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The Waved Albatross

The Family Affairs of a Critically Endangered Species

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Dr. Kate Huyvaert began working in Galápagos in 1994. Since then, she has researched a variety of questions on the population dynamics, behavioral ecology, and life history evolution of the Nazca booby and waved albatross. Kate completed her Ph.D. research in 2004 on extra-pair mating behaviour of the waved albatross. She is currently Assistant Professor in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University.

AT THE HEART OF STUDIES of evolution by natural selection is the idea that variation exists in life history traits. These are things like the age a frigatebird first lays an egg, the number of seeds an *Opuntia* cactus sets in its lifetime or how long a sea lion lives. In the end, how an ant, a finch or a marine iguana allocates resources to each of these traits is directly linked to its fitness — a measure of how many young it will produce that will produce offspring of their own — and thus, its contribution to natural selection operating in the population. Because resources are finite, organisms also have to make trade-offs, balancing the requirements of reproduction with the everyday costs of survival. What is fascinating is that neither two species nor even two individuals have the exact same set of traits, and this leaves general theories about life history evolution wide open to exciting new discoveries. Exploring the ins and outs of the life history of the waved albatross (*Phoebastria irrorata*) — and uncovering a rather unusual story in doing so — has played an important part in my own life's story.

My very first visit to Galápagos as an undergraduate student in 1994 was to Española Island, the southeasternmost of the islands and home to all but a handful of the world's waved albatrosses, the largest bird in Galápagos. Medium sized as albatrosses go, adults stand about waist high and have long tube-nosed bills, roughly the colour of a banana. While magnificent, this species has a goofy persona on land. Prominent eyebrows shade large brown eyes and these masters of the wind and water can, at best, toddle among the rocks and vegetation with a stumbling swagger. Once airborne, though, goofy is replaced by grace as the birds open their wings to their full 2.4 m (8 ft) span and soar above the crests and valleys of the ocean's waves.

BELOW LEFT: A waved albatross on final approach slows down for a controlled landing.
BELOW RIGHT: A mate's eye view of the gaping display, part of an elaborate courtship dance routine.

ABOVE: Española Island, the oldest and southernmost in Galápagos, is the only sizable breeding colony of the world's only tropical albatross.

A brief life history

As a resident of an archipelago straddling the equator, the waved albatross is the only tropical albatross in the world, but there are many other aspects of its life history in which the word 'only' will appear. They can raise only one chick per year, at best, a process that takes them about nine months. Males return to the colonies along the southern and southeastern coast of Española in late March or early April each year, followed closely by females a week to 10 days later. Established pairs quickly reunite and mate, then the female departs for a few days' respite before returning to lay a single egg, weighing 284 g (9 oz), on the bare ground. Both parents take turns during the 63 days of incubation, making far-ranging feeding trips while the other sits in the sweltering heat of Española for as many as 22 days at a stretch.

By the time the egg hatches, the parents' work has seemingly only just begun. For the next four to five months, they will both dedicate themselves to ferrying meals from the open ocean to their waiting chick. When a hatchling is still a mere fluff-ball, parents continue to take turns watching over it while making short feeding commutes, mostly within the Galápagos Marine Reserve. However, detailed satellite tracking studies of adults caring for larger chicks show they most often travel to the rich waters of the Peruvian coastal upwellings — round trips of up to 3000 km (1860 miles). By December, the surviving chicks lose their brown fuzz and, having acquired the body and plumage of an adult, make the leap from 'landlubbers' to denizens of the air and ocean. Another four or more years will pass before they may return to the colony to make their first attempt at breeding themselves.

COURTSHIP SPECTACLES

Albatrosses are not the only Galápagos seabirds to engage in spectacular courtship displays. The end of the warm season (February–March) sees colonies of greater frigatebirds, particularly on Genovesa, 'blossom' with the brilliant red balloons of males (above) perched in low bushes trying to impress females passing overhead. Cooing and warbling loudly, they use air sacs known as gular pouches, which they inflate while vibrating their outstretched wings for full effect. Blue-footed boobies, too, gather in raucous colonies to sky-point and dance, lifting their large blue feet rhythmically. Red-billed tropic birds court in flight, emitting ear-piercing screams above their nesting cliffs, while flightless cormorants perform their pirouetting dance in the waters of calm coves.
Tui De Roy

ABOVE RIGHT: The author taking notes amid her study subjects.
FAR RIGHT: The albatross colony at Punta Cevallos is a rowdy place where many unique Galápagos species mingle.

Mating behaviour: an albatross' 'one and only'

Walking through the colony during the early breeding season can be something of a sensory overload. The cries of Nazca boobies (*Sula granti*) and swallow-tailed gulls (*Creagrus furcatus*) provide a raucous backdrop for the more subtle sounds of waved albatrosses busily courting among the rocks and shrubbery, a repertoire of greeting honks, sighs, groans, bill-circling, claps and clunks. Arriving adults, after much circling, usually try to make a controlled landing within a few steps of their presumed territory and nesting site, but it seems this plan doesn't always work out.

And that's where the orderly scene ends. Not infrequently, arrivals touch down far from the home territory, with some final approaches ending in ignominious crash-landings. Birds already on the ground often rush over to meet, greet and sometimes attempt to copulate in a rough-and-tumble encounter between individuals who are not typical mates; these are called extra-pair copulations, or EPCs. Given the long-term pair bonds that tend to be the norm among the albatross family, what is going on with the waved albatross? My third and longest expedition to Española in 1996 and 1997 began to uncover a fascinating chapter of this species' unusual story, and later formed the basis of my doctorate.

Life history theory suggests that with only one shot at reproduction per year and the great commitment both parents must make in attempting to raise that single chick to fledging, waved albatrosses will have their 'one and only' mating partner and that this

relationship will be for life. And because adults must make a trade-off for that reproductive attempt in terms of energy expenditure and future survival, there are strong arguments why individuals should not attempt to breed if even a hint exists that the other partner has mated with a stranger. This means that when we look closely, we should find no evidence of chicks produced outside of the pair bond, so-called extra-pair offspring (EPO).

The first surprise came when we collected blood samples from chicks and their social parents — the term used to describe the pairs that raise them, but who are not necessarily genetically related — and then applied the molecular technique of DNA fingerprinting to evaluate parentage. What soon emerged was that the social fathers of 25% of the chicks in this first sample were not the genetic dads at all!

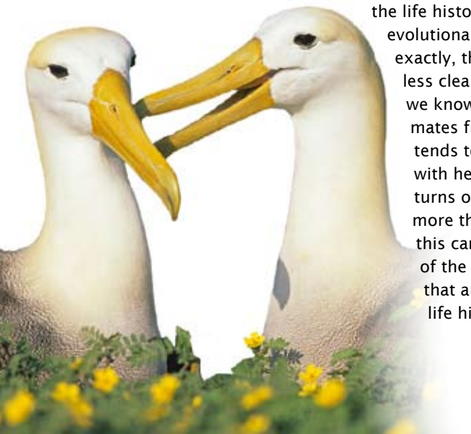
To better understand this unexpected result, we went straight to the authors of this remarkable story — the albatrosses themselves. Starting in 2000, teams of two to three observers and I recorded all of the 'goings-on' during the copulation part of three breeding seasons in a 3500 m2 (37,500 square ft) portion of the colony, an area about the size of a large playing field, near Punta Cevallos at the eastern end of the island. We banded every bird that entered the area with a large numbered plastic band readable from a distance, and watched their interactions from sunrise to sunset every day for six to seven weeks each year. In all, we documented over 3600 copulation attempts and, very much to our surprise, around 60% of these were EPCs!

Both males and females of all shapes and

ABOVE: Freshly returned from his ocean wanderings, a male feeds the young chick with a rich oily slurry, while the salt-encrusted female prepares to leave after several days on guard duty. Surprisingly, paternity tests show that about one-fifth of the chicks studied were not fathered by the males caring for them.
LEFT: Once the single chick is plump and downy, it will toddle off into the shady bushes, emerging to be fed at the sound of its calling parent.

LEFT AND OPPOSITE: Contrary to long-term pair bonding patterns, rough and tumble copulations frequently take place at the landing sites during the brief April mating period.
BELOW LEFT: Unique among birds, the waved albatross moves its large single egg considerable distances during incubation, leading to eggs cracked and lost between lava boulders.
BELOW RIGHT: A female is reluctant to relinquish the egg to her eager mate, taking turns that may last two or three weeks during the 63 days of incubation.

BELOW: Many pairs bond for life, rejoining to nest together year after year over three or four decades.



sizes participated in these EPCs. Some took place apparently peacefully, whereas others were aggressive, causing some participants to quickly run away from the scene. We also tracked the fate of all eggs laid in this study area until hatching, then took a small blood sample from both the chicks and the adults caring for them so we could again test for parentage. In the lab, we found that 14–21% of the chicks from those three years were also extra-pair and, in all of these cases, it was the father who was not related to the chick he was caring for.

While it is clear that extra-pair copulation and paternity are both important factors in the life history of waved albatrosses, evolutionary explanations for why, exactly, these traits persist are much less clear. From the data collected, we know that a female that switches mates from one year to the next tends to copulate in the first year with her current mate — and, as it turns out, next year's mate too — more than with other males. While this can account for some portion of the huge number of copulations that are outside of the pair bond, life history theory suggests that some other benefit must exist for the relatively large percentage of EPO. One idea that we explored in detail, called the 'good genes' hypothesis, suggests that females will accept and even pursue EPCs with males that are of better 'quality' than their social mates. But we found little support for this: males of all sorts (different shapes, sizes, behaviours and 'qualities') father chicks with females that are not their social mates.

Another set of ideas contemplates aspects of kinship. Because the vast majority of waved albatrosses live on just the one island of Española, and dispersal within the island appears relatively rare, males and females alike could be very close relatives. So, one possibility is that females have EPCs to avoid inbreeding. On the flip side of the coin, a male might, instead, tolerate raising a chick that isn't his own because the true father is a close relative carrying some of his own genes, such as a brother, uncle or father. This makes evolutionary sense, as the caretaking father would benefit because ultimately some of his genes will still make their way indirectly into later generations.

Alas, the data do not support any of these ideas. What we do know for sure is that the waved albatross' extra-pair behaviour is an intricate complex of social and genetic dynamics driven not by just one or the other partner, but by *both* males and females.

As if this were not sufficient, the waved albatross holds other unresolved mysteries. For example, while incubating, an adult may shuffle along the ground with the egg securely wedged between its powder-blue legs and brood patch (a soft featherless patch of skin on the bird's underside), effectively transporting the egg over sometimes quite rough terrain. By the end of the two months-plus incubation, the chick may hatch as far as 36 m (118 ft) away from where the egg was laid. This can have rather detrimental effects on hatching success, with many eggs becoming irretrievably wedged between boulders or falling into fissures. Yet intensive studies examining possible factors driving this behaviour, like seeking relief from excessive sun or tick infestations, have failed to cast light on why some birds move more than others and some not at all.

Photo courtesy Mark Jones

ABOVE: Retrieved at the beginning of the breeding season, a small leg-mounted logging device will reveal invaluable data recorded since the bird left three months prior.
ABOVE FAR RIGHT: Dozens of numbered bands from the author's study site, some still attached to the legs of dead birds, were retrieved from fishermen in Peru, exposing a serious conservation problem threatening the survival of the species.

Survival: only one chance

One evening, as we sat down to a dinner of tuna burgers and rice, a strange 'clink... clink... clink' sound floated out from the bushes behind camp. After several minutes, a male albatross emerged wearing an unusual thin metal band on his leg, not one we had attached. On inspection, we discovered that this bird had been banded at Punta Suárez, at the western tip of the island, by Michael Harris some 30 years earlier, at a time when all of us now gawking at him were, at most, toddlers. In the years since then, we've seen this old-timer wandering in the bushes on several occasions, and his presence reminds us that, while waved albatross reproduction is slow, they can afford to take their time because normally they live very long lives. Indeed, until recently the waved albatross population had appeared stable.

So how do we know whether a population is doing well? One way we measure its 'health' is to estimate rates of change where a measure of 1 means neither growth nor decline, below 1 and the population is declining, above 1, it's growing. In the years since the mating behaviour study, we've been carefully documenting the presence (or absence) of all banded individuals in our part of the island each year in May and June. Using these mark-resight data, we can estimate apparent annual adult survival. In recent years, the picture emerging from these analyses is worrisome.

Photo courtesy Jeffrey Mangel

In his time, Harris found that year-to-year survival of adults at Punta Suárez was about 95%. Our estimates at Punta Cevallos nearly four decades later now range from 88% during a mild El Niño to about 92.5% in typical years. While these seem like reasonably high figures, when used to estimate the population rate of change – our measure of its 'health' – in all cases that number falls below 1, highlighting that something extrinsic is contributing to the population's decline. Of the 22 species worldwide, 18 albatrosses are considered threatened to varying degrees, yet until recently the waved albatross was believed safe, so it is clear that something new has begun to happen.

Looking closely for possible sources of mortality, waved albatrosses do have a few pathogens, but nothing that stands out as an important cause of death. Plastic ingestion also is not a problem for this species as it is for other albatrosses. However, we have documented accidental and intentional bycatch of waved albatrosses in small-scale fisheries in the cold upwellings off the coast of Peru. In a survey of Peruvian fishing ports conducted by the small NGO Pro Delphinus, 107 albatross bands — some still attached to the legs of dead birds — were recovered from local fishermen, and even though some of the banding records had been lost and thus complete histories did not exist for all, 43 of those bands could be reliably traced to known waved albatross individuals. Although the magnitude of this problem remains difficult to quantify, its negative influence on current population dynamics are starting to show. Thus the waved albatross, unenviably, was recently added to the IUCN's Red List of threatened species as 'critically endangered', the worst rating before 'extinct'.

While the 'one and only' albatross in Galápagos is in trouble, many hands are poised and eager to help. Current projects in Galápagos include: tracking birds during the breeding season to better understand how often and where they overlap with fisheries, ongoing efforts to document changes in survival and population size, and a project looking at where albatrosses go during the many months they are away from Española after breeding is over. Galápagos is heralded as a living laboratory of evolutionary processes; it is here and almost nowhere else that we can see 'evolution in action.' With some of her glorious flora and fauna at risk, my hope is that someday Galápagos can also become a living example for conservation biologists, and a place that will inspire young people as the epitome of 'conservation in action' — a place where conservation is truly assured.

BELOW LEFT: An albatross returns from a distant feeding trip, a round trip of up to 3000 km (1860 miles).

ABOVE: A fishhook lodged in a nesting bird's throat attests to dangerous encounters on its Peruvian feeding grounds.
RIGHT: Easy to read, numbered bands allow every individual in the study area to be closely monitored.

GALÁPAGOS PETREL UNDER SEIGE

The Critically Endangered Galápagos or dark-rumped petrel, *Pterodroma phaeopygia*, has had the great misfortune of selecting the humid highlands of the lushest islands as its nesting grounds, as these areas have collectively been most heavily impacted by both farming developments and the spread of introduced species. Predacious pigs, cats, dogs and both black and Norway rats take a huge toll of adults, chicks and eggs, while invasive plants, such as quinine and blackberry, clog nesting habitat, making it almost impossible for nesting birds to land and take off. Forty years ago the garúa night skies above Santa Cruz resonated with their eerie courtship calls, whereas today to hear this sound is a rare treat, reflecting hope through years of hard work by scientists and park rangers. Ongoing rat control, using grids of regularly stocked bait stations in selected areas of Floreana and Santa Cruz, have given excellent results, with high proportions of chicks fledging every year where previously almost none survived. To help concentrate nesting efforts in such protected sanctuaries, recordings of courtship calls were played to successfully attract prospecting adults at the beginning of the nesting season. Eradication of pigs has also improved the situation on Santiago. But it will require enormous efforts on a wide range of fronts if we are ever to restore this species to its former glory.
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