

## SHORT NOTE

# Regurgitation of seeds from a native plant by the introduced common starling (*Sturnus vulgaris*)

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The regurgitation of large seeds is commonly observed in many frugivorous bird species (Corlett 1998; Meyer & Witmer 1998; Snow 1971; McKey 1975; Levey 1987). Many fruiting plants rely on regurgitation for seed dispersal, particularly those with large seeds (Meyer & Witmer 1998; Snow 1971; McKey 1975; Levey 1987). Regurgitation is thought to be an adaptation to disposing of seeds from some species of fruits that are too large and energetically costly to pass through the gut (Levey 1987). It reduces the weight and volume of material that pass through the gut, as the intake of indigestible seeds results in extra loading (Corlett 1998). By regurgitating seeds, frugivorous birds can reduce energy expenditure necessary for flight as well as any additional energy required to manipulate and transport them through the gut. Furthermore, the presence of indigestible seeds can limit food ingestion, and in turn reduce the rate at which food can be processed and nutrients assimilated (Corlett 1998; Levey 1987). For many fruiting plant species, having seeds treated "gently" can increase germination success (Meyer & Witmer 1998), and thus seeds may benefit from not having to travel the full length of the gut.

Despite its importance for understanding dispersal of native plants, the regurgitation of seeds by birds in New Zealand has been only rarely observed (Wotton *et al.* 2008), with no previously

recorded instances of introduced bird species regurgitating the seeds of native plant species. In this note, I describe an observation of the introduced common starling (*Sturnus vulgaris*) regurgitating seeds of a native plant.

On 12 Apr 2011 at 11:20 am in Kowhai Bush, Kaikoura (173° 37' E, 42° 23' S), I observed a single adult common starling regurgitating seeds. The bird was sitting in a tree at a distance of ~20 m, and I observed its behaviour for ~10 minutes. The observation was recorded onto an Olympus digital voice recorder and later transcribed. Approximately 15 to 20 seeds were regurgitated; these dropped to the ground and were collected after the bird flew away and later examined under a dissecting microscope. I identified the seeds as five-finger (*Pseudopanax arboreus*; Fig. 1).

Mature five-finger trees are common at the study site and produce large quantities of small black fruits in early autumn (Fig. 1), which are consumed by native frugivorous birds, particularly silvereyes (*Zosterops lateralis*) and bellbirds (*Anthornis melanura*; Williams & Karl 1996). Consequently, five-finger is probably dispersed by a variety of frugivorous bird species. Most of the seeds collected from the starling were regurgitated whole and intact, but several (20-30%) had the outer flesh removed. Not all the seeds could be retrieved so it was not possible to estimate the exact number that had the outer flesh removed. As the outer flesh on the majority of seeds was incompletely digested, it is likely that any benefit the seed obtained

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Fig. 1. Five-finger fruit with a 5 mm scale. Photo was taken in Kowhai Bush, Kaikoura.

in terms of processing would be minimal as would the nutrient assimilation for the starling.

Compared to other potential fruit seeds in New Zealand, the size of five-finger seeds was relatively small. Each fruit contained 2 flat oval seeds with a diameter of  $3.2 \pm 0.1$  mm across the mid-section (Fig. 1). Seeds of this size are generally smaller than that seen regurgitated elsewhere in the world, with birds predominately regurgitating only the larger seeds (Levey 1987). However, some bird species when stressed or after ingesting toxic fruit regurgitate seeds (McEwen 1978; Herrera 2002). Thus, it is possible that the observed bird may have regurgitated the seeds not as an action derived from the potential energetic value gained in expelling indigestible seeds but to relieve an unknown stress. There is anecdotal evidence that five-finger is mildly toxic (Connor 1977). Most frugivores can learn which fruits are toxic, and thus learn to avoid them or feed on them sparingly (Herrera 2002). Yet, I observed starlings visiting and feeding on the trees repetitively in large flocks. If five-finger fruit was toxic, birds would avoid these plants. As this was not the case it is unlikely that the observed starling was reacting to toxins in the fruit.

This is the first report of an introduced bird species regurgitating seeds in New Zealand. The regurgitation of seeds by starlings has previously been observed in captivity (LaFleur *et al.* 2009), and in the wild (Spennemann 1998). Although I only observed 1 individual dispersing seeds via regurgitation, large flocks of 40-50 starlings were often observed feeding on five-finger fruit in Kowhai Bush. Due to the large numbers of starlings feeding on five-finger, it seems likely that considerable quantities of seeds were

dispersed in Kowhai Bush and into surrounding areas. This is important because, unlike many native bird species, starlings are a predominately pastoral species in New Zealand (Coleman 1972; Coleman 1977), and they may act as an important dispersal agent of five-finger both within native forests and into the surrounding pastoral environment. The dispersal of seeds into pastoral environments could promote the reestablishment of native vegetation in areas that are not frequented by native bird species.

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