

Broughton Island raptors

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Surveys conducted on Broughton Island between 1999 and 2020 recorded 12 raptor species. The most common was White-bellied Sea-Eagle *Haliaeetus leucogaster* followed by Whistling Kite *Haliastur sphenurus*, Swamp Harrier *Circus approximans*, Osprey *Pandion haliaetus* and Black-shouldered Kite *Elanus axillaris*. Less common were Peregrine Falcon *Falco peregrinus* and Brown Goshawk *Accipiter fasciatus*. Other infrequently recorded species were Brahminy Kite *Haliastur indus*, Spotted Harrier *Circus assimilis*, Brown Falcon *Falco berigora*, Nankeen Kestrel *Falco cenchroides* and Australian Hobby *Falco longipennis*.

Of the common species, the populations of White-bellied Sea-Eagle and Swamp Harrier appear stable, Osprey and Brown Goshawk appear to be increasing and Black-shouldered Kite, Whistling Kite and Peregrine Falcon appear to be decreasing. The abundance of most species reflects the long-term trends from the Hunter Region, except for Brown Goshawk whose abundance was increasing on Broughton Island but decreasing in the Hunter Region.

Local factors that have impacted the abundance of species were the eradication of exotic mammals and the subsequent change in vegetation structure. This has reduced open-country foraging opportunities for Black-shouldered Kite, Swamp Harrier and Whistling Kite, that prey on small mammals and rodents, and increased foraging opportunities for still-hunting species such as Brown Goshawk and Brown Falcon that utilise the denser vegetation. The reason for decline in abundance of Peregrine Falcon is not apparent and further study is required. Brahminy Kite abundance is forecast to increase in the future as it expands its presence in the Hunter Region.

Four species have been recorded breeding on the island: Osprey, Swamp Harrier, Peregrine Falcon and Whistling Kite. Breeding conditions also appear suitable for White-bellied Sea-Eagle.

INTRODUCTION

Broughton Island (32° 37'S, 152° 19'E) is located 16 km northeast of the entrance to Port Stephens, and 3.5 km offshore from the adjacent coastline, on the New South Wales lower north coast. It is part of Myall Lakes National Park.

In August 2009 NSW National Parks and Wildlife Service (NPWS) conducted a programme to eradicate exotic mammals from the island. The target species were rabbits *Oryctolagus cuniculus* and ship rats *Rattus rattus*. The islands were declared free of exotic mammals in August 2011 (Priddel *et al.* 2011; Fawcett *et al.* 2016). Following eradication, the vegetation structure has changed and small to medium size shrubs (Broad-leaved Paperbark *Melaleuca quinquenervia*, broom heath *Monotoca elliptica* and Coastal Wattle *Acacia longifolia*) have proliferated over some parts of the island (Stuart 2020). The population of small passerine species that utilise this habitat has also increased (Stuart *et al.* 2017).

Since 2012, members of Hunter Bird Observers Club (HBOC), in collaboration with NPWS, have conducted regular surveys aimed at monitoring population change of terrestrial birds in response to the changed vegetation regime. The first five years (2012-16) involved twice-yearly surveys carried out in autumn and spring (Stuart *et al.* 2017). An expanded study to identify resident species, the size of their populations and movements to and from the island was commenced in 2017, with surveys conducted approximately quarterly (Stuart *et al.* 2017). Raptors were recorded during these surveys. Six more common and five less frequently recorded species were present 2012-2016 (Stuart *et al.* 2017), and nine species were recorded 2017-2020 (Stuart 2020). Two species that are regularly present on the island, Osprey *Pandion haliaetus* and White-bellied Sea-Eagle *Haliaeetus leucogaster*, and one less frequent visitor, Spotted Harrier *Circus assimilis*, are listed as Vulnerable under the NSW *Biodiversity Conservation Act* 2016 (BC Act).

The objectives of this study were to describe the change in raptor abundance following eradication of

exotic mammals, evaluate the patterns of monthly occurrences and review breeding records.

METHODS

Records were extracted from the BirdLife Australia Birddata portal (www.birddata.birdlife.org.au) for 1999-2020. There were no records from Broughton Island for 2001-2006. HBOC survey records for 2012-2020 were from five sites surveyed according to BirdLife Australia's standard 500-m radius protocols (Stuart *et al.* 2017). These sites covered all areas of the island plus the immediate coastal waters of Providence Bay and Esmeralda Cove. Surveys for 1999-2011 were mostly conducted according to BirdLife Australia's 5-km area survey protocols. As there were only 10 of these surveys over this 13-year period, the records were combined. Some 5-km area single day surveys from 2012-2020 were extracted from the Birddata database for periods in which there were no 500-m surveys.

Survey records were also extracted from the Cornell Lab of Ornithology eBird Australia portal (<https://ebird.org/australia/home>). There were a small number of these records for 2017 and 2019.

The number of surveys conducted each year for each species was compiled and the annual Reporting Rate (RR) calculated. Monthly records for each species were also compiled and monthly RR was calculated. (RR is the number of records for a species divided by number of surveys, expressed as a percentage.) For the purposes of this study, RR has been used as a measure of abundance. The results for Broughton Island were charted, local RR trends established and the mean annual rate of change of RR determined. For comparative purposes, Hunter Region RR data from 1999-2020 surveys for the same

species, conducted according to BirdLife Australia's 500-m, 5-km, fixed route and shorebird protocols, was downloaded from the Birddata portal. Regional trends were established and mean annual rate of change of RR determined. Undocumented breeding records were obtained from NPWS personnel and contractors who worked on Broughton Island during the study period.

RESULTS

A total of 588 records for 12 raptor species were downloaded from the Birddata portal, from 264 surveys. There were 14 additional records for five species downloaded from five surveys on the eBird portal. In the period 1999-2011, prior to commencement of HBOC surveys, there were 41 records for eight species from ten surveys. From 2012-2020 there were 561 records for 12 species from 259 surveys.

The mean annual RR and the mean annual rate of change of RR for the 12 species from both Broughton Island and the Hunter Region are shown in **Table 1**. The most common species on Broughton Island was White-bellied Sea-Eagle followed by Whistling Kite *Haliaeetus sphenurus*, Osprey, Swamp Harrier *Circus approximans* and Black-shouldered Kite *Elanus axillaris*. Peregrine Falcon *Falco peregrinus* and Brown Goshawk *Accipiter fasciatus* were less common. The overall RR for all seven species was greater than 10%. Reports of Brahminy Kite *Haliaeetus indus*, Spotted Harrier, Brown Falcon *Falco berigora*, Nankeen Kestrel *Falco cenchroides* and Australian Hobby *Falco longipennis* were infrequent.

Table 1. Mean annual reporting rate (RR) and mean annual RR rate of change, Broughton Island and Hunter Region raptors, 1999-2020.

Common name	Scientific name	Broughton Island		Hunter Region	
		Mean Annual RR (%)	Mean annual RR rate of change	Mean Annual RR (%)	Mean annual RR rate of change
Osprey	<i>Pandion haliaetus</i>	38.7	2.77%	4.5	0.18%
Black-shouldered Kite	<i>Elanus axillaris</i>	19.0	-2.52%	6.0	-0.26%
Swamp Harrier	<i>Circus approximans</i>	37.9	-2.51%	8.0	-0.03%
Spotted Harrier	<i>Circus assimilis</i>	3.0	*	0.3	**
Brown Goshawk	<i>Accipiter fasciatus</i>	11.2	2.07%	2.8	-0.14%
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	54.3	-2.23%	14.2	-0.17%
Whistling Kite	<i>Haliaeetus sphenurus</i>	40.5	-3.70%	13.3	-0.52%
Brahminy Kite	<i>Haliaeetus indus</i>	3.0	*	1.4	0.04%
Nankeen Kestrel	<i>Falco cenchroides</i>	1.1	*	6.7	-0.46%
Australian Hobby	<i>Falco longipennis</i>	1.1	*	3.1	-0.07%
Brown Falcon	<i>Falco berigora</i>	2.2	*	3.3	-0.20%
Peregrine Falcon	<i>Falco peregrinus</i>	11.9	-1.93%	1.5	-0.09%

* Insufficient records

** Irruptive species

Charts of annual reporting rate and linear trendlines for eight species are shown in **Figure 1**. Histograms of mean monthly RR are shown in **Figure 2**. There

were insufficient data to chart trends for the remaining infrequently reported species.

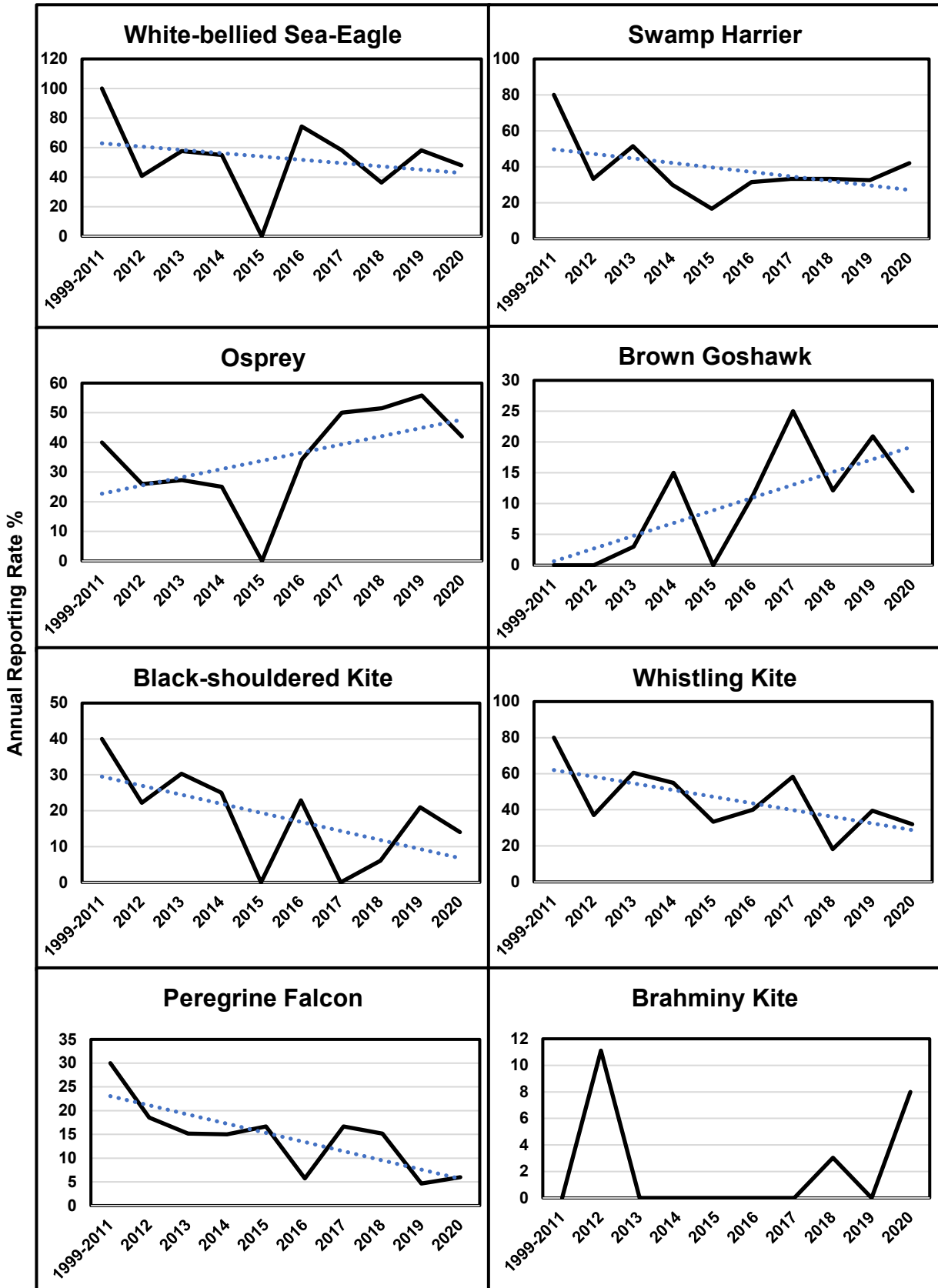


Figure 1. Charts and trendlines of annual reporting rates, Broughton Island raptors, 1999-2020.

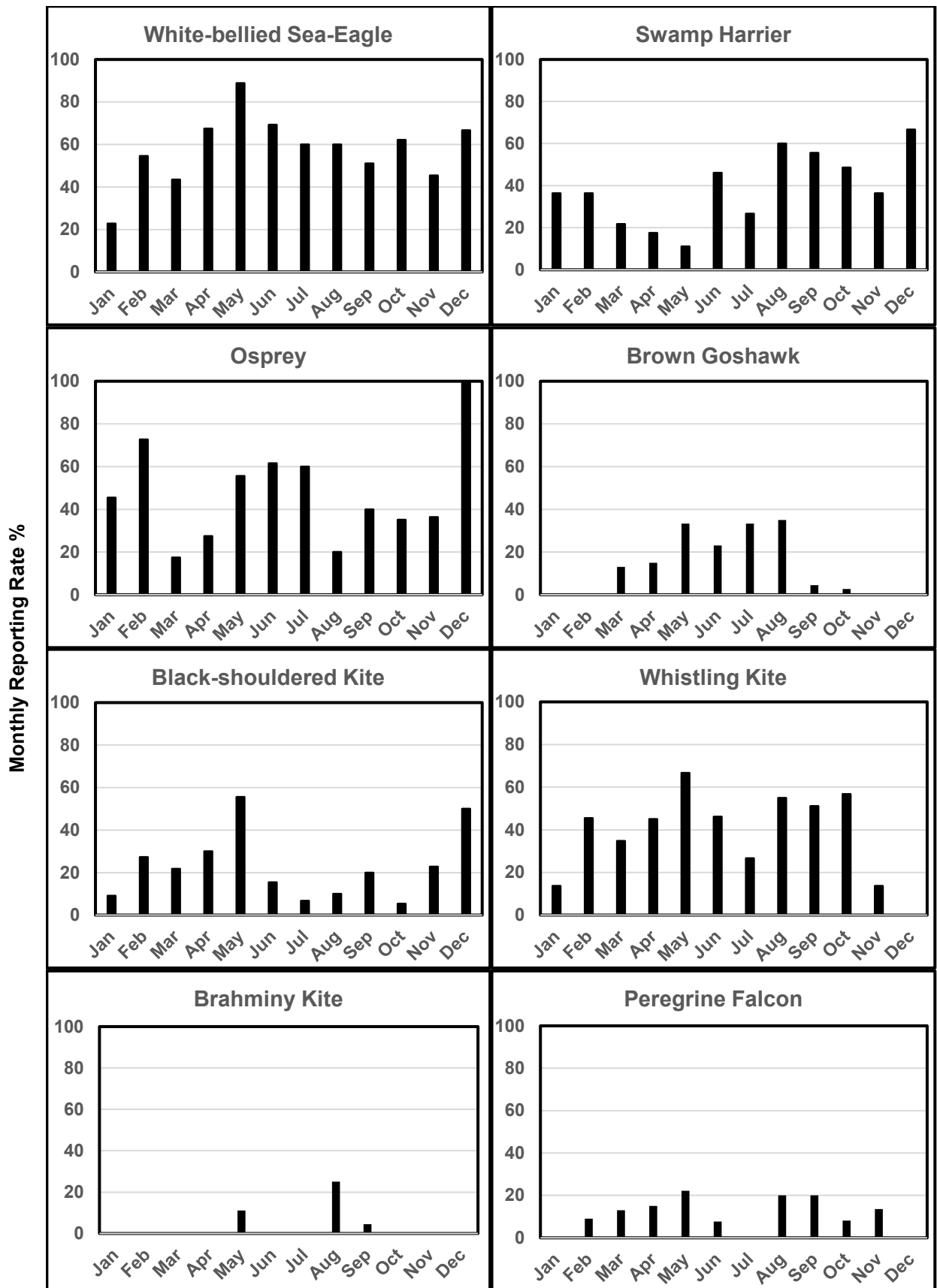


Figure 2. Histograms of monthly reporting rates, Broughton Island raptors, 1999-2020.

DISCUSSION

The mean annual RR trends presented in **Figure 1** show that the abundance of five species on Broughton Island has declined: Black-shouldered Kite, Swamp Harrier, White-bellied Sea-Eagle, Whistling Kite and Peregrine Falcon. However, the trend for White-bellied Sea-Eagle and Swamp Harrier has remained relatively constant since 2012. The RR trend for two species, Osprey and Brown Goshawk shows they have increased in abundance. There were insufficient data to establish trends for five other species: Spotted Harrier, Brahminy Kite, Nankeen Kestrel, Australian Hobby and Brown Falcon.

In the period 1999-2011, six of the 5-km surveys were conducted over several days and consequently, the average RR for some species was higher than would be expected from a 500-m survey. A notable decline in RR for some species was evident between the earlier surveys and 2012, reflecting the change in survey methodology (**Figure 1**). This decline has generally been disregarded in the evaluation of trends. The lack of records for most species in 2015 was anomalous. Six surveys were conducted and only three species were recorded.

The possibility of secondary poisoning of raptors by rodenticide used in the eradication programme affecting White-bellied Sea-Eagle, Swamp Harrier, Peregrine Falcon and Nankeen Kestrel abundance has not been considered here. However, it was unlikely to be significant as every possible step to avoid such events was taken during the eradication programme (Priddel *et al.* 2011; Fawcett *et al.* 2016).

Detailed discussion of individual species is presented below.

White-bellied Sea-Eagle

The RR trend in **Figure 1** has remained relatively constant since 2012, following an initial decline. The initial decline was attributed to the influence of 5-km survey data from 1999-2011. When this data was ignored, the mean annual RR rate of change shows a slight increase, 0.9%. Over the same period, the Hunter Region has a slight decline of -0.2%. (**Table 1**).

The species has been recorded flying above all parts of the island all year round and was more abundant between April and June (**Figure 2**). This may represent post-breeding dispersion from elsewhere to the island. The species is a regular visitor from the mainland and one or more birds were often

observed flying to the island in the morning or returning late evening. Its prey includes small mammals up to the size of rabbits, birds and eggs, large insects, frogs, fish and reptiles (Marchant & Higgins 1993). The removal of rabbits would have produced a reduction in foraging opportunities, but other options were available on and around the island. The change in vegetation structure in some areas should not have impacted its foraging options.

The White-bellied Sea-Eagle's nest is a large pile of sticks lined with leaves, grass and seaweed, placed on the ground or a cliff on offshore islands, otherwise 3-40 m above the ground in a large tree (Marchant & Higgins 1993). Although suitable locations for ground or cliff nesting were present on Broughton Island, there were no breeding records. A large, disused stick nest that could have been used by White-bellied Sea-Eagle or Osprey was present on the north side of Looking Glass Isle (M. Schulz pers. comm.). In early December 2020 two adult and two juvenile birds were observed soaring in the vicinity of Little Broughton Island over several days (M. Schulz pers. comm.).

Whistling Kite

The RR trend in **Figure 1** shows a continuing decline in abundance over the study period, although this may be partially influenced by the 5-km survey data from 1999-2011. The mean annual RR rate of change was -3.7% and the Hunter Region exhibits a decline, -0.5%. (**Table 1**). A decrease in Whistling Kite abundance in nearby Port Stephens since 2013 has also been reported (Stuart 2016). The species has been recorded flying above all parts of the island all year round but was less abundant from November to January (**Figure 2**). This may represent a reduced presence during breeding activity at another location.

The Whistling Kite's prey includes small mammals, birds, fish, reptiles, amphibians, crustaceans, insects and carrion. Food items are taken either from the ground or from the water surface, while insects are sometimes hawked from the air (Marchant & Higgins 1993). The eradication of exotic mammals should not have substantially impacted the foraging options for Whistling Kite but the change in vegetation structure in some areas may have done so. However, as the species is very catholic in its diet, this impact was considered to have been minimal. The decline in abundance was probably a reflection of the regional trend.

Whistling Kite build their nest in trees 3-62 m above the ground. The nest is a bowl of sticks 60-150 cm across, 30-100 cm deep and lined with green leaves.

Pairs often re-use the same nest year after year. (Marchant & Higgins 1993). In 2020, the species nested in a small stand of Swamp Oak *Casuarina glauca* on the north slope of Pinkatop Head (M. Schulz pers. comm.). This nest has been observed in this location since 2012.

Swamp Harrier

The RR trend in **Figure 1** has remained relatively constant since 2012 following an initial decline. This initial decline was attributed to the influence of 5-km survey data from 1999-2011. When these data were ignored, the mean annual RR rate of change is -0.02% which was comparable to the Hunter Region with -0.03%. (**Table 1**). The species was most abundant from August to December (**Figure 2**) which is the breeding season for the species (Marchant & Higgins 1993). On Montague Island, Swamp Harrier numbers increase in March and April as they harvest shearwater fledglings (N. Carlile pers. comm.). The reduced abundance of Swamp Harriers on Broughton Island at that time (**Figure 2**) suggest this does not happen locally.

The species has been recorded flying above all parts of the island all year round. Its prey includes small mammals, birds and eggs, large insects, frogs, fish and reptiles (Marchant & Higgins 1993). The eradication of exotic mammals would have led to a reduction in foraging opportunities. The change in vegetation structure in some areas may have impacted abundance as the species prefers to forage over open country. The recent increase in the population of small passerine species (Stuart *et al.* 2017), however, will have provided a new foraging option for the species.

The species nests on a low platform of sticks, reeds and grass constructed in swamps, near or on water, and rarely on the ground (Marchant & Higgins 1993). There are two ephemeral Common Reed *Phragmites australis* swamps on the island and extensive areas of Kangaroo Grass *Themeda triandra*, Blady Grass *Imperata cylindrica* and Bracken Fern *Pteridium esculentum* which could provide suitable nesting habitat.

There was one confirmed breeding record and several instances of diagnostic behaviour. A nest was discovered in June 2005 in a Broad-leaved Paperbark located in a swamp to the west of the track from Esmeralda Cove to Providence Beach. A Swamp Harrier was observed flying to the nest over several days. The nest was of similar size to a raven's nest and was about one metre above water (C. Anderson pers. comm.). A nest that appeared to have been recently used was discovered on the north

slope of Pinkatop ridge, near the Swamp Oak stand in April 1998 (N. Carlile pers. comm.). On more recent occasions, birds have been regularly observed by HBOC surveyors descending into grassy areas along the north slope of Pinkatop ridge. In early December 2020 a pair was observed landing repeatedly in the same location in tall grass on the north slope of the ridge and disappearing from view. Other raptors were aggressively chased from the area and the pair was assumed to be nesting (M. Schulz pers. comm.). In February 2020, a very young bird accompanying an adult was recorded over Looking Glass Bay and Esmeralda Cove.

Osprey

The RR trend in **Figure 1** shows a steady increase in abundance from 2012 to 2020. An initial decline to 2012 was attributed to the influence of 5-km survey data from 1999-2011. The absence of records from 2015 reflects a lack of survey effort in that year. The mean annual RR rate of change was 2.8% while for the Hunter Region, the increase was much less at 0.2% (**Table 1**).

The species was recorded flying above all parts of the island, all year round and was most abundant in December and February (**Figure 2**). The greater February abundance may reflect the presence of recently fledged juvenile birds, prior to dispersal. The Osprey's prey consists mainly of fish, and occasionally may include crustaceans, reptiles, small mammals or birds (Marchant & Higgins 1993). It would not have been adversely affected by the exotic mammal eradication programme. The increasing abundance however, may in part be due to the success of this programme. Removal of rats that were known to predate eggs and chicks (Priddel *et al.* 2011), may have allowed the species to breed with greater success and hence the more recent increase in abundance.

There is one active Osprey nest on Broughton Island, located on top of a steep-sided knoll on the southeast coastline of Looking Glass Bay. The nest is a large pile of sticks and driftwood with a central bowl lined with dried grass, seaweed and Prickly Pear *Opuntia stricta* (**Figure 3**). This nest was not present at this site in August 2009, although Osprey were present on the island (N. Carlile pers. comm.). One or more Osprey were regularly seen at the nest in April and October 2016 and breeding was confirmed in December 2016 when a near-fledged chick was photographed in the nest (N. Carlile pers. comm.). Two chicks were photographed on the nest in mid-December 2019 (**Figure 3**) and were subsequently banded. A banded bird was recorded at Looking Glass Bay in February 2020 and at

Esmeralda Cove in June 2020. Osprey are sedentary, and it is expected the pair will continue to utilise this site.

A large, disused stick nest that could have previously been used by Osprey or White-bellied Sea-Eagle was present on the north slope of Looking Glass Isle (M. Schulz pers. comm.). On the northeast coast of the island, a pair of Osprey have

been observed repeatedly around a section of cliff below Pinkatop Head that cannot be seen from land. The pair exhibited distressed behaviour, circling and calling loudly, when approached in November and December 2020. Similar behaviour was noted in the previous two years. A juvenile accompanied by one or both adults was subsequently recorded in March and April (M. Schulz pers. comm.)



Figure 3. Osprey chicks on nest, Looking Glass Bay, Broughton Island. Photo by T. Clarke, 23/12/2019.

Black-shouldered Kite

The RR trend in **Figure 1** shows a continuing decline in abundance over the study period, although this may have initially been influenced by the 5-km survey data from 1999-2011. The mean annual RR rate of change was -2.5%. This was greater than the Hunter Region which exhibits a decline of -0.3%. (**Table 1**).

The species has been recorded flying above all parts of the island all year round. Maximum abundance was in May and low abundance was recorded from June to November (**Figure 2**). The latter low RRs between July and October probably represent a reduced presence during breeding activity at another location.

The Black-shouldered Kite's main prey is small rodents plus occasional small birds, small reptiles and insects (Marchant & Higgins 1993). The removal of rats would have produced a reduction in foraging opportunities. The change in vegetation structure following exotic mammal eradication may also have impacted abundance, as the species prefers to forage over open country. However, the species has taken advantage of other foraging

options and has been observed taking Eastern Water Skink *Eulamprus quoyii* and Bar-shouldered Dove *Geopelia humeralis*. However, the abundance of Black-shouldered Kite on Broughton Island does appear to have been adversely affected by the exotic mammal eradication programme.

There were no breeding records for Black-shouldered Kite on the island, although an adult with two juveniles was observed in May 2019 and juvenile birds were present in October 2016 and November 2019. No behaviour suggestive of breeding has been observed. There are fewer records during the spring breeding season (**Figure 2**) suggesting that birds have departed the island to breed in another location. The Black-shouldered Kite prefers to nest in tall trees up to 35 m above the ground (Marchant & Higgins 1993). Trees of this stature are not present on the island.

Peregrine Falcon

The RR trend in **Figure 1** shows a continuing decline in abundance over the survey period, although this may have initially been unduly influenced by the 5-km survey data from 1999-2011. The mean annual RR rate of change was

- 1.9% which was higher than the Hunter Region with a decline of -0.1% (**Table 1**).

The species was most abundant in May, August and September and was not reported in December or January (**Figure 2**). The species' nesting period is August to November (Marchant & Higgins 1993). It has been recorded from all parts of the island although was most commonly recorded soaring over the slopes of Pinkatop Head. It mostly eats flocking birds, particularly pigeons, parrots and starlings, and on the coast, commonly takes seabirds. It occasionally eats large insects, and rarely takes fish, reptiles, small mammals or carrion. It forages by still-hunting from a high perch, by high quartering and soaring, or by low fast flight (Marchant & Higgins 1993).

The Peregrine Falcon nest is a scrape on a cliff ledge, an old stick nest of another raptor, or a ledge on a structure, up to 150 m above ground (Marchant & Higgins 1993). There were three records of breeding on the cliffs below Pinkatop Head in 2012, 2016 and 2017 (N. Carlile pers. comm.). A pair was reported behaving aggressively in this area and around the adjacent northern cliff edge in November and early-December 2019 (M. Schulz pers. comm.).

Although the removal of rabbits may initially have affected foraging opportunities, there were numerous other options. Changes that have occurred to the vegetation in some areas were unlikely to have affected these opportunities. There has been no obvious impact on potential seabird prey. The species is sedentary and the island habitat has been demonstrated to be suitable for both foraging and nesting. There was no obvious reason for their decline in abundance on the island.

Brown Goshawk

The RR trend in **Figure 1** shows an increase in abundance from 2013. There were no records prior to this date. The mean annual RR rate of change was 2.1% which contrasts with the Hunter Region, at -0.1%. (**Table 1**). The Brown Goshawk was a relatively recent arrival on Broughton Island and has been recorded from all areas during its non-breeding season between March and October. It has been most abundant between May and August and has been absent from November to February (**Figure 2**). The absence of records during this period suggests that it breeds elsewhere.

Its prey is mainly birds and young rabbits, plus reptiles, amphibians and arthropods, and occasionally carrion. It forages mostly by still-hunting from a concealed perch in foliage. Its

presence from 2013 suggests it has been attracted by the increasing number of small passerines utilising the recently emerging habitat of small to medium shrubs on some parts of the island. An adult female and a juvenile male were captured in this habitat during banding studies in May 2018. This suggests the species' presence represents post-breeding dispersion from elsewhere to the island.

Brahminy Kite

Brahminy Kite, although an infrequent visitor, may be expected to become more abundant in the future. The species has a mean annual RR rate of change in the Hunter Region of 0.04% (**Table 1**). It has been recorded on eight occasions since 2012, in July, August and September (**Figure 2**), during its non-breeding season. It has been expanding its range south into the Hunter Region since the mid-2000s (Stuart 2016) and was described breeding at Lemon Tree Passage in 2016 (Wooding 2017). A pair bred there subsequently in 2017 (Wooding 2019) and again more recently (L. Wooding pers. comm.). Records of the species on Broughton Island may be the result of post-breeding dispersal. A sub-adult bird was present in Esmeralda Cove for several days in August 2020.

Spotted Harrier

Spotted Harrier has been recorded on the island on eight occasions: in 2009, 2013 and 2014, most frequently in March and April. It is an uncommon resident and irruptive visitor to the Hunter Region (Williams 2019). The most recent irruptive peak was 2013 to 2015 and there were six corresponding records on Broughton island in 2013 and 2014. Its prey is terrestrial birds (including quail and pipit), mammals (including rabbits and rodents), reptiles, large insects and rarely carrion (Marchant & Higgins 1993). The eradication of exotic mammals and the change in vegetation structure may have reduced foraging options for the species, but the lack of records since 2014 more likely reflects its uncommon regional status.

Brown Falcon

Brown Falcon has been recorded on five occasions, in 2012, 2018 and 2020; the records were in June, August and November. It is an uncommon bird in the Hunter Region (Williams 2019) with a mean annual RR rate of change of -0.2% (**Table 1**). It feeds on mammals, birds, reptiles, amphibians, arthropods, carrion and rarely fish (Marchant & Higgins 1993). It forages mostly by still-hunting from an exposed perch. Three of the five records were from 2020 and it is possible that the areas of changed vegetation structure were providing more suitable foraging habitat for the species. The recent

increase in the population of small passerine species (Stuart *et al.* 2017) will have provided an additional foraging option for the species.

Nankeen Kestrel

Nankeen Kestrel has been recorded on four occasions, in 1999, 2000 and 2012; the records were in January, June and September. It is a common species in the Hunter Region (Williams 2019) with a mean annual RR rate of change of -0.4% (Table 1). It mostly eats invertebrates, particularly insects such as grasshoppers and crickets. It also occasionally takes small mammals, birds and reptiles. It forages by hovering or still-hunting from a perch in open country (Marchant & Higgins 1993). Hordern & Hordern (1931: 24) described the species as '*fairly common in cleared areas and on Broughton Island*'. Lane (1976) records grass on the island as being frequently burned by local fishermen. This would have maintained open areas suitable for foraging by the species. The lack of records since 2012 suggests the eradication of rats and the change in vegetation structure in some areas has made the island an unsuitable foraging habitat for the species.

Australian Hobby

Australian Hobby has been recorded on three occasions, in 2014 and 2016 (Table 1); the records were in March and April during its non-breeding season (Table 2). It is a common, widespread species in the Hunter Region (Williams 2019) with a mean annual RR rate of change of -0.1%. It eats small birds, insectivorous bats and flying insects, and forages by low fast flight, still-hunting from a prominent perch, or by quartering. It is most frequently recorded in open habitats including open woodland, water courses and vegetated urban areas. It is rarely recorded around cliffs or escarpments (Marchant & Higgins 1993). It is unlikely that the island provides suitable habitat to support a permanent presence of the species.

CONCLUSION

The abundance of three common raptor species on Broughton Island, Black-shouldered Kite, Whistling Kite and Peregrine Falcon, has declined since 2009. The populations of two other common species, Swamp Harrier and White-bellied Sea-Eagle appear relatively stable while those of Osprey and Brown Goshawk have increased. The mean annual RR rate of change of six of the species reflects the regional trend over the study period, although generally with a greater rate of change. The increasing trend for Brown Goshawk, however,

was the reverse of that for the region. Five additional raptor species were infrequently recorded and were considered to be vagrants to the island.

Following the eradication of exotic mammals, foraging options for some species were reduced. The change in vegetation structure in some areas may also have reduced options for some species while providing new options for others. As the vegetation structure continues to change, it is expected that opportunities for species that prefer open-country foraging, such as Black-shouldered Kite, Swamp Harrier and Whistling Kite, will decrease and their future abundance will continue to decline. On the other hand, the changes will favour still-hunting species such as Brown Goshawk and Brown Falcon, and it is anticipated that future abundance of these species will increase. This will be supported by the expected increasing population of small passerines.

It is anticipated that Osprey numbers will remain stable with an established nesting site on the island. It is also anticipated that Brahminy Kite abundance will increase as the species establishes an expanded presence in the region.

Four species have confirmed breeding records from the island: Osprey, Swamp Harrier, Whistling Kite and Peregrine Falcon. There were no breeding records for White-bellied Sea-Eagle, although there is suitable habitat for ground or cliff nesting and a variety of foraging options. Other raptor species appear to be daily or short-term visitors to the island in search of suitable foraging opportunities, mainly during their non-breeding seasons.

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