

A REVIEW OF THREE ALIEN PARROTS IN SINGAPORE

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ABSTRACT. — Alien invaders are emerging as an important driver of biodiversity changes. Using three introduced parrot species as case studies, viz. *Cacatua goffiniana*, *Cacatua sulphurea*, and *Psittacula alexandri*, this review suggests that alien birds in Singapore are poorly studied and much of their ecological impacts remain undocumented. Although, these parrots do not appear to have caused apparent ecological impacts, they have the potential to pose problems in the long-term. This paper finally discusses possible management interventions to address exotic species in Singapore.

KEY WORDS. — Psittaciformes, exotic species, impacts, management, Singapore

INTRODUCTION

Humans have been introducing an assortment of bird species to localities beyond their natural ranges for diverse reasons ranging from aesthetics (e.g., songbirds), food, hunting, biological control, and the pet trade (Long, 1981; Duncan et al., 2003). Species introduction has also resulted in many exotic birds becoming successfully established and even expanding their range into new areas (Long, 1981; Temple, 1992). Once established in the wild, alien birds become part of the local biotic community and will inevitably have a certain impact on their host environment (e.g., Lodge, 1993; Yap & Sodhi, 2004; Peh, 2010). In Singapore, alien birds originate mainly from the pet trade and their numbers have been growing each year. Since 1986, the Nature Society (Singapore)'s Bird Group has recorded more than 100 alien bird species in the wild (Lim, 1998). Of the extant 369 bird species on the Singapore list, 24 (6.25%) species have been introduced and have established populations that may or may not be self-sustaining (Lim, 2009). In the last 189 years, the loss of 74 native bird species in Singapore has been partially attributed to competition with alien species (Lim, 1992). The origins of many of these alien birds can be traced to the active cage bird trade (Nash, 1993; Lim, 2009) and bird releases during Vesak Day (a holy day celebrated by Singapore buddhists). Although such releases do more harm to the introduced birds (usually resulting in death due to lack of food or predation) than to the native birds, some of these aliens eventually survive and compete with the native species (Lim, 1998).

Parrots and cockatoos (order Psittaciformes) are commonly introduced to many parts of the world as cage birds (Blackburn & Duncan, 2001) and many species are now established outside their native range. In Singapore, five alien parrot species (Yeo & Chia, 2010; see Table 1) introduced as cage birds have since established feral populations across the island through escapees (Long, 1981; Briffett, 1984). In a local bird census report (conducted between 1996–2005) of the Psittacidae, 868 individual parrots were recorded (Lim & Lim, 2009). They consist of 8.9% Tanimbar corella, *Cacatua goffiniana*; 7.7% red-breasted parakeet, *Psittacula alexandri*; 4.5% yellow-crested cockatoo, *Cacatua sulphurea*; 2.3% rose-ringed parakeet, *Psittacula krameri*; and 0.5% rainbow lorikeet, *Trichoglossus haematodus*. The remaining 76% accounted for the three native parrots. Some species such as the yellow-crested cockatoo and red-breasted parakeet have shown increase in numbers over these years (Lim & Lim, 2009).

Table 1. Alien parrots with established populations in Singapore (Lim, 2009; Yeo & Chia, 2010).

Common name	Scientific name	Region of origin
Tanimbar corella	<i>Cacatua goffiniana</i> (Roselaar & Michels)	Asia
Yellow-crested cockatoo	<i>Cacatua sulphurea</i> Gmelin	Asia
Red-breasted parakeet	<i>Psittacula alexandri</i> (Linnaeus)	Asia
Rose-ringed parakeet	<i>Psittacula krameri</i> (Scopoli)	Africa and Asia
Rainbow lorikeet	<i>Trichoglossus haematodus</i> (Linnaeus)	Australasia

Despite the urgency for habitat management of alien birds in Singapore, there is a paucity of information regarding their ecological impacts on native biodiversity, thus resulting in a lack of implementation of appropriate management schemes to deal with alien species. Some potential impacts caused by introduced parrots include crop raiding on some Indonesian islands (Jepson et al., 2001) and causing vegetation damage in Hong Kong (Herklots, 1967). In this article, three parrots species, the Tanimbar corella, yellow-crested cockatoo, and red-breasted parakeet, were selected for discussion as they are the most common of the alien parrots in Singapore. Here, their current status in Singapore is reviewed, and their potential impacts on local biodiversity are discussed.

Cacatua goffiniana (Roselaar & Michels), Tanimbar corella
Fig. 1

This species is endemic to the Tanimbar islands (Yamdena, Larat, and Selaru) of Indonesia. Within Indonesia, there is a feral population on the Kai islands at Tual (Juniper & Parr, 1998; BirdLife International, 2012). Although listed as globally near-threatened (BirdLife International, 2012), it is a popular cage bird worldwide with over 52,000 individuals internationally traded between 1983 and 1989 (Juniper & Parr, 1998). In its native range, it occurs in primary and secondary coastal lowland forests and woodlands, and in areas with scattered trees (Long, 1981). In general, *Cacatua goffiniana*'s diet has been poorly documented other than its preference for maize crops on farmland in its native range (Juniper & Parr, 1998). This species is a secondary hole-nester (i.e., taking up a previous nest hole left by its previous owner) that lays two to three eggs (Juniper & Parr, 1998).

Cacatua goffiniana was introduced to Singapore sometime after 1980 (Briffett, 1984). Previously mistaken as the little corella, *Cacatua sanguinea* (Hails & Jarvis, 1987), it is absent in earlier literature (e.g., Medway & Wells, 1976; Long, 1981). By late 1990s, feral populations of *Cacatua goffiniana* had bred and established populations on mainland Singapore (e.g., Singapore Botanic Gardens, Bukit Batok Nature Park, and Changi) and some offshore islands (e.g., Sentosa and St John's Island) (Lim, 2009; Lim & Lim, 2009). First breeding record was at Commonwealth Crescent where adults were feeding an immature individual throughout Oct.1987, with subsequent evidence of breeding based on hole-nest digging at Jalan Loyang Besar (Lim, 2009). The breeding season has been documented to be from Jan.–Feb., Jul., and Oct.–Nov. (Lim, 2009). Locally, *Cacatua goffiniana* is far more widespread and common than its close relative, the yellow-crested cockatoo, *Cacatua sulphurea* (Jeyarajasingam & Pearson, 1999). This gregarious bird can be found in parks and wooded areas, foraging mostly in the canopy (Lim & Gardner, 1997; Jeyarajasingam & Pearson, 1999). Tanimbar corellas have been observed to feed on the fruits of numerous ornamental and roadside trees (Table 2). For example, 15 individuals were observed eating the fruits of sea almond trees (*Terminalia catappa*), in a field next to Changi Point Ferry Terminal (Bird Ecology Study Group, BESG, 2011a).



Fig. 1. Tanimbar corella, *Cacatua goffiniana*, at Changi Village, Singapore. Bird size = ~32 cm. (Photograph by: Y. C. Wee, 2006).

Cacatua sulphurea Gmelin, yellow-crested cockatoo

Fig. 2

The yellow-crested cockatoo occurs naturally in Indonesia on Sulawesi, the Lesser Sundas, and Masalembu islands (Long, 1981). This species was introduced to Hong Kong and Singapore as a cage bird (Juniper & Parr, 1998). It is currently listed as critically endangered (BirdLife International, 2012), whereby Collin Trainor (pers. comm., 2007) estimated that fewer than 7,000 individuals remain in its native range as the cage bird trade and widespread deforestation continue to decimate wild populations (Juniper & Parr, 1998; BirdLife International, 2012). In eastern Indonesia it is known to inhabit open woodlands, forest edges, and cultivated areas (Coates & Bishop, 1997). Its diet consists of a wide variety of food items such as seeds, nuts, berries, and other fruits (Juniper & Parr, 1998). This secondary hole-nester lays two to three eggs under captive situations (Marsden & Jones, 1997).

Bucknill & Chasen (1990) first reported *Cacatua sulphurea* on the outskirts of Singapore town particularly in the tall trees at Sepoy Lines (currently occupied by the Singapore General Hospital). However, Gibson-Hill (1949) did not record this species. Rowley (in Forshaw, 1973) later confirmed that *Cacatua sulphurea* was breeding and had established in the Singapore Botanic Gardens, with the largest known flock on Sentosa (Jeyarajasingam & Pearson, 1999). Breeding was first reported in the Central Catchment Area and Changi (Lim, 2009). Some observations suggest that *Cacatua sulphurea* populations may be on the decline with little or no breeding (Jeyarajasingam & Pearson, 1999), probably due to interspecific competition with the Tanimbar corellas for similar food and nesting resources (Lim, 2009). Feral populations of *Cacatua sulphurea* in Singapore prefer wooded areas, parks and gardens (Lim & Gardner, 1997; Lim & Lim, 2009) and they are usually gregarious, gathering to feed on fruiting trees (Juniper & Parr, 1998). However, records of their diet from Singapore are lacking.

Psittacula alexandri (Linnaeus), red-breasted parakeet

Fig. 3

The red-breasted parakeet has a wide distribution that ranges from northern India to continental Southeast Asia, Borneo, Java, Bali (MacKinnon & Phillips, 1993) and numerous intervening islands (Long, 1981; Jeyarajasingam & Pearson, 1999).



Fig. 2. Yellow-crested cockatoo, *Cacatua sulphurea* at Mount Faber, Singapore. Bird size = ~33cm. (Photograph by: Tan Tze Siong, Dec.2011).



Fig. 3. Red-breasted parakeet, *Psittacula alexandri*, at Pulau Ubin, Singapore. Bird size = ~30 cm. (Photograph by: Peihao Goh, Dec.2010).

1999). In its natural range, it inhabits all forest types and wooded areas, cultivated areas with trees, parks, and urban areas (Juniper & Parr, 1998). Its diverse diet includes wild figs, fruits, berries, seeds, leaves, and cereals such as rice and maize (Yap & Sodhi, 2004). A secondary hole-nester, it often occupies unused woodpecker or barbet nest holes, laying two to four eggs (Juniper & Parr, 1998).

The nominate subspecies, *Psittacula alexandri alexandri*, was introduced to Singapore in 1943 (Gibson-Hill, 1952; Long, 1981). Intermittent sightings on mainland Singapore suggest establishment of a feral population by escapees (Gibson-Hill, 1949; Medway & Wells, 1976). Red-breasted parakeets began spreading across mainland Singapore and offshore islands (Pulau Ubin and Pulau Sakijang Bendera [St. John's Island]; Lim & Gardner, 1997; Lim, 2009), with much evidence of breeding. One of the known breeding record was a pair feeding two juveniles at Pekan Quarry, Pulau Ubin on 29 Apr. 2005 (Lim, 2009). An established colony (and one of the largest known population with an estimate of almost 100 individuals) of *Psittacula alexandri* has a permanent nesting site in Changi Village among the old angasana trees (*Pterocarpus indicus*), along the main roads (BESG, 2007a). Nesting has been documented in Feb., Apr.–May, Jul., and Sep. (Lim, 2009). Today, this species is widespread in Singapore, with small groups (between 5–10 individuals) occurring in the built up areas (pers. obs.) and even a large roost of 100 individuals in the Buona Vista train station (D. L. Yong, pers. comm.). They commonly occur in gardens, parks, secondary growth, and scrub (Lim & Gardner, 1997; Lim & Lim, 2009). The parakeets have been observed feeding on seeds from several trees and plants (see Table 2).

Table 2. Plant species eaten by three alien parrots in Singapore as recorded by the Bird Ecology Study Group (BESG) [<http://www.besgroup.org/>]. Native plant species indicated by an asterisk.

Parrot Species	Species of food plants
Tanimbar corella	Starfruit, <i>Averrhoa carambola</i> (BESG, 2007c); golden shower, <i>Cassia fistula</i> (BESG, 2009a); pong pong, <i>Cerbera odollam</i> (BESG, 2009b); sea almond, <i>Terminalia catappa</i> * and petai jawa, <i>Leucaena leucocephala</i> (BESG, 2010a); papaya, <i>Carica papaya</i> (BESG, 2010b)
Yellow-crested cockatoo	None
Red-breasted parakeet	African tulip, <i>Spathodea campanulata</i> (BESG, 2007d); simpoh air, <i>Dillenia suffruticosa</i> * (BESG, 2009c); rose of India, <i>Lagerstroemia speciosa</i> (BESG, 2011b)

DISCUSSION

Factors leading to successful establishment of alien parrots. — The success of species establishment can be influenced by their life history and ecological attributes (Yap & Sodhi, 2004) as some ecological characteristics could favour a species in colonising new areas (Duncan et al., 2003). For example, these birds are known to congregate at food sources and roost sites (Long, 1981; Jeyarajasingam & Pearson, 1999). The Tanimbar corella's habit of feeding in a large group of 15 (BESG, 2011a) probably helps in predator avoidance and foraging (Johnston & Janiga, 1995). In Singapore, all three parrots could be found in highly disturbed habitats such as urban areas (pers. obs.), as well as scrub and sparsely wooded areas (Long, 1981; Juniper & Parr, 1998). As Singapore becomes increasingly urbanised, landscapes could favour more adaptable exotic species that may potentially displace natives (e.g., long-tailed parakeet, *Psittacula longicauda*). Such adaptability to varied environments has been shown to increase the probability of avian invasion success (Cassey, 2002). Being hole-nesting species also proves to be an advantage in establishment as they face lower predation pressures (Ricklefs, 1969) and less likely to suffer from stress caused by microclimatic changes of new habitats (i.e., physical conditions in hole-nests may be more stabilised; Dyer et al., 1977). Evidences of breeding from all three alien parrots are indications of reproductive success. The ability to exploit non-native ornamental plants may also explain why these introduced parrots are successful in Singapore. Locally, some of these parrots were observed to feed on seeds of exotic wayside trees that are usually not favoured by native birds (e.g., BESG, 2009a, 2009b).

Propagule pressure is a composite measure of the number of individuals released into a region where they are not native (Carlton, 1996). It can be used for explaining the invasiveness and invasibility of a species (Lockwood et al., 2005). It incorporates estimates of the absolute number of individuals involved in any one-release event (propagule size) and the number of discrete release events (propagule number). As the number of releases and/or the number of individuals released increases, propagule pressure also increases. Lockwood et al. (2005) compiled and found published evidence from numerous bird studies that have shown positive effects of propagule pressure on the establishment of invasive species. Data is, however, locally lacking for testing any relationship between propagule pressure and establishment success of these alien parrots. It highlights the need for more studies on these birds.

Potential impact: Interactions with native vegetation. — In their native and surrogate habitats, parrots in general are known to cause damage to crops (Long, 1981; Jepson et al., 2001), especially when they feed on young fruits (Forshaw, 1973). On farmlands within their native range, the Tanimbar corella and red-breasted parakeet raid maize and rice fields in huge flocks (Forshaw, 1973; Long, 1981), and have been known to damage up to 50% of the crops (Jepson et al., 2001). In Hong Kong, feral yellow-crested cockatoos have caused damage to trees in city parks by feeding on growing shoots (Herklots, 1967) and occasionally destroying whole crops of unripe fruits from native trees in secondary forest (Leven & Corlett, 2004). In Singapore, these parrots mostly fed on ornamental plants such as the cassia or golden shower (*Cassia fistula*; BESG, 2009a), the pong pong (*Cerbera odollam*; BESG, 2009b), and leucaena (*Leucaena leucocephala*; BESG, 2010a), as well as on two species of native plants (Table 2). However, plant damage caused by these aliens has not been reported in Singapore, and the paucity of information makes it difficult to assess their potential ecological impact.

As voracious granivores, parrots are major seed predators and their feeding habit potentially reduces effective plant dispersal and recruitment (Galetti & Rodrigues, 1992; Francisco et al., 2002). As important pre-dispersal seed predators (Forshaw, 1973; Janzen, 1981), parrots are also able to use their strong beaks to feed on mature or immature fruits to gain access to seeds and nuts (Janzen, 1981). Some studies on parrot seed predation suggest that once seeds are consumed, they are crushed and sheared within the gizzard, reducing the chances of viable seeds being passed out (Janzen, 1981; Francisco et al., 2002). Such seed predation patterns may affect the fitness and demographics of plant species, especially wind-dispersed plants (Galetti, 1993). In Singapore, feeding observations (Table 2) suggest that these parrots appear to favour seeds from ornamental plants, with only two observations on native species: the sea almond and simpoh air (*Dillenia suffruticosa*). The red-breasted parakeet has been observed to use its strong bill to consume the entire unripe fruit of simpoh air (BESG, 2009c), and this selective removal of immature fruits may lead to lowered recruitment of native plants. Another possible consequence is reduced food availability to native bird species. Again, detailed studies on seed predation by alien parrots will be necessary to determine their ecological impact.

Potential impact: Interactions with native birds. — The release of non-native subspecies may result in inter-breeding with local populations (Nash, 1993), e.g., local native races of oriental magpie robins, *Copsychus saularis*, and oriental white-eyes, *Zosterops palpebrosus*, were thought to have mixed with those races of imported birds from Indonesia, Malaysia or Thailand (Lim, 1989). Such genetic mixing will contaminate the gene pool of local populations, thus blurring the lines of conserving the local subspecies. There have been no reports of interbreeding between parrot species so far but we cannot rule out this possibility in the future.

Local birdwatchers have observed flocks of Tanimbar corellas harassing and mobbing the native pink-necked green pigeon, *Treron vernans* (BESG, 2007b) and oriental pied hornbill, *Anthracoceros albirostris* (BESG, 2009d) in urban areas. The reasons for such aggressive behaviour are not well understood.

Invasive birds may pose a threat to native bird species through competition for similar resources (Yap & Sodhi, 2004; Peh, 2010). On the same food source (simpoh air), the red-breasted parakeet has been observed to consume the entire unripe fruit (BESG, 2009c), while native birds such as the pink-necked green pigeon and yellow-vented bulbul, *Pycnonotus goiavier* usually feed upon the seeds of its ripen fruits (BESG, 2009e). Such removal of immature fruits may result in less food (i.e., ripen fruits) being available to the native birds.

The breeding success of native hole-nesters may also become compromised in the presence of non-native hole-nesters in the same area (Newton, 1994). Although Tanimbar corellas, red-breasted parakeets and hornbills share nesting cavities in the angšana trees at Changi village (BESG, 2006), both parrots have been seen disrupting an oriental pied hornbill's nesting attempts (Wee et al., 2008). As Singapore's landscape becomes more urbanised, hole-nests competition with alien species may become obvious, as suitable tree holes become limited owing to tree removals (Pell & Tidemann, 1997; Wee et al., 2008). This combination of hole-nest competition with alien birds and the lack of suitable nesting sites may further reduce breeding success of native hole-nesters such as the common goldenback woodpecker, *Dinopium javanense*, and the oriental dollarbird, *Eurystomus orientalis*.

Management issues. — In Singapore, the cage bird trade is the main avenue for introduced birds (Nash, 1993); parrots and parakeets, being popular pets, are difficult to remove from the trade. Although the impacts of bird trade on wild populations in exporting countries are more significant and well documented, the impacts of escaped birds from the pet trade on local avifauna populations are still considerable (Yap & Sodhi, 2004; Peh, 2010). Problems with an active bird trade include the release of pets by irresponsible owners (due to tiring of caring for these long-lived birds), and deliberate releases such as during Buddhist festivals, where followers buy and release birds to gain spiritual merits (Lim, 1998).

It appears that most Singaporeans are not aware of the potential ecological issues caused by non-native species. They do not see the distinction between native and alien birds, assuming that all birds 'naturally' occur in Singapore. There is an urgent need for the relevant government agencies (e.g., Agri-Food & Veterinary Authority of Singapore, AVA) to enforce stricter controls on the imports of wild-caught birds, and to educate the public that indiscriminate release of

birds into the wild causes more harm and does no good even for the birds released. Local agencies such as AVA, National Environmental Agency (NEA) and National Parks Board (NParks) could potentially work together on education programmes to improve awareness on alien birds amongst pet owners and members of the public.

There are also virtually no studies on how these three established alien parrots impact ecosystems in Singapore, and management schemes have not been implemented. The need for control and management may arise, as these parrots can potentially compete with native birds, especially if populations attain pest proportions in the future (Yap & Sodhi, 2004). It appears that direct control (i.e., killing and scaring) and sterilisation of feral bird populations may not be effective or viable in the long term (Yap & Sodhi, 2004), especially when these species are still readily available as cage birds. In Singapore, deliberate destruction of nesting sites has shown some success and has been adopted as an approach to tackle other invasive bird species such as house crows, *Corvus splendens* (Peh & Sodhi, 2002), and common mynas, *Acridotheres tristis* (Lim et al., 2003). Given this, the authorities can consider potential measures such as selective blockage of hole-nests and removal of nesting sites (Marsden & Jones, 1997). However, such measures will also affect the native hole-nesters.

CONCLUSIONS

This review suggests that alien bird species in Singapore are poorly studied and much of their ecological impacts remain undocumented. Furthermore, it is also difficult to attribute even known impacts to any one particular exotic species. The red-breasted parakeet, Tanimbar corella, and yellow-crested cockatoo all originated from the cage bird trade and presently do not appear to have caused severe ecological problems in Singapore given current field evidence. However, these species may pose problems in the long term through seed predation of native plant species or competition with native birds for similar resources such as food and hole-nests. It appears that management intervention is not immediately necessary; any implementation however requires a multi-pronged approach that addresses the pet trade and habitat management. An example of habitat management for these alien parrots could be making hole-nests unavailable for nesting through selective blockage. In addition, there is currently a lack of public awareness on alien species. This can be enhanced through education with the cooperation of the relevant agencies.

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