Back from the brink of extinction: how the recovery of the Yellow-eared Parrot united a nation

De vuelta desde el borde de la extinción: como la recuperación del Loro Orejiamarillo Ognorhynchus icterotis unió una nación

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Abstract
At the turn of the twentieth century, the Yellow-eared Parrot *Ognorhynchus icterotis* was considered abundant across the Colombian Andes but, by the 1990s, hunting of the parrot and logging of Quindío Wax Palms *Ceroxylon quindiuense* for Palm Sunday had decimated the population, pushing it to the verge of extinction. As an emergency response, a conservation campaign was mounted to protect this Critically Endangered species, involving collaboration among many entities and communities across Colombia, who together addressed the multiple challenges facing the species with innovative strategies. After starting conservation efforts, the population rebounded from 81 individuals in the early 2000s and started expanding back across its former range. By 2019, the population exceeded 2,600 individuals and it was no longer considered at imminent risk of extinction. The dire plight of the Yellow-eared Parrot unified a nation to work collaboratively to save the species. This resulted in one of the most successful recoveries of a species on the brink of extinction. In an era when mankind is struggling to reverse the fate of so many endangered species, the recovery of the Yellow-eared Parrot in Colombia offers hope that we can make a difference even in the face of great adversity.

Keywords: Yellow-eared Parrot, conservation, Colombia, wax palm, Critically Endangered, population recovery.

Resumen
A comienzos del siglo XX, el Loro Orejiamarillo *Ognorhynchus icterotis* se consideraba abundante en los Andes colombianos, pero hacia 1990, la caza del loro y la tala de la Palma de Cera del Quindío *Ceroxylon quindiuense*, relacionada con las celebraciones del Domingo de Ramos, habían resultado en la disminución de la población llevándola al borde de la extinción. Como respuesta de emergencia, se organizó una campaña de conservación para proteger a esta especie en Peligro Crítico, trabajando en colaboración con varias entidades y comunidades de Colombia. Se abordaron múltiples desafíos con estrategías innovadoras. Después de comenzar varios esfuerzos de conservación, la población del loro se recuperó desde 81 individuos y comenzó a expandirse. En el año 2019, la población había superado a los 2.600 individuos; por tal razón, la especie ya no se considera en riesgo de extinción. La grave situación del Loro Orejiamarillo unió la nación para salvar a la especie, resultando en una de las recuperaciones más exitosas de una especie al borde de la extinción. En una era en que la humanidad está luchando por revertir el destino de tantas especies amenazadas, la recuperación del Loro Orejiamarillo en Colombia ofrece la esperanza de poder hacer cambios incluso frente a una gran adversidad.

Palabras clave: *Ognorhynchus icterotis*, conservación, Colombia, *Ceroxylon quindiuense*, Peligro Crítico, recuperación de la población.

Introduction

A mass extinction crisis is upon us (Ceballos *et al*. 2017). A growing proportion of the earth's biodiversity has already disappeared in the form of species extinctions (Ceballos *et al*. 2015), whilst tropical forests and other natural habitats are being destroyed at an alarming rate (Laurance 2010). Whilst certain elements of human society seek to eliminate nature as a by-product of commercial activities, conservationists have engaged several last-ditch efforts to save species on the brink of extinction. Some of these have been too late, such as in the case of the Northern White Rhino *Ceratotherium simum cottoni* (Anon 2018), Poo-uli or Black-faced Honeycreeper *Melamprosops phaeosoma* (BirdLife International 2019), and Golden Toad *Incilius periglenes* (Anchukaitis and Evans 2010). In an era when conservationists are struggling to reverse the

Figure 1: Photo plate from Chapman (1917) and photograph from Google Earth (2019) typical of the current landscape on the Quindío trail.

grim fate of so many threatened species and face an overwhelmingly pessimistic outlook, we present a remarkable success story of a species recovery, for the Yellow-eared Parrot *Ognorhynchus icterotis*, that gives hope and reassurance that conservation efforts *can* make a difference in the face of adversity. Within two decades, sustained conservation actions have resulted in a lost species being rediscovered, its breeding grounds eventually found, the rebuilding of its population and a gradual downgrade from Critical Endangered status.

Once common in the northern Andes of Colombia and Ecuador, the Yellow-eared Parrot had essentially vanished by the 1990s. The species is a magnificent and unique green parrot with fluffy yellow cheeks. It is a member of a monotypic genus, so as well as being endangered, it is also unique. The species' ecology had previously been linked to the Quindío Wax Palm *Ceroxylon quindiuense* (Chapman 1917). Further investigations during this conservation project revealed that this giant palm is essential for the bird's nesting, roosting and feeding activities. Unfortunately, the tree itself is itself threatened (assessed as Vulnerable by the IUCN since 1998 to date). Deforestation for cattle pastures combined with overharvesting of the trees' leaves for use in celebrations of Palm Sunday nearly wiped out the wax palm. However, historically it was widespread (Salaman 1999, BirdLife International 2016).

In May 1911, the ornithologist Frank Chapman found extensive tracts of wax palms in the Colombian Andes supporting Yellow-eared Parrot populations. He noted: "*In places nearly every palm was occupied by a pair of these birds...*" (Chapman 1917). The accompanying landscape photo by Chapman (Fig. 1) depicts a substantial wax palm-dominated forest landscape. His description noted that the Yellow-eared Parrot was "*common, and in places, abundant...*" during his exploration of the Central Andes.

By 1996, the Yellow-eared Parrot population had been devastated by hunting and habitat loss. Wax palms had been decimated (Fig. 1) and few Yellow-eared Parrot flocks survived. It was clear that this enigmatic species, a unique monotypic genus, was fast approaching extinction (Salaman 1999). The species had already been wiped out from northern Ecuador (Krabbe & Molina 1996) and no Colombian records existed since 1985, possibly 1991 (Collar *et al*. 1992).

This situation paralleled the decline of the Carolina Parakeet *Conuropis carolinensis*, a formerly widespread species of eastern North America. Both species are monotypic, gregarious, non-range restricted and once reported as abundant. Both species were unwary of man and easily hunted – even failing to disperse when attacked. This facilitated the obliteration of local populations by over-enthusiastic hunters or collectors, with entire flocks slaughtered. In an encounter with Carolina Parakeets, the ornithologist Alexander Wilson documented: "*I saw them in great numbers… they settled, in one body, on a neighboring tree, covering almost every twig of it, and the sun, shining strongly on their gay and glossy plumage, produced a very beautiful and splendid appearance. Having shot down a number, some of which were only wounded, the whole flock swept repeatedly around their prostrate companions, and again settled on a low tree, within twenty yards of the spot where I stood. At each successive discharge though showers of them fell, yet the affection of the survivors seemed rather to increase; for, after a few circuits around the place, they again alighted near me, looking down on their slaughtered companions with such manifest symptoms of sympathy and concern, as entirely disarmed me*." (Brewer 1854). An extraordinary level of tameness to man also affects Yellow-eared Parrot, which likely contributed to its rapid extirpation for subsistence hunting.

Figure 2. Yellow-eared Parrot *Ognorhynchus icterotis* emerging from a Quindío Wax Palm *Ceroxylon quindiuense* cavity.

Extinction in Ecuador
In an attempt to help save the Yellow-eared Parrot from extinction, Loro Parque Fundación launched emergency conservation efforts first in Ecuador, attempting to save the last known flock in 1996. Three key properties were purchased in 1997 and 1998 totalling 160.2 ha in Cotopaxi Province and were managed with a view to protect habitat for the species. These properties included the last known roosting site in Ecuador. Despite these actions, the population continued to decline from hunting; two birds were seen in September 1998, but despite intensive searches that continued for years to come (Salaman 1999), the species has not subsequently been recorded in Ecuador (see further Krabbe & Molina 1996).

A new record, a glimmer of hope and Proyecto *Ognorhynchus*
Our work with this species in Colombia started when a flock of 24 parrots was discovered in October 1997 in Colombia's Central Andes by Paul Salaman, who was leading a bird tour across Colombia (Salaman *et al*. 1999).

This exciting find led to an immediate conservation response, via the formation of "Proyecto *Ognorhynchus*" (Salaman *et al*. 2006a). The project was supported by Loro Parque Fundación and led by project director Paul Salaman. It was organized as an emergency conservation project with project team members operating on the basis only of grants. The aim of the project was to find viable population of the Yellow-eared Parrot and save it from extinction. However, despite 3,500 field hours by experienced ornithologists on the team spent searching, over eleven months from May 1998, concentrated in the region of the 1997 sighting, no further records were made (Salaman *et al.* 1999). To collect local knowledge about the parrot's presence, an outreach poster was circulated across Colombia as part of a campaign, asking for sightings to be reported. Several promising reports by local residents were followed up on, but the study continued to draw blanks. The species was considered to be extinct at its historical stronghold sites. Its survival looked increasingly bleak (Salaman *et al*. 1999).

Golden-eared discovery
Just as efforts were drawing to a close, the project team followed-up on a report from the remote Cucuana valley in the Central Andes of mun. Roncesvalles, dpto. Tolima. Late afternoon on 18th April 1999, project team members Bernabé López-Lanús and Alonso Quevedo heard the faint but distinctive raucous chatter of parrots, and then descending from the clouds above a breath-taking alpine-like landscape, flocks of Yellow-eared Parrots swooped down in tightly synchronized barrel rolls into palm-studded pastures. The parrots alighted in Quindío Wax Palms *Ceroxylon quindiuense* overhead and clambered down the fronds in chattering pairs and small groups to gorge on bundles of ripening thumb-sized palm fruit. A total of 81 birds, including a breeding pair at a nest were discovered at this site (Salaman 1999, 2001, Salaman *et al*. 1999). After almost a year of unsuccessful searches, there was hope after all!

The site was 55 km from the 1997 observation, which may have involved wandering birds foraging for food. Critically, the nesting site of what appeared to be the last flock of *Ognorhynchus* had now been found! The plot of the film *Rio* 2 (2014) revolved around conservationists finding an undiscovered fantasy flock of the Spix's Macaw *Cyanopsitta spixii*, another Neotropical Parrot considered Critically Endangered. In 1999 in Colombia, this fictional story was imitated in real life, with the discovery of a viable flock of the Yellow-eared Parrot in its natural habitat!

The *Proyecto Ognorhynchus* team immediately launched a comprehensive conservation program in an emergency response to study and protect the species. Over the coming months, a wealth of information on the species' ecology and natural history was gathered from round-the-clock observations.

Every evening, the parrots would gather and socialize together, before roosting for the night beside the heart of the palm. Like a children's kindergarten class, pairs and small groups chattered, preened and frolicked amongst the palm groves, often flying within feet of people as they played, seemingly without a care in the world. It was clear that the Yellow-eared Parrot was an exceptionally social and strongly bonding species. They dispersed from roost sites at first light; during the day, they gradually returned, arriving at the wax palm roost site by mid- to late-afternoon.

Imminent threats
It quickly became apparent that there were multiple major threats facing the Yellow-eared Parrot and the wax palm upon which the bird depended, that collectively imperilled the species' long-term prospects of survival. The greatest issues hinged on four principal threats:

1) Hunting for food and sport: Unlike other parrots, this species is highly approachable and appears blissfully ignorant of people, so much so that children with slingshots could approach close enough to kill birds as a pastime. Local people would also shoot the parrots for food.

2) Habitat loss: 90-93% of montane forests had been decimated at key sites for the parrot. Although the national parks network includes several significant protected areas in the middle-section of the Central Andes (e.g. PNN Los Nevados, PNN Otún Quimbaya, PNN Páramo Las Hermosas, PNN Nevado del Huila), none of them included suitable habitats where Yellow-eared Parrot occurred.

3) Lack of nest site availability: The parrots nest only in dead standing wax palms. These were prime material for durable fence posts or firewood, causing the trees to be cut down and used by farmers. Furthermore, the time for a wax palm to develop from a sapling through life to a dead tree is significant, and the recuperation of nesting sites is therefore challenging.

4) Overharvesting of wax palm fronds for Palm Sunday: The central fronds or spike of live wax palms was coveted for traditional Palm Sunday processions in Colombia. Wax palm stands across the Colombian Andes were decimated for this demand.

With these principal threats identified, the team formulated a conservation strategy (Salaman *et al.* 2006b), which by necessity was founded on meticulous field study to elucidate the essential elements of the ecology and biology of the Yellow-eared Parrot (Flórez 2006, Pacheco & Losada 2006, Salaman *et al*. 2006c).

Grave situation, grave solution

Before addressing threats, the project had to address difficult security and health and safety issues as the newly discovered colony was located in an area under control of the 50th front of the FARC (*Fuerzas Armadas Revolucionarias de Colombia*) guerrilla and a major battle zone for confrontations with the national army. Since 1964, the guerrillas had been in armed conflict with the Colombian government and by 1999 the FARC were at an historic strong point with over 20,000 combatants and controlling much of Colombia's rural territory.

It was therefore necessary, consistent with most other conservation projects of the period in Colombia, to obtain permission and support for fieldwork from both governmental and non-governmental authorities and to obtain community support for the project. Biological conservation was generally consistent with the political ideals of this guerrilla group, who not only allowed the project to continue but issued a decree

Figure 3. Yellow-eared Parrot relies on Wax Palms for perching and feeding.

requiring protection of the Yellow-eared Parrot from hunting. This decree and educational aspects of the project resulted in broad adherence from local inhabitants; hunting stopped immediately, forming a starting point for population recovery. Thereafter the project team had no evidence of a parrot being harmed. Ironically, owing to the rebel prohibition, the Yellow-eared Parrot had become a beneficiary of Colombia's civil conflict.

Although hunting - a major immediate threat to the species – was soon averted, the *Proyecto Ognorhynchus* team worked at great personal risk in a conflict zone to study and protect the parrot. Enduring attacks from all sides, one member of the field team was kidnapped and held for eight months by guerrilla rebel forces. On another occasion, the National Army mistakenly shot at the field team with rocket-propelled weapons from a Sikorsky Black Hawk helicopter. One team member was imprisoned for five months on charges of being a guerrilla (and later released). And a team member was caught up in and survived a major battle between guerrilla and local police forces, which resulted in the death of all local police officers and a subsequent major bombardment and re-taking of Roncesvalles by the national army.

There appeared to be no lasting harm to the parrots, despite two separate major artillery battles that took

place between the government and guerrilla forces close to the parrots' roosting site. Also, while all the members of the field team survived, the often-dangerous work environment and some of the harrowing experiences they suffered resulted in post-traumatic stress for several. Despite the risks and sacrifices made by the field team, several senior persons in the broader ornithological community in Colombia offered little to no support for these efforts and more often alienated and criticized the team. Overall, the team's dedication to the conservation of the endangered parrot and the threatened wax palm was exceptional and possibly unparalleled.

Local institutional support

In 2000, it became apparent that to further the project's aims (and those of other conservationists in Colombia), a stronger local institutional support network was necessary. Proyecto Ognorhynchus had to date operated via volunteer and professional ornithologists receiving grants to carry out conservation from an external funding organization, namely Loro Parque Fundación via an unincorporated project made up of willing collaborators. However, those involved had found considerable difficulty in obtaining the local institutional support necessary to develop firmer conservation projects in Colombia. Colombia, the world's most biodiverse country with a bird list approaching 2000 species, lacked any effective local conservation NGO. Those working with birds were associated with universities and bird-watching groups, who were able to contribute information but had not succeeded in establishing protected areas or operating other on-the-ground practical conservation outcomes (one notable exception being Fundación Proselva, which had successfully established a reserve in dpto. Cauca but whose director Álvaro José Negret had then recently died). Some international NGOs were also present in Colombia, but operated out of offices rather than in the field. Finally, governmental organizations such as the National Parks network were slow to act and lacked any practical control of much of their territories, which were *de facto* controlled by insurgents. For safety reasons, most of their staff, like those of major NGOs, were located in offices in major cities and they avoided fieldwork in many areas.

The ten-person team established a non-profit organization called "*Fundación ProAves de Colombia*" (formally constituted a year later), with a mission to promote biodiversity conservation in Colombia. Certain other projects, such as Colombian EBA Project, an exploratory project to find new sites worth of conservation efforts, were also adjoined to ProAves. At a time of tremendous political insecurity in rural Colombia, the ProAves team sought to take practical steps to protect the Yellow-eared Parrot –and other species - for the sake of conservation. This seed project led to broader conservation successes. Today, ProAves owns 28 nature reserves, totally over 60,000 hectares in 13 departments of Colombia, which protect almost 1,500 bird species, including 80% of all threatened bird species.

Trafficking threat?

Global trade and wildlife trafficking have threatened the survival of many parrot species, and the increasing scarcity of species only escalated the amount that some people were willing to pay for captured trade birds. Between 1992 to 1996, nearly half of the 1,540 birds confiscated from being illegally smuggled out of Colombia were parrots – and probably undetected exports exceeded these figures by factors of ten. Of an estimated 16 million birds held as pets in the United States, the majority are parrots; aviculturists take a particular interest in rare species that others may not hold.

Tragically, Yellow-eared Parrots survive very poorly in captivity. Despite active trapping for the pet trade, the species' social behaviour and strong bonding appear to be a precursor to a rapid stress-related mortality when placed into caged confinement. For example, of one flock of 60 Yellow-eared Parrots in Ecuador, a farmer trapped 40 in the late 1980s, of which half died within one day and the remaining 20 died the following day (Forshaw 2017). There was documentation of only two Yellow-eared Parrots successfully being held in captivity. Both were imported into the UK in the 1960s (Low 1972). Since then, we have no evidence of the species being held in captivity.

Parrot and Palm

With the most urgent threat of hunting addressed locally, the ProAves team assessed potential obstacles and opportunities for a recovery.

The Yellow-eared Parrot is bound to the Quindío Wax Palm for nesting and roosting. It feeds the young the pulp from wax palm fruits. The wax palm is recognized as the world's tallest palm, standing over 59 m high. In 1986, it was declared the national tree of Colombia and received legal protection, but that was not enforced (Martínez 2018). By the 1990s, the core populations of Quindío wax palm were restricted to 12 sites in Colombia and four in northern Peru.

The palms are long-lived and slow–growing, with individuals first forming rosettes on the ground. After an average of 57 years old, they then start growing a trunk. This slow developmental phase of the wax palm

means they do not reach maturity until around 75+ years old when their above-ground stem reaches a height of *c*.12 m (Sanín *et al*. 2013).

In the Cucuana valley, sporadic pastures have stands of uniformly mature wax palms that averaged almost 100 years old (dated between 1914-1926) and are over 20 m tall (Sanín *et al*. 2013). As the Quindío wax palm was so durable and cast little shadow (as the tallest palm in the world), it was not always cut down when the forest beneath it was cleared to make way for pasture. However, there is almost no wax palm recruitment, as palm seedlings are eaten by cattle in pastures with standing palms, and cattle also venture into forest patches to eat palm seedlings.

The palms are so tall that they can be considered a "forest above a forest". Their trunks and leafy-fronded tops extended far above the canopy. The height of the trees made them ideal nesting sites for the parrots, being largely inaccessible to terrestrial predators. Interestingly, the wax palms were also sought after by early settlers, who harvested the trees for wax in a non-destructive manner – with each palm producing up to 12 kilograms (26 lbs) of wax per month (Madriñan and Schultes 1995). The wax had a similar composition to bee's wax and was used for torches that gave abundant light and an agreeable odour.

Challenges to the species' recovery

In 1998, the Quindío wax palm was declared Vulnerable on the IUCN Red List (Bernal 1998), a status it still holds. However, in our view, the species warrants Critically Endangered status, as it meets the relevant IUCN criteria (CR A4c,e, B1+2c) of having an observed population reduction of >80% over three generations (considering a single generation is >80 years) both the past and projected (e.g. lack of seedling recruitment and the present die-off).

Research has shown that the availability of suitable nest sites to form a colony was an obvious challenge, as standing dead palm trunks were scarce, although the crowns of dozens of wax palms were dying. From the flock of 81 birds, just one chick fledged on 9 June 1999 from a 20-meter standing dead hollow palm.

Many palms appeared stressed and diseased with evidence of a beetle (*Xyleborus* sp.) attack and a fungus (*Ceratocystis* sp.); the former is considered responsible for transmitting the latter. Overall, up to 30% of standing palms were at various advanced stages of senescing with the crowns dying and falling off the trunk. The high rates of mortality were of concern for the long-term, but in the short-term the dead trunks provided additional nesting sites for the parrot.

When the wax palms died, the soft, spongy ground tissue or pith would degenerate within months and collapse downwards inside the trunk. The hollow so created was protected by the extremely durable palm bark and cortex that could sustain the palm standing for many years. The palm bark was so hard that chainsaws would have difficulty cutting them, but an axe could eventually cut down a palm. The fibrous and naturally water-resistant bark of the dead palm yielded excellent fence stakes, so that when a palm died it was often cut down and cut-up, usually for stakes for fences and housing construction.

Farmers' crusade for conservation

To address the combined issues of preventing dead palms from being cut down and facilitate palm recruitment, Fundación ProAves sought the collaboration of local farmers to change farming methods. This effort focused on local pride for the last remaining populations of this parrot and its palm and awareness of issues to encourage voluntary actions needed to save the species. Once the people in rural communities of Roncesvalles municipality were made aware that the fate of the parrot and palm was in their hands, that elicited an extraordinary positive response from the entire community.

No further dead standing palms were cut down and ProAves staff assisted farmers with fencing materials and labour to protect forest patches from cattle encroachment. A palm nursery was established by ProAves to grow seedlings with the eventual hope to plant a future generation in secure locations.

Within just a few years, Yellow-eared Parrot breeding activities and reproductive success rates drastically increased with the associated increase in the availability of dead hollow palms that were no longer being felled.

Nest box initiative

Fundación ProAves developed one of the first artificial nest box campaigns in the Neotropics to supplement natural sites (Osorno 2006). Using wood shaped and painted as palm trunks, nest boxes were carefully mounted on live palms. The response to using the boxes was slow at first, but later deployment in other colonies with limited dead palms proved more successful. The most successful technique to facilitate nest availability was to cut a small (10-12 cm diameter) hole half-way up the side of a recently dead palm. Parrots readily took to these palms and breeding productivity accelerated.

Within just three years, the breeding colony grew and 93 young were fledged (in 2002), with two "back-to-back" nesting seasons *per annum*. Recorded fledgling

Figure 4. Active artificial nest (#4 la Palestina, Jardín, Antioquia).

Figure 5. Nest replicating natural conditions created by cutting holes in a dead palm stand.

recruitment success rate averaged 64% for all breeding pairs. Of successful nests, an average 55% of nests fledged one chick, 31% fledged two chicks and 14% of pairs fledged three chicks.

Breeding studies demonstrated the first example for a New World Psittacid using "cooperative breeding assistants", whereby Yellow-eared Parrot non-breeding offspring from a breeding pair assisted with the care and feeding of siblings. The bonding between pairs was extraordinarily affectionate in the species, with frequent and prolonged physical attention, such as preening, feeding and perching side-by-side. Pairs seemed almost inseparable. Frequent copulation events lasted up to twelve minutes in duration and involved various positions suggestive of cloacal locking as noted in Madagascar's Vasa parrots (Wilkinson and Birkhead 1995).

Habitat protection

Every day at dawn, Yellow-eared Parrot flocks disperse from the wax palm roost site across an area of 480 km^2 in search of fruiting trees in montane and subtropical forests. The species has a varied diet feeding on more than 18 different fruiting trees and regularly changing routes to seek seasonal sources of fruit. It predominately feeds on four species of Euphorbiaceae (*Croton magdalenensis*, *Hyeronima antioquensis*, *Sapium utile* and *S. stilare*), and one species of each Verbenaceae (*Citharexylum subflavescens*) and Ehretiaceae (*Cordia barbata*). *Hyeronima antioquensis* is considered regionally Endangered (Alzate *et al*. 2008).

The steep terrain and fertile volcanic-rich soils of the Central Andes are ideal for cattle pasture and consequently 89% of montane cloud forests in the region have been cleared. The Cucuana and adjacent Cucuanita valleys were progressively converted to pasture, mostly since the 1950s. Today, only 11% of forest patches remain, with wax palm stands distributed spottily.

The last surviving forests of the Cucuana and Cucuanita valleys were previously unprotected.

In 2009, with the growing breeding population Fundación ProAves focused on establishing new protection for the major foraging areas in the Cucuana and Cucuanita valleys. With the support of Rainforest Trust and American Bird Conservancy, the 3,998 ha Loros Andinos Bird Reserve was established in Roncesvalles Municipality (Tolima) through the purchase of private properties and their designation as nature reserves. The 189 ha Loro Orejiamarillo Bird Reserve was also established in Jardín Municipality (Antioquia) to establish a base of conservation efforts for a newly discovered population there. These new reserves focused on protecting surviving natural habitat, restoration of old pasture and selectively logged forest, and reforestation with native trees and wax palms.

Furthermore, material support was provided to private property owners in the Cucuana valley who were willing to enrol in a land stewardship scheme to set aside land for regeneration and reforestation. A voluntary environmental tax levied on water rates aimed to sustain the program, but the results were mixed as many people opted out of the voluntary contribution.

Figure 6. Nestling growth development showing the same bird developing from hatchling to pullus.

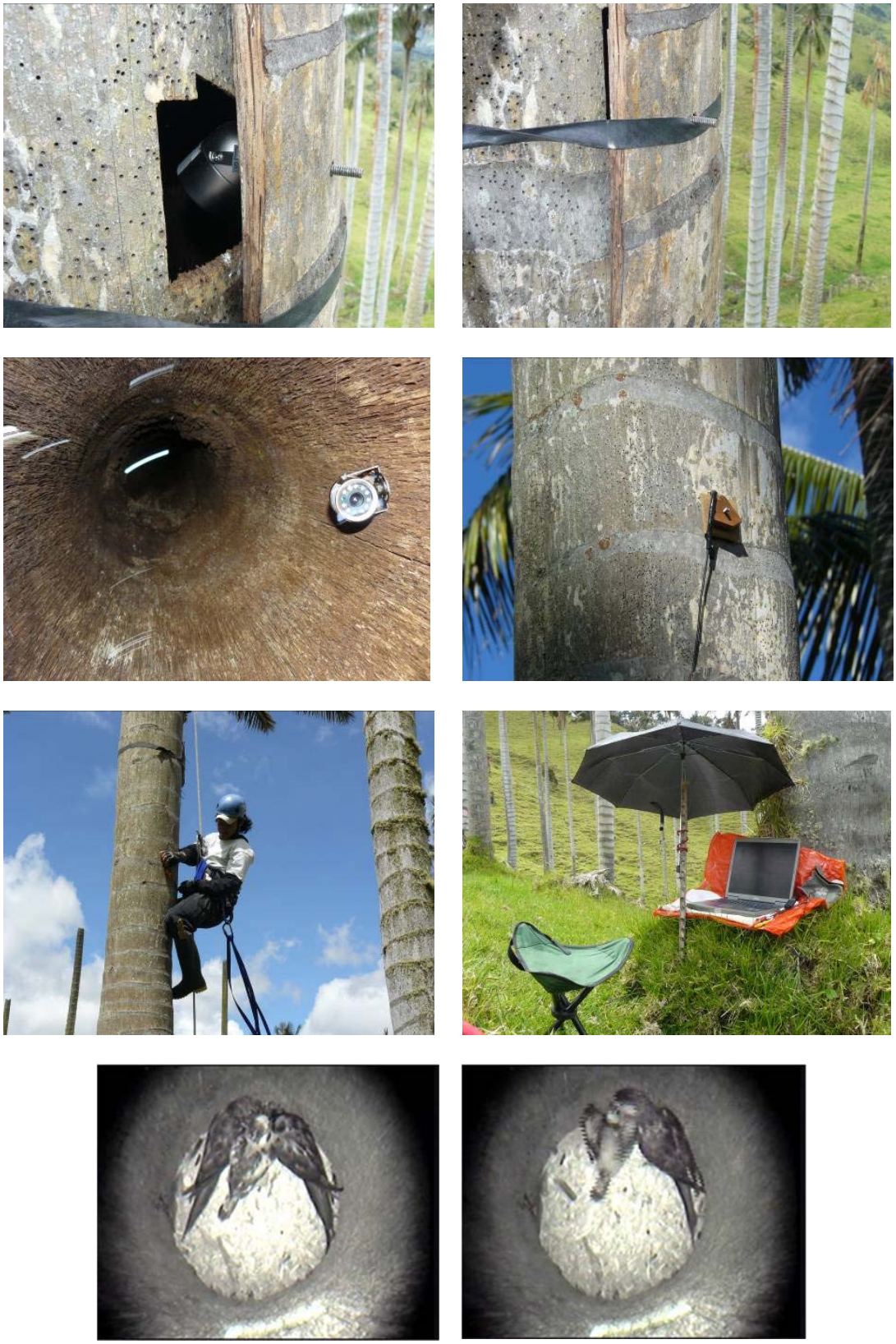

Figure 7. Instalation process for video cameras in nest cavities with example monitoring footage.

Extraordinary threats and unique solutions

The most bizarre threat and our greatest challenge was from the Roman Catholic church's tradition of celebrating Palm Sunday by laying palm fronds ahead of religious processions, replicating Jesus' triumphant entry to Jerusalem, which was accompanied by the laying of palms by the people. Since the 18th century, communities would celebrate the first day of Holy Week with a processions of wax palm fronds every Palm Sunday. The tradition is observed by millions of adherents to the Roman Catholic Church across the Andes of Colombia. Colombia is considered over 90% Christian and 80% Catholic.

For example, in Jardín – Antioquia, it was estimated in 2001 that between 200-300 wax palms were cut down to secure fronds counted in the Palm Sunday procession. Wax palms typically had 11 fronds at any one time, but fully-grown fronds were too heavy and not used. It was clear that wax palms were decimated ahead of each Holy Week, which presented perhaps the single greatest long-term threat to the survival of the parrot and palm.

Initially, the Roman Catholic leadership (e.g. nationally and in ecclesiastical provinces based on communications with bishops) rejected requests for a national moratorium on using wax palms on Palm Sunday, taking the view that the wax palm had been used for centuries and that it was "the palm of Palm Sunday". Although it was noted that Colombian law gave the wax palm full protection, thus it was illegal to be in possession of a living wax palm frond, the church was resistant to change.

However, ProAves did succeed in convincing local priests to encourage their congregations from restraining from using wax palms. In Roncesvalles, the Catholic priest was immediately open to not using the wax palm. ProAves assisted by providing hundreds of wax palm seedlings in paper cups for parishioners to carry in the procession with the message to plant them at home. This was largely a success with only a few wax palm fronds used (Salaman 2002).

It was not until 2004 that the Cardinal of the Roman Catholic church of Colombia instigated an immediate nationwide ban on using wax palms in Palm Sunday processions from then on. After just a few years, a centuries-old religious tradition was modified, and Palm Sunday processions have celebrated nature and life as well.

Figure 8. Project poster from 2008.

Colombians rally to save nature

From 2002, Fundación ProAves and Conservation International-Colombia united with regional environmental corporations across Colombia to form a major national awareness campaign called "Reconcile with Nature" to spread information about the fragile plight of the palm and parrot. The uniqueness of the campaign for nature and being connected to the most important religious festival immediately gained media attention. For example, a 25-second TV advertisement on the palm and parrot was repeated thousands of times across the national TV channels as free public slots before and during Holy Week for several years.

This sudden cascade of attention galvanized the Colombian National Police and environmental corporations to enforce environmental legislation to start confiscating palm fronds. Regional and national news of seized truckloads of palms inspired further enforcement efforts. Almost overnight, there was hope that the annual plunder of wax palms could be arrested.

Figure 9. Community outreach activities, including the Yellow-eared Parrot festival, workschops in schools and field trips.

Originally, many rural communities were ignorant of the plight facing the palm and the parrot. The "Reconcile with Nature" campaign ensured the plight of both species was firmly in the public eye and a national priority. To build that momentum, Fundación ProAves in partnership with local, regional and national governmental entities embarked on a "Loro bus" (Parrot Bus) roadshow campaign to reach hundreds of remote rural schools and communities across the Andes.

A 1967 U.S. school bus was converted into a mobile environmental classroom to present videos, exhibitions, workshops, and other activities. For almost five years, the bus toured across nine departments in the Andes, educating and involving an average of 2,600 children and 400 adults per month. Saving the wax palm and Yellow-eared Parrot was the new tradition – embraced and institutionalized across all generations of Colombians (Salaman *et al*. 2006d).

Population monitoring

The parrot population's response to conservation actions was quite unexpected. From 81 individuals in April 1999, the population breeding activity and fledging success rate increased year-on-year. By 2002, 93 chicks fledged successfully. Then, 155 km directly north of the Cucuana valley, a second breeding population of Yellow-eared Parrots was discovered in the Western Andes between the Municipality of Jardín (Antioquia) and Río Sucio (Caldas) by Juan Lazaro Toro (Toro & Flórez 2001). This was a major breakthrough and the beginning of pattern of the species recolonizing areas with wax palms from the two source populations with significant nesting activity, sometimes twice a year. By 2010, individuals had risen to 1,103 although it was considered that only 106 breeding pairs were active, as most individuals were considered immature. By 2013, there were 1,408 individuals.

Based on these two populations, the species started significantly expanding its range and reoccupying old haunts and new locations with remnant wax palm populations with small numbers of individuals apparently ranging further perhaps to explore new sites (e.g. Donegan *et al*. 2006). In 2009, a flock of 30 individuals was discovered 190 km directly east in the Eastern Cordillera (Murcia-Nova *et al*. 2009). By 2015 a flock of 15 individuals was located over 300 km south on the east slope of the Andes (Rosero-Chates 2015), just 110 km north of Ecuador. It is hoped that the Yellow-eared Parrot could soon recolonize Ecuador.

In order to best assess the population size, a national parrot census was organized by Fundación ProAves in December 2018 and in April 2019. In December 2018, a census was simultaneously conducted at 41 sites in seven departments in the Western, Central and Eastern Cordilleras that recorded 2250 individuals.

In April 2019, surveys at 12 locations in four departments documented a total of 2,601 individuals, including 998 individuals simultaneously in Roncesvalles (a 13-fold increase since 1999). The latter count is considered accurate, since it was undertaken during the principal breeding season and when most individuals congregate at roosts in the breeding colonies. After April 2019, a total of 240 chicks fledged in the Cucuana valley alone further increasing the population.

Conclusions

The decline of the Yellow-eared Parrot appeared to mirror that of the Carolina Parakeet, both having once been abundant and both having been hunted to the brink of extinction. By the late 1990s, the Yellow-eared Parrot was probably within a decade of going extinct, especially after efforts came too late in Ecuador where the species went extinct in 1998, exactly 80 years after the last Carolina Parakeet died.

From a total of 82 birds (including 24 adult pairs), in the Cucuana valley in April 1999 to 2,601 individuals as of April 2019, including hundreds of adult pairs plus a further 240 chicks fledged soon after the census. Importantly, the Cucuana valley population was the source that has repopulated the Andes, so that historic colony sites are being recolonized.

It is now considered that there are at least 1,000 mature individuals and the species continued recovery warrants the species IUCN threat status to be downgraded to Near-threatened. Two decades of conservation actions for the Yellow-eared Parrot has resulted in one of the most successful recoveries of a species on the brink of extinction.

What made the difference?

An intensive two-decade, multifaceted, science-driven conservation effort, initiated by interested persons who later drove forwards the project via Fundación ProAves, with two-decades of sustained support from Fundación Loro Parque was critical to the recovery of the species. However, the dire plight of the Yellow-eared Parrot and Quindío Wax Palm unified a nation to act. The parrot and palm brought together an eclectic alliance, on all sides of Colombia's armed conflict, of both scientists and religious persons, from school children to landowners. But what was key was

a nation working collaboratively to make changes and give nature hope.

Now, 100 years after the last individual of the Carolina Parakeet and the species went extinct, we are proud that the Yellow-eared Parrot has a new lease of life and its IUCN threat status has been downgraded from Critically Endangered to Endangered and soon it is expected to be considered for Near Threatened status.

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