

Worimi Conservation Lands bird surveys (2009-2013)

Ann Lindsey¹ and Mike Newman²

¹ 37 Long Crescent, Shortland, NSW 2307, Australia ann.lindsey@bigpond.com

² 72 Axiom Way, Acton Park, Tasmania 7170, Australia omgnewman@bigpond.com

During 28 surveys over a five-year period in the Worimi Conservation Lands (WCL), a coastal area immediately north of Newcastle, 71 species of birds were recorded. The primary focus was to determine the status of shorebirds; 12 migratory and an additional seven Australian breeding species were recorded. The only shorebirds regularly recorded were Australian Pied Oystercatcher *Haematopus longirostris*, Red-capped Plover *Charadrius ruficapillus* and Double-banded Plover *Charadrius bicinctus*. The first two species breed at WCL, but in the case of the Australian Pied Oystercatcher, with minimal success, which is attributed to the large volume of vehicular traffic along the beach. The Double-banded Plover, a winter visitor from New Zealand, occurred in sufficient numbers to suggest WCL is one of the most important locations for this species in the Hunter Region and NSW.

Seven of the 71 species are listed under the *Threatened Species Conservation Act 1995* (NSW). The Australian Pied Oystercatcher and Little Tern *Sternula albifrons*, both classified as Endangered, attempt to breed in WCL, but with minimal success. Great Knot *Calidris tenuirostris*, Curlew Sandpiper *Calidris ferruginea*, Sanderling *Calidris alba* and Osprey *Pandion haliaetus* are occasional visitors. The White-fronted Chat *Epthianura albifrons*, listed as Vulnerable, is regularly present and presumed breeding.

Flocks of Australian Ravens *Corvus coronoides* and Gull-billed Terns *Gelochelidon nilotica* occurred regularly. Both species are known predators of eggs and may have an adverse impact on ground-nesting species like oystercatchers and terns.

INTRODUCTION

The Worimi Conservation Lands (WCL) 32°48'S 151°56'E are located between Fern Bay and Anna Bay immediately north of the mouth of the Hunter River. The Lands are owned by the Worimi Aboriginal Community and leased to the NSW Government to be jointly managed with the Board of Management on behalf of the traditional owners. National Parks and Wildlife Service (NPWS) carry out the day to day management. WCL are gazetted as National Park, Regional Park and State Conservation Area and include 25.5 km of beach (Draft Plan of Management - WCL Board of Management 2014). The management strategy of WCL seeks to balance several sometimes conflicting objectives. It is imperative to respect and protect the heritage values of the traditional owners, the vegetation and wildlife of the area, which include a number of restricted-distribution and threatened species. It is also important to support public access for recreational and commercial purposes. It is noted in the Draft Plan of Management that current vehicle access is not sustainable. In 2010/11 12,585 three-day beach vehicle permits in addition to the 10,347 annual

beach vehicle permits were issued. During holiday time at one entrance, as many as 600 vehicles per day entered WCL. Vehicles have access to the entire length of the beach south of the northern entrance. Access to most of the dune system is now restricted and vehicles are excluded from the vicinity of Aboriginal midden sites and vegetated areas (WCL Board of Management 2014). The Sygna shipwreck and Tin City, a small collection of huts used by recreational fishermen, are the two main man-made landmarks within WCL.

Prior to this study knowledge of the bird populations of WCL was mainly based on incidental observations and there was no overview documentation. Our surveys were initiated by Warren Mayers of NSW NPWS with the dual objectives of establishing an inventory of the birds of WCL and increasing the skills of NPWS field staff in bird identification. Emphasis was placed on understanding the status of threatened species, such as the Australian Pied Oystercatcher *Haematopus longirostris*, Little Tern *Sternula albifrons* and White-fronted Chat *Epthianura albifrons*. Beach-nesting species like the Australian Pied Oystercatcher and Little Tern are often

severely affected by high vehicular usage (Weston *et al.* 2014). Disturbance may force them to use unsuitable nest sites and interfere with incubation of their eggs; and if chicks are hatched, these tiny flightless animals leave the nest and may be run over and killed, as one of their threat defense strategies is to freeze. The irony is that they frequently take shelter in wheel tracks.

SURVEY METHOD AND ANALYSIS

Two members (usually authors AL and MN) of the Hunter Bird Observers Club Inc. (HBOC) undertook semi-regular monthly bird surveys from July 2009 to December 2013, with support from NPWS. Initially a ranger and, in later years, two visitor service assistants, usually Nadine Russell (NR) and Robyn George (RG) participated in the surveys.

Surveys were carried out by four-wheel-drive vehicle usually commencing at the Lavis Lane entrance to WCL. Surveys were split into three segments (**Figure 1**) to facilitate analysis: “southern sector” from Lavis Lane entrance to southern boundary including the Sygna wreck; “central sector” from Lavis Lane entrance to Tin City; and “northern sector” from Tin City to Anna Bay (**Figure 1**). The route taken was usually the same at each survey and involved driving south to the WCL boundary behind the frontal dune, crossing the dune to the beach front and driving north along the beach front to the exit south of Anna Bay. Where the frontal dune had been breached, inspections of the swale system behind were made. Stops were made to count any birds present. The extent to which the dune system behind could be surveyed in the northern section of WCL varied; the dunes are constantly restructuring, necessitating restricted access following storm conditions. However, as the surveys were predominantly concerned with quantifying the use of WCL by species which frequent the beach, restrictions to access were of limited concern. Surveys commenced at 8.30am and lasted approximately three hours. The state of the tide was variable. All species and their numbers (other than off-shore species) were recorded

Twenty-eight surveys were completed from July 2009 to December 2013: four in 2009, seven in 2010, two in 2011, seven in 2012 and eight in 2013. Unfortunately it was not possible to conduct surveys every month as a consequence of limited NPWS staff availability and severe weather conditions causing beach closures.

Consequently, there were differences in annual and monthly survey effort which compromised trend analysis. The trends presented are limited to species which occurred sufficiently frequently for indicative variations in annual occurrence to be discerned. Even these instances are not statistically robust. Small sample sizes, sometimes compounded by large fluctuations in numbers, complicate the provision of summary statistics. We have chosen to present mean numbers

even though standard deviations are often high, because they provide the reader with an indication of whether a species is typically scarce or relatively numerous at WCL. Mean numbers were calculated based on surveys when species were present and surveys when species were not recorded were excluded.

To establish the first comprehensive inventory of WCL’s bird populations, which this paper provides, we drew on the incidental records of NPWS staff. Many important observations involving breeding behaviour and seabird wrecks cannot be effectively recorded by periodic surveys, even at regular monthly intervals. The role of AL and MN was to foster the recording of such additional information by providing verification of identification and explaining the conservation requirements and behaviour of breeding species.



Figure 1. Schematic showing the three segments of beach surveyed in the Worimi Conservation Lands.

RESULTS AND DISCUSSION

Seventy-one species, including sea birds which are incidental in this study, were recorded (see **Appendix**). Summary statistics involving reporting rates (RR), which indicate the frequency with which a species occurred, mean and maximum numbers per survey are provided as an indication of the status of each species.

In the following discussion of the results emphasis is placed on those species for which WCL is considered to provide important habitat (i.e. WCL is arguably the stronghold of the Double-banded Plover *Charadrius bicinctus* in the Hunter Region). Other species like Australian Raven *Corvus coronoides* receive detailed consideration because their presence may be detrimental to breeding species like Little Terns. Only eight of these species (**Table 1**) were observed frequently (RR >40%) during surveys.

Table 1. Summary statistics for eight frequently recorded species during all 28 surveys.

	Reporting Rate (%)	Mean No.*	Max. No.
Whistling Kite	43	3	10
White-bellied Sea-Eagle	86	4	12
Australian Pied Oystercatcher	100	13	27
Double-banded Plover	68	65	137
Red-capped Plover	84	17	37
Gull-billed Tern	64	44	119
White-fronted Chat	68	5	16
Australian Raven	100	23	53

*Mean numbers/survey were calculated using the number of surveys each species was present.

Australian Pied Oystercatcher

Australian Pied Oystercatcher, a beach-nesting species, listed as Endangered under the *Threatened Species Conservation Act 1995* (NSW) (*TSC Act*) was observed on all 28 surveys, the highest number being 27 in July 2013. Whilst the size of WCL suggests considerable potential for supporting oystercatchers, the observed carrying capacity (number of foraging birds including both non-breeding birds and breeding pairs) is well below that which would be expected for an ocean beach of this type. Further, breeding success at WCL is abysmally low with persistent failure often directly or indirectly due to the number of vehicles travelling along the beach front (Russell & George 2013). Ideally oystercatchers nest near the high tide mark (Fletcher & Newman 2010) and from an early age onwards chicks follow their parents out to the foraging areas as the tide falls and are fed prey as soon as it is captured (Ens *et al.* 1992). This optimal strategy is not tenable at the WCL.

Oystercatcher activity, particularly breeding, is primarily restricted to an area of approximately seven kilometres in length near and north of Tin City. The restricted distribution of oystercatchers along the beach is attributed to the intensity of disturbance in the vicinity of entrances to the beach alienating the birds from these areas. There may also be issues of limited and unevenly distributed food availability. Pipis *Donax (Plebidonax) deltoides*, which are a key prey for oystercatchers on high-energy beaches, are harvested at WCL. Compression of sand by vehicles can also have an adverse impact on pipi abundance. WCL is periodically closed to harvesting allowing pipi populations to recover from declines related to these activities.

Key breeding events of the Australian Pied Oystercatcher in the study area between 2009 and 2013 are summarized below:

2009 Three pairs nested and all apparently failed (Stuart 2010);

2010 Two pairs, each with two young in October and one pair with an advanced young in November (Stuart 2011);

2011 Successful breeding and outcomes are documented (Russell & George 2012);

2012 Two nests with eggs found in September, but both failed (RG pers. obs.);

2013 One nest with two tiny chicks on 9 December. (Media Release, WCL Board of Management, December 2013);

2013 One very young juvenile with two adults on 10 December (AL pers. obs.);

2013 One nest with two recently hatched chicks on 30 December, this being a separate breeding attempt from that reported earlier in the month and thought to involve the pair which successfully fledged a chick in 2011 (Russell & George 2012).

Between 2009 and 2011 only small numbers of oystercatchers were recorded with the mean number of birds per survey less than 10 (**Figure 2**). However, during 2012 numbers increased, a trend which continued in 2013 when the mean number counted (21.8) was nearly three times that for the total period 2009 to 2011. It is suggested that, until 2011, the oystercatchers recorded were mainly resident breeding adults. Increased numbers in 2012 and 2013 are attributed to the formation of non-breeding flocks. Inspection of the plumage of these birds during surveys indicated that they contained a number of immature birds, one to three years old, which is less than the known age of first breeding (Ens & Underhill 2014). This conclusion was confirmed by the presence of the following flagged birds of known age. Three Australian Pied Oystercatchers, flagged as runners in northern NSW (two in Bundjalong National Park and one at Broadwater National Park), were identified during the surveys. WCL is over 440 km south of these locations. One bird was first seen in July 2009 approximately eight months after fledging. This bird, at age 15 months, returned to the Hunter Estuary eight months later (ABBBS 2010). The second bird was almost two years old (ABBBS 2010) when first seen and was regularly recorded over a 13-month period. The third bird was almost three years old when first seen in 2009 during the first year of this study. It returned 10 months later in May 2010. Prior to the first sighting at WCL, this bird was seen at Botany Bay, at that time two years old (ABBBS 2010). In contrast, another oystercatcher was banded as a three year old at Corner Inlet in Victoria in May 2011, over 800 km south of WCL where it was seen in February and

March 2012. This bird was also present in the Hunter Estuary over three months, September, October and November 2011, before moving to WCL (ABBBS 2011).

Collectively these records illustrate the extensive movement of Australian Pied Oystercatchers along the eastern coast of Australia and confirm that the non-breeding flocks at WCL contain immature birds including some in their first year.

Injured Australian Pied Oystercatchers, involving at least 11 different individuals, were observed on 17 (61%) surveys. Injuries affected mainly the legs and feet, which were sometimes missing, or had fishing line wrapped around them. In addition to these, in 2014, a male bird, entangled in fishing line with a lure attached was observed for several weeks by NPWS staff. When it became too weak to fly, it was caught and put into care at Taronga Zoo. It survived its ordeal and was released on 14 March 2014 (Newcastle Herald: 15 March 2014).

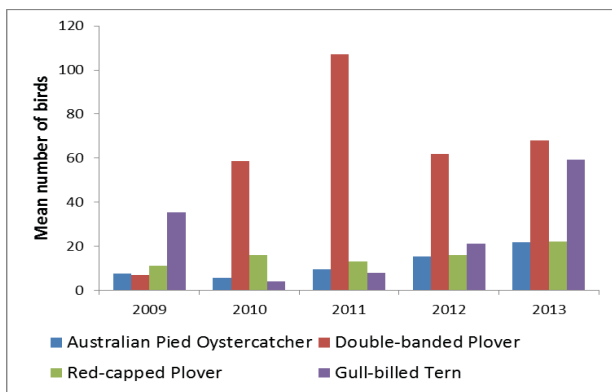


Figure 2. Annual variations in the mean number of birds present during surveys.

Pacific Golden Plover

This migratory species arrives in the Hunter Estuary in September and during diurnal high tides roosts principally on Kooragang Dykes. Pacific Golden Plover *Pluvialis fulva* are known to use WCL as a diurnal roost on occasions. It is probable that WCL is also a nocturnal roost site (Crawford & Herbert 2009). There are few records for WCL, probably because this species is easily missed during surveys if sheltering behind the frontal dune system or in the dunes south of WCL. The highest record involved approximately 220 birds in January 2006 (Stuart 2007). Pacific Golden Plover was seen on only two surveys in this study, the highest number being 67 in November 2009. On this occasion they were roosting near a swale behind the frontal dune. The other observation involved two birds in December 2013.

Double-banded Plover

In the Hunter Region WCL is one of three main destinations for this species which migrates from its breeding grounds in New Zealand. The other two are Port Stephens and the Manning Estuary. At WCL Double-banded Plovers were seen on 19 (68%) surveys. They normally arrive in February/March (Stuart 1994-2013), consistent with the monthly variation of our records (**Figure 3**), although one bird arrived abnormally early in January. Peak numbers were observed in May involving a mean of 106 (**Figure 3**) and a maximum count of 137 in 2011. Never very numerous, Double-banded Plover remain over the winter period until August/September (Stuart 1994-2013). Our records suggest the majority of birds have departed WCL by the end of August. Most observations were made of birds roosting above the high-tide mark, particularly in the vicinity of the Sygna. At times they were spread along the entire length of the beach or in small numbers on the edges of flooded swales. On one occasion they were actively feeding over an extensive area of the dunes immediately south of the Sygna.

Double-banded Plover were most numerous in 2011 as indicated by the variation of annual mean numbers (**Figure 2**). Annual variations may be impacted by the timing of the surveys as evidenced by the abnormally low mean number for 2009, the first year of the study, in which the initial survey was made in July after plovers have started to leave WCL.

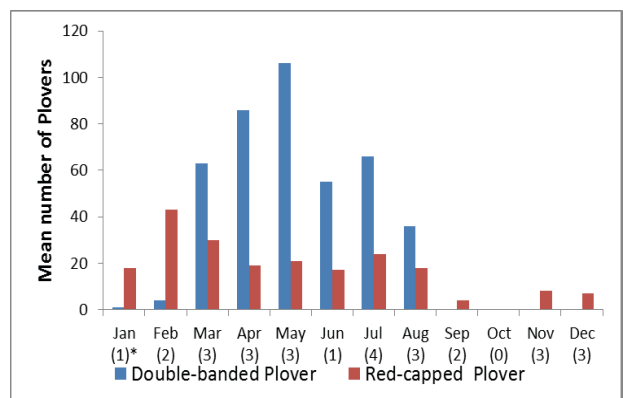


Figure 3. Monthly variation of mean numbers of Double-banded and Red-capped Plovers during 28 surveys at Worimi Conservation Lands from 2009 to 2013. *Numbers in parenthesis indicate the number of surveys conducted each month.

Red-capped Plover

Red-capped Plover *Charadrius ruficapillus* was observed on 25 (89%) surveys with the highest count of 37 on two occasions (March 2010 and May 2013). There was only one confirmed breeding record, a nest with eggs, in March 2013. Mean numbers were relatively stable between 2009 and 2012, but there was a 43% increase in 2013 compared with the previous four-year average (**Figure 2**). The monthly variation of numbers (**Figure 3**) indicates that Red-capped Plovers were more numerous between January and August than from September to December. Like the Double-banded Plover, Red-capped Plovers use a range of habitats – foraging at the edge of the waves or around the swales, when water is present, and roosting on upper areas of the beach front and in breaches in the frontal dune. They are difficult to see among the debris littering the beach and move only when a vehicle is within a few metres. Although Red-capped Plovers are regularly found at a number of coastal locations in the Hunter Region, they do not occur in large numbers and WCL is one of their strongholds.

Little Tern

Little Tern, listed as Endangered under the *TSC Act*, is a summer migrant arriving in the Hunter Region in August/September and departing by March. It was observed on six surveys which included visits to active breeding colonies. Below we draw on additional information obtained from the staff on the breeding events. Apart from a failed attempt at Lake Macquarie in November 2009 (Stuart 2010), WCL is the only known site south of the Manning Estuary where this species has attempted to breed in the past 10 years. Unfortunately the site chosen at WCL lies within the Recreational Vehicle Area which is most popular over the summer months at the height of the breeding season. Lack of staff and the relative remoteness of the site mean that observations are limited and breeding outcomes are not always known or documented. Eggs were laid in 2009/10 but the colony was abandoned, presumably due to disturbance, likely caused by vehicles. The 2010/2011 season saw nine chicks fledge. One nest with eggs was seen on 21 November 2012 (Stuart 2011-2013). On 21 January 2013 there were 15 nests and 2 chicks (R. George pers. obs.). During the next season there were 11 nests with 20 eggs on 9 December 2013 (Media Release WCL Board of Management December 2013).

Gull-billed Tern

Gull-billed Terns *Gelochelidon nilotica* roosted in compact flocks around water-filled swales and at the edge of the ocean with, but separate from, flocks of Silver Gulls *Larus novaehollandiae* and Crested Terns *Thalasseus bergii*. They were also seen foraging over dunes and using the water's edge as a flyway. Numbers of Gull-billed Terns recorded at WCL were high for the Hunter Region (Stuart 1994 to 2014), particularly in 2013 (**Figure 2**). There were complex variations in their annual (**Figure 2**) and seasonal (**Figure 4**) abundance. Between February 2010 and April 2012 Gull-billed Terns were only recorded once (8 birds in May 2011) during 11 surveys (RR 9%, n=11). In contrast Gull-billed Terns were recorded during all surveys outside this period (RR 100%, n=17) with a mean abundance of 47 terns/survey. This difference in frequency of occurrence was statistically significant when tested using the χ^2 test with Yates' correction for one degree of freedom ($\chi^2 = 62$, $P < 0.001$). The period of decreased occurrence corresponded to abnormally high rainfall in inland eastern Australia (Bureau of Meteorology Website, accessed 9 November 2014). We suggest this created conditions sufficiently favourable to Gull-billed Terns to temporarily negate the need for seasonal movements to the Hunter coast.

Gull-billed Terns were recorded in all months, except October when there were no surveys, but numbers were very low in January and February (**Figure 4**). Unpublished NSW Bird Atlas data shows numbers of Gull-billed Terns are present in NSW throughout the year with regular movement within the state (R. Cooper pers. comm. October 2014). Mapping of NSW Bird Atlas data confirms a strong seasonal movement into the inland during November-February, in particular to the Arid Bioregion and the far south-west and that increasing numbers of birds frequent the North Coast during May-August (with a corresponding substantial fall in inland numbers at this time). While some of the summer population could leave NSW during autumn and winter, the overall pattern suggests that there is a regular and strong seasonal movement of Gull-billed Terns within NSW. The movement is largely to and from the northern coastal parts of NSW (extending south to the Hunter Region) as few overwintering birds remain in southern coastal NSW (from the Central Coast southwards) and few or none are reported from the western plains to the tablelands. Small numbers may be present in the Arid and Riverine Plains Bioregions at this time (see Cooper *et al.* 2014 for description of bioregions). Breeding records of Gull-billed Terns in NSW (in the NSW

Bird Atlas dataset) show most breeding is in the far south-west (west and south from Lake Bancannia-Booligal-Barham). Breeding has been reported from September to April but the main season is November to February. Then they move. Higgins & Davies (1996) suggest that while some terns exhibit migratory patterns, as described above, others are nomadic. Monthly variations at WCL (**Figure 4**) which show low numbers in the summer months and maximum numbers between March and May are consistent with the monthly variations in the NSW Bird Atlas data set for the period 1971- 2006 (R. Cooper pers. comm. 2014).

Of considerable concern is the observed presence of Gull-billed Terns around the breeding colony of Little Terns at WCL as they have been observed predated Little Tern nests at the Manning Estuary colony (Fawcett & Thomas 2011). It is not suggested that the presence of breeding shorebirds and Little Terns attracts Gull-billed Terns to WCL. More probably their fluctuating abundance at WCL reflects broader-scale movements in NSW as discussed above.

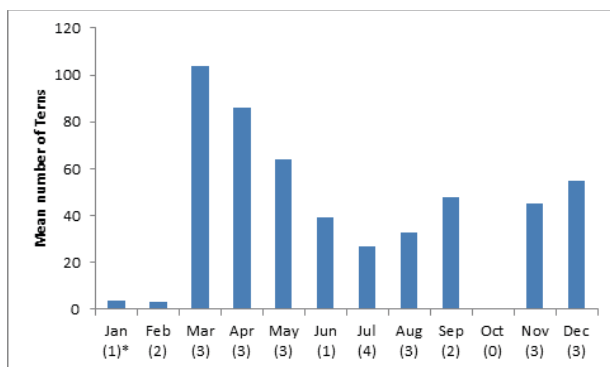


Figure 4. Monthly variation of mean numbers of Gull-billed Terns during 28 surveys at Worimi Conservation Lands from 2009 to 2013.

*Numbers in parenthesis indicate the number of surveys conducted each month.

Australian Raven

The Australian Raven has been identified as a major threat to beach-nesting birds taking both eggs and chicks (Maguire 2008). It was seen on every survey, usually in large numbers, with a mean of 23 and maximum count of 53 in July 2013. Anecdotal evidence suggested that they contributed to the failure of the 2009/2010 Little Tern nesting event. However, nesting shorebirds and terns are opportunistically exploited rather than a primary factor attracting ravens to WCL.

Other Shorebird Species

Fifteen additional species of shorebirds, including ten migratory and five Australian breeding species occurred occasionally as listed in the **Appendix**. One species, Bar-tailed Godwit *Limosa lapponica*, was not seen on the surveys, but four were present on 21 and 30 September 2011 (N. Russell pers. obs.). WCL habitat has limited suitability for most of these species, offering little by way of food resources. Black-fronted Dotterel *Elseyaornis melanops* and Masked Lapwing *Vanellus miles* were found after rain had filled the swales, but they disappeared when the swales dried out. Sanderling *Calidris alba* was recorded on two surveys with a maximum count of three. It has been recorded on six other occasions. One was flagged in South Australia about 1200 km south from WCL on an unknown date (Stuart 2000 – 2014). In the Hunter Region it occurs more frequently in the Manning Estuary (Stuart 2000-2014). It is surprising that the Sanderling, which favours open sandy beaches exposed to surf (Geering *et al.* 2007), is not more common as WCL appear to provide suitable habitat. Its scarcity may be the result of disturbance from the high volume of traffic along the beach front. Red-necked Stint *Calidris ruficollis* occurred on six surveys, the highest number, 19, was seen in December 2013. It feeds around the freshwater swales, as well as at the edge of the sea and has been seen roosting with Double-banded Plovers.

White-fronted Chat

The White-fronted Chat *Epthianura albifrons*, a small passerine, is listed as Vulnerable under the *TSC Act*. It inhabits dune and swale areas where vegetation is present and was observed on 19 (68%) surveys. Observations were widespread, the highest number of 16 in March 2012. WCL is one of three areas in the lower Hunter Region where this species regularly occurs (Roderick & Stuart 2010). Although not proven, breeding almost certainly occurs.

Pelagic Species

Pelagic species, which were regularly observed offshore, were neither systematically nor quantitatively monitored and our records are incidental, primarily because the birds were usually too distant to allow identification at the species level. However, periodically beach-cast carcasses were found allowing identification. Any beach the length of WCL will be the scene of seabird tragedies as occurred in November 2009

when approximately 8000 Short-tailed Shearwaters *Ardenna tenuirostris* were found dead or dying. Similarly, in November 2010 approximately 5000 dead shearwaters lined the beach front. The scene was even worse in October 2013 when as many as 30,000 were found (Peter & Dooley 2014). Other birds found dead or dying at various times were Australasian Gannet *Morus serrator*, White-faced Storm-Petrel *Pelagodroma marina*, Shy/White-capped Albatross *Thalassarche*, Light-mantled Sooty Albatross *Phoebastria palpebrata*, Gould's Petrel *Pterodroma leucoptera*, unidentified prion species *Pachyptila*, Arctic Jaeger *Stercorarius parasiticus* and Northern Giant-Petrel *Macronectes halli*, the latter banded on South Georgia as a first-year bird (ABBBS 2012). In June 2012 a Cape Petrel *Daption capense*, a true pelagic species, was seen foraging in the surf only a few metres from the water's edge. This in-shore sighting was most unusual and may have been connected with the ongoing storm events experienced at that time.

Raptors

Eight species of raptors were recorded; by far the most common was the White-bellied Sea-Eagle *Haliaeetus leucogaster* which was observed on 24 (86%) of the surveys, with 2 to 12 individuals present. As well as adults, a number of these birds were either juvenile or sub-adult. On 16 November 2009 a young sea-eagle was found on the beach unable to fly, hooked and entangled in fishing line. It was caught and released by the ranger. Whistling Kites *Haliastur sphenurus* were recorded on 12 (43%) surveys in numbers of up to ten.

CONCLUDING REMARKS

WCL are a cultural, recreational and environmental asset to the Port Stephens/ Newcastle area and in the broader sense to NSW. From a regional and state perspective they are important to a small number of bird species which have specialised habitat requirements. These include shorebirds which feed on ocean beaches such as the Double-banded and Red-capped Plovers and the Australian Pied Oystercatcher, the latter two species breeding. The extensive dune system also provides breeding habitat for Little Terns and White-fronted Chats, both listed as threatened species in NSW and having limited distribution in the Hunter Region. Little Terns have attempted to breed every season between 2009 and 2013, but success has been limited. These ground-nesting species are vulnerable to hazards such as disturbance from vehicles, unleashed domestic dogs, horses,

predation by Australian Raven and Gull-billed Tern. These anthropogenic causes of breeding failure are incremental to losses associated with natural causes such as the destruction of nests as a result of very high tides. Vulnerability extends through the period of egg incubation and continues after hatching until the chicks can fly. Flightless young are fed on the ground in a beach and dune system with limited vegetative cover to hide chicks. In the case of the Australian Pied Oystercatcher this total period of vulnerability is almost three months, which is exceptionally long compared with most other shorebird species because of their diet of bivalves which requires feeding techniques beyond the capability of chicks. Oystercatchers are the only shorebirds which feed their hatchlings.

The Little Tern, apparently a recent colonist, tends to breed in colonies in one area which simplifies the task of providing protection. Park staff respond rapidly to breeding events constructing temporary perimeter barriers and signage to prevent access and disturbance. Management is required to improve breeding success. Fortunately the terns have bred on higher ground well above the tidal zone. If current strategies for site selection continue they are unlikely to suffer inundation by high tides. In contrast the oystercatchers are highly territorial and their nest sites are both dispersed and difficult to find and hence to protect.

Intuitively a large length of undeveloped coastline like WCL would be expected to support a much larger population of breeding shorebirds like Australian Pied Oystercatchers. In north-eastern Tasmania Woehler & Ruoppolo (2014) located 460 Australian Pied Oystercatcher nests and territories during surveys in 2012/13 on just over 300 km involving 65 beaches (i.e. 1.5 breeding pairs/km compared with a maximum of five territorial pairs on 25.5km of beach at WCL). In the absence of baseline data it is impossible to determine the extent to which disturbance from recreational and commercial use is limiting WCL from reaching its full potential to support these species.

Continued good management is essential to preventing further damage to the WCL landscape such as around the swales behind the frontal dune where bird species are often found and in protecting nest sites. However unless vehicular usage during peak holidays is redirected impacts to the breeding success of beach-nesting species will likely continue. Provision of artificial chick shelters would have the dual advantage of decreasing the risk of loss to avian predators like

Australian Ravens and Gull-billed Terns and of attracting chicks to areas which could be fenced off and protected. Their beneficial use by Pied Oystercatchers has been demonstrated on beaches in northern NSW (Bob Moffat pers. comm. to MN). Elsewhere it has been concluded that it may be necessary to make permanent or temporary closures of the beach front or parts of it to successfully address this issue (Weston *et al.* 2014).

NPWS have allocated increased resources to continue the surveys on a monthly basis.

ACKNOWLEDGEMENTS

We wish to thank Warren Mayers of the NSW NPWS for his enthusiastic facilitation of the initial stages of this project. Those present will always remember his heroic rescue of the White-bellied Sea-Eagle entwined in fishing line. In the latter stages AL and MN were privileged to be accompanied by Nadine Russell and Robyn George. Nadine is a member of the Worimi people and through this interaction we obtained a better understanding of their culture. They are proud custodians of WCL with a deep concern for the sustainability of its wildlife values. We thank the Worimi for allowing us to undertake this study and NSW NPWS for logistic support and encouragement. We are indebted to Dick Cooper for his release of information on the distribution and movements of the Gull-billed Tern in advance of the publication of volume 2 of the NSW Bird Atlas. Harold Tarrant and Steven Cox are thanked for helpful comments.

The views expressed are those of the authors and not necessarily those of the NSW NPWS.

REFERENCES

ABBBS. (2014). Australian Bird and Bat Banding Scheme (Department of Sustainability, Environment, Water, Population and Communities: Canberra, ACT.)

Cooper, R.M., McAllan, I.A.W. and Curtis, B. R. (2014). 'An Atlas of the Birds of NSW & the ACT. Volume 1. Emu to Plains Wanderer'. (NSW Bird Atlassers Inc.)

Crawford, L. and Herbert, C. (2009). Roosting and feeding behaviour of Pacific Golden Plover in the Hunter Estuary, NSW. *The Whistler* 3: 30-39.

Ens, B.J., Kerston, M., Brenninkmeijer, A. and Hulscher, J.B. (1992). Territory quality, parental effort and reproductive success of oystercatchers (*Haematopus ostralegus*). *Journal of Animal Ecology* 61 (3): 703-715.

Ens, B.J. and Underhill, L.G. (2014). Synthesis of oystercatcher conservation assessments: general lessons and recommendations. In 'Conservation Status of Oystercatchers around the World'. (Eds. B.J. Ens and L.G. Underhill). *International Wader Studies* 20: 5-22. (www.waderstudygroup.org)

Fawcett, A. and Thomas, M. (2011). Manning Entrances Endangered Shorebird Colonies Annual Review 2010-2011 Breeding Season. (Unpublished Report for NSW National Parks and Wildlife Service, Hunter Region.)

Fletcher, A. and Newman, M. (2010). Studies of the Australian Pied Oystercatcher in south-east Tasmania 1964-2009. *Stilt* 58: 24-33.

Geering, A., Agnew, L. and Harding, S. (2007). 'Shorebirds of Australia'. (CSIRO Publishing: Collingwood, Victoria, Australia.)

Higgins, P.J. and Davies, S.J.J.F. (Eds) (1996). 'Handbook of Australian, New Zealand and Antarctic Birds. Volume 3: Snipe to Pigeons'. (Oxford University Press: Melbourne.)

Maguire, G.S. (2008). A practical guide for managing beach-nesting birds in Australia. (Birds Australia: Melbourne.)

Peter, J. & Dooley, S. (2014). The Fatal Shore. *Australian Birdlife* 3 (1): 24-27.

Roderick, M. and Stuart, A. (2010). The status of threatened bird species in the Hunter Region. *The Whistler* 4: 1-28.

Russell, N. and George, R. (2012). Australian Pied Oystercatchers leapfrog to reproductive success in the Worimi Conservation Lands. *The Whistler* 6: 35-38.

Stuart, A. (Ed.). (1994-2014). Hunter Region of New South Wales Annual Bird Reports. (Hunter Bird Observers Club Inc.: New Lambton, NSW.)

Weston, M.A., Schlacher, T.A. and Lynn, D. (2014). Pro-Environmental Beach Driving is Uncommon and Ineffective in Reducing Disturbance to Beach-Dwelling Birds. *Environmental Management* 53: 999-1004.

Woehler, E.J. and Ruoppolo, V. (2014). Distribution and abundance of shorebirds and estimated regional breeding populations, NRM North. *Tasmanian Bird Report* 36: 30-39. (BirdLife Tasmania: Hobart.)

Worimi Conservation Lands Board of Management. (2014). Worimi Conservation Lands Draft Plan of Management. (Office of Environment and Heritage: Sydney South, NSW.)

APPENDIX

Summary of Worimi Conservation Lands Survey Results

Species	Scientific Name	No. of Counts	RR (%)	Mean	Maximum
Australian Wood Duck	<i>Chenonetta jubata</i>	1	4	4	4
Pacific Black Duck	<i>Anas superciliosa</i>	1	4	3	3
Hardhead	<i>Aythya australis</i>	1	4	25	25
Great Crested Grebe	<i>Podiceps cristatus</i>	1	4	1	1
White-throated Needletail	<i>Hirundaps caudacutus</i>	1	4	50	50
Black-browed Albatross*	<i>Thalassarche melanophris</i>				
Cape Petrel*	<i>Daption capense</i>				
Wedge-tailed Shearwater*	<i>Ardenna pacificus</i>				
Short-tailed Shearwater*	<i>Ardenna tenuirostris</i>				
Fluttering Shearwater*	<i>Puffinus gavia</i>				
Australasian Gannet*	<i>Morus serrator</i>				
Great Cormorant	<i>Phalacrocorax carbo</i>	2	7	5	9
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	1	4	7	7
Pied Cormorant	<i>Phalacrocorax varius</i>	7	25	3	10
Australian Pelican	<i>Pelecanus conspicillatus</i>	1	4	1	1
White-necked Heron	<i>Ardea pacifica</i>	1	4	1	1
Great Egret	<i>Ardea alba</i>	1	4	2	2
White-faced Heron	<i>Egretta novaehollandiae</i>	5	18	2	2
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	1	4	1	1
Osprey	<i>Pandion haliaetus</i>	1	4	1	1
Black-shouldered Kite	<i>Elanus axillaris</i>	2	7	1	1
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	24	86	4	12
Whistling Kite	<i>Haliaeetus spheurnus</i>	12	43	3	10
Swamp Harrier	<i>Circus approximans</i>	1	4	2	2
Nankeen Kestrel	<i>Falco cenchroides</i>	10	36	1	2
Brown Falcon	<i>Falco berigora</i>	1	4	1	1
Australian Hobby	<i>Falco longipennis</i>	1	4	1	1
Australian Pied Oystercatcher	<i>Haematopus fuliginosus</i>	28	100	13	27
Black-winged Stilt	<i>Himantopus leucocephalus</i>	2	7	1	1
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	1	4	30	30
Pacific Golden Plover	<i>Pluvialis fulva</i>	2	7	35	67
Grey Plover	<i>Pluvialis squatarola</i>	1	4	1	1
Red-capped Plover	<i>Charadrius ruficapillus</i>	25	89	17	37
Double-banded Plover	<i>Charadrius bicinctus</i>	19	68	65	137
Greater Sand Plover	<i>Charadrius leschenaultii</i>	1	4	1	1
Black-fronted Dotterel	<i>Elsyornis melanops</i>	6	21	4	12
Banded Lapwing	<i>Vanellus tricolor</i>	2	7	2	2
Masked Lapwing	<i>Vanellus miles</i>	6	21	2	3
Ruddy Turnstone	<i>Arenaria interpres</i>	3	11	2	4
Great Knot	<i>Calidris tenuirostris</i>	1	4	1	1
Red Knot	<i>Calidris canutus</i>	1	4	1	1
Sanderling	<i>Calidris alba</i>	2	7	2	3
Red-necked Stint	<i>Calidris ruficollis</i>	6	21	7	19
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	1	4	47	47
Curlew Sandpiper	<i>Calidris ferruginea</i>	2	7	2	2

Species	Scientific Name	No. of Counts	RR (%)	Mean	Maximum
Little Tern	<i>Sternula albifrons</i>	5	18	15	33
Gull-billed Tern	<i>Gelochelidon nilotica</i>	18	64	40	126
Caspian Tern	<i>Hydroprogne caspia</i>	1	4	1	1
Common Tern	<i>Sterna hirundo</i>	1	4	6	6
Crested Tern	<i>Thalasseus bergii</i>	26	93	37	234
Silver Gull	<i>Larus novaehollandiae</i>	27	96	127	500
Superb Fairy-wren	<i>Malurus cyaneus</i>	11	39	3	8
Little Wattlebird	<i>Anthochaera chrysoptera</i>	1	4	1	1
White-fronted Chat	<i>Epthianura albifrons</i>	19	68	5	16
Eastern Whipbird	<i>Psophodes olivaceus</i>	1	4	1	1
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	1	4	2	2
Grey Butcherbird	<i>Cracticus torquatus</i>	1	4	1	1
Australian Magpie	<i>Cracticus tibicen</i>	19	68	7	20
Willie Wagtail	<i>Rhipidura leucophrys</i>	5	18	4	13
Australian Raven	<i>Corvus coronoides</i>	28	100	23	53
Golden-headed Cisticola	<i>Cisticola exilis</i>	1	4	1	1
Australian Reed-Warbler	<i>Acrocephalus australis</i>	1	4	1	1
Welcome Swallow	<i>Hirundo neoxena</i>	14	50	18	74
Common Starling	<i>Sturnus vulgaris</i>	7	25	22	52
Australian Pipit	<i>Anthus novaeseelandiae</i>	25	89	4	16

* Incidental observations; not sufficiently systematic for quantitative analysis.

In addition to sightings during the surveys, the following observations were made by NPWS staff:

Species	Scientific name	Observations
White-faced Storm-Petrel	<i>Pelagodroma marina</i>	
Light-mantled Sooty Albatross	<i>Phoebastria palpebrata</i>	
Northern Giant-Petrel	<i>Macronectes halli</i>	
Arctic Jaeger	<i>Stercorarius parasiticus</i>	
Kelp Gull	<i>Larus dominicanus</i>	
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	6 in August 2011
Pacific Golden Plover	<i>Pluvialis fulva</i>	2 in October 2010
Bar-tailed Godwit	<i>Limosa lapponica</i>	4 in September 2011