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SHORT NOTE

Storm damage to Westland petrel colonies in 2014 from cyclone *Ita*

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The Westland petrel (*Procellaria westlandica)* is a New Zealand endemic seabird which spends most of its life at sea in both New Zealand and South American waters, and returns to land in winter to breed (Baker & Coleman 1977). They breed exclusively near Punakaiki on the West Coast of the South Island, nesting in a specially protected area of 16 km^2 (Department of Conservation 2002). They lay their single egg in burrows of 1 to 2 m long in indigenous coastal broad-leaf/podocarp forest (Waugh *et al.* 2003; ACAP 2013). The population is estimated to be stable or slightly increasing, based on demographic studies at the largest colony (Waugh *et al.* 2015). The species has a threat ranking of vulnerable under the IUCN listing (BirdLife International 2012), on the basis of its restricted breeding range.

In April 2014 the tropical cyclone *Ita* developed in the South Pacific region. The remnants of the cyclone hit the west coast of the South Island on 17 April 2014, with strong southeast winds – gusts of 126 km/h were recorded at Westport Airport, the highest since 1973 when records began (NIWA 2015), along with heavy rain. Southeast winds are rare in this area. This caused widespread damage to indigenous forest, with many trees uprooted or damaged. The storm also affected the petrel colonies: windfall of canopy trees and landslips were recorded in the nesting areas of the Westland petrel, especially on steep slopes and ridges, where petrel nests are concentrated (Waugh 2014). Many trees and tree-ferns were stripped of foliage, although many have subsequently regrown their leaves. One year after the storm, we conducted a survey of the storm damage on 6 of the most accessible of the breeding colonies. Our objective was to conduct a preliminary assessment of the extent of storm damage to the colonies, so that quantitative surveys could be planned and implemented.

Westland petrels nest in 21 colonies, which were identified by Baker *et al.* (2011) using quantitative transect surveys. Most of the breeding population of 2,827 breeding pairs (95% CI; 2,143—3,510) occurs in 9 colonies varying in size between 200 – 1,500

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Table 1. Summary of damage caused by tropical storm *Ita* in April 2014 on Westland petrel colonies. Numbers of burrows reported by Baker *et al.* (2011). Scale of damage qualitative assessment rating: Low (<10%), Moderate (10 - 25%), High (25 - 50%), or Very High (>50%) proportion of habitat affected within the colony. Affected areas include landslips within or immediately adjacent to burrowed areas, or windfall of canopy trees within colony areas.

Colony name	Number of burrows (date)	Windfall of canopy trees within central part of colony	Landslips within colony or nearby	Scale of damage qualitative assessment	Observer(s) (date)
Study	1656 (2011)	¼ - ½ of canopy trees fallen	Large landslips encroaching on lower margins of colony, including areas with burrows	High	S.W., K-.J.W. (24 April 2014 27 March 2015)
Liddy's	1062 (2008)	Few trees fallen observed from the upper margins of the colony	None observed	Low	T.P., S.W. (28 March 2015)
Rowe	959 (2008)	¼ - ½ of canopy trees fallen in lower section of colony; ½ - ¾ of canopy trees fallen in upper section; many trees fallen along ridge crest at top of colony	Upper area substrate dislodged in major landslip, removing most burrows within ~½ of area of colony; smaller slips in lower section affecting some burrows	Very high	S.W., K-.J.W. (21 July 2014, 18 March 2015)
Solomon's	913 (2007)	Few trees fallen (S.W. observed by binoculars)	None observed	Low	A. Bollinger, *pers. comm.* (27 March 2015). S.W. *pers. obs.* (28 March 2015)
Middle	331 (2008)	Most canopy trees in upper section fallen, comprising around ¼ - ⅓ of trees in colony	Slips in southern margin of colony; unknown whether this slip included burrows	High	T.P., S.W. (28 March 2015)
Island or Knoisy Knob	325 (2011)	Most canopy trees fallen in upper section of colony	Major landslips on southwest of colony removing ½ -⅔ of soil in colony	Very high	T.P., S.W. (27 March 2015)

burrows or 99 – 870 breeding pairs per year (Baker *et al.* 2011). We visited 2 of the colonies immediately after the storm in April and then in July 2014, and these plus a further 3 colonies in late March and early April 2015 (up to 1 year after the storm). A sixth colony was observed using binoculars, and we discussed its condition with the neighbouring land owner (A. Bollinger, *pers. comm.*). The colonies we assessed were all accessible from the Scotsman's Creek catchment. These colonies comprise the nesting habitat of >75% of the total Westland petrel population (Baker *et al.* 2011), and vary in size from 325 – 1656 burrows (Table 1). We walked through parts of each colony, and obtained vantage point views of most colony areas, noting the occurrence of fallen trees and landslips in relation to the location of petrel burrows in previously mapped areas (Baker *et al.* 2011). Our observations were qualitative only, except at Rowe and Study colonies, where we had detailed data on the location of individual burrows from before the storm and could assess the proportion of monitored burrows affected by soil movement and tree fall (images of the damage at 2 colonies are available in Waugh [2014]).

EX-TROPICAL CYCLONE *ITA'S* DAMAGE TO THE PETREL COLONIES

All the colonies visited showed some degree of damage from ex-tropical storm *Ita*. Canopy trees were toppled, and on steep slopes forest and soil had been carried away, leaving exposed bedrock. Uprooted trees had disturbed burrows, and the resulting fallen trunks and branches blocked access to some burrows.

The severity of damage appeared to depend on colony location and exposure to south-easterly wind gusts. Two colonies, Solomon's and Liddy's avoided major damage from the storm, with just a few canopy trees fallen in each, and there was little apparent soil disturbance in the areas visited (Table 1). However, it should be noted that not all parts

of every colony were visited and damage may have occurred in inaccessible areas.

Damage at Middle colony was characterised by a significant amount of windfall of canopy trees in the upper areas of the colony, and one area of landslips at the southern margin of the colony. Precise estimates of the proportion of the colony affected will not be available until mapping of the colony and damage areas can be completed.

Considerable areas of landslips destroyed burrows and parts of the breeding habitat at 3 Westland petrel colonies: Study, Rowe and Knoisy Knob (the latter also called The Island; Table 1). At the monitored colonies, Study and Rowe, 25/91 (27%) and 27/64 (42%) of monitored burrows, respectively, were lost as a direct result of the storm. As approximately 1/3 of the breeding burrows at each of these 2 colonies were monitored throughout the central areas of each colony, these figures are probably representative of the overall losses of burrows for each colony. At Knoisy Knob, landslips have removed all soil and vegetation in areas with high burrow density, and we estimate that around half of the area of the colony has been removed by landslips.

Aerial photography was undertaken after the tropical storm, indicating considerable areas of windfall in some areas in the northeast of the Westland Petrel Specially Protected Area (S. Freeman, *pers. comm*.), an area where some of the more remote colonies are located. These areas of habitat were not surveyed in our study, but the occurrence of tree falls suggests these colonies may also have incurred damage.

Landslips have occurred in the Westland petrel colonies in the past. A major slip occurred in the Study colony prior to 1969 and at Liddy's Creek in 1983 (J.A. Bartle, *pers. comm*.). These are likely to have resulted in destruction of burrows and at Liddy's Creek colony, the slip occurred during the breeding period, probably leading to the death of breeding birds. In 1995 a slip was observed at Rowe Colony (K-J.W., *pers. comm*.), and in 2011, a section of hillside to the west of the Rowe colony slumped down removing all forest and soil in an area immediately adjacent to the breeding colony (S.W and K-J.W., *pers. obs*.).

Heavy rainfall in the Westland and Buller areas is a normal feature of the climate, and the April 2014 records show anomalies of between 100-200% of the annual rainfall totals for the last 30 years (NIWA 2015). Rainfall in the Scotsman's Creek catchment was an average of 2350 mm per year (2011 – 2015, all rainfall data from J. Washer, *pers. comm*). During the week of 17 April 2014, 143 mm of rain was recorded at this site, with daily records of up to 28 mm. Intense rain in those colonies which lost vegetation likely contributed to the landslips we observed. The storms which appear to provoke large-scale forest damage and landslips are predicted to increase in severity and frequency in future with climate change (IPCC 2007; Rhein *et al.* 2013).

Despite the disturbance from *Ita* occuring during the pre-laying stage (eggs are laid between the first and last weeks of May each year), birds in monitored burrows were observed breeding normally in 2014, and had an average-to-high breeding success: 60% at Rowe colony (n = 10 nests) and 74% at Study colony (n = 23 nests), compared with an average of 60% eggs fledged in the years 1993–2003 and 2012. For Westland petrels, however, the rate of nesting success does not currently appear to be a limiting factor for the population. While this species can breed every year, many individuals do not, with only 54% of the available population of birds attempting to breed in any one year. Thus, breeding frequency may be a limiting factor in population growth (Waugh *et al.* 2015). Nevertheless, factors which further reduce the breeding opportunities for birds, such as destruction of their breeding habitat, may influence the population's growth in the future.

One case of nest failure among the 35 monitored breeding burrows in 2014 could be attributed directly to the storm damage, after an uprooted tree destroyed the nest entrance. The pair attending this nest had a small chick in a burrow less than 50 cm long in July 2014; no chick was observed in November when the next checks were made, and the chick was assumed to have died in the intervening period. Predation by weka (*Gallirallus australis*), inundation, or lack of thermal protection for unguarded chicks are likely causes of nest failure in burrowing petrels. For the majority of burrows which were destroyed by soil movement or fallen trees in April 2014, it is difficult to monitor the outcomes for individual birds displaced by the storm. These birds may have tried to breed in new or vacant burrows in 2014, or may have been able to access burrows where it was impossible or too dangerous for researchers to visit.

CONCLUSIONS

Ex-tropical cyclone *Ita* impacted many Westland petrel colonies in April 2014. Our preliminary survey assessed damage at colonies containing over 75% of the estimated breeding population of Westland petrels, and high levels of damage were noted at 4 of the 6 colonies assessed. In some of these areas, a major part (over 50%) of the breeding habitat has been destroyed by landslips. Further detailed surveys are required to quantitatively assess the impacts on the breeding population and nesting habitat. Given the threatened status of this species, and its restricted distribution, this work is

of a high priority. The programme of demographic research on the Westland petrels at Rowe and Study colony continues, and assessment of the impacts of the storm on survival, breeding frequency and breeding output of individuals may be possible over coming years.

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