

The Status of the Christmas Island Hawk-Owl *Ninox natalis*

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ABSTRACT

Island birds are particularly vulnerable to extinction. The Christmas Island Hawk-Owl *Ninox natalis* is a small, forest-dwelling owl restricted to Christmas Island in the Indian Ocean. The island is small (13,500 ha) of which 75% remains naturally forested. Approximately 1,000 adult owls occupy territories in primary forest across the island with a small number of adults living in second growth vegetation. The owl is considered Vulnerable due to its small population size and particularly because it occurs as a single population on a remote oceanic island. Settlement of the island and anthropogenic factors appear to be the main threats to the owl population. Forest clearance has reduced the total population size by *ca.* 25%. Numerous exotic plants and animals have arrived and the risk of introduction of new diseases has markedly increased since settlement. Global climate change may alter the frequency of cyclones on the island, and increase environmental variability. Although most of the original forest is now protected in national park, significant areas remain without legislative protection. Greater economic independence is one of the most important goals for the island community and is inextricably linked to the future of conservation efforts on the island.

INTRODUCTION

Island birds are particularly vulnerable to extinction (King 1985). Sixteen species of birds have become extinct in historical times and of these ten were island birds (Collar *et al.* 1994). Island birds often have a small total population size and small populations are, in general, more vulnerable to extinction than large populations (Shaffer 1981; Soulé 1987). A small, declining population is one of the key criteria for recognising a taxon as being threatened (Collar *et al.* 1994). Island birds have often evolved in the absence of predators and disease, making them particularly vulnerable to the introduction of exotic biota (Caughley & Gunn 1996). Island birds also tend to show high rates of endemism, so a loss of a single population can mean the extinction of an entire taxon (King 1985). A single population is particularly vulnerable to extinction because there is no chance of recolonisation by neighbouring populations if it becomes extinct (King 1985). Island birds all over the world have suffered as a result of direct human activity such as hunting and habitat destruction. For example, in the Pacific, including New Zealand, at least 151 species and subspecies of birds are known to have become extinct since the late Holocene (Milberg & Tyrberg 1993) and the number could be much

larger. Humans probably hunted some species to extinction, as did their pigs, domestic dogs, and Polynesian Rats *Rattus exulans*, and others may have been affected by introduced diseases (Warner 1968; Diamond 1985; Caughley & Gunn 1996).

Christmas Island is in the Indian Ocean (10°25'S, 105°40'E) approximately 1,400 km north-west of Australia, and is 360 km south of Java in the Republic of Indonesia. It is an external territory of Australia. The island is 135 km² in area, of which 75% is covered with original vegetation. Most of the natural vegetation, and 63% of the island, is protected within the Christmas Island National Park (ANCA 1994). Christmas Island is oceanic and all its flora and fauna have arrived from neighbouring areas by sea or air (Gray & Clark 1995).

Christmas Island's avifauna is highly endemic, with at least nine endemic taxa out of a total of 18 resident taxa (excluding introduced species). No bird species on Christmas Island has become extinct since settlement. Although four of the taxa are considered to be threatened due to small population size and forest clearance, only one, Abbott's Booby, is considered endangered (Garnett 1993).

Unusually for a remote oceanic island, Christmas Island had three endemic mammals. MacLear's Rat *R. macleari* was very large (total length ca. 50 cm), very common at the time of settlement, nocturnal and a proficient climber, and the similar-sized Burrowing Rat *R. nativitatis* both appeared to be extinct within 10 years of human settlement (Andrews 1909). A shrew *Crocidura fuliginosa trichura* was also very common at the time of settlement (Andrews 1909) and is now very rare (ANCA 1994). A number of vertebrates have been introduced to Christmas Island, including the Black Rat *R. rattus*, a species which occurs throughout the island and is semi-arboreal, the Domestic Cat *Felis catus*, Tree Sparrows *Passer montanus*, and Java Sparrows *Lonchura oryzivora* (ANCA 1994).

HISTORY

The Christmas Island Hawk-Owl *Ninox natalis* (Norman *et al.* 1998) is a small (ca. 180 g), nocturnal raptor restricted to Christmas Island. The population size of the owl is assumed to have declined with forest clearance (Stokes 1988; Olsen & Stokes 1989). Van Tets (1975) suggested that the total population size was in the order of 10-100 pairs and Stokes (1988) thought the upper limit of this estimate might be more accurate. The Christmas Island Hawk-Owl is currently listed as Vulnerable (Schedule 1; Endangered Species Protection Act 1992). During 1994-96 Christmas Island Hawk-Owls were widespread across the island in all largely undisturbed habitats but also used secondary vegetation and the vegetation in the suburbs of the single township and Hill & Lill (1998) estimated the total population size to be 562 ± 105 territories comprising at least one adult owl. Owls occurred in largely undisturbed or primary forests at densities similar to those of the few other published studies of similar-sized rainforest owls (eg. Gerhardt *et al.* 1994), but were much less common in secondary vegetation and suburban areas (Hill & Lill 1998).

The total population size of Christmas Island Hawk-Owls has undoubtedly declined since settlement of the island occurred and clearance of primary forests commenced. By 1987, when clearing of primary forest ceased, 25% of the island had been cleared (ANCA 1994). Hill & Lill (1998) showed that density was relatively uniform at all census sites in primary forest, and the total owl population at the time of settlement was estimated from the original area of primary forest. If densities found in primary forest in 1995/96 are not significantly different from those at the time of settlement, then the population at that time was between 640 and 840 occupied territories (95% confidence limits). The impact of forest clearance has probably been slightly offset by the areas of secondary vegetation growing along roadsides and on old mine stockpiles which are occupied by owls, but at much lower densities (Hill & Lill 1998). Thus the total population size may have decreased by slightly less than 25% since settlement and this decrease is probably primarily due to loss of habitat. Such a decline has probably increased the risk of extinction.

Christmas Island Hawk-Owls appear, so far, to have been unaffected by the introduction of Black Rats and domestic cats. Both species arrived on the island in the early 1900's (Andrews 1909) and are now widespread and common (ANCA 1994; Tidemann *et al.* 1994). Christmas Island's

avifauna must have coexisted with its endemic rats for many generations, to some extent pre-adapting it to introduced predators. Only birds which could coexist with these species, at least one of which was a proficient climber (Maclear's Rat, Andrews 1900), would have been able to persist. Owls sometimes roost close to the ground and may occasionally be at risk of being caught by cats. Cat densities in primary forest are currently low (Tidemann *et al.* 1994; G. Van Der Lees 1995, pers. comm.). However, if cat densities increase significantly there may be cause for concern. The Galapagos Islands also had a number of endemic rodents and the introduction of the Black Rat there appears not to have had a significant impact on its avifauna (Atkinson 1985). The presence of partly-arboreal crabs on Christmas Island may also have selected for anti-predator behaviours in the endemic avifauna.

Island birds have often evolved in the absence of diseases that are common in continental bird faunas and the introduction of such diseases to island bird populations can be disastrous. For example, the introduction of avian malaria to Hawaii in 1826 is implicated in the extinction of almost the entire endemic bird fauna below 600m in altitude, and was probably the main cause of such extinctions (Warner 1968). The range of many surviving species was also severely reduced and fragmented, which in turn markedly increased their probabilities of extinction. Once established, a 'new' disease may persist on an island in introduced populations of continental bird species which have resistance to the disease. For example, the Black Francolin *Francolinus francolinus*, introduced to Guam, may have provided a reservoir of disease-carrying hosts accentuating the impact of disease on the island's endemic birds (Savidge 1984). Thus it is not only important to maintain strict quarantine controls to minimise the risk of introduction of new bird diseases, but it is probably also undesirable to have wild populations of feral birds on Christmas Island such as Eurasian Tree Sparrows and Java Sparrows. A quarantine barrier between the island, Indonesia and Australia has only been in place since 1994 and the benefits of this barrier for wildlife conservation on the island are recognised (ANCA 1994; Hill 1988).

PRESENT STATUS AND THREATS

The Christmas Island Hawk-Owl is endemic to Christmas Island; no other population of this species exists, so there is no potential for recolonisation if this species becomes extinct. The island is small, of which 75% is primary forest, and it seems unlikely that any population of the owl is isolated from any other. Thus in assessing the species' population viability, it would seem reasonable to consider it a single, small, completely isolated population. Of the 75% of primary forest, 84% is protected within national park (ANCA 1994). The 12% of primary forest outside the national park is to some extent protected from clearing by legislation; however, some of it may eventually be cleared. Modelling the effect of clearance of this unprotected forest on the population using Population Viability Analysis suggested that the rate of increase of the smaller population would be reduced, and that the likelihood of survival of the population over 100 years would be reduced (Hill 1998).

A number of other threats to the Christmas Island Hawk-Owl have been suggested. All four nests recorded for this species have been in hollows in Gowok *Syzygium nervosum* and all nest sites are likely to be in tree hollows (Hill & Young 1995). Gowok is a common emergent tree, particularly in plateau forests, where it forms approximately 18% of the forest canopy and constitutes 30% of the emergent species (ABRS 1993). It is commonly greater than 35m high and has abundant hollows, unlike most other tree species in plateau forest (author, pers. obs). Gowok may, therefore, be a very important tree species for Christmas Island Hawk-Owls. Most Gowok on the island are large, old trees and there are few seedlings due to their predation by Red Crabs *Gercacoidia natalis*, an endemic land crab (P. Green, CSIRO, Atherton, pers. comm.). Thus the recruitment of large Gowok is currently limited. If Gowok is a major source of nest sites for Christmas Island Hawk-Owls, nest sites may eventually be in short supply. Terrace forest appears to have more species of trees with hollows than plateau forest (author, pers. obs) and may have more potential nest sites for the owls. Further nest tree data may show that owls can nest in a number of tree species.

Garnett (1992) suggested that road-kill by vehicles might be a threat to Christmas Island Hawk-Owls; however, from data collected between 1994 and 1996, this appears unlikely. In 2.5 years on

Christmas Island eight Hawk-Owls were found dead on the road, presumably killed by cars (author, unpubl.data), and the number killed on the road is probably not much greater than this. Although these road-killed birds could not be aged conclusively, it seems unlikely, even if all of them were adults, that this level of mortality would have a significant impact on population viability. It is conceivable that road kills may limit population density in the settled areas of the island where traffic volumes are high and owl densities low (Hill & Lill 1998). There are suggestions that the human population, and therefore the number of cars on the island, will increase markedly in the future. If this eventuates, collisions with cars might become an issue in the conservation of owl populations in settled areas.

A secure economic future for the island is essential to ensure continued support for the high standard of environmental management the island requires. Christmas Island is very remote and has a small human population. These factors conspire to make economic activity on the island uncertain. Maintaining services to the human community equivalent to Australian mainland standards is very expensive and governments are anxious for the community to be as self-supporting as possible. This environment can encourage uncritical enthusiasm for proposed development which might bring investment to the island. It was very encouraging to see the Australian government recently resist pressure to fast-track a proposed space launch facility on Christmas Island and instead to require a full environmental effects study. Such a development *may* help safeguard both the economic and environmental well-being of the island if the proposal is carefully assessed.

CONCLUSION

In summary the Christmas Island Hawk-Owl is vulnerable to extinction for a number of reasons: it has a small population size which has been reduced by habitat clearance and is restricted to one oceanic island with no opportunity for recolonisation. It has probably been isolated for a long time and is likely to be immunologically 'naïve' to avian diseases common in nearby continental avifaunas. Unusually for oceanic island fauna, it appears to some extent to be pre-adapted to cope with terrestrial predators, probably because it has coexisted with endemic arboreal rats and land crabs*. Currently it is only known to nest in one species of tree, which itself may be declining in abundance. Finally the island's economic vulnerability also increases the risk of extinction for the Hawk-Owl along with all its endemic biota.

The following recommendations were made to the wildlife management agency on Christmas Island for the long term conservation of wild populations of Christmas Island Hawk-Owls:

- To monitor the Christmas Island Hawk-Owl population every five years to detect any significant change in the distribution or abundance of the species. The recommended monitoring programme can detect changes in total population size of more than 20%.
- To maintain ongoing negotiations with all landowners to ensure protection of primary forests outside the national park
- To maintain [and regularly review] a quarantine barrier between Christmas Island and all other land masses minimising the risk of 'new' avian diseases becoming established on Christmas Island.
- To establish a community education programme to raise awareness and interest in the conservation of Christmas Island Hawk-Owls.
- To investigate options for control/removal of feral populations of Eurasian Tree Sparrows and Java Sparrows.

* Footnote: In December 1998 'supercolonies' of an exotic invasive ant *Anoplolepis gracilipes* were reported for the first time on Christmas Island (P. Green, CSIRO, Atherton, Australia), although the ant had been recorded on the island for many years. This 'Crazy Ant' forages in all strata of the forest and supercolonies of it may prevent successful breeding by most or all of the avifauna of Christmas Island (C. Beare, WildWings Bird Management, Surrey, UK, pers.comm.). An Action Plan for the control of Crazy Ants is currently being implemented by the Australian Government.

REFERENCES

- ABRS. 1993. Flora of Australia, Volume 50. Oceanic Islands 2. Australian Biological Resource Study, Canberra.
- ANCA 1994. Christmas Island National Park Plan of Management. Australian Nature Conservation Agency, Commonwealth of Australia.
- ANDREWS, C.W. 1900. *A Monograph of Christmas Island*. London, British Museum of Natural History.
- ANDREWS, C.W. 1909. On the Fauna of Christmas Island. *Proceedings Zoological Society of London*: 101-103.
- ATKINSON, I.A.E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on island avifaunas. In *Conservation of Island Birds* (ed.) P.J. Moors, ICBP/Technical Publication No 3:79-96.
- CAUGHLEY, G. & A. GUNN 1996. *Conservation Biology in theory and practice*. Blackwell Science, Inc. USA.
- COLLAR, N.J., M.J. CROSBY & A.J. STATTERSFIELD 1994. *Birds to Watch 2*. The World List of Threatened Birds. Birdlife Conservation Series No. 4. Birdlife International, United Kingdom.
- DIAMOND, J.M. 1985. Population processes in island birds: immigration, extinction and fluctuations. In P.J. Moors (ed.) *Conservation of Island Birds*. ICBP/Technical Publication No 3: 214-231
- GARNETT, S. 1992. *The Action Plan for Australian Birds*. Australian National Parks and Wildlife Service, Canberra.
- GRAY, H.S. & R. CLARK 1995. *Christmas Island Naturally*. 2nd Edition. Christmas Island Natural History Association.
- HILL, F.A.R. & A. LILL, 1998. Density and Total Population Estimates for the Threatened Christmas Island Hawk-Owl *Ninox natalis*. *Emu* 98: 209-220.
- HILL, F.A.R. 1998. The Conservation Biology of the Christmas Island Hawk-Owl *Ninox natalis*. Unpublished MSc thesis, Monash University, Melbourne, Australia.
- KING, W.B. 1985. Island birds: will the future repeat the past? In *Conservation of Island Birds*. ICBP, Technical Publication No 3: 276-295.
- MILBERG, P. & T. TYRBERG, 1993. Naïve birds and noble savages-a review of man- caused prehistoric extinctions of island birds. *Ecography* 16: 229-250.
- NORMAN, J. A., L. CHRISTIDIS, M. WESTERMAN & F.A.R. HILL, 1998. Molecular data confirm the species status of the Christmas Island Hawk-Owl *Ninox natalis*. *Emu* 98: 197-206.
- OLSEN, P.D. & T. STOKES, 1989. State of knowledge of the Christmas Island Hawk- Owl *Ninox squamipila natalis*. In B.U. Meyburg & R.D. Chancellor (eds) *Raptors in the Modern World.*, WWGBP, Berlin:411-414.
- SAVIDGE, J.A. 1984. Guam: paradise lost for wildlife. *Biological Conservation* 30: 305-317.
- SHAFFER, M.L. 1981. Minimum population sizes for species in conservation. *Bioscience* 31: 131-143.
- SOULÉ, M.E. 1987(Ed). *Viable Populations for Conservation*. Cambridge University Press, Cambridge.
- STOKES, T. 1988. *A review of the birds of Christmas Island, Indian Ocean*. Australian National Parks and Wildlife Service, Occasional Paper No. 16.
- TIDEMANN, C., H.D. YORKSTON, & A.J. RASSACK, 1994. The diet of cats, *Felis catus*, on Christmas Island, Indian Ocean. *Wildlife Research* 21: 279-286.
- VAN TETS, G.F. 1975. *A report on the conservation of resident birds on Christmas Island*. ICBP Bulletin XII.
- WARNER, R.E. 1968. The role of introduced diseases in the extinction of endemic Hawaiian avifauna. *Condor* 70: 101-120.

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