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SHORT NOTE

Tree damage in Wellington as a result of foraging for sap and bark-dwelling invertebrates by the North Island Kaka (*Nestor meridionalis septentrionalis*)

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Kaka (*Nestor meridionalis*) forage for sap and invertebrates by removing bark and digging into the wood of live and dead trees. Damage to live trees as a result of sap feeding has been observed in native and plantation forests around the country, including in Westland (O'Donnell & Dilks 1989), Nelson (Innes 1994), Pureora (Innes 1994), Whirinaki (Beaven 1996), and on Stewart and Little Barrier Is (O'Donnell 1993). Two techniques of sap feeding have been described: stripping bark to expose the surface cambium, and the prising open of horizontal 'trapdoors' (O'Donnell & Dilks 1989). Kaka also feed on a variety of bark or wood-dwelling invertebrates, particularly kanuka longhorn beetles (*Ochrocydus huttoni*) in mountain beech (*Nothofagus solandri* var. *cliffortioides,* Beggs & Wilson 1987)and Hall's totara (*Podocarpus hallii*, O'Donnell & Dilks 1994). Although sap and bark-dwelling invertebrate foraging is known anecdotally, there is little literature describing the behaviour or resulting tree damage. Damage has not been previously described in urban areas, and apart from a study of sap feeding damage in plantation forests (Beaven 1996), research has been restricted to native forests. In this study, I detail the damage done to trees in urban areas of Wellington city from a reintroduced population of kaka.

North Island kaka (*N. m. septentrionalis*) were reintroduced to the Wellington region with the release of 6 captive-reared kaka to Karori Wildlife Sanctuary (-41.29°S, 174.75°N) in Aug 2002 (Miskelly *et al.* 2005). Subsequent translocations and local breeding have led to a current population in the area of 200-250 birds (Raewyn Empson, *unpubl. data*). Kaka are provided with supplementary food and nest boxes within the sanctuary's predator-proof fence but range widely outside the sanctuary borders. They are commonly sighted in the suburbs surrounding the sanctuary and have been seen as far as Makara (-41.27°S, 174.71°E), Tawa (-41.18°S, 174.82°E) and Red Rocks (-41.35°S, 174.69°E). The establishment and growth of the kaka population in Wellington is a wildlife restoration success.

From mid-2010 to mid-2012 I collated reports of bark damage from the public and Wellington City Council and Wellington Botanical Gardens employees. All reports of damage were followed up and personally observed by myself to confirm that damage can be attributed to kaka. Additional tree damage was also identified by opportunistic

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Fig. 1. Currently known distribution of tree damage caused by North Island kaka in Wellington, New Zealand. Each occurrence of tree damage is indicated by an X.

personal observation during other fieldwork. Bark damage was observed on trees in the Wellington Botanical Gardens, Wellington City Council parks, road reserves and verges and on private land in many suburbs throughout the city (Fig. 1.).

Two types of tree damage have been observed. The 1st consists of transverse gouges spaced at regular intervals along the trunk and main branches (Fig. 2). These often expose the vascular cambium and dried sap can be present. Gouges can be up to 40 cm long but rarely extend beyond 2/3 of the circumference of the trunk or branch. Similar to observations by O'Donnell and Dilks (1989) on southern rata (*Metrosideros umbellata*), trees with signs of sap feeding often have hundreds of scars. Trees near to those with extensive damage have been observed with 1-5 scars, suggesting that kaka may test a number of trees before selecting a preferred tree for foraging. This type of damage was observed on only a small number of species in Wellington, predominantly *Eucalyptus* spp. This technique of sap feeding appears to be distinct from the 'trapdoors' described by O'Donnell and Dilks (1989)as cambium is exposed in a continuous horizontal scar and bark is removed rather than levered downward.

The other type of damage is characterised by strips of bark being peeled off the trunk and/or branches of a tree (Fig. 3.). This results in patches of exposed vascular cambium that vary in size from a few centimetres to up to 2 m long. Some trees may only have 1 patch of removed bark whereas others have many areas of damage on the trunk and/or lateral branches. This type of damage has been observed on a wide variety of species, particularly conifers.

Damage has been observed on >32 taxonomically diverse tree species in Wellington city (Table 1). In some cases, damage is selective and localised, with damage located on one or a few clustered trees with surrounding trees undamaged. In other areas, such as the Wellington Botanical Gardens, large groves of trees have been damaged. This represents the 1st known observation of kaka damage on many of these species and on such a large number of tree species in 1 area. It has been suggested that sap feeding behaviour is not common and is likely to be restricted to a few plant species (O'Donnell 1993). Observations in Wellington city indicate that kaka may be able to utilise sap from a wider variety of tree species than previously thought.

Tree damage in Wellington has been observed predominantly on conifers and *Eucalyptus* species. Previous observations of kaka sap feeding in native forest habitats have also predominantly been on Myrtaceae species; rata (O'Donnell & Dilks 1989), hybrid rata/pohutukawa (O'Donnell 1993), and kanuka (*Kunzea ericoides*, Chris Smuts-Kennedy, *pers. comm*.), or conifers; rimu (*Dacrydium cupressinum*, O'Donnell 1993), matai (*Prumnopitys taxifolia*, Beaven 1996), tawa (*Beilschmiedia tawa*) and totara (*Podocarpus totara*, O'Donnell 1993; Beaven 1996). Why these taxa are favoured is unknown. Perhaps it is due to the sugar concentration or

Fig. 2. Damage to *Eucalyptus* sp. in Wellington, New Zealand as a result of sap feeding by North Island kaka. Horizontal gouges through the bark layer are characteristic of damage to this tree genus.

Fig. 3. Damage to *Thujopsis dolabrata* in Wellington, New Zealand as a result of sap feeding by North Island kaka. This type of damage is present on many tree species, particularly conifers.

volume of sap, or bark characteristics affecting sap accessibility. Removing bark to feed on sap is rare among vertebrates, yet among other sap feeders similar tree species are targeted. Marsupial gliders in Australia specialise in feeding on *Eucalyptus* sap (Craig 1985), and Hawaiian honeycreepers (*Hemignathus munroi*) forage for sap exclusively on *Metrosideros polymorpha* (Pejchar & Jeffrey 2004).

Native tree species in Wellington city, particularly within the Karori Wildlife Sanctuary, have also sustained damage. Sap feeding scars have been identified on mahoe (*Melicytus ramiflorus*), ramarama (*Lophomyrtus bullata*) and kanuka and 2 female kaka were observed removing bark and licking exudate from the exposed sapwood of mahoe (*pers. obs*.). Scars resulting from extraction of pururi moth (*Aenetus virescens*) larvae from mahoe trunks have also been observed within Karori Wildlife Sanctuary (*pers. obs*.). Bark damage has not been observed in Wellington on totara, rimu, rata or pohutukawa (*Metrosideros excelsa*), despite their presence near to damaged trees.

The tree damage caused by kaka in Wellington is a concern for a number of reasons. Damage compromises the structural integrity of the tree, leaving it vulnerable to branch fall especially during high winds (James Jones, *pers. comm*.). Epicormic growth has been observed on damaged *Eucalyptus* spp. This is characterised by rapid shoot elongation with little secondary growth, resulting in numerous weak stems. Due to their location in urban streets, parks and backyards these trees are a significant hazard.

Bark damage may cause crown dieback (Innes 1994) and this has occurred on a number of trees in Wellington. Dieback and epicormic growth indicate physiological stress which may increase a tree's vulnerability to infection (Schoeneweiss 1975) and bark removal may increase susceptibility to pathogens (Beaven 1996). Damaged trees must be monitored, and hazardous branches or whole trees removed if they are assessed as a risk.

Damage appears to be mainly present in large mature trees. In the Botanical Gardens many of the trees targeted have historical value as they represent some of the earliest plantings of exotic trees, particularly conifers, in New Zealand. Damaged trees include those listed as notable trees.

Table 1. Tree species observed to have bark damage caused by North Island kaka in Wellington, New Zealand. Unless otherwise indicated all damage has been observed directly by the author.

Species	Common Name	Location
Chamaecyparis lawsoniana	Lawson's cyprus	Wellington Botanical Gardens, Brooklyn
Thujopsis dolabrata	Japanese cyprus	Wellington Botanical Gardens
Taxodium distichum	Bald cyprus	Wellington Botanical Gardens
Sequoia sempervirens	California redwood	Wellington Botanical Gardens
Sequoiadendron giganteum	Giant sequoia	Wellington Botanical Gardens
Metasequoia glyptostroboides	Dawn redwood	Wellington Botanical Gardens[1]
Cupressus macrocarpa	Macrocarpa	Wellington Botanical Gardens, Newtown
Pseudotsuga menziesii	Douglas fir	Wellington Botanical Gardens
Pinus radiata	Radiata pine	Wellington Botanical Gardens
Pinus nigra	European black pine	Wellington Botanical Gardens
Pinus pinaster	Maritime pine	Wellington Botanical Gardens
Betula pendula	Silver birch	Wellington Botanical Gardens
Thuja plicata	Western red cedar	Wellington Botanical Gardens[1]
Cedrus atlantica	Atlas cedar	Wellington Botanical Gardens
Cedrus deodara	Himalayan cedar	Wellington Botanical Gardens
Cryptomeria japonica	Japanese cedar	Newtown
Juniperus chinensis	Chinese juniper	Wellington Botanical Gardens
Eucalyptus pulchella	White peppermint	Wellington Botanical Gardens
Eucalyptus gunnii	Cider gum	Newtown
Eucalyptus spp.(unidentified)	Gum	Aro Valley, Newtown
Acacia sp. (unidentified)	Acacia	Brooklyn
Quercus robur	English oak	Wellington Botanical Gardens[1]
Chiranthodendron pentadactylon	Devil's hand tree	Wellington Botanical Gardens
Liriodendron tulipifera	Tulip tree	Wellington Botanical Gardens[1]
Prunus serrulata	Flowering cherry	Northland, Aro Valley
Prumnopitys ferruginea	Miro	Wellington Botanical Gardens[1]
Vitex lucens	Puriri	Wellington Botanical Gardens[1]
Sophora microphylla	Kowhai	Wellington Botanical Gardens
Kunzea ericoides	Kanuka	Wellington Botanical Gardens
Melicytus ramiflorus	Mahoe	Karori Wildlife Sanctuary
Lophomyrtus bullata	Ramarama	Karori Wildlife Sanctuary
Pseudopanax arboreus	Five finger	Khandallah

[1] Observed by James Jones, Wellington Botanical Gardens

In addition to removing the bark of trees, there is some evidence that kaka cause other vegetation and property damage in Wellington city. This includes anecdotal reports from residents that kaka are eating crops of fruit or nuts and causing minor damage to joinery, cladding and chimneys. Similar problems caused by sulphur-crested cockatoo (*Cacatua galerita*) in Australia provide an example of the potential for parrots to generate human-wildlife conflict in urban areas. When attracted by food provision, these birds damage garden furniture, window and door frames and solar water heating systems (Temby 2004).

Damage on private property, although unlikely to have significant impact on livelihoods, is still cause for concern. Residents may be unaware of the safety risks posed by limbs weakened by bark removal. Property damage from kaka may also change people's attitudes and behaviour toward kaka and perhaps lessen their support for conservation. Ensuring public support is vital for private conservation organisations, such as the Karori Sanctuary Trust, that rely on donations from the public. Overseas research has found that experiencing property damage by wildlife may reduce people's support for conservation (Gadd 2005).

A detailed study of sap feeding may be important to the long term conservation of kaka (O'Donnell & Dilks 1989) and the Wellington population is ideal for studying this behaviour. The population is almost entirely banded and breeding is closely monitored, enabling individual identification and the collection of age, sex and group relationship data. The presence of kaka in an urban area also provides increased opportunities to directly observe the behaviour of kaka while engaged in sap and invertebrate foraging.

It has been suggested that sap may be an important supplementary food during late winter and early spring when there is a shortage of high energy food available (O'Donnell & Dilks 1989). Supplementary food (sugar water, parrot pellets, and a commercially prepared nectivore food) is provided within Karori Sanctuary year round, and the availability of easily accessible high quality food may reduce the need for sap feeding. The identity of kaka visiting feeders within the sanctuary is monitored monthly and provides an opportunity to investigate whether the same or different individuals also engage in sap foraging.

Given recent breeding success, it is likely that the kaka population in Wellington will continue to grow and therefore this problem is likely to increase. Further study of kaka behaviour that results in tree damage is warranted. Investigation into tree and site selection for sap and invertebrate foraging and the extent of damage in Wellington city will provide an understanding of the current situation and may enable predictions as to future changes. Research may enable practical recommendations for reducing damage and mitigating costs associated with monitoring and tree removal.

Research into social as well as ecological aspects of wildlife issues has been found to be vital in understanding and managing human wildlife conflicts overseas (Dickman 2010). Consideration of people's attitudes towards kaka and kaka damage will provide an understanding of the scope of this issue from a human perspective. With continued conservation success, avian-human conflict may increase in New Zealand and it is important to investigate how experience of conflict may impact on environmental attitudes, beliefs and behaviours.

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