



Galapagos Penguins: An Uncertain Future

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ABOVE RIGHT Nesting in lava cave, Mariela Islets. BELOW Sharing volcanic habitat with other tropical species, Isabela Island.

Synopsis: With a total population fluctuating between some 800 and 3400 individuals over the past 40 years, intense scrutiny reveals a bevy of threats for the only equatorial penguin.

The Galapagos penguin is arguably one of the most unusual members of its family, being the only species living in equatorial waters. But even though I grew up in the Galápagos Islands, our respective home ranges didn't overlap; its habitat is restricted to very specific areas flushed by cold, nutrient-rich upwelling currents, mostly along the western edge of the archipelago, whereas mine was on centrally located Santa Cruz Island, where penguins almost never stray.

This changed in 1978 when, as a high school student, I volunteered as a field assistant with biologists from the Charles Darwin Research Station. My assigned task — to collect and analyse feral dog faeces for dietary composition — documented for the first time, one of a fleet of human-induced threats to this critically endangered species.

Dogs were eradicated by the Galápagos National Park not long after, but my work has brought me back to the plight of Galapagos penguins ever since. To date much has been learned through a battery of complementary studies, all of which have cast further light on the Galapagos penguin's deepening troubles, together with efforts to mitigate human impact where possible.

A major threat appears directly linked to climate change, which historically has driven increasingly frequent, intense and prolonged El Niño events. Due to their coastal foraging habits and very restricted range (Steinfurth et al 2007; Vargas 2006), when high sea temperatures cause small schooling fish to disperse, penguins are left with no food and no place to go. The notoriously strong El Niño events of 1982–83 and 1997–98 caused mortalities of up to 77% of the total Galapagos penguin population (Valle and Coulter 1987, Boersma 1998, Vargas et al 2006, Vargas et al 2007). Several El Niño-free years after 1998 allowed a partial recovery, yet by 2009, when the last complete census was conducted (Jiménez-Uzcátegui and Devineau 2009), the total number of individuals counted was 1042, a sobering 40% below the pre-El Niño levels (see diagram below).

Unfortunately, with widespread climate change derived from global human activity, the best conservation strategies are limited to alleviating the effects of other, more manageable threats. One recent initiative, spearheaded by Dee Boersma in collaboration with the Galápagos National Park, involves the construction of shady lava shelters to increase the availability of potential nest sites. Based on the theory that a dearth in quality natural nesting caves may act as a limiting factor on breeding success during favourable La Niña conditions — when abundant food supplies

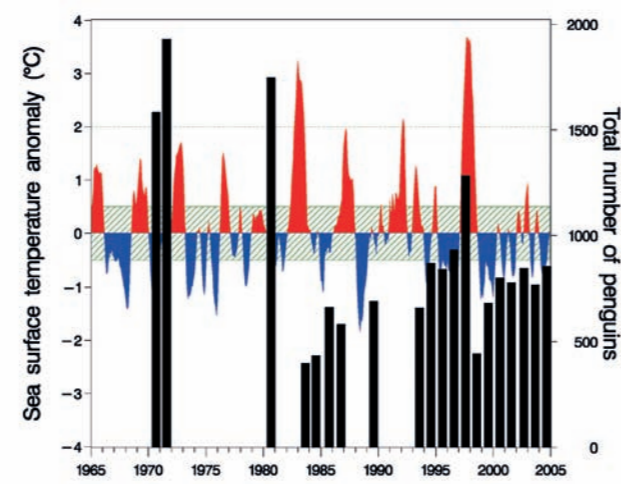


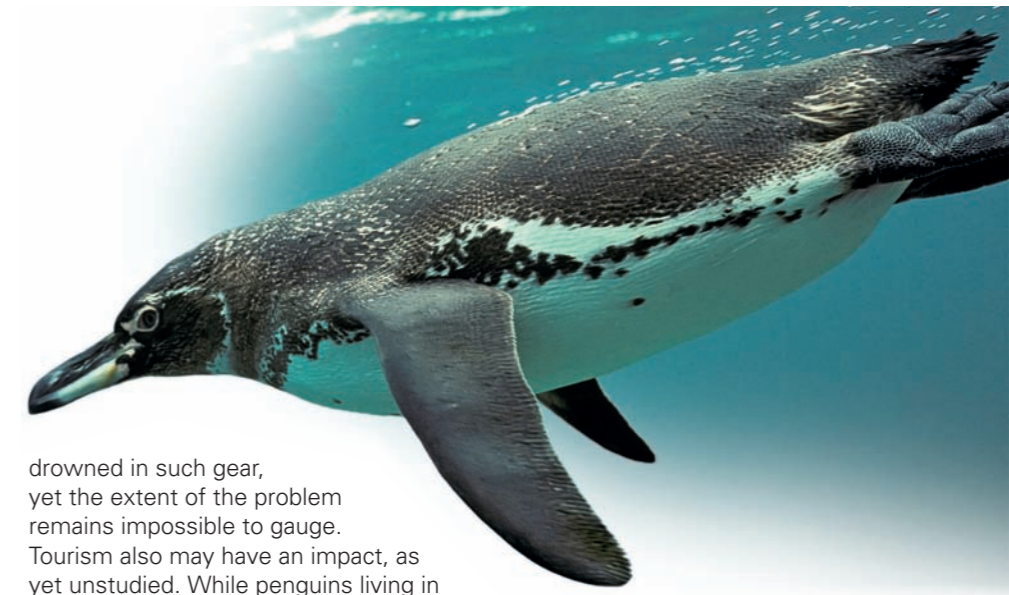
DIAGRAM H. VARGAS (2006)

could allow each pair to fledge two or three broods within a calendar year — it is hoped that this will serve as a hedge to offset catastrophic famines when El Niño strikes again (Boersma pers comm).

Another area of great concern is the effect, real and potential, of pathogens and parasites brought to the islands by human activities. Through collaboration with Professor Patricia Parker and her team from the University of Saint Louis, we have made great progress in assessing the situation as well as determining normal health parameters of individual penguins (Vargas 2009, Parker 2009 in De Roy 2009). An alarm was raised when a protozoan parasite of the genus *Plasmodium* was detected in penguin blood samples taken between 2003 and 2006. This parasite closely resembles *Plasmodium elongatum* which, together with *Plasmodium relictum*, are highly pathogenic parasites elsewhere in the world, responsible for deadly outbreaks of avian malaria in captive Humboldt penguins (Huff and Shiroshi 1962), the Galapagos penguin's closest relative (Bollmer et al. 2007). Neither of these two species has been found in the Galápagos (Levin et al 2009). This finding raised questions which we are still trying to answer: (1) what is the exact species of this parasite? (2) How closely is it related to the other two species? (3) What are the likely vectors and reservoirs in the Galápagos environment? And 4) What are the conditions for this parasite to become pathogenic? So far we have not succeeded in identifying the *Plasmodium* vector, although the mosquito *Culex quinquefasciatus*, introduced to the Galápagos in the early 1980s (Whiteman et al 2005, Parker et al 2006) is the most likely candidate, because of its documented role in spreading avian malaria in Hawaii (van Riper et al 1986; Atkinson et al 2000).

In our attempts to elucidate the matter, we are collecting mosquitoes to assess distribution patterns as related to *Plasmodium* prevalence in penguins, mapping freshwater sources where *Culex* can breed and testing blood from other birds sharing the penguins' range to establish whether these may act as reservoirs of parasites. The good news is that no mortality has been associated with any of these parasites, and the more than 500 penguins sampled throughout this exercise were all found to be in good health. But we now hypothesise that mass penguin mortality during major El Niño events could result from synergistic effects of food stress combined with *Plasmodium* parasites (Palmer et al in preparation). Fortunately, testing for West Nile Virus and Avian influenza, both diseases of recent worldwide concern, have so far proven negative in Galapagos penguins. Long-term monitoring of penguin health will be needed to help us understand these complex dynamics.

As if these major risks were not sufficient, other problems facing the penguins include predation by introduced animals, such as feral cats and dogs which are known to kill adults, and rats that can take eggs and nestlings. Although the use of gillnets is prohibited within the Galápagos Marine Reserve, illegal fishing activities have been implicated in reports of penguins



drowned in such gear, yet the extent of the problem remains impossible to gauge. Tourism also may have an impact, as yet unstudied. While penguins living in areas of heavy visitation seem to become easily oblivious to human attention — swimmers and small boats often approach within mere metres — it is the potential transportation of pathogens and their vectors into penguin habitat, as mentioned earlier, that remains the biggest danger. The high demand for fuel supplies for tour ships also carries the constant risk of lethal oil spills of disastrous proportions.

For decades, the Galápagos National Park has carried out relentless campaigns against introduced vertebrate pests, including expanding successes in ridding islands of their rat plagues. To control fishing activities, a number of no-take zones have been established along key stretches of coastline, and tourist access is strictly limited to a very small number of sites where penguins can be seen. An avian disease surveillance programme was initiated in 2001 by the Saint Louis Zoo and the University of Missouri–St Louis in cooperation with the Charles Darwin Foundation and Galápagos National Park (Parker et al 2006, Parker 2009).

The most stringent application of the existing quarantine system for Galápagos, plus substantial strengthening of many measures already in place, such as fumigation of all forms of human transport, from mainland Ecuador and between islands, will be our only hopes for stemming the tide of foreign organisms that threaten the integrity of the insular ecosystem — and this most vulnerable of penguins in particular.

THIS PAGE El Niño events and volcanic eruptions are among a host of threats for a highly sedentary species at the limit of climatic possibilities for penguins.

