I found no evidence of pollen limitation or an Allee effect acting *L. polyphyllus*. In fact there was a significant negative correlation between patch size and fruit and seed set, which suggests plants in large patches may be resource limited. There was no significant difference in seed set of supplementary pollinated and control flowers, which suggests this species is not pollen limited. There was also no evidence of an Allee effect acting on *L. arboreus*.

I did find a significant positive correlation between patch size and pollinator visitation rate for *L. polyphyllus*, but there was no evidence of increased fruit and seed set with increasing visitation. These results suggest that restricting the placement of commercial beehives around *Lupinus* patches would not help control their spread.

Despite the wide range of patch sizes and densities sampled, I did not find any evidence of a positive relationship between patch size or density and seed production. Therefore it is unlikely that pollination service will affect the population dynamics of these species.

Acknowledgement
I would like to thank the Auckland Botanical Society for choosing to support my research.

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Ecological Survey of Motukaraka (Flat Island), Beachlands, Auckland

James C. Russell, Ewen K. Cameron, Jamie W.B. MacKay, Jane L. Dudley & Mick N. Clout

Motukaraka (Flat) Island (5.6656ha; 36.8797° S, 174.9788° E; NZMS 260 R11, 2686800E, 6478500N; Fig. 1, 2) lies just under 500m off the coast of Beachlands, southeast Auckland (not to be confused with Motukaraka Island in the Rangauna, Hokianga or Whangarei Harbours). Dry-access is available approximately 2-3 hours either side of low-tide along a raised shellbank (note – this shellbank appears to have reduced in height over the last 15 years, which coincides with the construction of the nearby marina). Motukaraka was historically a Ngati Paoa pa site and was gazetted on 18 March 1905, becoming the first historic category Scenic Reserve in New Zealand. In 1965 a fire swept across the island for three days removing all vegetation except a few coastal pohutukawa (Anon. 1998), and the resulting bare plateau can clearly be seen in a 1967 aerial photo (Fig. 3; Anon 1980). It is believed that following this fire rabbits, possums and naturalised plants established on the island. Manukau City Council acquired the Beachlands Domain in 1952 and the island has been managed as a crown reserve since that date. Attempts to transfer management to the Hauraki Park Maritime Park in 1983 were rejected following a survey reporting the poor ecological condition of the island.

Fig 1. Motukaraka from North Howick. 20 Nov 2005.

Fig. 2. Motukaraka from Beachlands access (staircase). 20 Nov 2005.

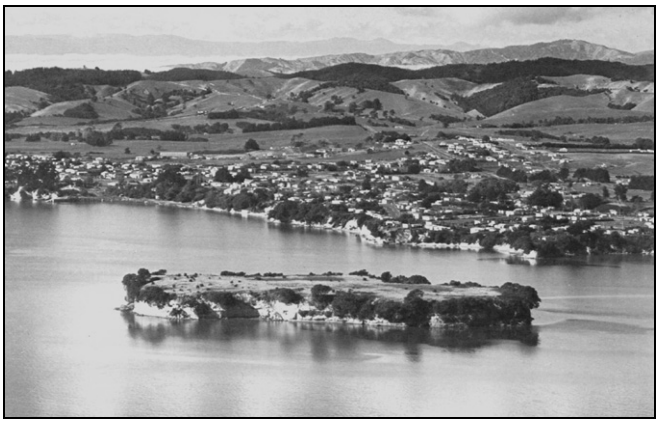

Fig. 3 Motukaraka in 1967 following the 1965 fire.

Following interest in the island around the late 1980s (Cameron and Taylor 1990) the island became a focus for restoration efforts, primarily led by a Forest and Bird South Auckland volunteer group formed in late 1990 and led by Joan Willan and Steve Quinn. Surveys at that time describe the bare vegetation (Fig. 4) as well as the presence of introduced garden snails, possums, rabbits and ship rats (Cameron and Taylor 1990). A follow-up survey also took place in 1991

(Cameron 1992; Beever 1992). From 10 September to 9 October 1990 Ace Environmental Services Limited undertook rabbit, possum and rat control across the island, though control rather than eradication appears to have been the goal. They comment on there being "more [rats] than anticipated". By 1994 possums and rabbits remained at very low numbers following ongoing poisoning. From 11 October to 10 November 1997 Malcolm Page (Manukau City Council) led a second concerted control programme for all three mammal species, including six permanent bait stations, but no follow-up monitoring appears to have been undertaken. In 1997 an elaborate staircase was constructed from the beach to summit plateau, and some water drainage issues around the stairs arose. Periodic Detention (PD) workers played a major role in clearing weeds from the island. Eleven karaka (*Corynocarpus laevigatus*) trees (1.0-7.5m tall) were present by the island's staircase in the late 1980s, and further karaka were planted in March 1997 west of the staircase. An official opening day was held on 6 July 1997 with the anticipated planting of 300 pohutukawa (*Metrosideros excelsa*). A 1998 survey by the Auckland Museum Institute Conchology Section describes the molluscs on the surrounding mudflats (Morley *et al.* 1998), and in that same year a Forest and Bird magazine conservation brief (Anon. 1998) describes the replanting efforts by the 'Motukaraka Conservation Volunteers' (formerly 'Local Conservation Volunteers' formed in late 1996). Rabbits were still seen on the island on 30 March 1998 (Joan Willan pers. comm. to EKC, April 1998). The N.Z. Gazette (15 August 2002) notes the incorporation of the 'Motukaraka (Flat) Island Reef Society Incorporated'. In 2003 an arbor day planting and a trip to the island by three members of the Auckland Museum Institute Conchology Section occurred.

Fig. 4. Motukaraka plateau "pasture" when rabbits were common. 17 Sep 1989.

It has been over 15 years since the previous full survey of Motukaraka and because of the large amount of activity since then it seemed timely to revisit the island.

Recent mammal management

From November 2005 to February 2006 the island was visited eight times and various mammal detection devices were placed at sites of six Victor professional yellow-treadle rat-traps (Fig. 5) baited with peanut butter or rat-attract (Connovations Ltd, Auckland), sometimes tied up trees to target ship rats. Variously, 5% and 10% peanut butter infused wax-tags (Pest Control Research, Christchurch) with flour/icing sugar blaze, tracking tunnels (Connovations Ltd, Auckland) with nutella or peanut butter bait and half-apples or pears pinned down were also placed.

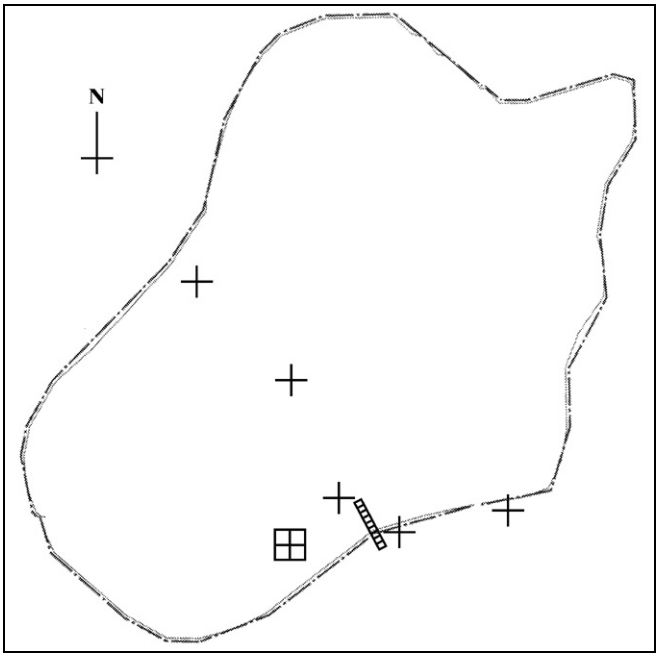

Fig. 5. Trap locations; + = trap site; □ = shed; □□□ = staircase.

Mammal detection revealed the presence of possums (apples and pears wholly taken and incisor marks in wax-tags) and mice (trapped, tracked and 1mm incisor marks in wax-tags). Wax tags placed 10cm off the ground were still reached by mice. Snap-traps wired in trees without covers were also still reached by mice and probably gave no advantage for targeting ship rats. No sign of rabbits was observed on the island, and despite substantial effort with waxtags, tracking tunnels and traps no rats were detected. Rabbits and rats were probably substantially reduced in numbers following control in 1997 to almost complete eradication. It is possible to eradicate a species without having killed every animal (Liebhold and Bascompte 2003), and so it seems most likely that since that time the remaining rabbits have either died off or left, and rats too have also disappeared. Possums remain on the island and may be occasionally dispersing from the mainland across the dry shellbank. The yellow-treadle Victor traps were very suitable for catching mice, which were not detected during Cameron and Taylor's (1990) investigation despite trapping for them, so it seems most likely that they have invaded since that time, probably facilitated by the absence of competing rodents on the island (Tennyson and Taylor 1999; Courchamp and Caut 2005), though mice are often difficult to detect when rats are present (Weihong *et al.* 1999). Whether mice

Table 1. Vascular plant additions to Motukaraka

Scientific name	Common name	Abundance	Notes
Wild plant additions (* = naturalised species)			
*Cynodon dactylon**	Indian doab	local	near top of staircase
*Pennisetum clandestinum**	Kikuyu grass	local	clumps by top of staircase
*Physalis peruviana**	cape gooseberry	local	plateau
*Raphanus raphanistrum**	wild radish	x2	shellbank
Planted species (= additions to the species list)**			
*Beilschmiedia tarairi***	taraire		
Corynocarpus laevigatus	karaka		
*Dacrycarpus dacrydioides***	kahikatea	x1	
Entelea arborescens	whau		
*Hedycarya arborea***	pigeonwood		
*Hoheria populnea***	lacebark		
*Kunzea ericoides***	kanuka		
Leptospermum scoparium	manuka		
*Melicope ternata***	wharangi		
Metrosideros excelsa	pohutukawa	many	
Phormium tenax cultivars**	coloured flax	many	
*Plagianthus divaricatus***	saltmarsh ribbonwood		
*Podocarpus totara***	totara	x1	
*Pseudopanax crassifolius***	lancewood		
P. crassifolius x *P. lessonii*	hybrid pseudopanax	x1	
*Rhopalostylis sapida***	nikau		
*Olearia solandri***	coastal tree daisy		
*Vitex lucens***	puriri		
Redetermination			
Calystegia sepium to *C.* ?hybrid*	bindweed	abundant	plateau weed
Major change in abundance (la = locally abundant, lc = locally common; o = occasional; r = rare)			
*Araujia sericifera**	moth plant	r to lc	plateau weed
*Atriplex prostrata**	orache	r to lc	shellbank
*Cortaderia jubata**	purple pampas grass	o to la	plateau weed
*Cortaderia selloana**	pampas grass	o to la	plateau weed
*Cotoneaster glaucophyllus**	cotoneaster	2 plants to lc	cliff weed
Historical addition (reference pers. comm. Bec Stanley)			
Clianthus puniceus	Kaka beak		(Cheeseman 1925: 527): "Flat Island, near Howick, *T.F.C.*, not uncommon in 1878, but has been extinct for many years."

were transported during the recent increase of human activity on the island, or dispersed across the relatively large 500m sandflats is unknown, though mice may have possibly also crossed over the 2km of tidal flats to invade Moturemu in the Kaipara Harbour. It is highly likely that stoats occasionally visit the island from the agricultural back-drop as was noted at Haulashore island, Nelson (Russell 2005).

Current vascular plant status

Ewen Cameron assisted by Jane Dudley revised the species list for the island during a brief visit on 17 February 2006. The base line survey of Cameron & Taylor (1990) with additions from the Auckland Botanical Society field trip of September 1991 (Cameron 1992) was compared with the present visit; planted species were also recorded. These additions and comments are grouped above (Table 1).

The two additional grasses, kikuyu (*Pennisetum clandestinum*) and Indian doab (*Cynodon dactylon*), may have been accidentally introduced with the plantings. Most of the plantings are on the plateau near the top of the steps, but some are in the bush slope by the steps – these are more protected and some have done particularly well here, e.g. nikau (*Rhopalostylis sapida*), pigeonwood (*Hedycarya arborea*) and a 5m-tall puriri (*Vitex lucens*). But most of the plateau plantings are less than 2m tall and are struggling in the open (Fig. 6). Although quite a range of species have been planted, the survivors of most

species only number a few examples of each (excluding pohutukawa and flax (*Phormium tenax*)).

Fig. 6. Motukaraka plateau plantings near the steps that have been recently weeded and mulched. 17 Feb 2006.

The density of weeds has exploded on the island following rabbit removal, which is to be expected (Courhamp *et al.* 2003). With the lapse of the volunteer group's activities much of the revegetation planting has now been smothered by these weeds which make the plateau generally impenetrable, a stark contrast to fifteen years ago. However, over the summer holidays 2005/06 a large amount of weed clearance and weed mulching has created a wide coastal loop track on the plateau, revealing a number of planted native trees. This along with weed spraying around the south-eastern side has rejuvenated the restoration programme; however such work will need to be ongoing for many years until a native canopy is established. With the abundance of dry weed vegetation currently across the top of the island the fire risk is higher than ever.

Apart from the weeds identified for control by Cameron and Taylor (1990), which are all still present on the island, other species that should also be targeted include: cotoneaster (*Cotoneaster glaucophyllus*) which has increased from two plants in 1989 to locally common status on the cliffs; the new single clump kikuyu grass – as this species has the potential to smoother new plantings and increase the fire risk; and the wide-leaved bindweed with pale pink flowers that is abundant on the plateau – this is now thought to be a hybrid between the native *Calystegia sepium* subsp. *roseta* and the European *C. silvatica* (Peter de Lange pers. comm.).

The existing plantings need to be denser, so that the weeds are suppressed more quickly. Karamu (*Coprosma macrocarpa* and/or *C. robusta*) would be a good plant to use to create a fast cover. The tall cliff-top pohutukawa trees which give the island an appealing perspective from the sea are gradually being eroded and replaced by expanding weeds. This process is slow and ongoing. As previously recommended coastal planting to replace these pohutukawa should be a priority.

Amongst the natural cliff vegetation are two species that are listed for the Auckland Regional threatened & uncommon plant list (see Stanley *et al.* 2005): the glaucous grass, *Elymus multiflorus*, listed as "Regionally Chronically Threatened – Gradual Decline", which was not searched for during the recent survey; and a fern, *Blechnum triangularifolium*, listed as "Regionally at Risk - Sparse", which is still present, but has decreased over the last 15 years.

It is our belief that Motukaraka should be handed over to the Department of Conservation (DOC), who have the capacity to manage island systems and invasions, however that is not to say that DOC should have to undertake any immediate work on the island, only that they would have the increased capacity to do so should it be undertaken. It should also be a priority to instate a current management plan with an appropriate timeline for weed and pest control followed by suitable revegetation plantings.

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The seed output of scarlet pimpernel (*Anagallis arvensis*)

Alan Esler

The life of annual plants is mostly short and sweet. They are opportunists that seemed to have evolved to ensure that there are no vacuums in nature. Their body building efforts are not great because their frame has to last only long enough to produce a good crop of seeds. When an adverse season approaches they duck for cover as seeds wrapped in a weatherproof blanket until the worst has passed. Some species duck when a cold season comes along; others thrive in the winter but cannot face the rigours of summer heat and drought. The brave scarlet pimpernel just slows down a bit in winter.

The key to success in annuals is in the seed. A plant must produce enough of them for replacement plus a lot more to cope with the contingencies in habitats that may last only a few weeks. Their story is wonderfully told in E J Salisbury's *Weeds and aliens* (1961) He was the most energetic and meticulous of plant recorders in the field over several decades from the 1920s.

The seed output of many annuals is phenomenal considering the brevity of life. Salisbury recorded many instances of thousands of seed per plant. Counting seeds is a tedious business so it is not surprising that there are not many records. There are plenty of challenges in weed science. Of scarlet pimpernel Salisbury said "The total seed production averages about 900 but larger plants may yield 12,000 seeds". The challenge for me was to see how many seeds an exceptionally large plant produced.

The opportunity presented itself on finding such a plant to uproot and take home for analysis. While botanising around Grey Lynn with son Wilson on 5 Jan 2005 we came on a monster fully 75cm across luxuriating on the poorest of clay with no competitors. Scarlet pimpernel is quite a smart plant that misses few opportunities to make seeds. At almost every node there are two capsules, and often three (rarely four) at more distal nodes. Here and there it has to concede a capsule if a message within the plant dictates that this is the right place for growing a branch at a particular node. I concluded that each capsule contained on average 18 seeds, as did Salisbury. The task was then to count the capsules and multiply by 18. There were 2028 nodes, 3674 capsules, thus 65,646 seeds on this plant at this time. The oldest capsules had remained unopened, and on the tips were flowers producing more capsules that could not be counted. In fact, the potential was much more than the 65,646 seeds calculated. On a time scale it is possible that the plant was producing three seed in every hour of its life.

Geoffrey Grigson (1975) was a poet, critic and editor, not a botanist but had an interest in plants, particularly their herbal properties and their local names. In his book he listed 45 common names for scarlet pimpernel and their geographical derivation, including adder's eye, drops-of-blood, old man, little Jane, shepherd's clock and weather flower – many reflecting its sensitivity to temperature and moisture. Also he included a poem in Middle English written about 1400:

Al day ageyn undern and non
He wyl hym spredyn and on-don,
And ageyne the ewene-tyde
He lokyth hym-self be every syde;
He growyth be the erthe lowe,
Nyh every man wyl hym knowe.

Who ever said weeds are not interesting?

Acknowledgement
I am grateful to my friend Sylvia Guo for typing this story.

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