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SHORT NOTE

# Successful restoration of an unnatural breeding habitat for white-fronted terns (*Sterna striata*)

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Although relatively abundant and widely distributed through much of New Zealand with additional breeding records in the Bass Strait, Australia, the white-fronted tern (*Sterna striata,* henceforth terns) is currently listed as 'At Risk – Declining' (Robertson *et al.* 2017). Despite numbers estimated at 24-30,000 birds (BirdLife international 2017), there are few published studies of its general biology (*e.g.* Mills & Shaw 1980, appears to be the only detailed analysis of breeding). Two key reasons for the lack of published research may be: (1) the ephemeral nature of breeding colonies (*e.g.* Mills & Shaw 1980; Spurr & Ledgard 2016), as terns regularly move location between seasons for no apparent reason; and (2) the sensitivity of breeding birds to disturbance (*pers. obs*). Nesting colonies and individual birds are often found on inshore rock stacks or cliffs, and on sand or gravel bars (Mills 2013). Most nesting locations are not closely linked to regular human activity, thus terns are not usually habituated to humans passing nearby and they flush readily (*pers. obs*.; Higgins & Davies 1996).

A small colony of nesting terns established some years ago on abandoned concrete and wood bridge supports in inner Tauranga Harbour, immediately adjacent to a busy commuting road (Turret Rd/15th Avenue, 37°42.8982′ S, 176°9.8883′ E, Fig. 1). The age of the colony is unknown, but breeding has occurred every year since 2008 (R. Adams, *pers. comm*.) and our records began in 2010.

The bridge history is as follows. In 1961/2, a 2-lane bridge was built immediately adjacent to a 1-lane bridge that had been in place since at least the 1930's (BoPRC archived maps http://boprc.maps.arcgis.com, accessed 20 July 2017). The terns now nest on the concrete (and wood) support structures from the original 1-lane bridge, which were left in place when the bridge platform was removed (date unknown, but between 1962 and 1977). Most of the original 1-lane bridge supports were concrete, but the 2 central supports were wooden trellises built

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**Fig. 1.** The old bridge supports as re-configured in winter 2013.

**Fig. 2.** Tern nest on concrete with drainage channel. The vegetation is growing naturally.

**Fig. 3.** Original concrete bridge supports on north side of bridge centre, re-surfaced with wooden sleepers taken from the old bridge trellis supports. Some concrete surface is still available on the resurfaced supports.

on 2 concrete piles that were lower, wider and longer than the others (to support a passing bay). The concrete has survived in good condition, but by 2010 the wood trellises were clearly rotting. One was missing, either removed or having fallen into the sea. The remaining trellis was dismantled in 2013 due to obvious imminent collapse. That wood was used to resurface 6 of the remaining concrete piles and supports, including the 2 central piles and 2 supports on either side of the central piles (the restoration).

Our initial observations (2011–2012) prior to the restoration indicated that terns bred on both concrete (Fig. 2) and wood (Fig. 3) surfaces, although the wood-finished lower central piles were preferred. However, it was possible that the central piles were preferred because they enabled nesting slightly further away from people and disturbance, rather than because of the wood surfacing. Also, the only nest placed directly on concrete on a low pile was washed away by wave action at high tide in 2011, indicating that the level of the nesting surface should be raised. The restoration therefore involved (1) refinishing the 2 central piles to raise the nesting height by 60 cm, and (2) creating a choice of breeding surfaces with a mix of refinished (wood) and bare-concrete in the central part of the bridge where most nesting occurred.

Most nests on concrete were placed in indentations created by the original bridge-building process (such as for bolts). In 2011/12 several nests placed directly on concrete were lost due to flooding of those indentations. Hence, during the restoration we created drainage from those indentations by drilling out small channels in the concrete (Fig. 2). With respect to future breeding by the terns, we were concerned that removal of the central wooden frame and refinishing of concrete surfaces would result in the entire colony abandoning the site. However, the imminent collapse of the wooden trellis forced a response.

In August 2013 (before the arrival of breeding terns), the concrete supports were re-finished as follows. The 2 low central piles were given a raised wooden finish (Fig. 3) to ensure that any nests on

**Fig. 4.** The 2 old central concrete bridge piles are low to the water, and were each re-surfaced with 2 parallel wooden sleepers raised about 60 cm to get above wave action at high tide. There are 3 nests and 2 resting birds (mates of the females on the nests) in the picture.

the wood would be well above wave action. These 2 piles were wide enough to support 2 lines of wood each (Fig. 4). Four of the higher supports were re-surfaced, leaving 12 as bare concrete. Counting from the nearest low central pile as number 1, the re-surfaced high supports were numbers 3 and 4 to the south, and 2 and 4 to the north, creating a slightly different choice array on either side of the low piles. Most nests, and all successful nests, in all years of study have been located on the 8 central structures (the 2 low central piles, and the 3 high supports immediately on either side). Thus, concrete supports further towards the land on either side of the centre of the old bridge are unimportant to the birds, but are potentially available if the population expands. They currently offer the same concrete surfacing with indentations as the central piles, although drainage channels were not created in them.

In reality, the concrete was used only rarely once more wooden surfacing was available (beginning 2013/4). However, 1 successful nest (i.e. chicks achieving 1-2 weeks post-hatching) on concrete in 2015/6 appeared to benefit from having drainage.

We checked the colony approximately weekly from mid-October (when birds were first arriving) until the last chicks were fledging (usually late December/early January), from 2011 to 2016. During each visit we followed the fate of nests by recording the presence/absence of adult birds, apparent incubation behaviour, and the presence of chicks. Our checks were most consistent in the 2 summers following the restoration (2013/4 and 2014/5). Our ability to determine clutch size and breeding success was limited as we did not disturb birds from the nest, there were no marked birds, and chicks began to leave the nest well before fledging. We therefore report 2 measures: 1) number of nests initiated; and 2) percent of nests where chicks survived for 1-2 weeks. The bridge was also checked regularly throughout the year in case terns were present, but they were rarely seen.

The clutch size in many nests was not recorded and we give only a qualitative summary here. All clutches seen were of 1 or 2 eggs, with most nests having a single egg; in some years no 2-egg clutches were seen. Successful rearing of 2 chicks was recorded (for 3 nests) in only 1 year (2011/2).

The appearance of the terns at the bridge in spring was quite variable, beginning as early as July, with occasional sightings of terns in August and September. Birds seen before mid-October appeared to be prospecting and were mostly flying around and not settling. Birds settled and resting were seen any time from mid-October, with number of settled birds increasing reliably from about 20 October. Breeding was consistently initiated in the last week of October. However, the 2016/7 season was very late, with 2 nests being incubated on 6 November and no other birds present (13 nests were eventually recorded, Table 1).

For example, a copulation was seen on 22 October 2014, when no other birds were incubating. On 26 October 2017, 5 birds were sitting tight (possibly incubating). On 30 October 2017, 2 birds were sitting on one egg each (both nests were empty on 26 October), three apparently incubating birds had no egg in the nest, three other pairs were seen copulating at empty nests, and three more were sitting tight with nest contents not determined. Based on the 26 and 30 October checks, there was only one nest that might have contained an egg on 26 October.

The incubation period was estimated to be 27-28 days, based on 3 nests with complete records from before birds started incubating, through to newly

**Table 1**. Nesting details for white-fronted terns in Tauranga Harbour; "success" defined as a chick achieving 1-2 weeks post-hatching from all initiated nests. *Data from Adams (2012)

| Year | | Attempts | % Successful | Notes |
|---|---|---|---|---|
| 2010/11* | Pre- restoration | 12 | 58.3 | |
| 2011/12 | | 13 | 61.5 | |
| 2012/13 | | 11 | 45.5 | |
| 2013/14 | Post- restoration | 22 | 77.3 | Last chick fledged late February |
| 2014/15 | | 16 | 43.8 | Last chick fledged mid-January |
| 2015/16 | | 15 | 40.0 | No successful late nests |
| 2016/17 | | 13 | 46.2 | No successful late nests |

hatched chicks seen in the same nest. In most years, there was little re-nesting, late nests all failed, and most breeding was completed by early January. However, in 2013/4 there was considerable re-nesting and the last chick fledged in late February.

Following the restoration, the 2013/4 breeding season was the most successful recorded (Table 1), with the most nesting attempts and the highest proportion of successful nests. However, the unusually extended nesting season in that year suggests that the restoration was not the primary cause leading to success. Other environmental factors (such as food availability) may also have been influential. Either way, the birds clearly accepted the restoration. Post-restoration, slightly higher numbers of nesting attempts were recorded each year relative to pre-restoration, although success rates declined (Table 1). The loss of 3 early breeding females in 2014 (see below) may have affected these results.

In 2014 the season began in late October as expected, but the first 3 birds to begin incubation were killed by rocks in early November, presumably thrown from the bridge at night. The distances involved are small (5–8 m) and the birds are easily hit. Mills & Shaw (1980) found that breeding white-fronted terns were likely to be over 6 years old, and the earliest breeders were considerably older. Nisbet *et al*. (1984) similarly found that older common terns (*Sterna hirundo*) bred earlier and were more successful (although they also found evidence of declining breeding success in very old birds). The earliest breeding terns in Tauranga were therefore likely to be older and more experienced, and the loss of 3 older breeding adult females in a single event could be catastrophic for the colony. Certainly, the colony had poorer breeding success in all 3 years after 2013/4 relative to both 2013/4 and pre-restoration (Table 1). Atlantic puffins (*Fratercula arctica*) similarly show long-term sensitivity to disturbance (Rodway & Montevecchi 1996). Success was also lower in those 3 years relative to pre-restoration success (Table 1). In December 2016, a chick appeared to have been killed by a thrown rock (a distance of 3–4 m). The colony is also threatened by pressure from the communities of eastern Tauranga to widen the current 2-lane bridge and road to 4 lanes, due to rush hour commuter traffic delays. Thus, the colony is under threat in several ways and its persistence is remarkable.

Although tolerant of people passing on the adjacent bridge walkway, the terns sometimes responded with nervousness and even aggression if people stopped to watch or photograph them. Nests placed close to the walkway on the high concrete supports were the most exposed. Our data set is too small to determine if these nests had a higher failure rate, but all 3 nests placed on the current bridge supports directly below where people stand (these are not connected to the old supports) have failed. Birds sitting on these nests have people passing by or looking directly down onto them at a distance of 2–3 m, and they frequently responded to such observation with agitation. However, some birds that regularly became agitated when people stopped to watch still successfully fledged chicks. It is possible that some self-selection in relation to tolerance has occurred through time, with more sensitive birds abandoning the site and breeding elsewhere.

The colony is possibly unique in New Zealand due to its accessibility, the tolerance of the birds, its location in the inner harbour, and the opportunity to observe and photograph nests from above. We have met people on the bridge from many parts of New Zealand who have come specifically to

photograph these birds. Despite that attention and occasional publicity in local media, many people in Tauranga have no knowledge of this unusual wildlife resource in the middle of the city. Along with many other environmentally-aware members of the Tauranga community, we regularly promote the interests of the terns in the context of roading discussions, planning meetings, and district plan submissions. Unfortunately, raising genuine interest in the fate of the terns is difficult and these comments and submissions appear to have little impact in the face of "failing" infrastructure and ongoing urban growth (e.g. NZ Herald, 2017a). Fortunately, funding for widening the bridge and road is not yet available to the Tauranga City Council, which is already in danger of breaching its borrowing limits (NZ Herald 2017b). Thus, the terns may be protected by fiscal constraints for a few more years yet. If (when) bridge widening becomes likely, we will be lobbying hard to ensure that the breeding needs of the terns are taken into account. We will also continue to monitor the colony in case population growth creates a demand for more wooden surfacing for breeding.

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