

Numbers of spotted shags (*Stictocarbo punctatus*) at breeding sites in Wellington Harbour, 2002 – 2012

SUSAN WAUGH*

ALAN TENNYSON

Museum of New Zealand Te Papa Tongarewa, PO Box 467, Wellington 6011, New Zealand

ROD ORANGE

Kilmister Ave, Thorndon, Wellington 6011, New Zealand

STEVEN SHARP

6 Espin Cres, Karori, Wellington 6012, New Zealand

REG COTTER

1 Bolton Street, Petone, Lower Hutt 5046, New Zealand

ROS BATCHELER

DEREK BATCHELER

126 Homebush Road, Khandallah, Wellington 6035, New Zealand

Abstract We conducted counts of spotted shags (*Stictocarbo punctatus*) at Matiu/Somes and Mokopuna islands in Wellington Harbour quarterly during the period from 2002-05 and sporadically at these sites and at Makaro/Ward Island during 2007-12. This population is important as it is one of the few North Island breeding areas, and one of only 2 in the Wellington region. Shag numbers appear to have been stable or possibly declining during this period, with fluctuations between both months and years. An average of 210 individuals was noted during 12 comprehensive counts, with a maximum of 354 spotted shags in 2004. Breeding occurred during late winter and spring in 2010 and 2012. We recommend ongoing monitoring of this population as an important population at a New Zealand level, which is accessible and easily counted from a boat.

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INTRODUCTION

The spotted shag (*Stictocarbo punctatus*) is endemic to New Zealand and has a total population of up to 30,000 breeding pairs. Spotted shags are found mainly around the South I, with only small scattered colonies around the North I, and (treating all Wellington Harbour colonies as one population)

only 2 in the Wellington region (Taylor 2000; Gill *et al.* 2010). It has been suggested that North I populations are declining (*e.g.*, Taylor 2000; Cameron *et al.* 2007), but there are few counts available. Taylor (2000) recommended Matiu/Somes I (41.249 S, 174.853 E), in Wellington Harbour, as an ideal site for long term monitoring of this species.

The population of spotted shags at Matiu/Somes I has been documented since 1972 when Kendrick (1973) noted 7 nests at the site. This

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*Correspondence: Susan.Waugh@tepapa.govt.nz

followed an increase in numbers of non-breeders in the Wellington region between the 1940s and 1970s (Wodzicki & Kennedy 1978). Miskelly & Benfell (1981) noted that the numbers of nests at Matiu/Somes I were increasing in the 1970s - 1980, with a maximum of 41 nestlings in 1979. By 1982, Rod Cossee (*in* Robertson 1992) estimated that about 150 breeding pairs occurred on the island but no specific counts for this time were documented. A boat-based count of only the main nesting/roosting site ('Shag Rock'/Te Papa a Tara) on 12 May 1990 estimated a population of 100 birds (Tennyson 1991; AJDT, *unpubl. data*).

On nearby Makaro / Ward I, nesting was reported by Marchant & Higgins (1990) but no counts were presented. Three birds, including a pair at a nest site, were seen on 12 May 1990 (AJDT, *pers. obs.*), and 22 birds and at least 8 nests were reported in Aug 2002 by Cotter & Nicholson (2005). Only 2 other breeding sites are known in the Wellington region. Miskelly (2000) reported a new colony on Kapiti I with about 10 nests in Oct 1999. On 26 May 2013 Peter Hodge (*pers. comm.*) observed 2 nests on an islet at the eastern end of Breaker Bay and found another 5 nests on the south side of this rock stack on 13 July 2013; chicks were present here on 2 and 8 Sep 2013. At Matiu/Somes I, the species was noted breeding between Jun to Aug and Nov to Jan in 1980-81 (Miskelly & Benfell 1981) and birds were seen at nests in May 1990 (AJDT, *unpubl. data*).

Holocene fossils indicate that spotted shags were common in pre-human times along parts of the southern and eastern North I coastline (Millener 1981; McFadgen 2003; AJDT *unpubl. data* based on Te Papa collections). Archaeological remains from Matiu/Somes I include adult and juvenile spotted shag bones which indicates the presence of a breeding colony in pre-European times (Hector 2011). Therefore recently established colonies in the Wellington region apparently represent recolonisation of the species' former range.

Nationwide, the spotted shag population is increasingly well documented. At many sites the species is relatively easy to monitor, being large, conspicuous, and living in areas close to human habitation. However, at some sites its cliff-nesting habits make colonies hard to access or view. As an endemic New Zealand species, it is useful to monitor populations to identify whether there are threats or sudden changes to populations which may warrant conservation management.

The population in the Otago region was surveyed 1977-93 by Lalas (1993), who found that numbers there fluctuated between about 1,000 and 2,000 pairs. The population at Banks Peninsula was surveyed in 1960 and 1996 at over 80 sites, and comprised nearly 10,000 pairs and 22,000 pairs, respectively, with an average of 270 nests per colony

in 1996 (Doherty & Brager 1997). Approximately half of the Banks Peninsula colonies in 1996 contained 200 or more nests, with a maximum of 1103 nests. Fewer than 100 nests occurred in only one quarter of the colonies. In the 1960 counts at Banks Peninsula, average colony size was 137 (Turbot & Bell 1995). In the Marlborough Sounds, a survey in 2006 identified 1,254 pairs at 193 sites (Bell 2012). Colonies with fewer than 10 nests dominated (85% of colonies), with the largest colony holding 76 nests (Bell 2012). Clearly, total numbers and numbers of nests per colony in the Marlborough Sounds were much lower than at Banks Peninsula.

Our objectives were to document the spotted shag populations around the Wellington region, with a focus on those in Wellington Harbour. We drew on both observational data and records, both published and unpublished to present some information about changes in the populations through time.

METHODS

Counts of birds were undertaken regularly by OSNZ members at Matiu/Somes I and its northern islet Mokopuna during 2002-05. These counts were replicated from May 2012, and a set of opportunistic observations of shags at Matiu/Somes I were made between late 2010 and late 2012. At Makaro/Ward I (41.293 S, 174.872 E), 9 counts in 2007 - 2012 were undertaken. A specific protocol for counts at Matiu/Somes I and Mokopuna Islet was set out at the onset of a regular count series in 2002.

At Matiu/Somes I, birds were identified from the main 'circular' track around the island and associated look-out points, using binoculars. Individual birds were counted from the land, termed "on-shore surveys". From Nov 2010, nests and spotted shags were counted, although nest contents were only rarely visible. During some survey periods, observations from boats were made using binoculars and photographs (termed "boat surveys"). Any birds on shore and at sea within 50 m of shore were counted. At Makaro/Ward I total numbers ashore and close to shore were counted and nest presence was noted.

Trends for the datasets were estimated using linear regression, using Microsoft Excel software.

RESULTS

The number of individual shags on each survey is presented in Table 1. Annual maximum numbers of spotted shags counted at Matiu/Somes and Mokopuna Is varied between 85 - 354 individuals during the 10 year period of our observations (mean = 210 ± 76 [1 s.d.]). The counts of 190 and 176 birds observed in Oct 2010 and Sep 2012, respectively for both islands together, are within the range for the

Table 1. Spotted shag numbers (individual birds) at Matiu/Somes, Mokopuna and Makaro/Ward Is during 2002-12 from on-shore surveys and boat surveys.

Date	Matiu/Somes and Mokopuna Is		Makaro/Ward I
	Individuals from on-shore surveys (nests in parentheses)	Individuals from boat surveys (occupied nests in parentheses)	Individuals from on-shore surveys (unoccupied nests in parentheses)
Mar 2002	83	171	-
Jun 2002	75	260	-
Sep 2002	56	248	-
Dec 2002	44	-	-
Mar 2003	74	85	-
Jun 2003	45	-	-
Sep 2003	69	183	-
Dec 2003	56	260	-
Mar 2004	29	240	-
Jun 2004	71	-	-
Sep 2004	129	354	-
Dec 2004	89	-	-
Mar 2005	70	96	-
Jun 2005	83	257	-
Sep 2005	38	-	-
Dec 2005	31	-	-
Sep 2007	-	-	5 – 8 (4)
Dec 2007	-	-	6
Mar 2008	-	-	1
Nov 2008	-	-	8
May 2009	-	-	4 (5)
Mar 2010	-	-	1
Aug 2010	-	-	4
Oct 2010	-	190	3
Nov 2010	35 (8)	-	-
Feb 2011	0 (0)	-	-
Dec 2011	-	139	-
May 2012	-	-	11
Jun 2012	90	-	-
Sep 2012	41 (3)	176 (52)	-

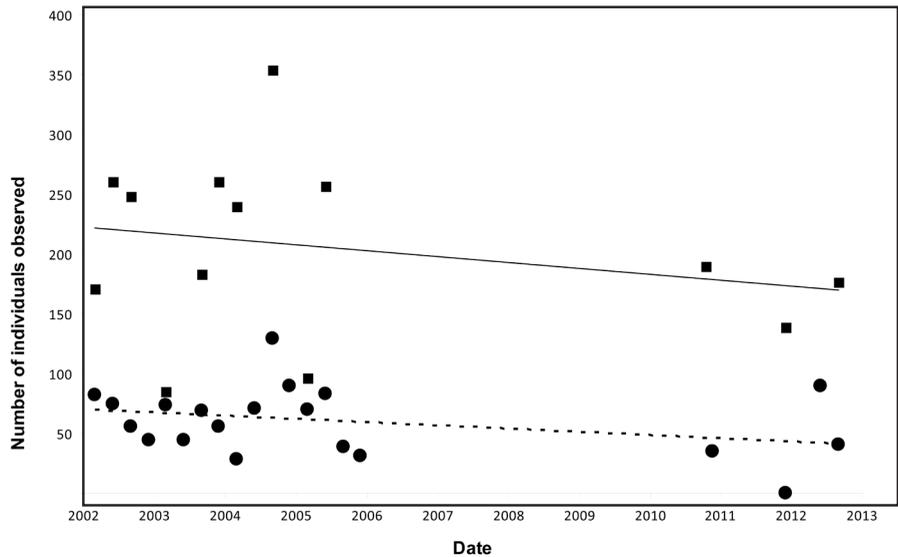
population observed between 2002 and 2005, but further surveys would assist in assessing current trends.

When the colony was first established, all nesting occurred at Shag Rock/Te Papa a Tara of Matiu/Somes I (Miskelly & Benfell 1981). However, Robertson (1992) reported nesting had spread around the entire west coast, including on the

northern islet of Mokopuna. We recorded 10 active nests on Mokopuna in 2010 and 3 in 2012.

At Makaro/Ward I, counts were made opportunistically from 2007-12, and the numbers may represent birds which travelled between this site and Matiu/Somes I, and counted there at other times. We assume these birds were part of the same population. Nests were observed at this site

Fig. 1. Numbers of spotted shags observed at Matiu/Somes and Mokopuna Is during on-shore (circles) and boat surveys (squares). Solid line = boat surveys; dashed line = on-shore surveys.



in Sep 2007 and May 2009, and a dead juvenile was seen in Dec 2007.

The number of birds observed on Matiu/Somes and Mokopuna Is fluctuated considerably between years and seasons without clear patterns (Table 1, Fig. 1). Trend lines for both the on-shore surveys showed a stable or slightly negative tendency ($y = -0.33x - 69$, $r^2 = 0.027$), as for boat surveys ($y = -1.224x + 222.5$, $r^2 = 0.057$), though neither dataset showed a significant negative trend (Fig. 1). A negative trend would be supported if the 1982 estimate of 150 breeding pairs was correct, as it appears that fewer birds nest on these islands now than in 1982.

During 2010–12, birds were noted on active nests from Sep to Nov. However, a freshly dead chick (now NMNZ OR.29300), estimated to be 4 weeks old based on Marchant & Higgins (1990), was found on Mokopuna I on 3 Oct 2010. This means it would have come from an egg laid in late Jul/early Aug.

DISCUSSION

Our surveys of spotted shags, conducted at breeding sites in Wellington Harbour over a 10 year period, indicate a fluctuating stable or possibly declining population. The population expanded rapidly after colonisation in 1972 and by the early 1990s had spread from a single site on Shag Rock/Te Papa a Tara to several nesting sites along the west coast of Matiu/Somes I and to Mokopuna and Makaro/Ward Is. By 2013 the Harbour's breeding population had expanded even further to include a new site off Breaker Bay. However, this breeding range expansion appears not to be linked with an overall increase in the population size. Similarly on Kapiti I, the small nesting population was still roughly the same size in 2011 as it was in 1999 (C. Miskelly, *pers. comm.*).

Boat surveys were the most effective means of estimating the population size, especially for nests, which were mostly obscured from the land. Only around one quarter of the individuals present at the site were able to be seen from land, compared with the boat-based counts (Table 1). Given the difference in ability to detect birds in land-based vs. boat-based surveys, we recommend future surveys concentrate on boat-based surveys to ensure more complete coverage of spotted shags nesting sites.

The nesting period of spotted shags may have shifted compared with the 1970s–1990s, as more recent observations noted a more restricted breeding season from Jul–Nov, rather than May–Aug and Nov–Jan in earlier years. However, more information on the timing of breeding is required before drawing firm conclusions, as the species can have an “exceptionally irregular” breeding season with birds at nests at any time of the year (Turbott 1956). A shift in breeding season may explain the peaks in relative abundance observed in Wellington Harbour surveys which had changed considerably between decades (Robertson 1992). A long nesting season with seasonal variation between years contributes to the difficulty of assessing local population trends.

Based on surveys at Banks Peninsula and in the Marlborough Sounds, there appears to be no ‘normal’ colony size for spotted shags. These findings show that there is considerable variation in numbers of pairs between colonies. The species appears to be able to withstand considerable intra-specific competition, with several hundred to over 1000 pairs nesting in colonies at Banks Peninsula. Numbers in Marlborough Sounds are limited to a few tens of birds at the majority of sites. Perhaps greater numbers per colony reflects greater local availability of food.

Surveys of birds from the Wellington Harbour shoreline (Robertson 1992) have not included the 3 breeding sites detailed here. However, these harbour surveys showed a marked increase in numbers of spotted shags between 1975-77 and 1986-1988, with maxima of c. 15-20 and 35-40 birds/100 km in the 2 periods, respectively. This increase coincided with the establishment of the Matiu/Somes I colony. Robertson (1992) noted that the timing of peaks of occurrence had changed between the 2 periods, but with no clear pattern between seasons. Compared with the 1980s counts, more recent Wellington Harbour surveys (2008-2010) showed a pattern of seasonal peaks, with greatest numbers in Feb and Jun-Jul at around 60 birds/100 km and 10-40 birds/100 km in intervening months (H. Robertson, *pers. comm.*).

Seasonal information indicates that there is an influx of migrants to Wellington from autumn to early spring from the much larger South I colonies. Wodzicki & Kennedy (1978) noted non-breeders coming into the region between Apr and Sep, but no breeding from the 1940s to 1970s. There are banding recoveries of Canterbury birds in the Nelson region (Marchant & Higgins 1990). Therefore some birds recorded at Wellington Harbour breeding sites during Apr to Sep may be non-breeding immigrants rather than local birds. On the other hand, birds from Wellington colonies may move away seasonally during the non-breeding period. Some local birds move long distances, as demonstrated by a chick banded on Matiu/Somes I that was recovered 4 months later, 1,100 km away north of Coromandel township, in Dec 1979 (Miskelly & Benfell 1981).

Numbers of spotted shags in Wellington Harbour may reflect nationwide trends or local conditions. We do not know if the numbers reflect the carrying capacity being reached or are due to human influences such as food supply changes or fisheries by-catch. Certainly local food availability has changed greatly in recent times (Robertson 1992). How the Wellington population fits into nationwide population trends is an interesting question, and the mechanisms impacting on the number of spotted shags presently in the region is a potential topic for future research.

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