Her mother encouraged an interest in nature; birds were only a part of it. Her father encouraged an interest in medicine, and she helped him in his practice as a country doctor for a year. Her career began in earnest when she went to Edinburgh as an undergraduate and entered Conrad Waddington's genetics department. She learned quantitative genetics from Douglas Falconer as he tried out in his undergraduate lectures the chapters of his forthcoming and, as it turned out, highly influential book. The Edinburgh atmosphere was exciting, stimulating, and encouraging to the students lucky enough to be among the chosen few for the diploma course: six from Britain and six from overseas. For a PhD degree Rosemary decided to study genetic differentiation and speciation in land-locked char in Iceland. Before that happened, she took a year off to teach embryology, cytology, and genetics at

the University of British Columbia. It took a long time for her to visit Iceland, and then only as a tourist first and as a lecturer later. Her husband-to-be had complicated her life.

Peter's bird watching began when he was about four years old, but for quite some time it took third place to butterfly catching and bouncing a ball. I was a general naturalist, and I was encouraged in this branch of biology at school and at university. At Cambridge I was influenced by two ornithological ethologists, Bill Thorpe and Robert Hinde, and a naturalist, Hugh Cott, but also, not far offstage at Oxford, by David Lack and Niko Tinbergen and, more distantly, by E. B. Ford. Their combined work in animal behavior, ecology, and genetics became the heterogeneous framework in which Rosemary and I now seek an understanding of evolution in the natural world. David Lack's *Life of the Robin* stimulated me to catch one in a makeshift trap fashioned out of a fire-guard, and I still remember the thrill of holding that first bird. While an undergraduate I joined the Cambridge Bird Club. I learned from contemporaries that there

other hand, was much clearer, and although he was concerned with selection operating at the level of the gene, his central theme was about the functioning groups of genes in *individuals* (Segerstråle 2000: 71; Birkhead and Monaghan 2010).

Prior to the 1970s most field ornithology—with a few notable exceptions—was descriptive natural history. Behavioral ecology, by focusing on whether behaviors or other traits, such as elaborate plumage or songs, were adaptive, allowed ornithologists to generate hypotheses and test specific predictions within an individual selection framework (Brown 1964; Krebs and Davies 1978). In so doing, behavioral ecology changed the very nature of ornithology, elevating its scientific status and influencing where ornithologists published their results. Prior to the mid-1970s, ornithologists aspired to publish their results in journals like *Ibis* or *The Auk*, but once behavioral ecology took off these journals were passed over in favor of new, concept-based publications, such as *Behavioral Ecology* and *Behavioural Ecology and Sociobiology*. The introduction of journal impact factors and citation indices in the 1980s and 1990s further damaged bird journals, and indeed, after the mid-1970s many researchers who worked on birds ceased calling themselves ornithologists at all, because that now seemed too narrow. Instead they often referred to themselves as behavioral ecologists or, sometimes, evolutionary biologists—who happened to study birds.

Hamilton's ingenious solution to the paradox of altruism prompted new interest in cooperative breeding in birds. We therefore start with this topic and then consider three other central areas of behavioral ecology where the study of birds, informed by

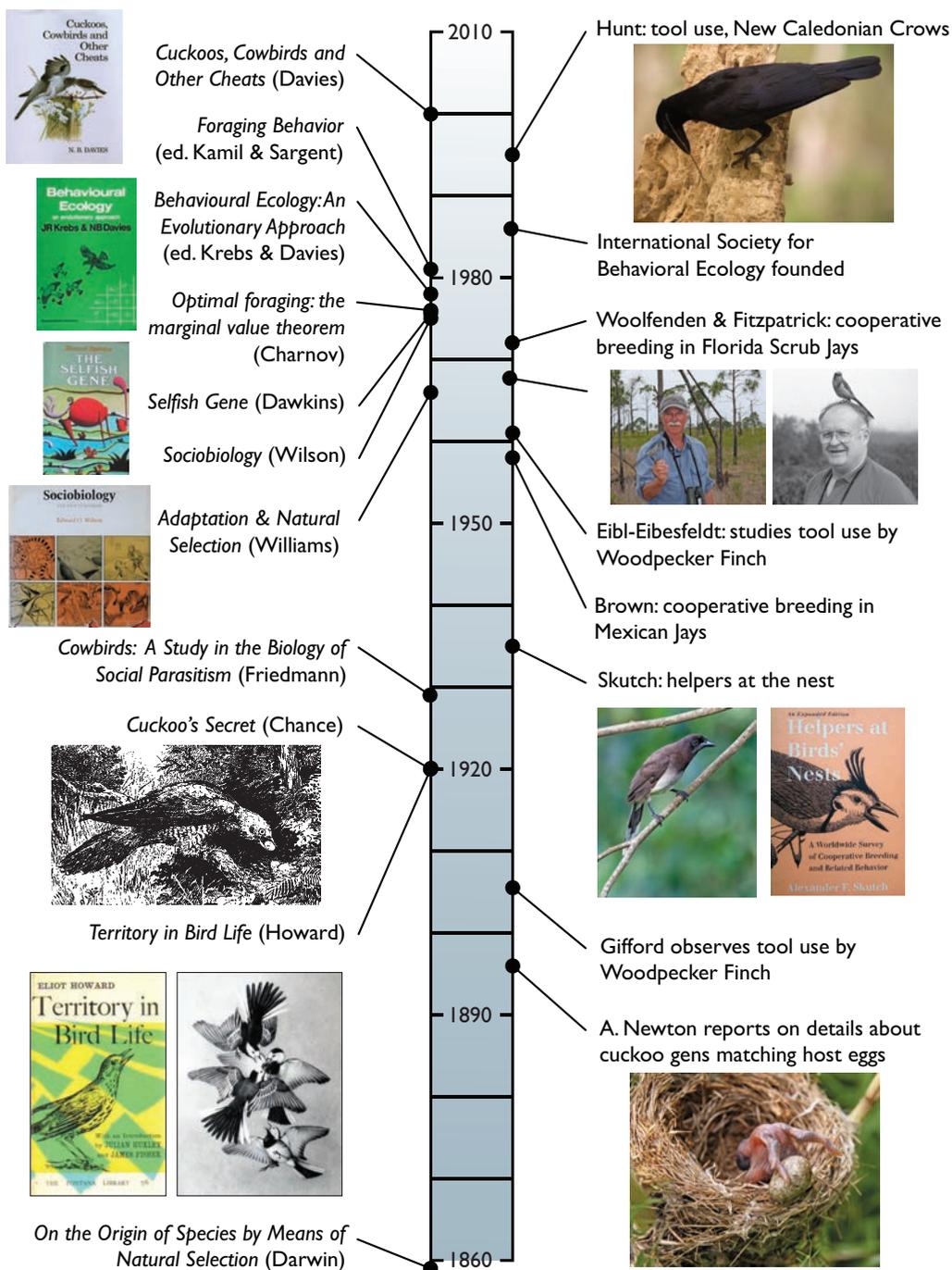
individual selection thinking, changed or is changing our understanding: foraging, brood parasitism, and cognition.

COOPERATIVE BREEDING

It is hard to imagine what Costa Rica must have been like in the 1930s, when the biologist Alexander Skutch decided to live there. American by birth, Dutch by descent, Skutch trained first as a botanist, studying bananas for his doctoral research. On seeing a Rufous-tailed Hummingbird building its nest just outside his lab window in Panama in 1928, he switched from “foliage to feathers” and never looked back:

I found this [the hummingbird], and the many other birds that nested in the garden, so fascinating that I decided to learn more about tropical American birds. After my return to the United States, I delved into the literature and found that nearly every species had been collected, named, and minutely described, but that very little was known about their habits. I concluded that I could do nothing more important and satisfying than to learn the intimate details of their lives.⁵

After more than a decade traveling about Central America, Skutch bought a farm (Los Cosingos) in Costa Rica, where he remained, with his wife, Pamela, but without electricity or a telephone line,⁶ for the rest of his long life. He continued to study and write about birds, eventually becoming the premier Neotropical ornithologist. When asked, at the age of ninety-six, what he considered his most important ornithological contribution, he said, “Writing about the life histories of many tropical birds, whose nesting and other habits were previously little known or



TIMELINE for BEHAVIORAL ECOLOGY. Left: Covers of Davies (2000), Krebs and Davies (1978), Dawkins (1976) and Wilson (1975); Common Cuckoo visiting a host's nest; cover of Howard (1920); two pairs of Pied Wagtails fighting over territory depicted in Howard's *Territory in Bird Life*. Right: New Caledonian Crow using a stick to extract a grub from a crevice; John Fitzpatrick (left) and Glen Woolfenden (right), each with a Florida Scrub Jay at Archbold Biological Station; Brown Jay; cover of Skutch (1987); Common Cuckoo chick ejecting a host egg from a nest.

America, those conducting studies of other species, such as Kirtland's Warbler (Mayfield 1961) and the Prairie Warbler (Nolan 1978) in the 1960s and 1970s, could not fail to see the deleterious consequences of brood parasitism by cowbirds. Conservation was therefore an important motivation for cowbird studies, accelerated by the interest in evolutionary questions arising from behavioral ecology in the 1970s.

Herbert Friedmann—one of the fathers of avian brood-parasitism research—was among the first to study cowbirds and provided a solid account of their natural history (Friedmann 1929). A gentle, enthusiastic scholar, Friedmann—who also studied other cowbird species in South America and honeyguides and cuckoos in Africa—recognized the enormous potential of brood parasites to inform us about coevolution, social behavior, and the reproductive strategies of birds. A PhD student of the great ornithologist

Arthur Allen at Cornell University, Friedmann's doctoral thesis became his classic book *The Cowbirds: A Study in the Biology of Social Parasitism* (1929). He continued to study cowbirds and other brood parasites throughout his life, publishing numerous papers and several monographs—many of which are still cited today. Friedmann was president of the AOU between 1937 and 1939, elected to the National Academy of Sciences in 1962, and awarded the Brewster Medal from the AOU in 1964.⁴¹

The Brown-headed Cowbird is an extreme generalist, its eggs having been found in the nests of 220 other species and successfully raised in the nests of 144 species (Friedmann and Kiff 1985)—far more than the Common Cuckoo (Davies 2000). The cowbird does not mimic the eggs of its hosts, and individual females often parasitize a range of species. However, the Brown-headed Cowbird does share many features in common with the cuckoo, including flexibility in its mating system and rapid laying (which occurs early in the morning while the host parent is absent). It also pays for the cowbird eggs to hatch first, but unlike the cuckoo, this is achieved by rapid embryo growth rather than by internal incubation (Kattan 1995).

Inspired by Rothstein's experimental studies of cowbirds, Nick Davies and Mike Brooke in the late 1980s used model eggs, matched for color and mass to resemble those of the Common Cuckoo, to investigate acceptance and rejection among potential hosts. They were especially pleased when the ornithologist Bruce Campbell, unaware of their work, mistook one of their model eggs for a genuine cuckoo egg. Davies's and Brooke's studies (e.g. Davies and Brooke 1989a, b) marked a new era in brood



Herbert Friedmann (right, at age ca. 53), here with Alexander Wetmore (at age ca. 61), looking at specimens at the US National Museum, Washington, DC, in 1951.

parasitism research, testing a suite of ideas suggested by a range of earlier workers.

They tested, for example, Alfred Russel Wallace's (1889) idea that cuckoos produced mimetic eggs as camouflage against predators, but they found no evidence for this. They also tested some of Chance's (1922, 1940) ideas, asking why Common Cuckoos lay in the afternoon and finding that, as predicted, hosts were less attentive at this time. Davies and Brooke also showed that by laying just after the host had started to lay, cuckoos were more likely to have their eggs accepted than if they laid in the host's nest before the host had started laying eggs.

It had been a long-standing question why cuckoo hosts often react so strongly to a "foreign" egg, but so readily accepted a foreign chick—even though a cuckoo chick is usually very different from host chicks. Arnon Lotem (1993) addressed this question using a theoretical model, pointing out that it would be maladaptive for hosts to learn by imprinting on their first brood, because, if their initial brood is parasitized, they would then discriminate against their own offspring in subsequent broods. In other words,

"misimprinting" (on the cuckoo chick) might result in hosts failing to raise all subsequent broods.

Langmore et al. (2003) later showed that Superb Fairywrens in Australia, which are parasitized by both the Shining Bronze Cuckoo and Horsfield's Bronze Cuckoo, *do* discriminate between their own chicks and those of cuckoos and abandon parasitized nests. The reason that chick discrimination occurs in the fairywren, but not in Eurasian Reed Warblers, is probably because the higher incidence of parasitism among wrens outweighs any costs of misidentification and because the fairywren's longer breeding season allows them to compensate for losses due to brood parasitism. Studies of other brood parasites subsequently demonstrated chick recognition and ejection behavior by hosts (e.g., Grim 2007; Sato et al. 2010).

New technologies will undoubtedly further our understanding of brood parasitism. For example, in Claire Spottiswoode's study in Zambia, 20 to 30 percent of all prinia nests are parasitized by Cuckoo-finches, yet she rarely sees or hears female Cuckoo-finches. Different types of tracking devices, now tiny



The Cuckoo-finch (male left, female second from left) is a brood parasite of the Tawny-flanked Prinia (right), producing remarkably variable, mimetic eggs (host eggs in the outer ring; Cuckoo-finch eggs in the inner ring).



PARADISORNIS RUDOLPHI, Finsch.

W. Hoar del. et lith.

Museum. Brit. Imp.

CHAPTER 9

Selection in Relation to Sex

The external beauty of form and colour which birds present, has so far proved a serious distraction, so that ornithologists, captivated thereby, have paid but little heed to the possible factors to which these features are due.

—WILLIAM PYCRAFT (1910: VII), IN HIS *A HISTORY OF BIRDS*,
POINTING OUT HOW LITTLE HAD BEEN DONE TO FOLLOW UP
ON DARWIN'S INSIGHTS INTO SEXUAL SELECTION

A SWEDE IN AFRICA

IN KENYA'S FERTILE GREEN HIGHLANDS, thirty-three-year-old Swedish ornithologist Malte Andersson is on vacation with his wife, escaping the worst of a Scandinavian winter. Every few minutes a male Long-tailed Widowbird emerges from the long grass in a magical floating display flight. Like a black sparrow sporting a tail 50 centimeters (20 inches) long, the male widowbird is distinctly unbirdlike. The female, on the other hand, is dull, brown, and all but tailless. Seeing the male display for the first time, Andersson is captivated.

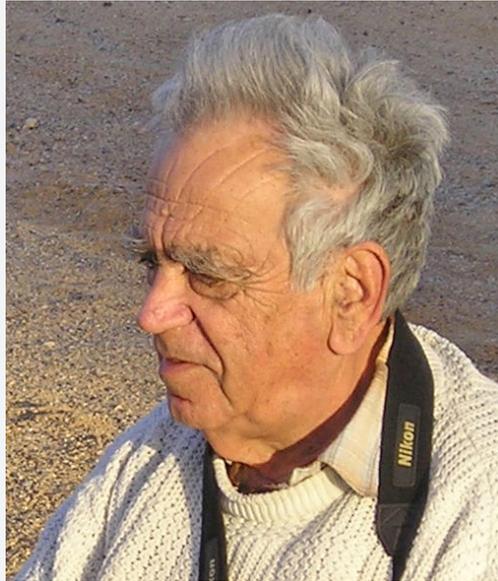
A bird watcher since childhood but with an interest in physics, Andersson trained first as an engineer. At university he switched to biology and animal behavior after reading books by Eric Fabricius and Niko Tinbergen.

As well as liking birds, Andersson was fascinated by the explanation of evolution by George Williams, whose book *Adaptation and Natural Selection* (1966) was one of the foundations of behavioral ecology.

After his first degree, Andersson went on to do a PhD on the behavior of skuas, inspired by Tinbergen's (1959) comparative studies of gull displays. Andersson's research compared the social signals of the skuas and jaegers and demonstrated unexpected behavioral similarities between Great Skuas and one of the smaller species, the Pomarine Skua. It was in 1975, after completing his PhD, with its public examination as the finale, that Andersson and his wife headed for Africa.

Fascinated by the huge difference in appearance between male and female

Male (right) and female (left) Blue Bird-of-paradise illustrated by William Matthew Hart. Hart did his best to imagine the display, not knowing that the male actually displays hanging upside down.



I have been watching birds since I was a small boy. As no one around me in my small native town of Petach Tiqva knew anything about them, I had to invent my own names for many of the birds I encountered. I learned their proper names only when, at the age of twelve, I met H. Mendelsohn, who was the director of a small zoo and bird collection at the Pedagogical Institute in Tel-Aviv, which years later became the Department of Zoology at Tel-Aviv University. He introduced me to systematic bird watching, convinced me to study zoology at the Hebrew University, and supervised my study (an MSc project) of the birds of the Huleh swamp and lake. The time I spent at this beautiful site impressed me about the importance of conservation.

Niko Tinbergen's book *The Study of Instinct* influenced my decision to spend a year with him at Oxford. With a recommendation from Colonel Meinertzhagen, whom I accompanied on his last tour of Israel, I received a British Council scholarship to go to Oxford. Tinbergen and his student group meetings

introduced me to the study of behavior, and I spent the spring of 1955 at Ravenglass with Uli and Rita Weidman. While watching the incubation of the Black-headed Gulls from a hide (blind), I wondered whether the birds were pressured to leave the nest by the presence of the mate that was eager to replace them. I tested this by building an additional, adjacent nest in their territory with an opaque partition between the two nests. Both birds incubated simultaneously more than twice their usual shifts. The findings from that experiment (which I have never published) prepared me, years later, to gather data on the competition displayed among babblers to serve their group.

In 1953 I was among the small group of naturalists who established the SPNI (Society for the Protection of Nature in Israel). Returning from Oxford at the end of 1955, I opted for the position of secretary of the society rather than that of a demonstrator at the Hebrew University. I was its secretary-general from 1955 to 1969, during which the SPNI succeeded in promoting conservation legislature and building a system of field study centers that serve thousands of youth and tourists annually. Like in other countries, here too bird watchers were the pioneers and more active members of the SPNI.

In the late 1960s I studied the wintering White Wagtails around Tel-Aviv. M. Cullen, a close friend from our time as Tinbergen's students, suggested that a modern PhD project demands some experimentation. Hence, by changing the dispersion of the wagtails' food, I manipulated them into altering their dispersal from territorial behavior into that of flocking.

I returned to Oxford to the Edward Grey Institute in 1970, to write up the wagtail study, suggesting that the wagtail roosts function as information centers. That year I met with P.



The EXTINCT GUADALUPE CARACARA

Ryan Stedman 2011

CHAPTER II

Tomorrow's Birds

Birds are among the best indicators of a healthy environment.

—ERNST MAYR, IN STRESEMANN'S (1975: 396) *ORNITHOLOGIST: FROM ARISTOTLE TO THE PRESENT*, POINTING OUT WHY ORNITHOLOGISTS WERE AMONG THE EARLIEST CONSERVATIONISTS

THE TRAGEDY OF SHIFTING BASELINES

SPIX'S MACAW IS ONE OF THE LARGEST AND most spectacular parrots in the world. It is also balancing on the brink of extinction, and in the wild it is almost certainly extinct. A victim of habitat loss in its native Brazil and a corrupt global cage-bird trade, Spix's Macaw currently (2013) consists of around just eighty-five captive individuals held at five locations around the world. Most are derived from a single breeding pair and are so inbred they are effectively clones of each other: clones with an unlikely future.

Discovered by Johann Baptist von Spix in 1817, the species was already in decline—the result of habitat destruction and exploitation along the Rio São Francisco corridor. Yet as it became rarer, Spix's Macaw became more attractive for bird dealers—rarity has always

bred demand—and it was this secondary cause that effectively sealed its fate. In 1978 Spix's Macaw was listed as “vulnerable” in the IUCN's Red List,¹ and just ten years later only three or four individuals were thought to be left in the wild. The rapid decline in the 1970s and 1980s was engineered by just two bird dealers known to have taken twenty-three individuals from the wild, which they sold for about \$10,000 apiece. By 1990 only a single bird, a male, remained in the forests of Brazil. In a desperate attempt to save the species, a captive female was released nearby in 1995. Ironically, but fortuitously, this female was thought to have been the male's partner prior to her capture six years earlier. Just six weeks after the pair was reunited, the female disappeared and was later found dead

In 1900 Rollo Beck (chapters 2–3) collected nine individuals of the already rare Guadalupe Caracara from a flock of eleven he encountered on Guadalupe Island, Baja California. There was one further, unconfirmed sighting of this species in 1903, and the species was certainly extinct by 1906. Painting by Ralph Steadman.



Whooping Cranes.

genetic introgression still occurred through the 1990s (Kennedy 2009), and while numbers continue to slowly rise, the population is still critically endangered.³⁴

Once the misimprinting problem was recognized, offspring were hand reared using glove puppets resembling the correct parental species, an approach pioneered with Peregrine Falcons (Cade and Fyfe 1977) and later used on other species, including Sandhill Cranes (Horwich 1989), Takahe (Maxwell and Jamieson 1997), and California Condors (Snyder and Snyder 2000). Whether hand-reared birds misimprint seems to depend on whether they are reared alone or with conspecifics of the same age: misimprinting is less of a problem if conspecifics are reared together (Curio 1996).

The phenomenon known as “predator blindness” was first noticed among hand-reared African Collared Doves (Klinghammer 1967). In virtually all subsequent studies, hand-reared birds proved to be less fearful of predators than parent-reared offspring. The mechanism for this is unknown, but it must involve cultural learning (Curio 1998: 174-5). Vulnerable species can be conditioned to avoid predators—as Curio (1969) did with Darwin’s finches harassed by a cat, and as has been shown in Takahe chicks trained to avoid stoats (Hölzer et al. 1995; McLean et al. 1999). But as Curio (1998) pointed out, for this conditioning to have a lasting effect in the wild, these behaviors would need to be culturally transmitted across generations. So far at least, there’s no evidence that this occurs.



Once thought extinct, New Zealand's South Island Takahe was rediscovered in 1948; conservation measures including captive breeding and translocations have resulted in their numbers increasing to 260 by 2012.

In an overview of the role of behavioral studies in conservation, Caro (1998) recognized both the advantages and disadvantages of employing behavioral knowledge. The main limitation is that behavioral studies are labor intensive and often take time, whereas conservation problems are often urgent and require a rapid response. Second, with a handful of notable exceptions—such as the Spotted Owl (Forsman et al. 1984), Seychelles Warbler (Komdeur et al. 1997), and Stitchbird (Ewen et al. 1999)—there have been relatively few behavioral studies of endangered species, so it is difficult to make appropriate generalizations.

DDT

The acronym DDT³⁵ is almost synonymous with environmental contamination. DDT is a particularly persistent pesticide that, once ingested, accumulates in fat stores and then builds up in the food chain with devastating effects on top predators. The removal of DDT from western agriculture was one of the major success stories in environmental protection during the twentieth century, and it set precedents for the removal and control of other toxic pesticides. Many people worked to achieve this goal, but the contribution of Rachel Carson is particularly significant.

APPENDIX 2: FIVE HUNDRED ORNITHOLOGISTS

WE MENTION OVER SEVEN HUNDRED ORNITHOLOGISTS in this book, but space allows us to list only about five hundred here. This biographical register saves us from including birth and death dates in the main text and provides a quick source of the most basic biographical information. The information is arranged as last name, first name, initials, birth-death dates, nationality, and (if different from country of birth) the country or countries (abbreviations below) in which that person was employed as an ornithologist, and research field (categories below). We have also included a photograph of a sample of individuals whose image does not already appear in the text.

COUNTRY CODES (from http://www.immigration-usa.com/country_digraphs.html): AR = Argentina, AT = Austria, AU = Australia, BE = Belgium, CA = Canada, CN = China, CH = Switzerland, DE = Germany, DK = Denmark, EE = Estonia, FI = Finland, FR = France, HU = Hungary, IE = Ireland, IL = Israel, IT = Italy, JP = Japan, LK = Sri Lanka, LT = Lithuania, LV = Latvia, NL = the Netherlands, NO = Norway, NZ = New Zealand, PA = Panama, RU = Russia, SE = Sweden, SN = Senegal, US = United States

of America, UK = United Kingdom, ZA = South Africa.

FIELDS OF STUDY: anat = anatomy, behav = behavior, coll = collector, cons = conservation, ecol = ecology, evol = evolution, feath = feathers and flight, gene = genetics, hist = history, life = life history, migr = migration, homing, and navigation, orni = ornithology in general, paleo = paleontology, phys = physiology, popn = population ecology, syst = systematics.

Abbott, Ian J 1947 AU-CA evol

Ahlquist, Jon E b? US syst

Aldrich, John W 1906–95 US popn

Alerstam, Thomas b1949 SE migr

Alexander, Horace G 1889–1989 UK orni

Alexander, Wilfred B 1885–1965 UK orni

Allen, Arthur A 1885–1964 US behav

Allen, Joel A 1838–1921 US behav

Amadon, Dean 1912–2003 US syst

Andersson, Malte 1941 SE behav

Armstrong, Edward A 1900–78 UK

behav-ecol

Aschoff, Jürgen 1913–98 DE phys

Ashmole, N Philip b1934 UK ecol

Askenmo, Conny b1941 SE behav



434 Alerstam



Amadon



Armstrong



Aschoff



Bang



P. Bateson

Audubon, John J 1785–1851 FR-US-UK orni
 Axel, Bert 1915–2001 UK orni
 Bairlein, Franz b1952 DE migr
 Baker, Allen J b1943 NZ-CA syst
 Baker, John R 1894–1973 UK ecol
 Baker, E C Stuart 1864–1944 UK behav
 Baldamus, Eduard 1812–93 DE behav
 Baldwin, S Prentiss 1868–1938 US orni
 Bang, Betsy G 1912–2003 US phys
 Barrett, John 1913–99 UK orni
 Bateson, Patrick P G b1938 UK behav
 Bateson, William H 1861–1926 UK gene
 Beach, Frank A 1911–88 US behav
 Beal, Foster E 1840–1916 US ecol
 Bechstein, Johann M 1757–1822 DE orni
 Beck, Rollo H 1870–1950 US coll
 Bécoeur, Jean-Baptiste 1718–77 FR orni
 Beebe, William 1877–1962 US orni
 Beecher, William J 1914–2002 US anat
 Benkman, Craig W b1956 US ecol-evol
 Bennett, George 1804–93 UK anat
 Bennett, Peter b1960 UK ecol-evol
 Bent, Arthur C 1866–1954 US orni
 Benvenuti, Silvano b1944 IT migr
 Berkhoudt, Herman b1945 NL anat-phys
 Bert, Paul 1833–86 FR phys
 Berthold, Arnold A 1803–61 DE phys
 Berthold, Peter b1939 DE phys-migr
 Boag, Peter T 1953 CA evol
 Bock, Walter J 1933 US anat-evol
 Borelli, Giovanni A 1608–79 IT feath
 Bourlière, François 1913–93 FR migr

Bowman, Robert I 1926–2009 CA-US
 evol-ecol
 Brodkorb, W Pierce 1908–92 US paleo
 Brooke, Mike de L b1950 UK cons
 Broom, Robert 1866–1951 UK paleo
 Brown, Jerram L b1930 US behav
 Brown, Richard G B 1935–2010 UK-CA
 migr-cons
 Bruch, Carl 1789–1857 DE syst
 Brush, Alan H 1934 US feath-evol
 Bumpus, Hermon C 1862–1943 US evol
 Burke, Terry 1957 UK gene-evol
 Burkitt, James P 1870–1959 IE orni
 Burley, Nancy T b1949 US behav-evol
 Butler, Pat J b1943 UK phys
 Buxton, John 1912–89 UK orni
 Campbell, W Bruce 1912–93 UK ecol
 Carson, Rachel L 1907–64 US cons
 Cayley, Neville W 1886–1950 AU orni
 Chance, Edgar P 1881–1955 UK behav
 Chapin, James P 1889–1964 US syst
 Chapman, Frank M 1864–1945 US orni
 Charmantier Anne b1977 FR-UK ecol-evol
 Chiappe, Luis M b1962 US paleo
 Cinat-Tomson, Hilda b?-d? LV behav
 Clarke, William E 1853–1938 UK migr
 Clayton, Nicky S b1962 UK-US behav
 Cobb, Stanley 1887–1968 US anat
 Coburn, Charles A b?-d? US behav
 Cockburn, Andrew b1954 AU behav
 Cody, Martin L b1941 US ecol
 Collinge, Walter E 1867–1947 UK ecol



Berkhoudt



Burley



Charmantier



Clarke



Clayton



Coues

“A first-class review not only of the recent history of ornithology but also of the key players involved. No other book of this type comes anywhere near this one in its breadth of coverage and depth of scholarship. *Ten Thousand Birds* is in a class by itself, and an outstanding read.”

—**Ian Newton**, author of *The Migration Ecology of Birds*

“This book fills an important and neglected niche. The mix of science, history, personality, and human interest is unique and one that people will find highly appealing. I found the prose not only engaging but downright riveting.”

—**Walt Koenig**, coeditor of *Ecology and Evolution of Cooperative Breeding in Birds*

“This is a hugely impressive book that synthesizes an enormous amount of information in a very accessible and engaging way, and makes an original contribution not only to the history of modern ornithology but also to the general history of biological science since Darwin. It will be an invaluable reference for general readers and students, and offers specialists a paradigmatic case study of the scientific method in action.”

—**Jeremy Mynott**, author of *Birdscapes: Birds in Our Imagination and Experience*

“This brilliant, wide-ranging book examines the debates, mistakes, and major conceptual breakthroughs that advanced our knowledge of avian biology. It documents how science proceeds, and skillfully humanizes it. *Ten Thousand Birds* is not only the best modern treatise on the history of ornithology. It is also a powerful summary of the remarkable biology of birds and what we still don’t know. This book is not just for ornithologists or serious birders.”

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