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Hybridisation by South Island pied oystercatcher (*Haematopus finschi*) and variable oystercatcher (*H. unicolor*) in Canterbury

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Abstract We document hybridisation between South I pied oystercatcher (*Haematopus finschi*) and variable oystercatcher (*H. unicolor*) in Canterbury from 1989 to 2005. From 2 observations of hybridisation between South I pied oystercatcher x variable oystercatcher when first discovered, the hybrid swarm has increased to around 17 pairs, including South I pied oystercatcher pairs, variable oystercatcher pairs, hybrid pairs, and mixed pairs. We present data on the birds and their offspring and speculate on possible causes and implications of hybridisation for conservation of the taxa.

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Keywords South Island pied oystercatcher; *Haematopus finschi*; variable oystercatcher; *Haematopus unicolor*; hybridisation; conservation management

INTRODUCTION

South I pied oystercatchers (*Haematopus finschi*) (hereafter SIPO) and variable oystercatchers (*H. unicolor*) (hereafter VOC) are taxa of uncertain affinities endemic to New Zealand's main islands (Banks & Paterson 2007). Both have undergone recent and substantial population increases (e.g. Sagar *et al* 1999; Crossland 2001). SIPO are most readily distinguished by a sharp border on the lower chest between the black upperparts and white underparts, and a white tab that extends upwards in front of the folded wing, whereas pied VOC are larger and have a smudgy border on the chest (Heather & Robertson 1996). Other measurable features can also separate the 2 species. Hybridisation between these 2 species of oystercatchers has not been documented in detail previously. Here, we outline the discovery and monitoring of an initial 2 hybridising pairs of SIPO/VOC, leading to the establishment of a small local hybrid population.

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METHODS

Our first study area was located at Ashworth's Lagoons, North Canterbury (43°12'S, 171°44'E). This area was comprised of several shallow ponds bordered by areas of sandy dunes, some stabilised by marram grass (*Ammophila arenaria)* and other vegetation, but bordered on the seaward side by extensive areas of open sandy beach for a number of kilometres to the north and south. Above the tide-line, the beach was littered with driftwood. The combination of dune and beach was considered

Table 1. Mass (g) and bill length (mm) of birds in mixed South Island pied oystercatcher (SIPO) x variable oystercatcher (VOC) pairs, banded at Ashworth's Lagoons, Canterbury, New Zealand.

Pair	Taxon	Band no.	Date	Mass	Bill length
A	VOC	K-8613	11 Oct 1997	658	84.0
	SIPO	K-8611	15 Oct 1995	625	99.4
B	VOC	K-9397	27 Oct 1994	710	78.1
		K-9397 retrapped	11 Oct 1998	695	78.7
D	VOC	K-8623	2 Dec 1999	555	78.0

typical VOC breeding habitat (Heather & Robertson 1996). Breeding (and non-breeding) oystercatchers used the open beach for feeding and adjacent unstabilised sandy areas for feeding and rearing chicks.

Identification of dark VOCs is straightforward, based on all or nearly all black plumage. SIPOs in our study pairs were identified using plumage characters considered diagnostic of the species, i.e., sharp demarcation between black upperparts and white underparts on lower breast and presence of a 'white tab', as well as morphometric features (Heather & Robertson 1996: see Results).

Visits were made to the study site throughout each breeding season and less regularly at other times from 1993 until 2002. Hybrids had been observed in this area prior to 1993 by Andrew Crossland (*pers. comm.*) and for completeness, we also report his observations here. The identity of each bird was confirmed using 8x binoculars and telescopes, and through the examination of captured birds. Birds were captured on the nest using noose mats, and a drop-trap over the nest, the eggs having been replaced with dummies. Hybrids were subsequently identified by being banded or having been flagged green as pulli when captured before fledging with their parents and observed subsequently with their parents. Other birds were assumed to be hybrids based on their similarity to the plumage characters of these known, marked hybrids.

In the late 1990's, increasing damage by off-road vehicles likely caused most oystercatchers to abandon the Ashworth's Lagoons site, and from 2005 to 2009 our attention shifted to the Ashley Estuary spit (then an island) some 1-2 km to the SSW (43°14'S, 171°44'E). This spit became increasingly favoured by breeding oystercatchers, which fed on the adjacent ocean beach as well as in the estuary and used the unvegetated dune areas for breeding. Our methods of observation, capture, and banding of birds at the Ashley Estuary was similar to that used at Ashworth's Lagoon.

RESULTS

General observations

On 15 Nov 1989, Andrew Crossland recorded a pair of oystercatchers at Ashworth's Lagoons comprising a normal-coloured SIPO and an all-black VOC, which he noted as clearly defending a territory (*pers. comm.*). He also noted at least 3 SIPO x SIPO pairs along the beach, including one with a nest containing 2 eggs, situated just above the tide-line. Crossland's report of the occurrence of SIPOs nesting on a sandy beach is, to our knowledge, a first record for this taxon. Similar situations occurred in the early summer periods up to around 1992.

On 27 Oct 1992, Crossland observed a suspected hybrid oystercatcher among a large SIPO flock on the adjacent Ashley Estuary. He noted the bird was the size of a SIPO and with a shoulder-hook, but with smudgy plumage and diminished wing bar. Two black, and 1 pied phase VOC were also present for comparison. At Ashworth's Lagoon on 3 Dec 1992, he caught the surviving nearly-fledged chick, from an original brood of 2, of the presumed original 1989 hybridising pair, which he banded (K-4947). In 1993 he noted 2 mixed pairs with eggs.

Our observations began in 1993. TC located one 2-egg nest on 27 Oct 1993, with a VOC incubating and both adults (SIPO and VOC) participating vigorously in its defence. On 2 Jan 1994, we located the presumed same mixed pair at the same site with a juvenile which solicited food from both adults. A second mixed pair *c.*500 m to the south had 2 approximately 10-day old chicks (Fig. 1).

These 2 pairs (or replacement birds) continued to breed in this area and held territory year-round, in contrast to the SIPO pairs which dispersed after breeding, until 2005, when they dispersed or disappeared. During these intervening years one or both birds would false-brood in winter on occasion. The 2 pairs tolerated the presence of other oystercatchers (mainly SIPO) within their territories outside the breeding season, but excluded them at other times. Each breeding season they nested,

producing a second clutch if the first failed, and usually successfully fledged 1-2 chicks/pair/year.

Banding

Three of the 4 initial adults located in 1993 were caught, banded and measured (Table 1). The measurements of birds from Pair A fell within the range of a male VOC and a large female SIPO (Baker 1972). Eggs (n = 19, from 7 clutches) from this pair averaged 55.7 x 39.8 mm (Table 2) which is within the range reported for SIPO (Baker 1972), and thus supports the assignment of the female as a SIPO. Within Pair B, measurements fell within the range of a male VOC (Table 1). However, the eggs (n = 7, from 4 clutches) of this pair averaged 60.20 x 40.50 mm, and fell into the range of large VOC eggs (Baker 1972; Table 2). The SIPO of this pair showed all diagnostic SIPO plumage features. Therefore, it is possible that the VOC was an exceptionally large female. Measurements of the VOC from Pair D also lie within the range for males of this taxon. Measurements of 2 eggs from 1 clutch of this pair fell within the range reported for SIPO.

On 10 Nov 1995, we applied a green leg flag to a chick of Pair A (the chick was too small to band). Subsequently, 8 further chicks were banded (K-8617-18, K-8615, K-8620-22, K-8320, K-8921) in Nov 1997 and Oct-Nov 1998, and green flags were applied to the left tibia. At least 2 of these birds (but likely more than 2) were seen regularly in subsequent years on the Ashley Estuary, and bred there from 2002 to 2008. Two sightings of green-flagged oystercatchers have been reported to the Banding Office (Department of Conservation): on 22 Nov 1998 a SIPO was observed Big Sand I, Tapora, Kaipara Harbour, approximately 755 km to the north, and on 14 Dec 1999, a SIPO or VOC with green flag tibia was seen at Matarangi, Coromandel Peninsula, approximately 775 km to the north.

Taxonomic composition of breeding population

By the late 1990's a growing oystercatcher population was breeding each season on the spit (then an island) at the Ashley Estuary. On 13 Sept 1998, we recorded 2 presumed hybrid (unbanded) birds which were behaving as a territorial pair, and on 11 Oct 1998, a smudgy (or hybrid) bird paired with a SIPO. On 17 Oct 1998, at Ashworth's Lagoon, we observed 2 territorial SIPO x VOC pairs, a SIPO x smudgy (or hybrid) pair, and 2 SIPO x SIPO pairs. On 9 Nov 2000, K-4947 was seen with a chick, our first confirmation of a hybrid breeding.

A census of the Ashley Estuary spit (*c.*2 km long) on 11 Nov 2001 produced 3 SIPO x SIPO pairs, 4 presumed hybrid x hybrid pairs (including 2 flagged birds, confirming they were progeny of the original hybridising pairs), 2 hybrid x dark-phase VOC pairs (no flags), and a SIPO x VOC pair (presumed Pair B as the VOC was banded). On this date Pair A was still at Ashworth's Lagoon.

Fig. 1. A, pair A at nest, **B**, South Island oystercatcher pair A, **C**, variable oystercatcher pair B. All photos taken in Nov 1994. Photos: Don Hadden.

On 3 Nov 2002, a repeat census produced a total of 13 territorial/nesting pairs comprised of: SIPO x SIPO (2 pairs), SIPO x banded VOC (presumed pair B), SIPO x VOC or hybrid (noted as very pale

Table 2. Measurements of eggs of clutches of hybridising VOC/SIPO pairs (note some replacement/first clutches not measured).

	Date	Length (mm)	Width (mm)
Pair A	Nov 1994	55.0	37.0
		54.0	38.5
		55.0	40.0
	Oct 1995	56.3	40.7
		54.5	40.4
	Oct 1996	51.3	39.8
		54.6	39.9
	Oct 1997	54.8	40.0
		57.1	40.2
		56.7	40.0*
	Oct 1998	57.0	39.7
		58.0	41.2
		55.9	40.7
	Nov 1999	58.0	40.4
		56.9	39.5
		57.1	38.6
	Oct 2000	55.6	38.7
		55.1	39.6
		55.7	39.6
Pair B	Oct 1994	60.6	40.6
		57.1	40.7
	Oct 1996	62.1	40.7
		57.0	40.7
	Oct 1997	63.9	39.5
		60.9	40.6
	Oct 1998	60.4	40.7**
Pair C***	Oct 1998	60.4	40.5
		59.3	40.0
	Nov 1999	57.4	39.8
		58.5	40.0
Pair D	Dec 1999	53.8	38.3
		53.7	40.1

* Egg abandoned outside scrape
** Plus one newly hatched chick
*** Pair 'C' (SIPO/VOC pair, both unbanded)

plumaged), SIPO x hybrid or pied-phase VOC (3 pairs), VOC x hybrid (green-flagged), VOC x hybrid or pied-phase VOC, hybrid or pied-phase VOC x hybrid or pied-phase VOC (2 pairs), VOC x unknown taxon (on nest with 3 eggs), and hybrid (metal-banded smudgy, presumably Crossland's chick of 3 Dec 1992) x hybrid (green-flagged). On 30 Nov 2002, presumed Pair A were at Ashworth's Lagoon with 2 large chicks.

Plumage changes

The juvenile observed on 2 Jan 1994 closely resembled a newly fledged SIPO in all respects. This continued to be our impression of the progeny of the original mixed pairs, but banded and flagged birds gradually acquired the appearance of 'smudgy' VOCs over 1-2 years. Unlike SIPO, these hybrid young showed indistinct or no shoulder 'tabs', reduced wing bars, an indistinct breast band, and variable amounts of dark feathering on the lower breast. For example, 2 apparently paired flagged birds on 5 Aug 2001 were noted as being smudgy under the (closed) wing and almost to vent but still with a faint 'tab'. We note (*contra* Crossland) that known and presumed hybrids generally appear to be similar in size to VOCs post fledging, and are substantially larger than SIPOs even when viewed at a distance of up to 100 m with a spotting scope.

DISCUSSION

As pied-phase VOCs are relatively infrequent in Canterbury, it is possible than one or more, or even all of the hybrids or pied-phase VOCs in our 2001/2002 censuses were individuals of this morph. However, the occurrence of 27 breeding birds, comprising 10 SIPOs, 2 known and 1 presumed (Crossland's metal-banded bird) hybrids, 5 black or nearly black VOCs, and 9 presumed hybrids or pied-phase VOCs (i.e., 12 in total with the marked birds included), means that we are confident that most of the presumed hybrids were correctly assigned and were not pied-phase VOCs. Thus, our observations indicate that hybrid pairs have been recorded breeding in most years between 2001-2008, and were regularly producing offspring, proving their fertility.

Our observations show not only successful interbreeding between SIPO and VOC, but also that the resulting offspring are viable. There have been a number of records of hybridisation between sympatric black and pied oystercatcher forms, including American (*H. palliatus*) and black oystercatchers (*H. bachmani*) in Baja California, and American and blackish (*H. ater*) and blackish and Magellanic oystercatchers (*H. leucopodus*) in Argentina (Jehl 1978). There have also been records of possible hybridisation between pied (*H. longirostris*) and sooty (*H. fuliginosus*) oystercatchers in Australia (McGarvie & Templeton 1974; Hewish 1989, Collins *et al*. 2001).

Baker (1975) reviewed 'hybridisation' (*sensu* Short 1969) of pied, intermediate, and black phase VOCs in New Zealand, and speculated that their polymorphism 'presumably' (Baker 1972) results from an initial invasion of pied stock from Australia which subsequently became melanistic in the manner of several other New Zealand taxa, such as the black stilt (*Himantopus novaeseelandiae*), Snares tomtit (*Petroica macrocephala dannefaerdi*) and black robin (*P. traversi*). This was then followed by a second invasion of pied birds. Banks & Paterson (2007) reported the results of a preliminary study of the genetic differences in New Zealand oystercatcher species in which they found no genetic differences between VOC and SIPO. Although based on sample sizes of just 1 individual per taxon, the results suggested that oystercatchers radiated within New Zealand relatively recently, and that SIPOs and VOCs have diverged from each other even more recently (Banks & Paterson 2007). In any event, polymorphism in VOCs due to a secondary invasion seems unlikely, due to the assumed requirement of a large number of pied individuals (centred predominantly on northern New Zealand where the majority of pied birds are currently located) to account for the large proportion of pied and intermediate forms presently found in northern New Zealand (22% and 35%, respectively; Heather & Robertson 1996). Furthermore, this would have had to have occurred a sufficiently long time ago, and resulted in stable plumage types across the species, prior to a presumed further arrival of sufficiently differentiated pied birds ancestral to SIPOs, resulting in an apparently hitherto reproductively isolated taxon.

Baker (1972) suggested that the maintenance of SIPOs and VOCs in reproductive isolation was based on differing breeding habitat requirements (inland riverbeds/farmland for SIPO and open shorelines for VOC), timing of breeding (eggs Aug-Dec, mostly Sep-Nov for SIPO; Sep-Feb, mostly Nov-Dec for VOC (Heather & Robertson 1996)), to which we might add the mainly migratory behaviour of SIPO and mainly sedentary (and territory holding) behaviour of adult VOC. However, both species have recently experienced large and well-documented population increases (e.g. Sagar *et al.* 1999; Crossland 2001). Cessation of hunting in 1940 and the conversion of tussock grassland to pasture are cited as reasons for the dramatic increase in SIPO, though the reasons for recorded increases in the far less numerous VOC remain unclear. At the Ashley Estuary, substantially larger numbers of both taxa are present year-round than was the case 20 or so years ago (*pers. obs.*). In the case of SIPO (128% increase from 1973 to 1994; Sagar *et al.* 1999), this likely placed greater pressure on nesting habitat. The recent occurrence of nesting SIPO pairs on sandy beaches represents a breeding habitat extension into the range formerly occupied exclusively by VOC.

We suggest that the occurrence of hybridisation in these 2 previously isolated taxa may have occurred due to the anthropogenically-induced increase in SIPO numbers, resulting in them expanding into VOC habitat. Of concern are possible future effects of hybridisation, as can be seen in the imminent extinction of the grey duck (*Anas superciliosa*) in New Zealand due to hybridisation with introduced mallards (*A. platyrhynchos*) (Williams & Basse 2006), and the extirpation of black stilts (*Himantopus novaeselandiae*) to a remnant population due to hybridisation and competitive exclusion by recently arrived pied stilts (*H. himantopus*) (Pierce 1984; Maloney & Murray 2002). Depending on the success or otherwise of hybrid birds – and they currently appear to be thriving at the Ashley estuary - this may have implications for the future integrity of these New Zealand endemic species from a conservation management perspective.

There are anecdotal reports of isolated instances of apparent mixed SIPO/VOC pairs from elsewhere in the South I, but we have been unable to follow these up. We also note the occurrence in 1999 of an almost black oystercatcher found breeding with a normally-coloured SIPO in a farm paddock in Clarkville, some 21 km inland from the Canterbury coast. SP measured and banded this bird. It appeared to be consistent with SIPO measurements. The 2 chicks were subsequently colour banded 6 weeks later by John Dowding, who speculated it may have been an early example of melanism in SIPO, as has occurred in the evolution of many of New Zealand's birds. We mention these reports to encourage observers to examine unusual oystercatcher pairs closely, especially in parts of their range where pied-phase VOCs are scarce.

In addition to future monitoring of these and potentially other hybridising SIPOs and VOCs, we hope to encourage the use of modern DNA analyses to unravel the affinities of SIPOs, VOCs, the 'nationally critical' (Miskelly *et al.* 2008) Chatham oystercatcher (*H. chathamensis*), and their Australian congeners and putative forebears.

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