A copy of: Minton, C., Pearson, G. & Lane, J. (1995). *History in the mating.* Wingspan 5(2):13-15. (June 1995 issue).

Note that it contains photos of BaSt on the colony, the BaSt colony from the air, BaSt attempting to copulate, brooding BaSt 'with little breeding plumage', BaSt nests with eggs, and JL, GBP & MR marking nesting quadrats with coloured tape, all taken by CDTM on 15/3/19995, that JL does not (as at 30/4/2014) have copies of.

History in the mating:

Banded Stilts do it again!

Banded Stilts — endemic to Australia — are unique among the 214 species of wading bird in the world in that they: nest colonially, lay white eggs (with a few black streaks and blotches), have white downy chicks and put their young into crêches. They also have a special habitat requirement — recently-flooded salt lakes — because the young are reared predominantly on brine shrimps, so opportunities to breed only arise every few years. Only about 20 nesting events have ever been recorded — three in inland South Australia and the remainder in the southern interior of Western Australia.

We, and the ABC Natural History Unit, have been (im)patiently waiting for several years for the next nesting event, determined to move quickly enough to locate a nesting colony at an early stage of the breeding cycle. Most previous nesting attempts have only been identified once chicks have become mobile, or once breeding was over (via the abandoned colony).

Cyclone Bobby dumped 380 mm of rain in the Kalgoorlie area of WA in four days of continuous downpour over 25–28 February this year. Banded Stilts disappeared from all their coastal fringe sites in WA (e.g. Rottnest Island near Perth) almost immediately. Everything looked right for a Banded Stilt nesting spree.

Banded Stilts in colony at Lake Ballard in various stages of plumage.

Grant Pearson, Clive Minton and Marj Reni of the Victorian Wader Study Group, carried out a 4.5 hour aerial survey from Kalgoorlie on 12 March. Three large salt lakes, 150-250 km north of Kalgoorlie were covered — all previously known nesting locations. All three were full of water (Lake Barlee least so) and looked ideal,

with myriads of small islands dotted evenly throughout. Lake Marmion had no birds. But as soon as we reached Lake Ballard we encountered Banded Stilts on the water — all paired — and about 20 km down the lake a nesting colony. We could hardly believe our eyes! Only 16 days after the rain started there they were, some 2,000 nests on the top of a small island with about 5,000 birds in attendance. At the core of the colony incubation seemed to have already begun.

Aerial view of the colony — an estimated 4,500 nests.

This observation, and later observations on incubation periods and hatching dates, indicates that the first eggs in the colony must have been laid around 8 March, an incredible 12 days after the start of the rains, and only 8 days after they ceased! Not bad for birds which had to recognise that a 'rain event' had occurred, migrate around 1000 km, find a suitable location, pair, mate, select a nest site, and grow and lay a clutch of eggs weighing almost as much as the female herself!

The aerial survey revealed a total of 10,000 Banded Stilts on Lake Ballard and 20,000 on Lake Barlee, but there was no sign of a colony forming on the latter.

We immediately decided to visit the nesting colony and set up the first stages of a comprehensive research programme. A helicopter was available from Kalgoorlie on 15 March, and this enabled us to spend 8 hours observing activities at the colony, pegging out and photographing a grid, and marking some 250 clutches of eggs to determine information such as clutch size, nest density, incubation period and hatching success. As no-one has previously found a colony at such an early stage, much basic breeding biology of the Banded Stilt was unknown (see the frequent references to such in Vol. 2 of *HANZAB*).

Since the nesting island was part of a small archipelago of small islands, it was possible to land the helicopter (and then to make the research base camp) some 600 m away from the colony on a rocky knoll (which even had some trees and shade!), without disturbing the birds. We initially made observations from a distance, but soon found we could sit quietly within 10-20 m of the colony without the birds apparently taking any notice.

The colony had doubled to an estimated 4,500 nests within three days...

There was an unbelievable frenzy of activity. The colony had doubled to an estimated 4,500 nests within three days, and more birds were settling in every minute. Birds seemed to be bustling in every direction. Aggression associated with mates and nesting selection was widespread. Up to 20 copulations were visible at any time — on the water, on land, in the colony, standing, sitting, walking, swimming (and each lasting an average of 45 seconds!). Incubating birds were leaving the nest and running down to the water to dunk their breast-feathers in the water and have a quick drink before returning to the nest (it was a hot day). Overall it was like a cross between the main street of Tokyo and the 'red light' district of Kalgoorlie!

One of the most surprising observations was that a third of the birds did not have complete breeding plumage, and 10% had none at all, being completely white underneath and lacking the chestnut band on the breast and black patch below it. Yet such plumaged birds did not seem to be inhibited from full participation in activities, including copulation (both males and females) and incubation. It seems that assuming breeding plumage is a secondary consideration to being 'quick off the mark' to take advantage of these rare breeding opportunities (then why have a breeding plumage?).

The research team, together with the ABC film crew, returned to Lake Ballard, by amphibious vehicle and boat, on March 31, and one (or more) of us has been in residence almost continuously ever since. A further aerial survey on March 30 revealed three new nesting colonies on Lake Ballard (but still no nesting, and fewer birds, on Lake Barlee). The

Below left: Banded Stilt eggs. Clutches of 3 or 4 are most frequent, but 2 or 5 sometimes occur.
Below: Pegging, marking and photographing the nests in the colony.

main colony had grown to 20,000 nests (at 10 per square **metre** — just pecking distance apart), and there were 15,000 nests in the largest of the new sites, only 4 km to the west.

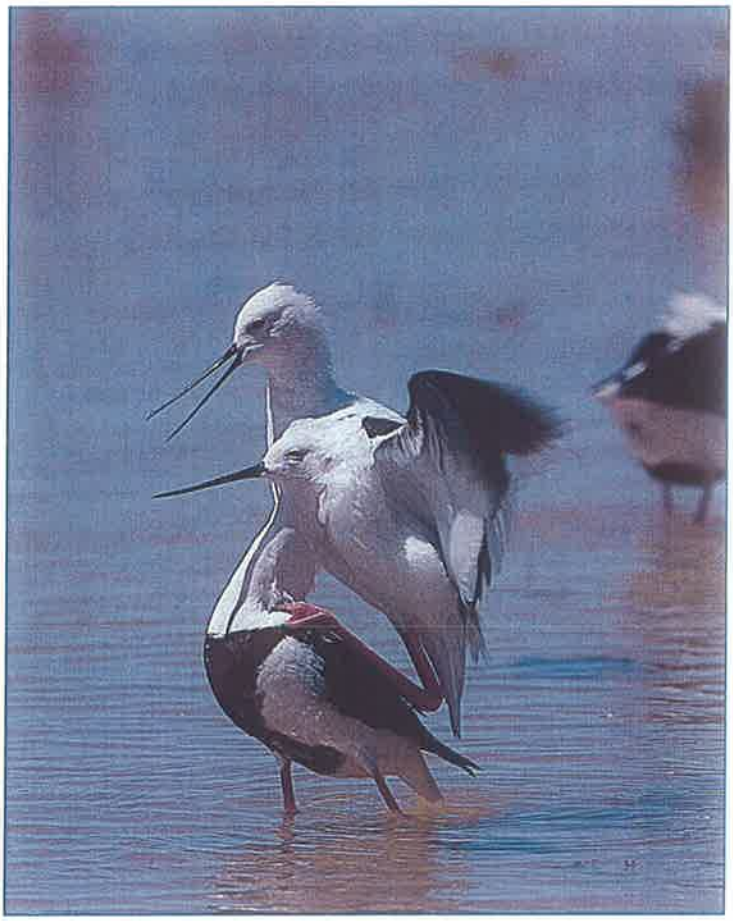
Hatching began on 3 April. It was wonderful to see each family of chicks being led down to the water by a parent, then sailing away like little blobs of white fluff on the water. Most had 2, 3 or 4 chicks, but the occasional bird had successfully hatched a brood of 5. Several families were often all closely associated, but it was always possible to discern the individual parent-offspring relationships, and there was no sign of true crêching (handing over the care of chicks to a lesser number of adults) at this stage or over the next few days when the chicks were still within 3 or 4 km of the colony. On some mornings up to 2,000 chicks would leave the colony in just a couple of hours. Such sights will remain imprinted on our memories forever.

A pleasing feature was the relative lack of predation. The Banded Stilt nesting event at Lake Torrens in 1989 was heavily molested by Silver Gulls, that eventually totally destroyed the last part of the colony as well as taking many eggs and some chicks throughout the breeding cycle. At Lake Ballard a few crows (thought to be Little Crows) started visiting the colony regularly once the chicks began to hatch, but they mainly fed on chicks which were already dead around the colony and were only twice seen to take live chicks (often seen to fail in their attempts). Once a Wedge-tailed Eagle snatched a chick from a group of adults and chicks which were crossing an island in the archipelago.

But, thankfully, not a single Silver Gull appeared. A consequence of their absence was that the colony became littered with 'lost' eggs — ones that had rolled or been blown out of nests, laid in the wrong place, or been left parentless for whatever reason. These quickly went bad in the hot sun, often popped (causing a minor local disturbance in the colony), and must have given a nasty surprise to any would-be predators.

A vast amount of detailed information has been collected on this breeding event and all aspects of the birds' behaviour and this will subsequently be submitted as a paper to *Emu*. The story at the time of writing (late April) is still not complete. The chick crêching process has to be followed, and banding/colour leg-flagging of the chicks carried out. And, who knows, a further round of the breeding cycle may be aided by an unexpected 70 mm 'top up' of rainfall on 10 April, which restored the gradually drying lake almost to its maximum level.

There is no doubt that Banded Stilts are marvellously adapted to take up any opportunity to breed which may arise from a 'big wet' in these ephemeral salt lake areas. It really is a case of 'making hay while the sun shines' or, more appropriately, 'breeding while the brine shrimps last'. Perhaps the most baffling question of all is — How do they know? — especially when they are sunning themselves on Rottnest Island where it didn't even rain!



Banded Stilts mating.

...it was like a cross between the main street of Tokyo and the 'red light' district of Kalgoorlie!

CLIVE MINTON, GRANT PEARSON AND JIM LANE
PHOTOS: CLIVE MINTON

THE BANDED STILT is certainly an enigmatic bird. Once the current breeding event at Lake Ballard is fully documented, we will know more about the breeding of the Banded Stilt than ever before! Volume 2 of *HANZAB* summarises all we know of their biology. One of its least-known aspects is what governs their movements. As in the preceding article, Banded Stilts living on the coastal fringe of WA, including Rottnest Island, will desert these sites to head inland to inundated salt lakes, although no rain has fallen on the coast itself. Equally mysteriously, the flooding in the Lake Eyre basin, SA, stimulates the departure of birds from coastal SA and Vic. Flooding of the Cooper and Darling basins, however, do not seem to elicit equivalent responses. Rainfall may result in influxes of Stilts as the dry wetlands are filled, or in the birds' departure, perhaps because the salinity of wetlands is reduced, or because the birds have dispersed more widely across suitable habitat. Just as their movements to breeding sites can be mystifying, so too are their departures. At Lake Torrens, chicks and adults dispersed within a few days of hatching, moving 50–100 km across the lake. Adults have been recorded abandoning young once the salt lake dried out, and bands of wandering chicks have been recorded numerous times dispersing from breeding colonies along roadways. There is one record from Menzies of 1,400 chicks walking through the town. Unfortunately, some 500 met their end on the busy road, so even they never solved the mystery of their eventual destination.

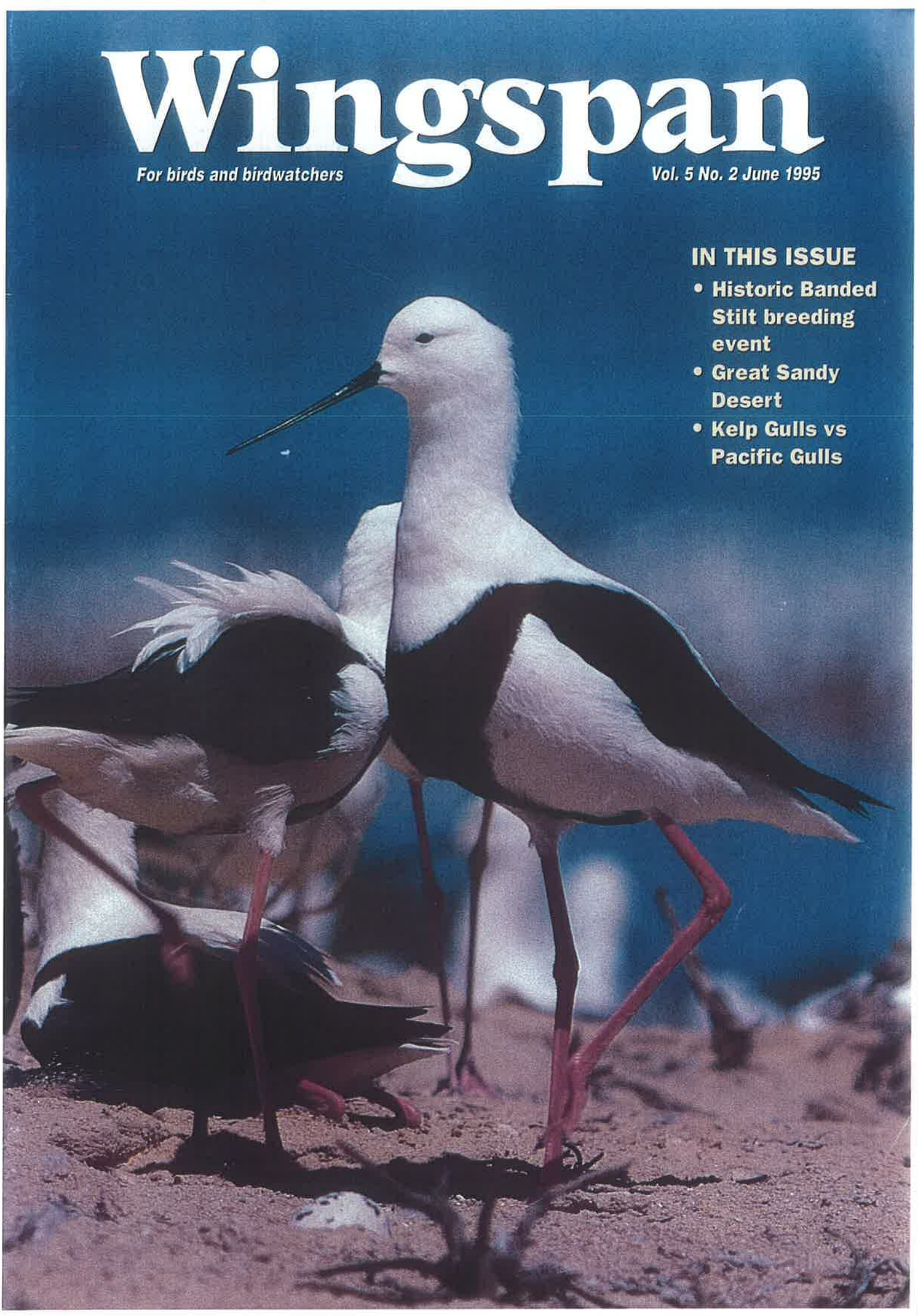
DETAILS FROM *HANZAB*

Banded Stilt with little breeding plumage about to brood eggs.

Wingspan

For birds and birdwatchers

Vol. 5 No. 2 June 1995



IN THIS ISSUE

- Historic Banded Stilt breeding event
- Great Sandy Desert
- Kelp Gulls vs Pacific Gulls

A copy of Lane, J. (1995) *Leg-flagged Banded Stilts.* WA Bird Notes No.74, p.19 (June 1995 issue), under the heading 'STOP PRESS'.

See below for hand-written draft, which was slightly edited by WABN before printing.

Leaders: Jan and Rob Hill

Monday 25 September Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Neil Hamilton is Section Keeper of Birds at the Perth Zoo and will talk about the Zoo's role in bird conservation, a role often performed in conjunction with other organisations such as government departments and other zoos.

Monday 23 October Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Michael Craig, a former secretary of the WA Group, will help us with wader identification, a source of considerable difficulty to many, as migrant wader species, normally in WA in the summer, are then less distinctive.

Monday 27 November Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Some time ago Gordon Tozer and others started a photographic group within the RAOU in Perth. Gordon, Peel Howden and Mavis Norgard will show 15 slides apiece and Dusty Millar will display print photographs. In discussing their work, they will be giving helpful hints for beginners in bird photography.

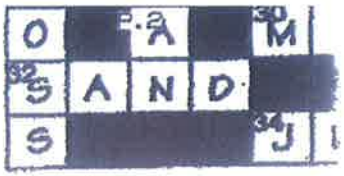
STOP PRESS — Leg-flagged Banded Stilts

Tens of thousands of Banded Stilts have nested at Lake Ballard near Menzies during the past two months, following cyclonic rain in January. During the first week of May, Alan Clarke, Andy Chapman and I leg-flagged 170 chicks at various stages of growth. The leg-flags are small, made of stiff yellow plastic and located above the left "knee" (on the tibia).

The lake's water level is high and food supply (brine-shrimps) abundant so the majority of these chicks should survive to fledge and disperse to other wetlands.

Should you sight any of these leg-flagged stilts we would be most grateful if you could pass the details on to me at CALM's Busselton office (ph: 097-521677 or fax: 097-521432 or mail c/o Dept. of CALM, Queen Street, Busselton, 6280). Information we would like is location, date, number of "flagged" stilts seen, total number of stilts and any other information of possible interest. Include the name of the observer and a contact number or address.

Jim Lane



6.

STOP PRESS — Ele

Following what so
a Night Parrot sighting
Blyth and Phil Fuller of
about 25 km south eas

Unfortunately, the
southwestern species
Goldfields, but presum
following heavy rain
least four birds and p
not, it must be said, as
Night Parrots would h

WABN #74 p 19.

June '95 issue (N° 74, p 19)

" Wader Ant-
Bird Notes "

Fax (30/5/1995) from JL to CDTM with a hand-written copy of the article: Lane, J. (1995) *Leg-flagged Banded Stilts*, that JL faxed to John Blyth (Editor of WABN) on 16/5/1995 for printing in the June 1995 issue of WA Bird Notes (see above).

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432

111-
108.

TO: CLIVE MINTON **URGENT: YES / NO**

AT: .....

..... **Fax No.** 03 9 589 6901

FROM: JIM LANE

DATE: 30/5/95

Your Ref: .....
Local Ref: .....

Accompanying is the article that will appear in the June issue of "W.A. Bird Notes"

No. of pages inc. this page: 2
Please call us on (097) 521 677 if this message was incomplete or illegible

"and" "disperse to other wetlands.

Should you most sight any of these leg-flagged Stilt we would be grateful if you could pass the details on to me at C.A.L.M.'s Busselton Office (ph 097 521 677 fax 097 521 432 or mail c/o Dept of C.A.L.M., Queen St Busselton #6280).

Information we would like is location, date, number of "flagged" stilt, total number of stilt and any other information of possible interest. Also the name of the observers and a contact number or address.

The leg flags are small, made of stiff yellow plastic and located above the left "knee", ie on the tibia.

Thanking you in anticipation! Jim Lane, Busselton.

16/5/95

(16/5/96) 40. 113.

February

LEG-FLAGGED BANDED STILT

Two of thousands of Banded Stilt have nested at Lake Ballard near Menzies during the past two months following cyclonic rains in January.

During the first week of May, Glen Clarke and I leg-flagged 170 (one hundred and seventy) chicks at various stages of growth.

The lake water level is high and food supply (brine-shrimp) abundant so the majority of these chicks should survive to fledge and disperse to other wetlands.

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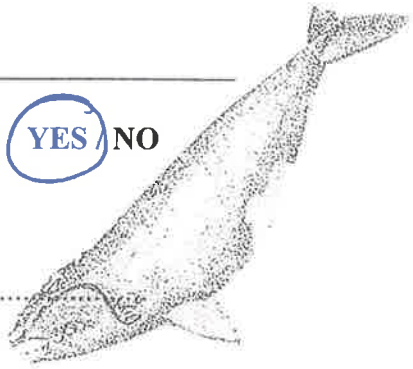
DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432

112 + 109.



TO: JOHN BLYTH **URGENT:** (YES) / NO

AT: .....

..... **Fax No.** .....

FROM: JIM LANE

DATE: 16/5/95

Your Ref: .....
Local Ref: .....

As discussed — thanks

No. of pages inc. this page: 2

Please call us on (097) 521 677 if this message was incomplete or illegible

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(c/o 16/5/96) 40. 113.

February!

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Copy of: Minton, C., Pearson, G. & Lane, J. (1995). *Banded Stilts quick off the mark.* The Tattler, No.3, p.3 (April 1995 issue).

rugged-up, with long pants, beanies and jumpers. But we soon felt at home lugging keeping cages and dragging cannons back to the trailer.

It was great to visit the RAOU Head Office and we thank everyone there for making us welcome. The new meeting room was put to the test when Danny Rogers and Mike Weston entertained us with their superb Siberian slides and fascinating talk. Another benefit of our trip was the placing of 70% of the AWSG North-West banding data on out computer by Mark Barter. With answers at our fingertips, we now feel more in control of our shorebird banding project.

Wader Catches at Broome 6/10/94-31/10/94

WADERS	New	Retrap	Total
Masked Lapwing	6	0	6
Lesser Sand Plover	5	5	10
Greater Sand Plover	112	40	152
Red-capped Plover	34	1	35
Black-front. Dotterel	3	0	3
Black-winged Stilt	21	1	22
Red-necked Avocet	1	0	1
Ruddy Turnstone	14	9	23
Eastern Curlew	1	0	1
Little Curlew	2	0	2
Wood Sandpiper	1	0	1
Grey-tailed Tattler	16	14	30
Common Sandpiper	2	0	2
Marsh Sandpiper	1	0	1
Terek Sandpiper	14	2	16
Asian Dowitcher	2	0	2
Black-tailed Godwit	9	0	9
Bar-tailed Godwit	195	31	226
Red Knot	99	12	111
Great Knot	192	15	207
Sharp-tailed S'piper	12	0	12
Little Stint	1	0	1
Red-necked Stint	492	107	599
Long-toed Stint	3	0	3
Curlew Sandpiper	129	18	147
Broad-billed S'piper	4	0	4
TOTALS	1371	255	1626

GULLS & TERNS			
Little Tern	18	0	18
Whiskered Tern	2	0	2
Caspian Tern	1	0	1
Gull-billed Tern	6	0	6
Silver Gull	18	0	18
TOTALS	45	0	45

These figures exclude banding carried out by the AWSG NW Expedition earlier in the year.

TRAVELLING CANNON-NETS - Clive Minton

Clive Minton was invited to take part in an international team which visited Tierra del Fuego for two weeks in February this year. This southern province of Argentina is the most southerly non-breeding area for northern hemisphere migrant waders in the world (55 deg. south, which is the same as Macquarie Island).

Seventeen thousand waders were found in the Rio Grande area (10,000 White-rumped Sandpiper, 3000 Red Knot, 3000 Magellanic Oystercatcher) and 50,000 in Bahia San Sabastian (30,000 White-rumped Sandpiper, 20,000 Hudsonian Godwit).

Several cannon-net catches were made including one of 850 Red Knot. Five of these already carried bands and colour bands/flags from Brazil and two from USA/Canada.

Extensive food and feeding rate observations were also made on Red Knot (Theunis Piersma, head of the International Wader Study Group, is the world expert on Red Knot). DNA samples were collected extensively by Prof. Allan Baker and his team from Toronto Museum/University (They financed the expedition).

By far the greatest problem was the transport, as excess airline baggage, of a full sized cannon-net set, plus keeping cages, electric fuses, firing boxes etc from Melbourne to Tierra del Fuego (and back!)

BANDED STILTS QUICK OFF THE MARK - Clive Minton, Grant Pearson & Jim Lane.

Clive Minton, Grant Pearson at CALM, and the ABC Film Unit have been "at the ready" for several years to move into action as soon as a rain event occurred which was likely to lead to a Banded Stilt nesting event. No one has ever previously filmed a Banded Stilt nesting event from wo to go.

Cyclone "Bobby" dumped 385mm (15.5 inches) of rain in the saltmarshes area of The Goldfields region of southern central WA in four days of continuous rain over 25-28 February.

Marj Reni (VWSG), Grant and Clive did a 4.5 hour aerial survey from Kalgoorlie on 12 March. They covered lakes Marmion, Barlee and Ballard - all previously known Banded Stilt nesting sites, about 150 to 200 km north or north-west of Kalgoorlie. All of the lakes were full and looked perfect nesting sites with hundreds of small islands. Marmion had no birds, Barlee had 20,000 - all seemingly paired - but no sign of a nesting colony. Ballard had 10,000 and half of these were at a colony which already appeared to have around 2000 nests.This was only the 16th day after the rain commenced and 12 days after the rain stopped. Subsequent information indicated that the first eggs must have been laid around 8th March - 12 days from the start of the rain. During this time the birds had to recognise the rain event had occurred, migrate possibly 1000 km from coastal areas of WA, pair, mate, select a site and produce eggs.

We set up a full scale research program and visited for 9hrs by helicopter on 15th March. By then the colony had grown to 4500 nests. We pegged and photographed about half the area and marked the eggs in several hundred nests (for incubation period, clutch size, hatching success determination

etc). It was a real frenzy of activity. Pairing, fighting, copulating - 20 visible at any moment - like a cross between the main street of Tokyo and the 'red light' district of Kalgoorlie. Particularly interesting was that many of the birds were not in full breeding plumage even - in fact 10% had no breeding plumage at all! Yet these birds were still taking part in all activities even incubating! Needless to say we have a few photos.

About ten days later Jim Lane (from CALM) and the ABC Wildlife Film Unit arrived and spent ten days at the colony and carried out a further aerial survey as well as much research and observations. The initial colony had grown to 20,000 nests at the rate of 10 per square metre and a second colony of 15,000 nests was forming about 3 km away. There were also two smaller colonies. Hatching commenced on April 3rd and data suggests that the incubation period varies between 21 and 23 days.

The white eggs (with a few black streaks and spots) produce lovely fluffy white chicks - both unique for waders. When they are all dry one parent takes them down to the water and away they swim. Grant and I arrived on our eturn visit to relieve Jim Lane on 8th April and stayed until 15th (last three days on my own - living on an island 30 km from the nearest station was quite an experience in itself). Each morning ca 2000 chicks left the colony - a wonderful, unforgettable sight.

We collected lots more data and started some banding/leg flagging. Jim returns on April 26th to continue the studies - especially banding and creche formation.

BYE-BYE WADERS

The wardens at Broome Bird Observatory, Jon Fallaw and Becky Hayward, have been assiduously logging the departure of waders from Roebuck Bay on the first leg of their journey back to their northern hemisphere breeding grounds. Most departures take place between 4 and 6 pm but on really good days flocks may also go earlier in the day (particularly triggered by a rising tide).

So far (21 April) over 20,000 have been counted. Eastern Curlews were the first to depart from March 7th. Most Great Knot went in the last week of March (from 21st March). Bar-tailed Godwits were the main migrants for the first two weeks of April, with males departing first. In mid-April Black-tailed Godwit and Whimbrel took over, followed in the next week by Red Knot, Grey-tailed Tatter, Terek Sandpiper and Ruddy Turnstone.

The most amazing count was a total of 1800 Whimbrel over 6 days. It is rare to be able to find more than 2-300 on any formal count. They must be distributed all round the mangrove borders of Roebuck Bay and only congregate in a compatible location at the departure point in Crab Creek when assembling for migration.

Only Red-necked Stints and the rest of the Curlew Sandpiper to go, migration normally ceases by the end of April.

MORETON BAY - AN UNCERTAIN FUTURE - Sandra Harding

Moreton Bay became one of two sites listed under the Ramsar Convention in Queensland in December 1993. In March 1994 it was decided that Brisbane, the city adjoining Moreton Bay, would host the 1996 conference of Contracting Parties for the Ramsar Convention.

Yet there is no management plan in place for Moreton Bay. A Strategic Plan for the waters areas of the Bay provides only a policy guideline and the Local Government Planning Schemes do not extend beyond the line of highest astronomical tide. The Moreton Bay zoning plan which is intended to provide for control of activities likely to cause significant environmental impacts such as dredging, mining and some commercial activities was prepared in December 1993 but has still not been adopted by Government.

How long will it take to see a conservation management plan for Moreton Bay, a Ramsar site? In the meantime, ongoing battles are fought against the threats to Moreton Bay. Some of the recent threats are:

* Proposed Belmis Creek Sewage Treatment Plant
* Coral mining around Green Island
* Pollution from the Brisbane River - no management plan either
* Urban development in areas adjoining mangroves and in reclaimed areas
* Port of Brisbane reclamation works
* Proposed Manly boat harbour extension
* Industrial uses of the Brisbane River mouth

Much of the loss of wetlands in Moreton Bay is insidious, occurring incrementally due to lack of planning and poor management practices. Urban sprawl is extending further along the coast, bringing the pressure of high population living in close proximity to and recreating on the edge or in Moreton Bay. For waders, the loss and continued disturbance of roosting areas fringing Moreton Bay by dogs, boats, bikes and general people presence is having a significant detrimental impact on the numbers of waders supported by Moreton Bay.

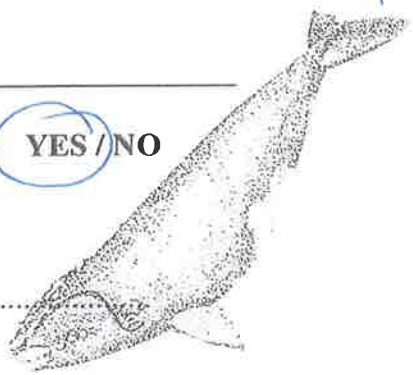
There is still several months for the government to put in place a conservation management plan for Moreton Bay before the 1996 Ramsar meeting. We

Fax (20/3/1995) from JL to CALM Library requesting a copy of: Bellchambers, K. & Carpenter, G. (1992). *Sudden life on Stilt Island.* Natural History 4:42-48. The title of the article was not known to JL at the time of composing this fax.

A copy (see below) of this 1992 article was obtained by JL on 01/5/2014.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432

42.



TO: LISA WRIGHT **URGENT:** YES / NO

AT: WOODVALE

Fax No.

FROM: JIM C.

DATE: 20/3/95 **Your Ref:**
Local Ref:

Would you please obtain a photocopy of
BELLCHAMBERS, K., and G. CARPENTER (1992):
Nat. Hist 4: 42–48 (title unknown)
for me by Wed noon. Thanks.

No. of pages inc. this page: 1

Please call us on (097) 521 677 if this message was incomplete or illegible

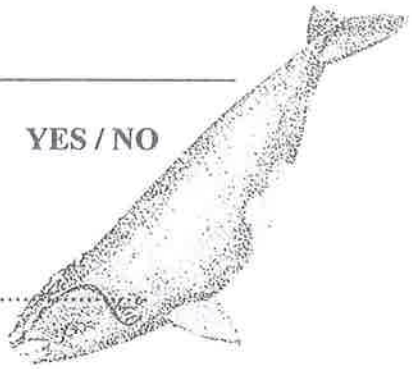
Fax (20/3/1995) from JL (at CALM Busselton) to Raelene [Hick] (at CALM Woodvale) with corrections (typos) to her typescript of the 'Banded Stilt Research Programme – Lake Ballard, March/April 1995' that CDTM had hand-drafted (see 14/03/1995 below).

Inter alia, CDTM refers to a number of publications including: 'There are estimated to be 250,000 Banded Stilts in Australia (Watkins 199..)' and 'Breeding has only been recorded about 20 times (Higgins 1994 [or 1993, see hand-written draft – This seems to be a reference to the relevant volume of HANZAB])'.

Regarding publication, CDTM wrote: 'Results should be published in both the scientific literature (e.g. Emu), and in more widely circulated 'popular' journals. If the ABC [Australian Broadcasting Commission] decides to make a half hour documentary then this will provide further dissemination of the information gained of this spectacular Banded Stilt breeding phenomenon'.

This typescript does not appear to have been developed further by JL or CDTM.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432



TO: KAELENE **URGENT:** YES / NO

AT: WOODVALE

Fax No.

FROM: JEM L.

DATE: 20/3/95 **Your Ref:**
Local Ref:

Please amend draft [redacted]
and place copy [redacted] in my Region hole for Wed.
(and fax to me in Bsn if completed today)
Thanks.

No. of pages inc. this page: 5

Please call us on (097) 521 677 if this message was incomplete or illegible

Of the 70 species of wader which have been recorded in Australia (55 regularly), it is one of the eight resident endemic species.

There are estimated to be 250 000 Banded Stilts in Australia (Watkins 199). Some 60-70% of these live in Western Australia, the remainder being in South Australia and Victoria.

Breeding has only been recorded about 20 times (Higgins ~~1984~~ 1993) since it was first proved in 1930 (at Lake King in W.A. and at Lake Callabonna in S.A.). All but three of these attempts have been in Western Australia, with Lakes Barlee, Ballard and Marmion most favoured. The last known breeding occurred at Lake Barlee in 1992 and at Lake Torrens (S.A.) in 1989.

The Banded Stilt is one of the least studied species of wader in Australia. In particular its breeding biology is little understood. This is because breeding takes place in remote locations, which are especially inaccessible after the heavy rains which precede such events. In fact most breeding records relate to colonies found after

~~DRAFT~~ Single Space pls 29

BANDED STILT RESEARCH PROGRAMME - LAKE BALLARD, MARCH/APRIL 1995

(drafted by C.D.T. Minton) ~~following discussion with ...~~

__Background__

See folios 3-10 of this file for Clive's handwritten originals of this.

The Banded Stilt is unique amongst the 214 species of wading birds in the world in that it

(a) nests colonially

(b) rears its chicks in crêches

(c) only nests intermittently - when inland salt lakes become flooded by exceptional rains

Of the 70 species of wader which have been recorded in Australia (55 regularly), it is one of the eight resident endemic species.

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Fieldwork programmes

The initial visit by Jim Lane, Grant Pearson, Reni and Clive Minton on 15th March can make initial observations and measurements on many of the specific study objectives (a, b, part of c, d, part of e, k, l, and o).

In particular the main existing nesting area can be 'pegged out' and eggs (particularly of incomplete clutches) marked as a foundation for future follow up (e.g. to determine incubation period/hatching success).

It is desirable that a scientist be made available to undertake the detailed study over the whole nesting cycle. This would involve extended periods of observation and activity at the breeding colony, preferably commencing whilst new pairs are still arriving and especially covering the hatching period (likely to be extended). Subsequent follow up during the fledging period could be done more intermittently by boat and/or from the air.

It is also desirable that occasional (aerial and/or ground) surveys be made of Lake Barlee to determine breeding activities there and their outcome.

This breeding event is likely to continue until the end of April, and longer still if any re-nesting occurs.

Publication

Results should be published in both the scientific literature (e.g. Emu), and in more widely circulated "popular" journals. If the ABC decided to make a half hour documentary then this will provide further dissemination of the information gained of this spectacular Banded Stilt breeding phenomena.

References

Watkins, D. (199..). A national shorebird plan for Australia. WWF and RAOU Publn.

Marchant, S. and P.J. Higgins (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Vol II Raptors to Lapwings. Oxford University Press, Melbourne

Extract (15/3/1995) from JL's field notebook that reads 'Lake Torrens account was in ANH [Australian Natural History?], American Natural History magazine (Natural History Bulletin) also in Birds International'. This would have been based on advice from CDTM to JL. Obtain copies of each of these.

John ---- ? is wanders at Broome

Andy Chapman will provide name of station owner on north side — we break in.

We should do pre-long netting & Jellery and Barlee early next week (from Wal)

Contact ~~Clive Minton~~
091 935 600 Broome Bird Observatory — much of the time — till May 2nd. (from Fri 17th March)

Lake Torrens account ~~[illegible]~~ was in ANH, American Natural History magazine (Natural History Bulletin)
also in Birds International

Kalgoorlie Airport Wed 15/3/95 contd

Subsequent monitoring ? (another go after nine a creche)

Once the chicks hit the water they should be feeding themselves.

Banding / Colour Marking

If can band chicks — the more the better — colour flag ~~[illegible]~~ with yellow (from Broome or Melbourne).

Can you band them?

Put band on one tibia + flag on other Tibia

~~Get~~ Get bands + flags now. (including) 5500-6000 bands from

JL's field notebook.

Printed 10/4/2014.

Extract from a fax (14/03/1995) from CDTM to JL with his (CDTM's) draft manuscript headed 'Banded Stilt Research Programme – Lake Ballard, March/April 1995'.

See 20/3/1995 above for typed copy of this manuscript.

14/3/95

DRAFT (1)

Banded Stilt Research Programme – Lake Ballard March/April 19

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The Banded Stilt is unique amongst the 214 species of wading birds in the world in that it

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The Banded Stilt is one of the least studied species of wader in Australia. In particular its breeding biology is little understood. This is because breeding takes place in remote locations, which are especially inaccessible after the heavy rains which precede such events. In fact most breeding records relate to colonies found after breeding has finished (often abandoned in mid breeding because of declining water levels / food supplies) or at the chick stage (often roaming many kilometres from the actual breeding site).

The discovery of a nesting colony on Lake Ballard on 12th March 1995, only 15 days after the commencement

(4)

Fieldwork programme

The initial visit by Jim Lane, Grant Pearson, Mary Reni and Clive Minton on 15th March can make initial observations and measurements on many of the specific study objectives (a, b, part of c, d, part of e, h, l, and o).

In particular the many existing nesting area can be 'pegged out' and eggs (particularly of incomplete clutches) marked as a foundation for future follow up (eg to determine incubation period / hatching success).

It is desirable that a scientist be made available to undertake the detailed study over the whole nesting cycle. This would involve extended periods of observation and activity at the breeding colony, preferably commencing whilst new pairs are still arriving and especially covering the hatching period (likely to be extended). Subsequent follow up during the fledging period could be done more intermittently, by boat and/or from the air.

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Results should be published in both the scientific literature (eg Emu), and in more widely circulated "popular" journals. If the ABC decides to make a half hour documentary then this will provide further dissemination of the information gained of this spectacular banded Stilt breeding phenomen

A copy of an entry in the 'ERRATA' section of WA Bird Notes No.71, p.3, (Sept 1994 issue) that reads 'Banded Stilt – 15000 (incorrectly 1500 in WABN 70), April 94, Cargills Salt Works, Port Hedland (Port Hedland) – AWSG'.

WEST AUST BIRD NOTES N°71 p.3.

326

Australian Magpie-lark - 1, May 1994, North Island, Houtman Abrolhos (Northampton) (rare vagrant to the islands) - JF, BF

ARID ZONE (including the Pilbara, Gascoyne, interior and Nullabor)

Great-billed Heron - 1, 20/5/94, Cape Keraudren (East Pilbara) (southern most record for this species) - KC

Pink-eared Duck - 2 with 6 young (half length), 30/4/94, "Lake Julia", 12 km E of Binthalya HS on Mooka Station (Carnarvon) - AB

Grey Falcon - 1, 19/5/94, Hales Well, N of Newman (East Pilbara) - KC

Inland Dotterel - 1, 29/5/94, Culi Lake, Canning Stock Route (East Pilbara) - KC * 17, 29/5/94, Lake Tobin, Canning Stock Route (East Pilbara) - KC

Common Redshank - 2, 27/7/94, Pelican Point, Carnarvon (Carnarvon) - AJ, RJ

Alexandra's Parrot - 45 in small groups, 30/5/94, between Wells 40 and 37, Canning Stock Route (East Pilbara) - KC

Budgerigar - flock of 2000, drinking at a pool, 6/94, just south of the De Grey River (East Pilbara) - SN

Mulga Parrot - 1, 17/6/94, Carawine Gorge, Oakover River (East Pilbara) - JM

Chiming Wedgebill - 1, 5/94, Well 41, Canning Stock Route (East Pilbara) - KC * 20, feeding on the ground, 17/7/94, 75 km E of the North West Coastal Hwy (Shark Bay) - RS

Banded Whiteface - 4, 24/6/94, Nallan Station (Cue) - SN

Rufous-crowned Emu-wren - 1 +, 19/4/94, 20 km W of Neale Junction Nature Reserve on Ann Beadell Hwy (Laverton) - KC

Rufous Treecreeper - 1, 19/4/94, Neale Junction, Great Victoria Desert (Laverton) - KC

Striated Grasswren - 1 +, 19/4/94, Neale Junction (Laverton) - KC

Spiny-cheeked Honeyeater - 1, 5/94, Well 37, Canning Stock Route (East Pilbara) - KC

Dusky Woodswallow - 200, 17/7/94, on Butcher's Track, 50 km E of the North West Coastal Hwy (Shark Bay) - RS * 100, 17/7/94, 75 km E of the North West Coastal Hwy (Shark Bay) - RS

KIMBERLEY

Letter-winged Kite - 2, 31/7/94, Near Derby Sewage Works outfall (Derby-West Kimberley)- BB, GS

Grey Falcon - 1, 15/6/94, Charnley River crossing (Derby-West Kimberley) - SN

Red-capped Plover - 1039, 6/94, Eighty Mile Beach (Broome) - BBO

Partridge Pigeon - 1 +, 24/5/94, Mitchell Plateau (Wyndham-East Kimberley) - KC

Purple-crowned Fairy-wren - 6, 25/5/94, Drysdale River crossing, Gibb River Road (Wyndham-East Kimberley) - KC

Black Grasswren - 1 +, 24/5/94, Surveyor's Pool, Mitchell Plateau (Wyndham-East Kimberley) - KC * 22 in 2.5 km, 13/6/94, Backstein Gorge, Beverley Springs Station (Derby-West Kimberley) - SN

Black Honeyeater - 1, 16/6/94, Ellenbrae Station (Wyndham-East Kimberley) - SN

Yellow Chat - several birds plus 3 nests, 2 with 3 eggs each, 18/6/94, Parry Lagoons (Wyndham-East Kimberley) - SN

Gouldian Finch - 12, 23/5/94, 10 km S of Gibb River Road and Kalumburu Road junction (Wyndham-East Kimberley) - KC * 8, 3/6/94, Kangaroo Springs, Beverley Springs Station (Derby-West Kimberley) - KC

ERRATA

Banded Stilt - 15000 (incorrectly 1500 in WABN 70), April 94, Cargills Salt Works, Port Hedland (Port Hedland) - AWSG

Gilbert's Whistler - 1 male, 3/4/94, Ryan's Find Road on track to Mt Walton, 13 km S of Jaurdi Station HS (Coolgardie) - HC, BM & RAOU Campout (locality incorrectly described in WABN 70)

Observer Codes

AB = Allan Burbidge	JKR = Jim Rolfe
AJ = Allan Jones	JM = John Malcom
AWSG = Australian Wader Study Group	KC = Kevin Coate
BB = Bruce Buchanan	KD = Kate Dawson
BBa = Bryan Barrett	MBa = Mike Bamford
BBO = Broome Bird Obs	MC = Margery Clegg
BF = Beth Fitzhardinge	MCr = Michael Craig
BM = Bill McRoberts	PB = Pam Burgess
CD = Colin Davis	PC = Peter Coyle
GM = Glen Moore	RJ = Rose Jones
GS = George Swann	RS = Rod Smith
HC = Helen Clark	SN = Simon Nevill
JB = Jeff Burrows	SR = Sandy Rose
JBo = John Boughey	TK = Tony Kirkby
JF = John Fitzhardinge	UE = Una Edwards

RAOU Office WA	Perry House, 71 Oceanic Drive Wembley 6014 or PO Box 199 Jolimont 6014.
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Birding Hotline	(09) 387 8412.
Chairman	B. Wilson, 46 Farrant Street, Gooseberry Hill, 6076 tel 293 1094.
Editor	B. Buchanan, PO Box 10, Wannamal, 6505.

Notes For Contributors

The Editor requests contributors to note :-

*WABN normally only publishes material on WA birds
*contributions should be written or typed with **Double Spacing**
*WABN uses RAOU recommended English names
*copy will be edited where appropriate
*contributions will be published unless the contributor is informed to the contrary

Deadline for the December Issue
21 November1994

This is the Sept 1994 issue of WABN. 01/9/2014

A copy of an entry in the 'Observations' section of WA Bird Notes No.70, p.2, (June 1994 issue) that reads 'Banded Stilt – 1500, 4/94, Cargills Salt Works, Port Hedland (Port Hedland) – AWSG'.

Importantly, '1500' was corrected to 15000' in the next (Sept 1994) issue of WABN (see above).

WA Bird Notes N° 70, June 1994, p2. RO1/5/2014

Observations

Compiled by the Observations Committee. Shires are in brackets.

SOUTH-WEST (Shark Bay to Cape Arid)

Cattle Egret - 1, 10/5/94, Claremont (Claremont) - PS

Great Egret - 44, 3/4/94, Jandabup Lake (Wanneroo) - AB, JR

Little Egret - 22+, 29/12/93, Mandurah (Mandurah) - IS, JH * 25, 12/2/94, Island Point, Harvey Estuary (Mandurah) - AB, MJB (high counts for the SW of WA)

Yellow-billed Spoonbill - 60, 3/94, Forrestdale Lake (Armadale-Kelmscott) (high number at this site) - SN * 114, 27/3/94, Jandabup Lake (Wanneroo) (high number for SW) - AB

Chestnut Teal - 1, 27/3/94, Lake Monger (Perth) - IS * 2, 14/2/94, Lake Joondalup South (Wanneroo) - JB * 4, 6/3/94, Thomsons Lake (Cockburn) - RS

Pink-eared Duck - 200, 9/3/94, Lake Joondalup South (Wanneroo) (High number this site) - GL

Peregrine Falcon - 1, 16/2/94, Vasse Estuary, Busselton (Busselton) - RP * 1, 20/3/94, Lake Monger (Perth) - IS, BS * 2, 17/4/94, Mt Cook (Wandering) - IS, BS

Malleefowl - 2, 21/4/94, Karroun Hill Nature Reserve (Mt Marshall) - BB * 1, 17/12/93, Useless Loop Road, Shark Bay (Shark Bay) - TV

Spotless Crake - 10+, 20/3/94, Lake Monger (Perth) - IS, BS, DN, JN

Eurasian Coot - 3000+, 26/3/94, Joondalup Lake (Wanneroo) - AB, JR

Black-fronted Plover, 97, 16/3/94, Adventure World wetland, near Bibra Lake (Cockburn) - JH

Hooded Plover - 1, 28/12/93, Lake Clifton (Murray) - MB * 38 (about one-third in juvenile plumage), 25/2/94, Fitzgerald River National Park (Jerramungup) - BN * 44, 30/4/94, Lake Preston (Wanneroo) - BW * 2, 13/5/94, Cape Leeuwin (Augusta-Margaret River) - IS, BS

Double-banded Plover - 1, 6-7/4/94, Forrestdale Lake (Armadale-Kelmscott) - TK

Large Sand Plover - 1, 26/10/93, Quindalup sand bar, Dunsborough (Busselton) (uncommon in the lower SW cnr of WA) - RP

Banded Stilt - 1000+, 16/2/94, Vasse Estuary, Busselton (high number this wetland) (Busselton) - MJB

Wood Sandpiper - 10, 13/3/94, Jandabup Lake (Wanneroo) - AB

Terek Sandpiper - 9, 30/10/93, mouth of Preston River, Bunbury (Bunbury) - RP

Red Knot - 120, 8/2/94, Pelican Point, Swan River (Nedlands) - MBy, FO

Pomarine Skua - 20+, 6/5/94, Woodman Point (Cockburn) - FO

Silver Gull - 1, blackish all over except for smudgy white nape; legs and bill reddish, 9/93, Coogee (Cockburn) KL * 1, sooty all over, black legs, dark reddish black bill, 1/94, Mullaloo Beach (Wanneroo) - DC * 2200, 12/2/94, Lake Cooloongup (Rockingham) - AB (high number for this site)

White-winged Tern - 100+ (many in breeding plumage), 25/3/94, South Yunderup (Murray) - TK

Roseate Tern - 7 in breeding plumage, 7/3/94, Woodman Point (Cockburn) - JH, IS

Rainbow Lorikeet - about 50, 2/94, Attadale (Melville) - PH * 9, 5/94, Lake Goollelal (Wanneroo) - MJB (this species is increasing in abundance in the Kingsley-Wanneroo area)

Regent Parrot - 1, 27/3/94, Lake Monger (Perth) - IS, BS * 1, 25/4/94, Yokine (Stirling) - IS (unusual in suburban areas; possible aviary escapees)

Fork-tailed Swift - 50+, 13/3/94, mouth of Poison Creek, Cape Arid National Park (Esperance) - SR, AR * 5, 20/3/94, Morley (Bayswater) - HvW

Tree Martin - 1000+, 3/94, Geordie Bay, Rottnest - MCa

Gilbert's Whistler - 1 female, 21/4/94, Karroun Hill Nature Reserve (Mt Marshall) - BB

Restless Flycatcher - 1, 7/5/94, Thomson's Lake (Cockburn) - MM, RS

House Sparrow - about 60, breeding, early 1994, Mariginiup (Wanneroo) - MM (the APB is controlling this population)

Australian Magpie-lark - 200, 25/4/94, corner Nicholson Road and Thomas Street, Oakford (Armadale-Kelmscott) - MJB

ARID ZONE (including the Pilbara, Gascoyne, interior and Nullabor)

Australian White (Sacred) **Ibis** - 1, 15/4/94, near mangroves, Carnarvon (Carnarvon) (rarely recorded in this area) - AB

Royal Spoonbill - 3, 11/1/94, man-made ponds near corner David Brand Drive and Babbage Island Road, Carnarvon (Carnarvon) (rarely recorded in this area) - GMo

Freckled Duck - 5, 6/4/94, Carnage Lake, 4 km S of Rowles Lagoon (Boulder) - BM & RAOU Campout

Marsh Harrier - 1, 10/1/94, Hamelin Pool, Shark Bay (Shark Bay) - GMo

Grey Falcon - 1, 4/5/94, Boolathana Station, north of Carnarvon (Carnarvon) - AB

Banded Stilt - 1500, 4/94, Cargills Salt Works, Port Hedland (Port Hedland) - AWSG Corrected to 15 000 in WAB N° 71

Red-necked Avocet - 5000, 4/94, Cargills salt works, Port Hedland (Port Hedland) - AWSG

Gallinago sp. snipe - 1, 18/1/94, Nanutarra Roadhouse, Pilbara (Ashburton) - GMo

Asian Dowitcher - estimated 100 before migration, April 94, Cargills Salt Works, Port Hedland (Port Hedland) - AWSG

Red-necked Stint - 3000+, April 94, Cargills Salt Works, Port Hedland (Port Hedland) - AWSG

Broad-billed Sandpiper - estimated 1000 before migration, 4/94, Cargills salt works, Port Hedland (Port Hedland) - AWSG

Barking Owl - 2, 24/3/94, Weeli Wolli Spring, Marillana Station (Nullagine) - MJB

Common Bronzewing - 100+, 8/4/94, Dead Man's Soak, Nineteen Mile Rocks, Goongarrie National Park (Menzies) (arriving at dusk, landing nearby and walking into water) - BM & RAOU Campout

Gilbert's Whistler - 1, male, 3/4/94, Ryan's Find Road on track to Mt Walton, 213 km S of Jaurdi Station HS (Coolgardie) - HC, BM & RAOU Campout

Thick-billed Grasswren - 1, 9/4/94, 7.5 km south of Denham (Shark Bay) - AB

KIMBERLEY

Pied Heron - 1, 4/94, Broome Sewage Works (Broome) (rarely recorded in west Kimberley) - BBO, GS et al.

Marchant, S. & Higgins P.J. (1993). ***Handbook of Australian, New Zealand & Antarctic Birds [HANZAB], Volume 2 Raptors to Lapwings.*** **Melbourne, Oxford University Press. (pp.780-790, Plate 59 – Banded Stilt).**

Handbook of AUSTRALIAN, NEW ZEALAND & ANTARCTIC BIRDS

Volume 2 Raptors to Lapwings

S. Marchant and P.J. Higgins (Editors)

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Colour illustrations by J.N. Davies
with P. Marsack, F. Knight and B. Jarrett

Melbourne
Oxford University Press 1993
Oxford Auckland New York

	MALES	FEMALES
TARSUS	(4) 90.8 (2.3; 4)	85.6 (5.8; 9)

	UNSEXED
WING	(4) 236 (11.0; 37)
TAIL	(4) 79 (4.3; 33)
BILL F	(4) 66.2 (2.5; 27)

Hybrid types C–G: (5) adult, skins (AWMM, CM, NMNZ).

	MALES	FEMALES	
WING	(5) 239 (8.83; 236–250; 7)	227 (5.29; 220–235; 7)	*
TAIL	(5) 74 (4.54; 68–80; 7)	74 (3.75; 65–78; 10)	ns
BILL F	(5) 62.8 (2.51; 60.5–67.5; 6)	63.7 (1.5; 61.9–65.7; 9)	ns
TARSUS	(5) 96.0 (2.26; 93.5–98.6; 5)	91.2 (2.56; 87.5–94.5; 9)	*
TOE	(5) 34.8 (1.44; 32.5–36.1; 5)	33.5 (1.47; 31.7–35.7; 10)	ns

Hybrid females shorter in wing and longer in tarsus than Black Stilt but differences not significant in samples.

WEIGHTS Three adult females: 135, 147, 190; juvenile male 2.5 months old: 150 (NMNZ). Four live unsexed birds in Mackenzie Basin, SI, mean 223 g (Pierce 1982). Three chicks at hatching, 13.3, 14.0 and 14.8 g (CM); at 19 days, female, 40 g (NMNZ); reach 100 g by c. 5 weeks (Pierce 1982).

STRUCTURE Wing, medium to long, narrow, pointed. Eleven primaries; p10 longest; p9 3–9 mm shorter, p8 13–22, p7 29–43, p6 43–57, p5 57–73, p4 73–88, p3 83–99, p2 95–113, p1 102–122, p11 minute. Fourteen secondaries including about four tertials; tips of longest tertials fall between p5 and p6 on folded wing. Tail, square; 12 rectrices. Body plumper than Black-winged Stilt; neck, rather long, though shorter than that of Black-winged Stilt (Pierce 1982). Bill, very long, fine, straight for basal half and finely upturned distally, with small fine hook at tip; longer and broader at base than that of Black-winged Stilt (Pierce 1982). Tibia, long, slender, bare; tarsus, long, slender, laterally compressed; scales, reticulate. No hind toe. Outer toe 85–91% of middle, inner 71–78%.

GEOGRAPHICAL VARIATION None.

REFERENCES

Buller, W.L. 1878. *Trans. NZ Inst.* 10: 201–9.
— 1888. *A History of the Birds of New Zealand.* Author, Lond.
Chambers, S. 1989. *Birds of New Zealand.* Arun Books, Hamilton, NZ.
Child, P. 1958. *Notornis* 8: 53.
Collar, N.J., & P. Andrew. 1988. *ICBP Tech. Publ.* 8.
Falla, R.A., *et al.* 1981. *The New Guide to the Birds of New Zealand.* Collins, Auckland.
Hadden, D. 1990. *99 New Zealand Birds.* Caxton Press, Christchurch.
Hutchinson, F. 1900. *Trans. NZ Inst.* 33: 213–21.
Moon, G. 1992. *A Field Guide to New Zealand Birds.* Reed, Auckland.
—, & R. Lockley. 1982. *New Zealand's Birds.* Heinemann, Auckland.
O'Donnell, C.J.F. 1988. *Notornis* 35: 247–8.
Pierce, R.J. 1982. Unpubl. PhD thesis, Univ. Otago, Dunedin.
— 1983. *Notornis* 30: 169–85.
— 1984a. *Notornis* 31: 7–18.
— 1984b. *Notornis* 31: 106–30.
— 1985. *NZ J. Zool.* 12: 467–72.
— 1986a. *Auk* 103: 273–80.
— 1986b. *Black Stilt.* John McIndoe & NZ Wildl. Serv., Dunedin.
— 1986c. *NZ J. mar. freshwat. Res.* 20: 17–28.
IUCN. 1979. *Red Data Book.* IUCN, Morges, Switzerland.
Reed, C.E.M. 1986. Unpubl. MSc thesis, Massey Univ.
Soper, M.F. 1959. *Notornis* 8: 163.
— 1967. *Notornis* 14: 8–10.
Stead, E.F. 1932. Pp 97–105 **In**: *The Life Histories of New Zealand Birds.* Search, Lond.

Sponsors: Mrs M & Mr P McLauchlan

Cladorhynchus leucocephalus Banded Stilt

COLOUR PLATE FACING PAGE 776

Recurvirostra leucocephala Vieillot, 1816, *Nouv. Dict. Hist. nat.* 3: 103 — 'Terres Australes' = Victoria *apud* Mathews = probably Rottnest Island, Western Australia, *apud* Stresemann 1951.

The generic name combines the Greek κλάδος, a twig or thin branch (i.e. thin), with ῥύγχος, the bill. The specific name is Greek λευκός + κεφαλή, for white-headed, and refers to the bird's diagnostic plumage.

OTHER ENGLISH NAMES Bishop or Rottnest Snipe.

MONOTYPIC

FIELD IDENTIFICATION Length 35–43 cm; wingspan 55–68 cm; weight 220–260 g. Full-bodied stilt, with slender black bill, long orange-pink legs and pied plumage. Similar in size to Black-winged Stilt *Himantopus himantopus* but bulkier, with shorter legs and shorter, narrower wings. Sexes alike. Marked seasonal variation. Juvenile separable.

Description **Adult breeding** White except for black scapulars and wing, and diagnostic broad roughly U-shaped chestnut band across lower breast and central belly, with narrow dark upper edge. In flight: from above, pattern diagnostic: upperbody, white; upperwing, black except for white secondaries and tips of inner primaries, which form broad white trailing-edge, tapering outwards; tail, white, washed grey-brown; from below: white except for dark breast-band, narrow black leading-edge round carpal, and dusky outerwing. **Adult non-breeding** Varies; some similar to adult breeding except: breast-band narrower, slightly duller chestnut, and with some white mottling; dullest birds have breast-band reduced to ashy-brown smudges on belly and lower breast, and faint grey loral stripe or patch before eye; legs become duller pink. In intermediates, breast-band reduced to patchy chestnut, ashy brown and white. **Juvenile** As adult breeding except: lores and forehead, grey when fresh; no band on underbody; scapulars and inner upper wing-coverts have narrow pale fringes when fresh; black parts of plumage, duller, becoming

browner with wear; white trailing-edge of upperwing extends farther onto primaries; legs and feet, dark grey.

Similar species None; in breeding plumage, broad U-shaped band on lower breast and central belly, diagnostic; in all plumages, white head, neck and mantle, and white secondaries, diagnostic. In Aust. **Black-winged Stilt** has wholly white underbody, some black or grey on head or neck or both, dark-brown or black lower mantle, black secondaries, and mostly black underwing. **Red-necked Avocet** *Recurvirostra novaehollandiae*, distinguished by strongly upcurved bill, chestnut head and neck, and pale blue-grey legs and feet.

Highly gregarious, in small parties to dense flocks, sometimes in thousands, mainly on inland saltlakes. Disperse after breeding to coastal saltmarshes, commercial salt-fields, sewage farms and, sometimes, estuarine mudflats. Usually in large dense single-species flocks, but often associate with Red-necked Avocets and Black-winged Stilts when feeding. Vagrants associate freely with other waders. In flight, wing-beats flickering and considerably faster than those of Black-winged Stilt or Red-necked Avocet. Wade in shallows; feet partly webbed and birds swim well, often far from shore. Downy young can swim and feed themselves very soon after hatching. Voice, soft barking that can become loud when given from dense flying flock; also plaintive whistling.

HABITAT Mainly saline or hypersaline waters of inland and coast; typically large, open and shallow (McGilp & Morgan 1931; Carnaby 1947; Crawford 1975; Kolichis 1976; Badman 1989; Hewish 1989a). In coastal and near-coastal areas, large congregations occur at flooded ephemeral saltlakes and on ponds in saltworks; occasionally use saltpans, claypans and water storages (McGilp & Morgan 1931; Carnaby 1933, 1946; Jones 1945a; Jenkins 1975; Kolichis 1976; Burbidge & Fuller 1982). Large numbers may also occur on marine wetlands, such as lagoons, inlets, estuaries, sheltered bays and intertidal flats, especially where evaporation increases salinity of water (Jones 1945a,b; Watson 1959; Gibson 1977; Burbidge & Fuller 1982; Henderson 1982; Close & McCrie 1986; Hewish 1989a); sometimes recorded on ocean beaches (Sedgwick & Sedgwick 1950; Martindale 1980; P.J. Higgins). Round Port Phillip Bay, forage in waters with salinity of 40–145 ppt (Jessop 1987); at L. Eyre, salinity 104 ppt (Lane 1984); at L. Grace, bred when salinity was 21.3–29.7 ppt (Carnaby 1946). Occasionally recorded on lower salinity waters: brackish lagoons, freshwater lakes, sewage farms, farm dams and water storages (Jones 1945b; Morris 1975; Henderson 1982; Sonter 1987; Pearson 1989). Leave coastal habitats for inland when rain or floodwater in arid zone fills large systems of ephemeral saltlakes. Chicks, leaving breeding colonies, have been recorded walking through mulga or bluebush country (Garstone & Jefferies 1983; Pearson 1989).

Breed only in arid inland at large shallow ephemeral saltlakes inundated by rain or floodwaters. Nest on low islands or spits (1–1.5 m above water-level) beside shallow (10–60 cm) water; nesting areas may be bare or have sparse cover of vegetation (McGilp & Morgan 1931; Carnaby 1933, 1946; Jenkins 1975; Kolichis 1976; Burbidge & Fuller 1982; Pearson 1989; Bellchambers & Carpenter 1992).

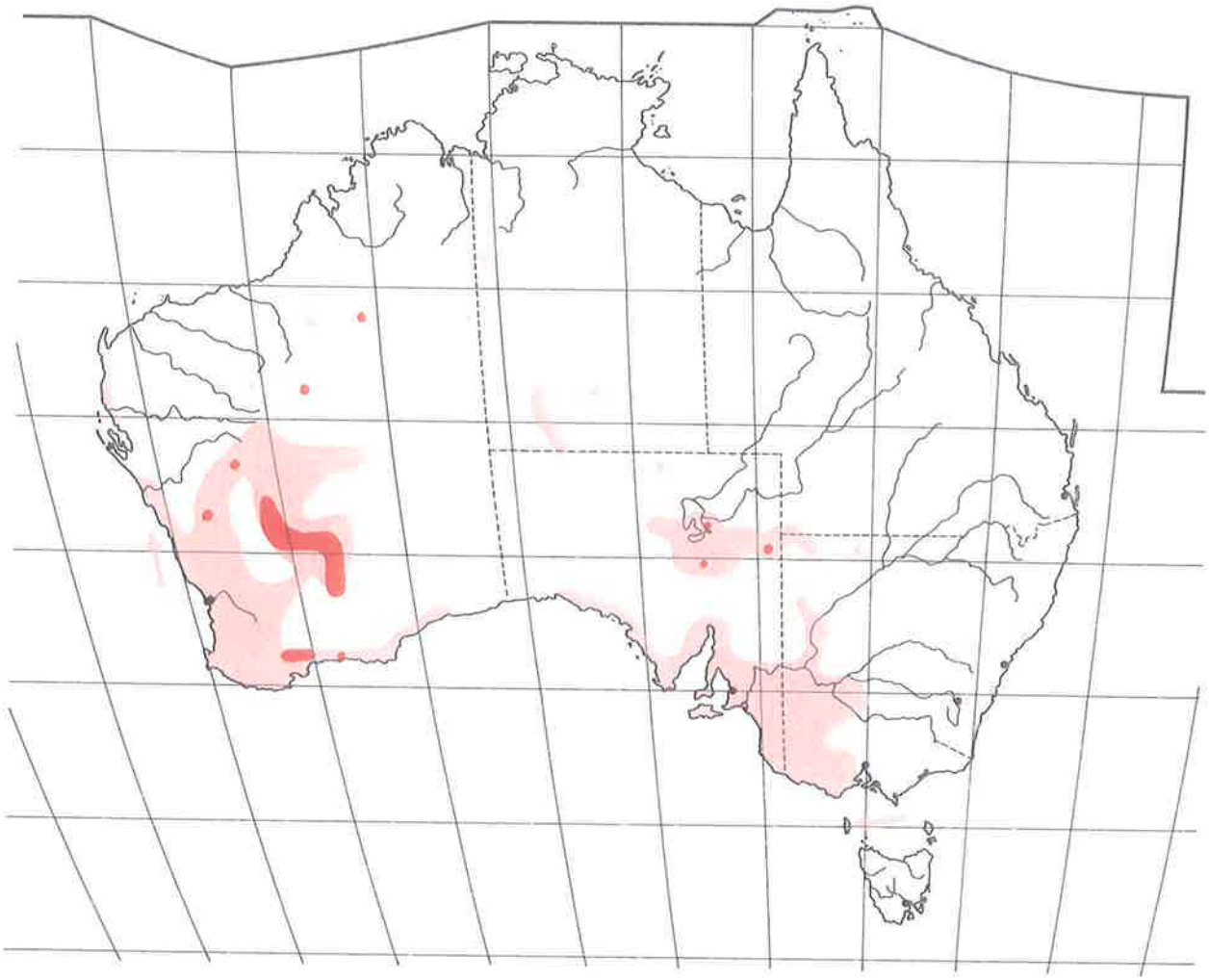
Forage by wading in shallows or swimming in deeper water (Wheeler 1955; Watson 1959; Storr 1965; Jessop 1987; Sonter 1987). Rarely, drink at freshwater pools (Storr 1965). Chicks recorded feeding in brackish samphire swamps (Burbidge & Fuller 1982). Roost or loaf on banks, bars, shores, islands or spits of sand, shell-grit or soil, or in shallow water in saltlakes, salt-ponds or lagoons (McGilp & Morgan 1931; Wheeler 1955; Ford 1965; Storr 1965; Close & McCrie 1986; Jessop 1987).

Large numbers occur at some saltworks, which provide consistently suitable habitat where salinity and depth of water maintained (Hewish 1989a). Increased salinity of many wetlands in sw. WA and Murray–Darling Basin may make them more attractive to Stilts (Lane 1987).

DISTRIBUTION AND POPULATION Endemic to Aust., mainly in S and inland.

Qld Rare visitor; single Atlas record from near Orientos Stn in SW, 25 Oct. 1979. Subsequently recorded on regular AWSG surveys: Moreton Bay, 26, 6–7 July 1981; sw. lakes, 500, 12–13 Feb. 1983 (AWSG data). Most, if not all, reports from the SE almost certainly immature Black-winged Stilts (Storr 1973; Roberts 1979) and need to be substantiated. **NSW** Mostly in w. and Riverina regions; sporadic records elsewhere, including coasts from Hunter to s. coast and s. Tablelands and also slopes W of Great Dividing Ra. Unusual number of records in 1984 (Gibson 1977; Morris *et al.* 1981; NSW Bird Reps; Aust. Atlas). **Vic.** Widespread from w. Port Phillip Bay, W through w. Districts, Wimmera and Mallee; occasionally reported in e. Port Phillip (Vic. Atlas; Vic. Bird Reps). **Tas.** Rare visitor; influx in 1981, with widespread sightings in several districts. Single, specimen, Ralph's Bay, 1854 (Anon. 1855); single, specimen, Sandford, Aug. 1921 (Lord & Scott 1924); unconfirmed report of unknown number on Flinders I., before 1974 (D.L. Serventy); single, Lauderdale, from 29 Dec. 1976 to June 1978 (Wall & Harris 1978; Wall 1981); single, Great Bay, Bruny I., 31 July–7 Aug. 1977 (Tas. Bird Rep. 7); single, Okehampton Lagoon, between Triabunna and Orford, 4 Jan. 1981 (Tas. Bird Rep. 11); single, Ravensdale, 5 Jan.–Feb. 1981 (Tas. Bird Rep. 11); single, Henty R. mouth, 17 Jan. 1981 (Tas. Bird Rep. 11); ≤13, Sandy C. region (Wild Wave R. mouth, Greenes and Chimney Cks), 17 Jan.–7 Sept. 1981 (Henderson 1982; Green 1984); single, C. Portland, 20 Jan. 1981 (Tas. Bird Rep. 11); single, Sea Elephant, King I., Mar.–Apr. 1981 (Tas. Bird Rep. 11). **SA** Coastal regions from SE to Head of the Bight; recorded inland in NE and Murray-Mallee. Widely scattered records in L. Eyre drainage basin; mainly E of 136°E. Isolated records from 150 km NE of Oodnadatta and the nw. Aboriginal Reserve (Aust. Atlas). **WA** Few records in w. Deserts region, mainly on Nullarbor Plain; widespread in SW districts; also widespread in inland Goldfields district, S of 26°S and Murchison R., along coast, records extend N to Carnarvon. Mostly scattered records in Pilbara Division, N to Newman and E to Percival Ls in Great Sandy Desert (Aust. Atlas), though regularly recorded Port Hedland Saltworks, in thousands (C.D.T. Minton). **NT** Few records. First published record, Alice Springs Sewage Farm, 10 Feb. 1979 (Roberts 1980); three additional records there, 1986 (CCNT); Uluru: 1977, May 1979 (Aust. Atlas); L. Amadeus, more than 20, 5–7 July 1979 (Aust. Atlas); single record in middle of nowhere, E of Bauhinia (18/129) (Aust. Atlas); *c.* 2300 birds on ephemeral lake near Erldunda, Sept. 1989 (ANPWS 1993); single, Howard Springs, near Darwin, July 1990 (CCNT); Saltbeef L., 800 birds, Feb. 1991; 1200, Mar. 1993 (K. Bellchambers; M. Fleming).

Breeding Rarely recorded; sporadically at inland saltlakes. Most known colonies have been in WA; only two colonies located in e. half of Aust. **WA** L. Cowan, large colony (unconfirmed), 1904 (Whitlock 1932); Quinn's Find, 64 km SW of Nannine, May–June 1923 (Jones 1945a); Menzies district, young walking through town, Mar. 1929 (Glauert & Jenkins 1931); L. Grace, Aug. 1930 (Glauert & Jenkins 1931), Sept. 1945 (Carnaby 1946), *c.* 500 nests, Aug. 1946 (Carnaby 1947); L. King, tens of thousands of birds and countless chickens, 1930 (Glauert & Jenkins 1931), 12,000–16,000 adults and 21,000 and 28,000



chicks, Aug. 1988 (Bougher 1988); Wagga Wagga L., 40–50 nests, Nov. 1960 (Fuller 1963); L. Ballard–Menzies district, chicks walking through town, 1963 (Jenkins 1975), *c.* 60 breeding pairs, July 1973 (Jenkins 1975), July 1974 (Kolichis 1976), several thousand birds, May 1975 (Kolichis 1976), chicks on road, Sept. 1981 (Garstone & Jefferies 1983), chicks walking through town, Sept. 1986 (Pearson 1989); L. Disappointment, Canning Stock Route, probable colony, Aug. 1971 (Kolichis 1976); L. Marmion: 50,000 breeding pairs (Kolichis 1976; Burbidge & Fuller 1982), *c.* 2500 nesting pairs, May 1975 (Kolichis 1976); L. Barlee, *c.* 179,000 nests, Sept. 1980 (Burbidge & Fuller 1982); L. Goongarrie, 1980 (Aust. Atlas); Esperance, 1980 (Aust. Atlas). Subfossilized eggs with pigment discovered at Percival Ls, WA, Sept. 1975 (Kolichis 1976), but no evidence to suggest that the species had bred there in 1975 (*contra* Aust. Atlas). SA L. Callabonna, SA, *c.* 27,000 nests, Dec. 1930 (McGilp & Morgan 1931), June 1936 (Anon. 1937); L. Eyre, single chick, 1984 (Minton 1989); L. Torrens, up to 100,000 birds, Apr.–May 1989 (Minton 1989; Robinson & Minton 1989; Bellchambers & Carpenter 1992; Carpenter & Bellchambers in prep.).

Formerly thought to be extremely rare visitor to sw. NSW, Sunraysia and Murray-Mallee districts before 1975; now reasonably common (Sonter 1987). With salination of farmlands in Vic., SA and WA creating areas of suitable habitat, greater numbers could be expected in these regions in future.

Total population, *c.* 206,000 (D. Watkins). Sites of significance and maximum or average counts from summer and winter counts round Aust., 1981–82, were: The Coorong, SA, 77,000; L. Eyre, SA, 30,000; St Vincent Gulf, SA, 6100; se. coastal lakes, SA, 5900; Esperance coast, WA, 2380; se. inland lakes, SA, 2190; Western District lakes, Vic., 2050 (Lane 1987). Recorded on 51 of 197 wetlands surveyed in sw. WA, 1981–85 (Jaensch *et al.* 1988). Totals for summer and winter counts, 1986–90, in Aust. are summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992).

Table 1

DATE	NUMBER OF BIRDS	NUMBER OF SITES
summer 1986	45,667	23
winter 1986	21,526	23
summer 1987	22,071	22
winter 1987	4676	23
summer 1988	37,975	22
winter 1988	5030	23
summer 1989	10,946	22
winter 1989	0	21
summer 1990	21,306	21

When chicks disperse from breeding colonies, can be found along roads, and struck by vehicles (Garstone & Jefferies 1983). Of c. 1400 chicks seen walking through town of Menzies, estimated 500 were hit by cars in 2 days (Harris 1987). Occasionally hit overhead wires (Lashmar 1936; Jones 1945a; Carnaby 1946; Wheeler 1955). Chicks a delicacy to some Aborigines, who ate many at breeding colonies at L. Ballard, 1973 (Jenkins 1975). Formerly 'preserved' on Rottnest I., while the Governor's summer residence was maintained there, for his shooting parties; hides were erected round the lakes for this purpose (Serventy & Whittell 1981). Bags of up to 300 shot by superintendents of the native gaol between 1883 and 1898, after Aboriginal prisoners drove the birds toward the shooters (Storr 1965). Occasionally shot in more recent times (Wheeler 1955). Sold in Melbourne markets in 1880s (Bryant 1946).

MOVEMENTS Little known. Dispersive; movements complex and often erratic, in response to availability of feeding and breeding habitat across range. Populations coastal and near-coastal when arid inland dry, returning inland to breed after rain or flooding.

S. climatic pattern dominates movements when arid inland dry. Counts suggest seasonal patterns of abundance in some parts of range with seasonal rainfall, particularly coastal and near-coastal regions of Vic., SA and WA. Numbers peak in spring–summer, corresponding with dry periods inland; birds perhaps dispersing with winter rainfall (Jones 1945a; Wheeler 1955; Storr 1965; Jenkins 1975; Saunders & de Rebeira 1985; Close & McCrie 1986; Lane 1987; Hewish 1989a; Aust. Atlas). May be present all year where habitat consistently suitable, but seasonal fluctuations in numbers evident in most years, e.g. Moolap Saltfields, Vic.; St Kilda and Price Saltfields, SA (Hewish 1989a). Unusual seasonal pattern at Clinton Conservation Park, SA (numbers peak in May, fall Sept.–Oct.), poorly understood (Close & McCrie 1986); site used for roosting not feeding. Counts vary more in enclosed natural wetlands, where suitability of habitat fluctuates in response to rainfall, inflow and evaporation, but dispersal in response to rainfall suggested in places by peak counts in spring–summer and lower counts or absence in winter. Exploit unpredictable resources by large-scale movements between wetlands; may gather rapidly in great numbers and leave abruptly. At L. George, SA, and Wimmera Ls, Vic., counts vary greatly, birds sometimes absent, but highest counts generally spring–summer (Hewish 1989a; Alcorn & Alcorn 1990). At L. Wyn Wyn, Vic., 24,000 birds present, Jan.–Apr. 1983 (Lane 1987); at Mitre L., Vic., 50,000 present 29 Sept. 1985, none 6 days later (Alcorn 1985). Rainfall may result in influxes as dry wetlands are filled, or departure, perhaps because salinity of wetlands reduced or because birds dispersed across wider area of suitable habitat; flock of 1000 left Mildura, Vic., after heavy rainfall (Lane 1987); on Rottnest I., flock of c. 3000 reduced to <200 in 1 day after heavy rain over sw. Aust.; birds also left island late Feb. after rain (Storr 1965; Saunders & de Rebeira 1985). Counts at Freshwater L., Avalon Saltworks and Laverton Saltworks, Vic., suggest that overflow from favoured sites to nearby wetlands can occur for short periods when population high (Hewish 1989a).

Heavy rainfall or flooding that fills saltlakes of inland overrides other patterns of movements. Movement in response to arid zone rainfall rapid. In WA, departure from coast stimulated by flooding in Goldfields region, where large numbers of birds gathered to breed (Storr 1965; Serventy & Whittell 1981). In SA and Vic., flooding in L. Eyre basin stimulates departure from coastal areas (Hewish 1989a); flooding in Cooper and Darling basins, where saline wetlands less common, does not (Lane & Jessop 1984). Confirmed breeding at L. Torrens, SA, Apr.–May 1989 (Minton 1989; Robinson & Minton 1989; G. Carpenter; K. Bellchambers) coincided with absence from Vic. coast in regular counts, June 1989 (Hewish 1990b), indicating mass movement inland. In 1984, departure from Vic. and SA coast in Feb. preceded high counts at L. Eyre, SA (30,000) in July (Lane 1987; Hewish 1989a); L. Eyre filled by 25 Jan. (Close & McCrie 1986); by mid-Feb., birds had left Port Phillip Bay, Vic., and Clinton Conservation Park, SA; departure from Price Saltfields, SA, less rapid though closer to area of inland flooding than Vic. sites, with low counts in mid-Feb. and complete departure by July (Hewish 1989a). At L. Grace, WA, no birds present 19 Dec. 1930; breeding colony established 10 days later (Howe & Ross 1931). Rainfall occurred at L. Torrens, SA, in Mar. 1989 and colony established by Apr. (Minton 1989; Robinson & Minton 1989; G. Carpenter; K. Bellchambers).

Return to coastal and near-coastal sites slower than departure; gradual retreat as inland dried. L. Eyre suitable for Stilts until at least Sept. 1984, when 24,000 counted (Lane 1984); dry by Dec. 1984 (Close & McCrie 1986). At Port Phillip Bay, 640 birds present July 1984; thereafter counts increased to peak in summer 1986 (Hewish 1989a). Stilts returned to Clinton Conservation Park, SA, by May 1985 (Close & McCrie 1986); to The Coorong, SA, by winter 1985; and to Wimmera Ls, Vic., by winter 1985 (Lane & Starks 1985). Normal seasonal patterns of abundance re-established in some coastal districts by 1986.

May abandon breeding site when water-levels fall or after flooding (Carnaby 1946; Kolichis 1976; Young 1981; Harris 1987). At L. Torrens, chicks and adults dispersed within few days of hatching, moving 50–100 km across lake. Young may leave colony when food and water scarce; flightless chicks observed walking through bush, with high mortality reported (Glauert & Jenkins 1931; Jenkins 1975; Young 1981; Burbidge & Fuller 1982; Garstone & Jefferies 1983; Harris 1987; Pearson 1989). At colony in L. Barlee in 1980, only 12 live chicks found 3–4 weeks after abandonment; others had either left site or died (Young 1981).

Move at night; birds heard flying overhead (Glauert & Jenkins 1931; Kolichis 1976); observed leaving Rottnest I. in thundery weather (Storr 1965). Seldom recorded in Tas. but influx recorded 1980–81 (Henderson 1982; Tas. Bird Rep. 11; Aust. Atlas); influx into Vic. in July 1983 (Lane & Jessop 1983).

Banding At L. Torrens in 1989, 120 adults, ten immatures and seven chicks banded (Robinson & Minton 1989); no recoveries.

FOOD Mainly crustaceans, including branchipods and ostracods; also molluscs, insects, vegetation, seeds and roots. **Behaviour** Diurnal; dependent on availability of prey in ephemeral saltlakes. Forage by pecking, probing and scything on saltlakes, either by wading in shallow water or swimming (feet, partly webbed), often some distance from shore. At L. Eyre in 1984, observed pecking from surface of water, seldom probing with bill far into water or mud; average of 73 pecks/min (five observations) (Lane 1984). Will up-end, putting head underwater (Jones 1945a). Also glean insects from surface of water while swimming (Beruldsen 1972) and observed turning on water to create vortex, which brings up food (G.F. van Tets). Peak rate, 30.7 pecks/min (10.8; 60) and successful pecks 27.2 pecks/min (11.9; 60) (Jessop 1987). Seldom observed drinking fresh water (Storr 1965), although recorded drinking by bending down so that neck and bill parallel to water, or lying down flat in water (Sutton 1931).

Adults No detailed studies. Plants (Hall 1974): *Ruppia maritima* sds and turions (Paton 1982); *R. tuberosa* sds and turions (Paton 1986). Animals: Molluscs (Mathews; Barker & Vestjens):

gastropods (Boehm 1960): *Salinator fragilis* (Barker & Vestjens); *Coxiella filosa* (Jones 1945a); *C. striata* (Paton 1982); bivalves: *Sphaericum* (Lea & Gray). Crustaceans (Heathcote 1945; Jones 1945a); branchipods: brine shimps (Storr 1965; Kolichis 1976); Notostraca: *Apus* (McGilp & Morgan 1931; Jones 1945a); *Triops*, *Lepidurus* (Jones 1945a); Anostraca: *Artemia salina* (Jones 1945a; Serventy & Whittell 1981; May 1972; Wheeler 1955); *Parartemia* (Jones 1945a; Serventy & Whittell 1981; Jenkins 1975; MV); ostracods (Jones 1945a; Burbidge & Fuller 1982; Bougher 1988; MV); isopods: *Haloniscus*, *Deto* (Jones 1945a). Insects (Beruldsen 1972; Mathews): Hemiptera (Barker & Vestjens): Corixidae (Jones 1945a; Lea & Gray); Coleoptera: Carabidae (Barker & Vestjens): *Clivina* (Paton 1982, 1986); Anthicidae (Paton 1986); Staphylinidae (Paton 1986); *Sitona* (Paton 1986); *Apion* (Paton 1986); *Eretes* (Jones 1945a); Hymenoptera: Formicidae: flying ants (Paton 1986); Diptera: Culicidae (Barker & Vestjens); Chironomidae: larv. (Paton 1986); *Ephydrella* larv. (Jones 1945a). Spiders (Paton 1986). Fish (Kolichis 1976): Atheriniformes: Atherinidae: hardyhead (Paton 1976); *Craterocephalus* (Paton 1982). Fine grit (Hall 1974; Lea & Gray); sand (Jones 1945a).

Young At L. Torrens, chicks were not seen to be fed by adults, either at nest or in water; chicks fed themselves once they reached water, mainly *Parartemia* (Bellchambers & Carpenter 1992). **Intake** No data.

SOCIAL ORGANIZATION Little known; mainly based on anecdotal observations at breeding colonies, especially L. Torrens, SA (Robinson & Minton 1989; Phillipps 1990; Bellchambers & Carpenter 1992). Gregarious at all times. When not breeding, numbers at sites can fluctuate dramatically and unpredictably: found in small parties of tens of birds, groups of hundreds (e.g. Jones 1945a; Wheeler 1955; May 1972; Robinson & Minton 1989), or larger flocks of up to several thousand (e.g. Sutton 1931; Jones 1945a; Condon & Rix 1936; Kolichis 1976; Sonter 1987; Robinson & Minton 1989); some concentrations very large, e.g. Mitre L. (*c.* 2 km diameter), Vic., 50,000 (Alcorn 1985); L. Callabonna, SA, vast feeding flocks of inestimable numbers covering up to 100 acres (May 1972); combination of two flocks at least 50,000 (Sutton 1933). Twos or single birds unusual (e.g. Wheeler 1955; Sonter 1987); injured birds usually accompanied by another bird (Wheeler 1955). Breed in large colonies. After breeding, unfledged young gather in crèches and move away as groups from breeding sites (see below); flying immatures gather in large flocks (Bellchambers & Carpenter 1992); adults disperse. When feeding, appear to work in parties, rarely singly; to form feeding party, individuals walk or fly from different parts of flock (Jones 1945a). If only a few Banded Stilts present, feed in loose flock and may mix with Avocets; larger numbers (*c.* 100+) often form tight feeding flocks several rows deep, which do not contain other species (Jessop 1987). Outside breeding season remain separate from Black-winged Stilts if present, though some authors mention the two keeping company (Jones 1945a; Jessop 1987; North); often in company of Red-necked Avocets (e.g. Wheeler 1955; Sonter 1987; Gould), resting, feeding and, when alarmed, rising and moving together, sometimes even performing co-ordinated flights (Jones 1945a).

Bonds Probably some pair-bonding, as change-over seen at nest (McGilp & Morgan 1931; Bellchambers & Carpenter 1992). Some evidence that mating occurs on way to breeding sites, as birds seen courting away from breeding sites (Robinson & Minton 1989). **Parental care** Nest duties shared, assumed between mated birds (Robinson & Minton 1989; Bellchambers & Carpenter 1992); role of sexes not known as sexes indistinguishable in field and banding studies not yet made (K. Bellchambers cf. Phillipps 1990). Adults abandon chicks if lakes dry out (Burbidge & Fuller 1982). Otherwise broods, sometimes only a few hours old, led off by parents, joining up with other families as they go (Robinson & Minton 1989; Bellchambers & Carpenter 1992), presumably seeking suitable feeding grounds. Chicks form crèches (Burbidge & Fuller 1982; Phillipps 1990) at edge of colonies (Burbidge & Fuller 1982); smallest chicks closest to nesting area and largest chicks farthest away (*c.* 2 km) (Kolichis 1976); form feeding crèches as soon as they reach water (Bellchambers & Carpenter 1992). Role of sexes in attending crèches not known (K. Bellchambers cf. Phillipps 1990); different reports of composition of crèches: from three young with two adults to *c.* 40 young with 6–9 adults (Kolichis 1976); from one adult with two chicks to 30 adults with 200 chicks (Bougher 1988); three adults led *c.* 60 young into water (McGilp & Morgan 1931); up to several hundred chicks accompanied by a few adults (Bellchambers & Carpenter 1992); sometimes groups without adults (e.g. Garstone & Jeffries 1983). Young in crèches walk or swim away from colonies; left behind if unable to keep up with group (Bougher 1988). One crèche travelled 130 km in 6 days on L. Torrens, most leaving mid-morning to midday; movement in lake from S to N was wind assisted (K. Bellchambers); at destination *c.* 150,000 chicks gathered, and many adults had left; small crèches had amalgamated, creating crèches of thousands of chicks (Phillipps 1990; Bellchambers & Carpenter 1992). Near Menzies, Goldfield district, WA, chicks recorded walking through bush, in several years; thousands of flightless chicks found, some having crossed at least 40 km of bush (Glauert & Jenkins 1931; Harris 1987); small groups of 30–40, without adults, recorded every kilometre or so (Garstone & Jeffries 1983); found 5–10 km from breeding site (Burbidge & Fuller 1982).

Breeding dispersion In large tightly packed colonies, sizes of which vary considerably, see Population. **Density of nests** L. Grace, WA, 1930, probably *c.* 40,000 nests (Burbidge & Fuller 1982), *c.* 30 cm apart (Carnaby 1933), 1 nest/930 cm^2 (Glauert & Jenkins 1931); L. Callabonna, SA, 1930, 26,100 nests in *c.* 3640 m^2, nests almost exactly 30 cm apart (McGilp & Morgan 1931); L. Marmion, WA, Mar. 1975, 25,000 breeding pairs, nests averaging 30.5 cm apart (Burbidge & Fuller 1982), in May, 2500 nesting pairs, nests 30–40 cm apart (Kolichis 1976); L. Barlee, WA, 1980, abandoned colony of *c.* 179,000 nests, average 7.4–11.1 nests/m^2 but as high as 18/m^2, probably very high density resulted from successive waves of birds laying within colony (Burbidge & Fuller 1982); L. Torrens, SA, 1989, at one site *c.* 5000 nests, typically *c.* 10–15 cm apart with up to 15 nests/m^2 (Robinson & Minton 1989); *c.* 32 cm apart, measured centre to centre (Carpenter & Bellchambers in prep.). One colony contained nests at all stages from fresh eggs to fully fledged, but non-flying, young; most nests in centre of colony more advanced (or empty) than nests at edge; fresh eggs found in nests round perimeter, or in new nests in centre, of colony; new nests constructed in centre of colony

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Plate 61

New Zealand Dotterel *Charadrius obscurus* (page 818)
1 Adult breeding, s. population; **2** Adult breeding, n. population; **3** Adult non-breeding; **4** Downy young; **5** Juvenile; **6, 7** Adult non-breeding

Shore Plover *Thinornis novaeseelandiae* (page 912)
8 Adult male; **9** Adult female; **10** Downy young; **11** Juvenile; **12, 13** Adult male

where older nests have been abandoned by running young (Burbidge & Fuller 1982). Within colonies, nests regularly spaced (Burbidge & Fuller 1982); arranged in slightly sinuous rows along long axis of colony, but not as regular along short axis (McGilp & Morgan 1931). Some colonies contain patches of unused ground (Kolichis 1976).

Roosting Unknown. Some resting during day in compact flocks; at Rottnest I., WA, as feeding periods rather short, spend much time resting on spits and banks of shell-grit (Storr 1965), and on sandbars in saltlakes (Saunders & de Rebeira 1985). At Laverton, Vic., on ponds, on large lagoon, in salt-paddock, or on muddy bank of dam (Jones 1945a; Wheeler 1955). At night, heard calling and flying (Glauert & Jenkins 1931; Kolichis 1976). Said to rest with bill under wings (Jones 1945a).

SOCIAL BEHAVIOUR Little known; based mainly on observations at breeding colonies, specially at L. Callabonna, SA (McGilp & Morgan 1931) and at L. Torrens, SA (Robinson & Minton 1989; Phillipps 1990; Carpenter & Bellchambers in prep.). Quiet; observations on colonies can be made from *c.* 30 m (McGilp & Morgan 1931); disturbance by observers may result in increased predation by Silver Gulls *Larus novaehollandiae* (Robinson & Minton 1989; Carpenter & Bellchambers in prep.). **Flock-behaviour** When not breeding, resting flocks compact; when bathing or swimming, birds often 30–60 cm apart; if startled, very co-ordinated in flight; large flocks may split and then rejoin (Sutton 1931; Wheeler 1955; Saunders & de Rebeira 1985). When incubating, all sitting birds face into wind (McGilp & Morgan 1931); also see below.

Aggressive behaviour Usually little interaction between nesting birds (Robinson & Minton 1989), though fights occur between sitting birds where they attempt to peck each other, fencing with bills, while feathers of head, neck, and back ruffled. After disturbance of colony birds sometimes appear to resettle on one another's nests, causing owner to turn sitting bird off nest 'angrily' and to take its place (McGilp & Morgan 1931). **Alarm** Mobbing behaviour recorded; see Parental anti-predator behaviour. Noted flying towards and calling at approaching observers (Wheeler 1955); flocks of immature birds buzzed human intruder (Bellchambers & Carpenter 1992). Two birds observed swimming close together in deep open water, apparently not feeding, possibly in response to presence of seven Swamp Harriers *Circus approximans*; when approached by observer, flew in circle and landed at same place, then swam in tight circle; circled and landed again, appearing nervous, before flying away (Sonter 1987).

Sexual behaviour McGilp & Morgan (1931) noted that occasionally a bird would run up from water, feed sitting mate, and sometimes take its place; resulted in constant procession of birds running between nests and water. Mating occurs in breeding colony, on water and land (Robinson & Minton 1989). Following behaviour observed among roosting Stilts at early stages of breeding attempt, possibly mate guarding (Carpenter & Bellchambers in prep.): two or three birds (assumed to be males) pursue a single bird (possibly female) through the colony with one of the pursuers, possibly the mate of the female, attempting to maintain a protective position between the pursuers and the pursued. **Copulation** Observed several times, in same colony. Male stood on back of standing female with bill open, keeping his balance by flapping wings; during copulation, female stretched neck forward with bill pointed slightly upward; copulation lasted *c.* 30 s. Male dismounted to side, bending neck over that of female for a few seconds. With body and neck erect, bills pointed down, pair ran forward, side by side, for *c.* 1 m; in unison, birds lowered bodies and neck until parallel to and just above ground, bills pointed slightly upward, then ran another 2 m; birds parted and continued with normal activities (Carpenter & Bellchambers in prep.).

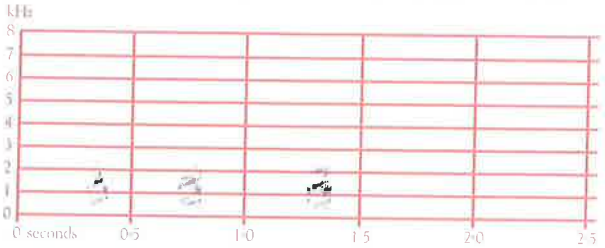
Relations within family groups Incubating birds regularly stand and stretch wings and legs and walk briefly from nest, which allows predation of eggs by Silver Gulls (Bellchambers & Carpenter 1992). After disturbance, some birds apparently settle on nest, then leave a few minutes later for another nest (McGilp & Morgan 1931). During hatching period, chicks huddle together in nest; within 2 days of hatching chicks led to water as single birds or as small groups of amalgamated broods with several adults; sometimes adults appear to entice young to enter water (Glauert & Jenkins 1931; McGilp & Morgan 1931; Robinson & Minton 1989; Bellchambers & Carpenter 1992). Chicks not fed by adults; once chicks in water, immediately start to feed on abundant invertebrates (Robinson & Minton 1989; Bellchambers & Carpenter 1992) (see also Food); swimming young peck at small crustaceans floating on surface of water (Kolichis 1976). Unusual observations by G.A. Lodge (Burbidge & Fuller 1982) that young stayed in nest for 1 week before leaving; also thought chicks in crèches fed by adults, though this seems incorrect. Adults maintain contact with their young using soft calls; often attack strange chicks within reach (Bellchambers & Carpenter 1992). **Anti-predator behaviour of young** When disturbed at colony, rush between nests and settle in at nests, so that up to 15–20 chicks in some nests and one or none in others; one observer in colony had *c.* 200 chicks nestling against his legs (McGilp & Morgan 1931). After leaving nest, chicks reasonably safe from predation though seen being snatched from water, by Silver Gulls, as they swam (Bellchambers & Carpenter 1992). Large flightless young also huddle (Kolichis 1976). **Parental anti-predator behaviour** Less vocal when breeding and not seen to feign injury (McGilp & Morgan 1931; Sutton 1931). Defence limited to covering eggs or chicks or rather half-hearted pecking at attackers (Bellchambers & Carpenter 1992). Groups of Stilts seen jointly threatening Gulls, which prey on young and eggs (Robinson & Minton 1989; Bellchambers & Carpenter 1992). When colony approached by aircraft, birds seen to leave eggs, huddle together in shallow water off edge of colony, and then quickly return to nests once aircraft have passed (Kolichis 1976). When observers approached, colony rose with whirr of wings, flew a few metres, and settled among mates in water; returned quickly as group to eggs, settling at far end of colony from observer, then walking leisurely in straight line through colony; examined nests either side until found their own; before sitting, each bird stood a little distance from nest, bent neck forward momentarily and touched or nearly touched ground or edge of nest; gave soft call when returning. During hatching, adults behave similarly but only move to edge of water; when returning to nest, if too many young to cover, adult flicks surplus out with bill and they scuttle for other nests (McGilp & Morgan 1931; Kolichis 1976).

Plate 62

Ringed Plover *Charadrius hiaticula* (subspecies *tundrae*) (page 828)
1 Adult male breeding; 2 Adult female breeding
3 Adult non-breeding; 4 Juvenile; 5, 6 Adult non-breeding

Little Ringed Plover *Charadrius dubius* (subspecies *curonicus*) (page 832)
7 Adult male breeding; 8 Adult female breeding;
9 Adult non-breeding; 10 Juvenile; 11, 12 Adult non-breeding

VOICE Little known; anecdotal information only. Calls are occasional barks or softer wheezier notes, slow and deliberate (Condon & McGill 1952); also plaintive whistle (Gould). Calls have spluttering character, and said to be inaudible at any distance (Whitlock 1939); however, bickering and screaming from large colony audible for over 3 km in early morning (Carnaby 1946). Very faint musical barking heard from large flock in flight (Sutton 1933); though no calls heard from large numbers, often disturbed into flight (Jones 1945a). Barking call similar to Yelp of Black-winged Stilt but not so strong or incisive (Sutton 1931; Jones 1945a); of softer pitch and not so harsh (McGilp & Morgan 1931); also, less vocal when breeding (Sutton 1931). When flying in mixed flock with Red-necked Avocets, calls difficult to differentiate, having same reedy tremulous quality (Jones 1945a).



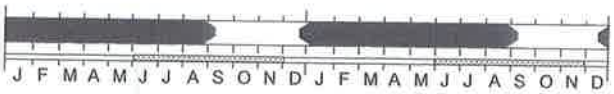
A R. Swaby; Price, SA, Nov. 1979; P36

Adult BARK: *cow* (Condon & McGilp 1952) or *chowk* (Slater 1970) (sonagram A). May be disyllabic: *chowk-uk* (Slater 1970), *chuk-uk* (Lane 1987). Softer, more wheezy *cow-cow-cow*, slow and deliberate (Condon & McGill 1952). PLAINTIVE WHISTLE: uttered while sitting on water (Gould). **Other calls** Soft musical chattering when returning to nests after colony disturbed, which continued while incubating (McGilp & Morgan 1931); chatter may be composite of many individual calls. Bickering and screaming audible from large but distant colony (Carnaby 1946).

Young No information.

BREEDING Not well known. Studied in SA, at L. Callabonna in 1930 (McGilp & Morgan 1931) and L. Torrens in 1989 (Robinson & Minton 1989; Bellchambers & Carpenter 1992), and less detailed studies in WA, at L. Barlee (Burbidge & Fuller 1982) and L. Grace (Carnaby 1947). Breed in simple pairs, in large colonies.

Season Entirely dependent on suitable conditions: whenever heavy rain has resulted in inundations of saltlakes, resulting in abundant food (Jones 1945a). **SA** L. Callabonna: laying from 29 Dec., continued through early Jan. (McGilp & Morgan 1931); L. Torrens: after widespread rains in SA from 4–15 Mar., breeding colony was established within 4 weeks, first eggs *c.* 13 Apr., laying continuing as birds arrived, with a wave of hatching from N to S across island, from 4–15 May, with a second wave of laying on other islands starting 18 May, and a third between mid-May and mid-June (Robinson & Minton 1989). **WA** Eggs in mid-Aug. and early Sept. (Carnaby 1946, 1947); L. Marmion: young, and many abandoned clutches in late May, after heavy rain in Feb. (Kolichis 1976). Colonies containing all stages of breeding, from eggs to fledged young, suggest either same birds lay successive clutches or successive waves of birds laying within colony; may lay continuously while conditions suitable (Burbidge & Fuller 1982).



Site On small islands in lake, occasionally on sand-spits; on bare patches of sandy clay, sometimes stony soil, with scattered samphire shrubs (Jones 1945a; Kolichis 1976). Distance between nests 10–15 cm (Robinson & Minton 1989), 30–40 cm (McGilp & Morgan 1931; Kolichis 1976). Silver Gulls may establish colonies on same or nearby islands; small colony of Red-necked Avocets on mud-spit on island (McGilp & Morgan 1931; Robinson & Minton 1989).

Nest, Materials Scrape in ground, saucer-shaped or like inverted cone; occasionally lined with dry grass and stems of samphire (Glauert & Jenkins 1931; McGilp & Morgan 1931; Kolichis 1976; Robinson & Minton 1989; Carpenter & Bellchambers in prep.). On an island with stony soil, did not make obvious scrapes but dragged any vegetation within reach of nest round their bodies (Robinson & Minton 1989; Carpenter & Bellchambers in prep.). MEASUREMENTS: diameter, 15 cm; depth, 3 cm (McGilp & Morgan 1931; Kolichis 1976).

Eggs Vary; blunt to short or sharply pointed oval; chalky, finely granular, lustreless; ground-colour varies from deep fawn through all shades to pure white, occasionally very deep brown; markings vary from irregular lines, spots or blotches of black, or chestnut, to large black blotches edged brown, with more or less submerged markings of grey or faint purple, evenly distributed or sometimes forming zone or ring at larger end, some eggs almost unmarked (Howe & Ross 1931; McGilp & Morgan 1931; K. Bellchambers; G. Carpenter). Eggs of each clutch have distinctive markings but, within clutches, intensity of markings varies; some clutches include an unmarked egg (Carpenter & Bellchambers in prep.). MEASUREMENTS: L. Callabonna, SA: 55 (49–58; 50) x 40 (36–48) (McGilp & Morgan 1931); L. Torrens, SA: 54.0 (2.3; 46.6–58.5; 79) x 38.6 (1.8; 30.5–47.4) (Bellchambers & Carpenter in prep.); L. Grace, WA: 55.7 (1.38; 53.2–57.7; 8) x 39.0 (0.82; 38.0–40.7 (Howe & Ross 1931); L. Barlee, WA: 55.5 (51.5–68; 20) x 38.3 (35.0–41.4) (Burbidge & Fuller 1982). At L. Torrens, no significant difference found between size of eggs on n. and s. islands (Carpenter & Bellchambers in prep. *contra* Bellchambers & Carpenter 1992).

Clutch-size One to five, usually 3–4 (McGilp & Morgan 1931; Kolichis 1976; Carpenter & Bellchambers in prep.). Evidence for dump-nesting: clutches of 2–3 eggs had fairly uniform markings; clutches of four eggs usually had at least one egg of another pattern, and clutches of five sometimes had three types of differently patterned eggs (McGilp & Morgan 1931). At L. Torrens, Carpenter and Bellchambers (in prep.) found egg markings within clutches similar, although sometimes varying in intensity, suggesting all eggs laid by same bird; the discovery twice of a Banded Stilt egg in Silver Gull *Larus novaehollandiae* nests, however, further suggests dump-nesting. At L. Torrens, no significant difference between clutch-sizes on n. and s. islands (Carpenter & Bellchambers in prep. *contra* Bellchambers & Carpenter 1992).

Laying Synchronic (McGilp & Morgan 1931; Bellchambers & Carpenter 1992), or as wave through colony as new birds arrive and colony expands (Robinson & Minton 1989); claimed that eggs laid at intervals of 24 h (Phillipps 1990). Recorded preparing to re-nest 2 weeks after first clutches had hatched (Phillipps 1990).

Incubation By both sexes (McGilp & Morgan 1931; Robinson & Minton 1989). With marauding Silver Gulls about, incubation continuous; birds sit tight rather than leave to chase Gulls, even when Gull grabs sitting bird by tail (Robinson & Minton 1989; Carpenter & Bellchambers in prep.). Sitting bird fed on nest by mate (McGilp & Morgan 1931). On a day when temperature was 40 °C, sitting birds occasionally went to water, soaked feathers of breast and neck 2–3 times and returned to eggs;

may cool eggs (McGilp & Morgan 1931). Instances of a bird settling on a nest, only to leave it for another after a few minutes (McGilp & Morgan 1931). INCUBATION PERIOD: 19–21 days (Robinson & Minton 1989); *c.* 21 days (Bellchambers & Carpenter 1992); *c.* 28 days (McGilp & Morgan 1931).

Young Precocial, nidifugous. Down, white, unique among Charadriiformes; bill and eye, black; legs, grey (Bougher 1988). At hatching: length, 85 mm; bill, 12.5 mm; tarsus, 25 mm; weight, *c.* 30 g (Glauert & Jenkins 1931; Robinson & Minton 1989). Chicks fully feathered at 6 weeks but lack chestnut breast-band (Bellchambers & Carpenter 1992). Young fly at 50 days (Balogh 1989). Growth of bill and tarsus from 6 to 49 days summarized in Table 2 (Balogh 1989). **Parental care, Role of sexes** Chicks remain in nest until all eggs hatch, then leave to form crèches, usually within 1 day of hatching; maximum time from first- to last-hatched egg is *c.* 2 days (Bellchambers & Carpenter 1992; C.D.T. Minton); however, Burbidge & Fuller (1982) claimed that young stay in nest for a week. Adults never feed chicks (Bellchambers & Carpenter 1992 *contra* Burbidge & Fuller 1982). Chicks feed themselves upon reaching edge of water.

Table 2.

AGE (DAYS)	LENGTH OF BILL	LENGTH OF TARSUS
6	2.5 (2.4–2.6; 3)	–
10	3.0 (2.7–3.3; 4)	4.2 (4–4.4; 4)
15	3.8 (3.3–4.1; 4)	4.8 (4.4–5.1; 4)
20	4.6 (4.5–4.8; 3)	5.8 (5.7–5.8; 3)
25	5.0 (4.9–5.1; 3)	6.6 (6.3–6.7; 3)
30	5.3 (5.2–5.6; 3)	6.9 (6.7–7; 3)
34	5.5 (5.3–5.7; 3)	7.2 (7–7.3; 3)
40	5.7 (5.6–5.8; 3)	7.4 (7.2–7.6; 3)
45	5.9 (5.7–6; 3)	7.5 (7.3–7.6; 3)
49	6.1 (6–6.1; 3)	7.6 (7.3–7.8; 3)

Adults brood young in nest (McGilp & Morgan 1931). As each brood dried, they were led across island by parents, joining up with other families as they went, walking up to 450 m to water's edge; form floating crèches of up to several hundred birds as chicks swim to feeding grounds, one crèche on L. Torrens travelling 130 km in 6 days (though passage was assisted by wind from S to N across Lake) (McGilp & Morgan 1931; Robinson & Minton 1989; Phillipps 1990; K. Bellchambers). When observers approached nests, young scurried about from one nest to another, at times resulting in 15–20 in a nest, none in others; chicks also ran up to observers and clustered round their feet (McGilp & Morgan 1931). Adults abandon young to fend for themselves if lake dries out (Burbidge & Fuller 1982). At L. Torrens, when nests were approached to catch chicks for banding, adults abandoned nest, circling overhead several times before leaving area; chicks then left to fend for themselves; banders then curtailed attempts to band chicks (K. Bellchambers & G. Carpenter). Groups of flightless chicks have been found walking through bush (Burbidge & Fuller 1982; Harris 1987).

Success Colonies may be deserted at any stage if lake dries or floods; eggs have been found clumped against shrubs or in depressions, blown by wind (Burbidge & Fuller 1982), almost all broken and eaten (Carnaby 1947), young of varying ages dead on shore of lake (Burbidge & Fuller 1982); sometimes dying in huge numbers, on one occasion estimated that hundreds of thousands died walking across country near Menzies, WA (Jones 1945a). At L. Barlee, WA: from 170,000 nests, mortality of eggs and young reached 216,000 as water-level fell (Harris 1987). Chicks may smother each other (McGilp & Morgan 1931). A mouse was seen leaving a half-dead chick whose scalp had been partly eaten, and numerous dead chicks were found with their heads partly eaten (Kolichis 1976); Brown Falcon *Falco berigora* took chicks; Silver Gulls take unguarded eggs, newly hatched and downy young, even plucking them out of water; at end of cycle, took 99.5% chicks hatched in one colony; Silver Gulls will pull brooding adults off nests and raid contents (Robinson & Minton 1989; Bellchambers & Carpenter 1992; A.J. Baker). Foxes take chicks (Jenkins 1975; Pearson 1989). Increases in populations of Gulls associated with human settlement may be cause for concern for Stilts.

PLUMAGES Prepared by D.I.Rogers. Hatch in natal down, replaced by juvenile plumage. Juvenile plumage, distinctive when fresh, difficult to distinguish from some individuals in basic plumages when worn; replaced in partial moult to first-basic plumage during first year. An alternate plumage probably attained in first year. Complete second pre-basic moult when 1-year old brings on adult plumage; basic plumages vary considerably, from closely similar to breeding plumage to closely similar to worn juvenile. Pre-alternate body-moult brings on breeding plumage; timing of this varies considerably.

Adult breeding Alternate plumages from second year onwards. Sexes similar. **Head and neck** White. Feathers have concealed pale-grey (c86) bases. **Upperparts** White, except for blackish (89) scapulars and subscapulars; these fade to black-brown (c119). **Underparts** Mostly white. Broad chestnut (c32–223A) band runs across central and upper breast; usually very narrowly bordered black-brown (119) and always adjoins large black-brown (119) patch in centre of belly. **Uppertail** White; with light brown-grey (c91–c79) wash on vanes of central feathers; tinge sometimes strong, also occurring in smaller patches on outer rectrices. **Undertail** White. **Upperwing** Mostly black (89), becoming black-brown (119) when worn; greater secondary coverts sometimes narrowly tipped white. Secondaries (but not tertials) and tips of inner primaries, white, forming broad white trailing-edge, which peters out round p3–p5. Outer webs of white-tipped inner primaries often dark brown, slightly paler than other dark areas of upperwing. **Underwing** Mostly white; outer primaries and primary coverts, dark grey (c83–c84). These, and blackish (89–119) lesser and marginal coverts outside carpal, form dark marking at wing-tip tapering towards carpal joint. Lesser primary coverts sometimes have narrow white tips or rosethorns. Blackish (89–119) tertials sometimes exposed.

Adult non-breeding Varies greatly; some individuals (here referred to as 'dull'), rather similar to worn juveniles. Others (referred to as 'bright') only readily distinguished from adult breeding in the hand; full range of intermediates occurs. Dull non-breeding adults have been treated as immatures in much literature, even though many skins available (including all adults in active primary-moult) in which pectoral band being replaced by white or dusky-tipped feathers. Gould was first to point this out; field observations (Jones 1945a; Wall 1981) consistent with seasonal change in plumages. **Head and neck** Usually pure white; dullest individuals can have grey (c80) tips to feathers of lores and forecrown. These usually form faint speckling but lores may look uniformly grey (c80) in dullest individuals. **Upperparts** Similar to breeding plumage but subscapulars can have narrow white fringes; innermost subscapular strongly tinged greyish (c79). **Underparts** Mostly white, with varying pectoral band and belly-patch. In dullest individuals, most of breast and belly white but some feathers have ashy-brown (c121) to ashy-grey (c79) tips, up to 7 mm wide; these form diffuse gorget of heavy mottling, and mottling (often less conspicuous) on belly. In dullest skins exam-

ined, dark mottling occupied only c. 20% of breast and 5% of belly; Wall (1981) observed an individual that attained totally white breast but retained dark smudge on belly. Brighter individuals have broader ashy-brown tips to feathers (broadest at sides of breast), which form narrow but fairly evenly coloured breast-band. Still brighter individuals have varying chestnut subterminal bands to many feathers, especially on centre of breast; as with duller individuals, all dark feathers of underparts have sharply defined white bases, which are often exposed because dark feather-tips seldom broader than 1 cm; net effect can be patchwork of white, chestnut and ashy brown on breast, even when no active moult in progress. Brightest individuals can look closely similar to adult breeding; best distinguished by traces of white mottling in breast-band and, especially, belly, and apparently duller colour of breast-band. Latter effect caused by ashy-brown tips partially concealing chestnut areas of feathers; more marked on edges of breast markings, so pectoral band can look dull chestnut margined with dark brown. Breast-band averages narrower than in breeding plumage. **Tail, Wings** As adult breeding.

Downy young Unique among waders in being pure white. Down, short and silky; faint grey tinge occasionally seen on lores, caused by partial exposure of underlying skin. When down fully grown it has light-grey (c85) to grey (84) bases, which can be slightly exposed by wear in largest chicks. Olson & Fedducia (1980) said that downy young have two generations of down; this needs further study.

Juvenile Head and neck White; when fresh, lores and forehead tinged by brownish-grey (c80) tips to feathers, which can occur less conspicuously on forecrown. Lores retain grey tinge for longer than other areas. **Upperparts** Mantle, back, rump and upper tail-coverts, white. Scapulars, dark brown to blackish brown (c119), averaging browner than adults; when fresh they are scalloped by white tips 1–2 mm wide. Inner subscapular has small white rosethorn and rather broad white fringes at tip; these white markings seldom lost with wear and even when this does happen shape remains distinctive, feathers narrowing abruptly at tip. **Underparts** White. **Tail** When fresh, t1 light brownish-grey (c80) with white fringes; extent of grey diminishes on other feathers and, on t6, restricted to greyish-brown streak parallel to outer edge. Tail fades to off-white with wear. **Upperwing** Most coverts, blackish brown (c119), generally browner than in adults; when fresh they have white tips 1–2 mm long. White tips lost with wear; usually retained longest on greater secondary coverts. Greater primary coverts, as adult. Tertials, narrowly fringed white when fresh. Remiges generally slightly shorter and narrower than in adults; white trailing-edge longer, extending to p6, p7 or p8 when primaries fresh. Outer white-tipped primaries have white semicircular corner to inner web; in adults, distal corner of inner web of outer white-tipped primary has white marking with rather straight edge running roughly parallel to inner edge. **Underwing** Similar to adult.

Immature First basic. Closely similar to dull individuals in adult non-breeding. Grey wash on forehead and lores perhaps generally larger than in non-breeding adults but can be entirely absent in worn plumage. Breast-band and belly-patch average smaller and duller than in non-breeding adults and in some, underparts, wholly white. Breast has no chestnut marking but dark ashy-grey (c79) to dark ashy-brown (c121) tips to white feathers can form subdued pectoral band. Outside carpal joint, coverts on leading-edge of upperwing, narrowly tipped white; not known if this can be the case in non-breeding adults. Above differences do not allow totally reliable separation from non-breeding adults; this is only possible if remnant juvenile plumage can be found. Juvenile primaries always retained and longer white trailing-edge of juvenile wing, extending to p6, p7 or p8, is diagnostic if present. However, white tips of outer primaries can be lost when worn. A few white-tipped juvenile upper wing-coverts and subscapulars sometimes retained; latter especially useful in ageing because they remain distinctive when worn. Not known if alternate plumage develops in first year (see Moults); if so, it is probably indistinguishable from subsequent alternate plumages.

BARE PARTS From photos (Pringle 1987; Robinson & Minton 1989; unpubl.: J.N. Davies).

Adult breeding Bill, black (82–89). Iris, black-brown (119). Tarsus, tibia and toes, dark pink (3) to pink-red (c10). **Adult non-breeding** Ground-colour of tibia, tarsus and toes usually duller pink (7–108D) or orange-pink (5) than in breeding birds. In some individuals, tibio-tarsal joint is grey (c79) to dark grey (c83). **Downy young** Bill, grey-black (82). Iris, black-brown (119). Dark-grey (c84) skin of lores occasionally exposed as narrow dark line joining eye and bill. Tibia, tarsus and toes, dark grey (c83). **Juvenile** Legs, grey (c87) at first; before post-juvenile moult, become dark pink (c3) with large area of dark grey (c83) to grey (c84) at tibio-tarsal joint. **Immature** Similar to adult non-breeding. Not known if some lack grey markings at tibio-tarsal joint.

MOULTS Based on skins of 83 adults and 16 subadults (HLW, MV, SAM, WAM), except where stated. **Adult post-breeding** Complete; second and subsequent pre-basic moults. Primaries moult outwards; sequence sometimes irregular (AWSG), delaying moult of one or two primaries between p1 and p6 until p10 begins to grow; usually 2–3 grow concurrently, occasionally one or four. Sequences of moult of secondaries, tail and body, not known. Moult of body-feathers and primaries begins at about same time; primary-moult completed before that of body. Pre-basic moult generally occurs in winter or spring; all available records of skins in active primary-moult (n=26) come from this period, as do field records of Wall (1981), Bamford (1983) and Heathcote (in Jones 1945a). Birds collected from one flock at one time generally at similar stage of moult but much variation in timing occurs from year to year. For example, a series of 12 adults collected at Seaspray, Vic., on 3 Oct. 1957 had primary moult-scores ranging from 36–49; in Shark Bay, WA, in late Sept. 1981, some adults had already completed primary-moult (Bamford 1983); at Port Headland, WA, 27–29 Aug. 1982, primary-moult scores ranged from 25 to 50 (median score 48; 13 had completed moult and 15 had scores below 40) (AWSG); four adults collected at L. Alexandrina, SA, Oct. 1983, had yet to begin primary-moult. Photos (Robinson & Minton 1989) suggest there is little or no overlap of moult and breeding but it is not known if moult can begin at breeding grounds. All records of active pre-basic moult are from wetlands near coast but this may simply reflect paucity of data from inland sites. **Adult pre-breeding** Alternate. Partial; involves feathers of body and most wing-coverts, but not remiges, upper greater primary coverts or tail. Probably much variation in timing because breeding plumage has been recorded in all months; basic plumage only recorded from Oct. to June, which suggests irregular interval between pre-basic and pre-alternate moults. Few records available of active pre-alternate; one each from Nov., Mar. and May; two records from Feb. Field observations of individual in Tas. (Wall 1981) suggested pre-alternate occurred in Feb. and Mar., while observations in Vic. (Jones 1945a) suggested most had begun moult in Jan. All adults are in pre-alternate plumage during breeding. Possibly paucity of records of active pre-alternate is explained by this moult being rapid, with timing

being flexible to take advantage of unpredictable inland rainfalls that create suitable breeding conditions. **Post-juvenile** First pre-basic, occurring in first year. Partial, not involving remiges; tail probably also retained. Some individuals retain juvenile subscapulars and a few upper wing-coverts. Active moult has been recorded in Sept., Nov.–Jan. and Mar.–Apr. **Immature pre-breeding** First pre-alternate. Partial moult of body-feathers to breeding-type plumage probably occurs during first year; for no records are available of first-basic plumage occurring later than May, and in all birds examined in a complete moult, the older generation of feathers was breeding-type. However, only one record of active first pre-alternate moult available: an SA skin (SAM B39761) on 2 Apr. 1983 moulting to breeding-type plumage, which had replaced inner six primaries. Ageing of this specimen was tentative (based on some white-tipped lesser coverts and on outer primaries being shorter than inners) and confirmation that a pre-alternate moult usually occurs in first year is still lacking.

MEASUREMENTS (1) SE. Aust., adult, skins (HLW, MV, SAM). (2) WA, adult, skins (HLW, WAM). (3) SE. Aust., juvenile and immature, skins (HLW, MV, SAM). Juvenile wing significantly shorter than that of adults.

		MALES	FEMALES	
WING	(1)	201.5 (5.49; 190–215; 25)	196.2 (5.67; 187–206; 23)	**
	(2)	200.0 (3.51; 196–206; 6)	194.0 (8.56; 180–203; 5)	ns
	(3)	193.2 (4.71; 186–199; 4)	185.8 (3.89; 179–191; 6)	*
8TH P	(1)	129.6 (2.98; 125–134; 22)	126.8 (4.52; 116–134; 13)	*
TAIL	(1)	82.7 (3.14; 75–89; 32)	78.3 (4.16; 71–90; 18)	**
BILL	(1)	71.4 (3.39; 65.2–79.9; 26)	66.3 (2.58; 62.5–70.7; 16)	**
	(2)	72.3 (3.27; 69.7–77.8; 4)	64.5, 65.5	
	(3)	66.8	73, 76, 76	
TARSUS	(1)	86.8 (4.13; 77.3–94.7; 32)	80.8 (2.52; 75.1–83.8; 18)	**
	(2)	86.7 (3.17; 82.3–91.5; 6)	79.4 (3.54; 75.0–85.5; 7)	**
	(3)	73.5, 80.7	76.2, 79.1, 80.7	
TOE C	(1)	34.9 (1.50; 32.8–37.9; 11)	33.6, 32.0	

(4) Port Hedland, WA, adults, live, 27–29 Aug. 1982 (AWSG).

	UNSEXED
WING	(4) 198.8 (5.49; 20)
BILL	(4) 68.1 (3.22; 71)
THL	(4) 103.8 (3.68; 46)

WEIGHTS Data from labels (MV, SAM, WAM) unless stated. Considerable variation occurs, causes of which unknown; apparently more than individual variation, because birds collected at one site on one date usually similar in weight. No seasonal trends obvious, e.g. adult males collected Seaspray, Vic., Oct. 1957, 229 (15.8; 210–250; 10), lighter than adult males collected at L. Alexandrina, SA, Oct. 1983, which were 275 (33.6; 232–311; 4). Below, data are presented for: (1) adults in pre-basic primary-moult (skins sexed by gonads); (2) adults with no active-moult, including several birds known to have thick layers of subcutaneous fat. These data suggest moulting birds lighter than those without moult but confirmation needed.

	MALES	FEMALES	
(1)	225.0 (23.1; 172–268; 15)	238.4 (30.0; 205–275; 5)	ns
(2)	262.8 (28.1; 218–311; 9)	261.0 (33.3; 212–301; 5)	ns

(3–4) Port Hedland, WA, adults, live (AWSG): (3) 27–29 Aug. 1982; (4) 20–21 Mar. 1988. (5–6) ICI Saltfields, SA, 15–16 Apr. 1980 (AWSG): (5) adults; (6) juveniles.

	UNSEXED
(3)	244.4 (23.04; 71)
(4)	247.5 (20.56; 215–270; 6)
(5)	216.4 (12.16; 190–235; 14)
(6)	305.7 (35.01; 265–390; 9)

In samples from ICI Saltfields, adults significantly heavier than juveniles. Adults from Port Hedland in Mar. had completed moult and were extremely heavy; shortly after they were weighed (first week Apr.) heavy rains fell and they left (C.D.T. Minton). Some records of birds lighter than those in tables: an unsexed adult in breeding plumage weighed 165 and a juvenile female weighed 162.

STRUCTURE Wing, moderately narrow and pointed. Eleven primaries; p10 longest, p9 2–8 shorter, p8 9–14, p7 21–30, p6 34–44, p5 45–57, p4 52–70, p3 70–82, p2 79–84, p1 91–100; p11 minute; one individual recorded with extra primary (AWSG). Outer web of p9 slightly emarginated. About 16 secondaries, about four of which are tertials. Tail, slightly rounded; 12 feathers. Bill, slender, long (about twice length of head) and straight (may look slightly upcurved at times). Nostrils, narrow, pervious; large suborbital salt-glands about 6 x 15 mm, but no sunken areas in the skull to receive them; they thus contribute to steep area of forehead (S.A. Parker, note on SAM data-sheet). Incubating adults do not develop highly vascular brood-patches but have small bare patches on each side of sternum (Robinson & Minton 1989). Tarsus, long and slender, strongly laterally compressed; scaling, reticulate. Toes, fairly short, webbed; web between outer and middle toes, largest and strongly indented; web between middle and inner toes is smaller and more strongly indented.

GEOGRAPHICAL VARIATION Probably none. Measurements available from WA suggest that birds from e. and w. populations are similar in size.

REFERENCES

Alcorn, M., & R. Alcorn. 1990. *Stilt* 16: 57.
— 1985. *RAOU Newsl.* 66: 4.
Anon. 1855. *Pap. R. Soc. Van Dieman's Land* 3: 176.
— 1937. *S. Aust. Orn.* 14: 104.
— 1992. *Stilt* 20: 33–7.
ANPWS. 1993. *Directory Import. Wetlands Aust.* Unpubl. Rep., ANPWS.
Badman, F.J. 1989. *The Birds of Middle and Lower Cooper Creek in South Australia.* Nature Conserv. Soc. South Aust., Adelaide.
Balogh, E. 1989. *Hand Raising of Banded Stilts.* Unpubl. Rep. to SA NPWS.
Bamford, M.J. 1983. *Stilt* 4: 13–14.
Bellchambers, K., & G. Carpenter. 1992. *Nat. Hist.* 4: 42–8.
Beruldsen, G.R. 1972. *Aust. Bird Watcher* 4: 129–30.
Boehm, E.F. 1960. *Emu* 60: 211–8.
Bougher, A. 1988. *West. Aust. Bird Notes* 48: 1.
Bryant, C.E. 1946. *Emu* 45: 314.
Burbidge, A.A., & P.J. Fuller. 1982. *Emu* 82: 212–16.
Carnaby, I.C. 1933. *Emu* 33: 103–9.
— 1946. *Emu* 46: 156–8.
— 1947. *Emu* 47: 66–7.
Carpenter, G., & K. Bellchambers. In prep. *The 1989 Breeding of Banded Stilts at Lake Torrens, South Australia.*

Close, D.H., & N. McCrie. 1986. *Emu* 86: 145–54.
Condon, H.T. 1969. *Handlist of the Birds of South Australia*. S. Aust. Orn. Assoc., Adelaide.
—, & A.R. McGill. 1952. *Field Guide to the Waders*. Bird Obs. Club, Melbourne.
—, & C.E. Rix. 1936. *S. Aust. Orn.* 13: 211.
Crawford, D. 1975. *S. Aust. Orn.* 26: 193–5.
Ford, H.A., & D.C. Paton (Eds) 1986. *The Dynamic Partnership: Birds and Plants in Southern Australia*. The Flora and Fauna of South Australia Handbooks Comm., South Aust.
Ford, J. 1965. *Emu* 64: 181–203.
Fuller, P.J. 1963. *West. Aust. Nat.* 9: 9–12.
Garstone, R., & B. Jefferies. 1983. *West. Aust. Nat.* 15: 123.
Gibson, J.D. 1977. *Aust. Birds* 11: 41–80.
Glauert, L., & C.F.H. Jenkins. 1931. *J. Proc. R. Soc. West. Aust.* 17: 1–6.
Green, R.H. 1984. *Rec. Queen Vict. Mus.* 84.
Hall, B.P. (Ed.) 1974. *Birds of the Harold Hall Australian Expeditions 1962–70*. Brit. Mus. (Nat. Hist.), Lond.
Harris, A. 1987. *Bird Obs.* 660: 11.
Heathcote, W. 1945. *Wild Life* 7: 45.
Henderson, D.G. 1982. *Tas. Bird Rep.* 11: 14–15.
Hewish, M. 1986. *Stilt* 9: 21–9.
— 1987a. *Stilt* 11: 18–22.
— 1987b. *Stilt* 11: 23–31.
— 1988. *Stilt* 12: 41–6.
— 1989a. *Stilt* 14: 14–20.
— 1989b. *Stilt* 15: 13–15.
— 1990a. *Stilt* 16: 23–35.
— 1990b. *Stilt* 17: 5–16.
—, & J.A. Ross. 1931. *Emu* 31: 63–5.
Jaensch, R.P. 1988. *Stilt* 12: 57–8.
—, *et al.* 1988. *RAOU Rep.* 30.
Jenkins, C.F.H. 1975. *West. Aust. Nat.* 13: 94–5.
Jessop, A.E. 1987. *Stilt* 10: 15–19.
Jones, J. 1945a. *Emu* 45: 1–36.
— 1945b. *Emu* 45: 110–17.
Kolichis, N. 1976. *West. Aust. Nat.* 13: 114–19.
Lane, B.A. 1984. *Rep. Trip L. Eyre North*. Unpubl. Rep. to RAOU.
— 1987. *Shorebirds in Australia*. Nelson, Melbourne.
—, & A. Jessop. 1983. *Nat. Wader Count, Winter 1983*. Rep. to Participants.
—, — 1984. *Nat. Wader Count, Winter 1984*. Rep. to Participants.
—, & J. Starks. 1985. *Stilt* 7: 2–7.
Lashmar, A.F.C. 1936. *S. Aust. Orn.* 13: 200–3.
Lord, C.E., & H.H. Scott. 1924. *A Synopsis of the Vertebrate Animals of Tasmania*. Oldham, Beddome & Meredith, Hobart.
Martindale, J. 1980. *RAOU Rep.* 1: 4–40.
May, I. 1972. *Bird Obs.* 485: 6–7.
McGilp, J.N., & A.M. Morgan. 1931. *S. Aust. Orn.* 11: 37–53.
Minton, C. 1989. *RAOU Newsl.* 80: 3.
Morris, A.K. 1975. *Aust. Birds* 9: 37–76.
—, *et al.* 1981. *Handlist of Birds in New South Wales*. NSW Field Orn. Club, Sydney.
Olson, S.L., & A. Feduccia. 1980. *Smithson. Contrib. Zool.* 316.
Paton, P.A. 1982. *Biota of the Coorong*. Rep. to S. Aust. Dept. of Env. & Plan., Adelaide.
— 1986. Pp 94–101 **In:** Ford & Paton 1986.
Pearson, D. 1989. *West. Aust. Nat.* 18: 34–6.
Phillipps, H. 1990. *Aust. Nat. Hist.* 23: 322–9.
Pringle, J.D. 1987. *The Shorebirds of Australia*. Angus & Robertson, NSW.
Roberts, G.J. 1979. *The Birds of South-east Queensland*. Qld Conserv. Council, Brisbane.
— 1980. *S. Aust. Orn.* 28: 99–102.
Robinson, T., & C. Minton. 1989. *Birds Int.* 1(4): 72–85.
Saunders, D. & C.P. de Rebeira. 1985. *The Birdlife of Rottnest I.* Authors, Perth.
Sedgwick, E.H., & L.E. Sedgwick. 1950. *West. Aust. Nat.* 2: 111–18.
Serventy, D.L., & H.M. Whittell. 1981. *Birds of Western Australia*. Univ. West. Aust. Press, Perth.
Slater, P. 1970. *A Field Guide to Australian Birds*. Rigby, Adelaide.
Sonter, C. 1987. *Aust. Bird Watcher* 12: 98–9.
Storr, G.M. 1965. *Emu* 64: 105–13.
— 1973. *Spec. Publs West. Aust. Mus.* 5.
— 1985. *Rec. West. Aust. Mus. Suppl.* 21.
— 1987. *Rec. West. Aust. Mus.* 27.
Sutton, J. 1931. *S. Aust. Orn.* 11: 74–92.
— 1933. *S. Aust. Orn.* 12: 19–28.
Wall, L.E. 1981. *Tasm. Nat.* 64: 7.
—, & J.G.K. Harris. 1978. *Emu* 78: 163.
Watson, J.A.L. 1959. *West. Aust. Nat.* 6: 185–90.
Wheeler, R. 1955. *Emu* 55: 279–95.
Whitlock, F.L. 1932. *Emu* 31: 271–2.
— 1939. *Emu* 38: 438–42.
Young, C. 1981. *SWANS* 11: 3–5.

Sponsors: Mr D Pearson, Mr TM Putt, Ms E Bear

Recurvirostra novaehollandiae **Red-necked Avocet**

COLOUR PLATE FACING PAGE 776

Recurvirostra Novae-Hollandiae Vieillot, 1816, *Nouv. Dict. Hist. nat.* 3: 103 — New Holland = Victoria *apud* Mathews = probably Van Diemen's Land *apud* Stresemann ex Condon 1975: 122, but based at least in part on description by Dampier (1697–99) at Shark Bay, Western Australia.

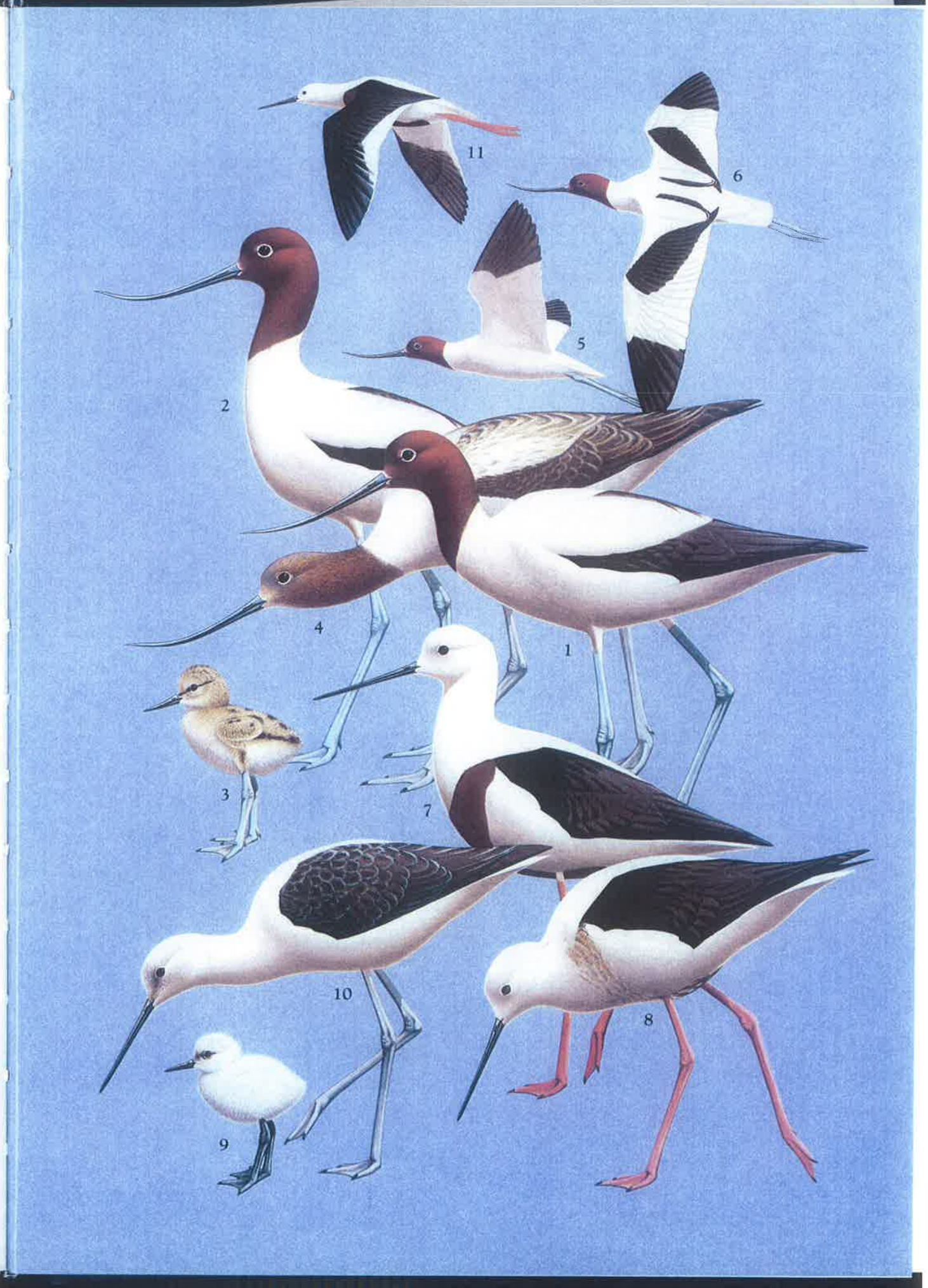
The generic name combines the Latin *recurvus*, bent, curved back, with *rostrum*, bill, for the characteristic upturned bill. Specifically of New Holland, being Australia's only avocet.

OTHER ENGLISH NAMES Yelper, Cobbler, Trumpeter, Avocet.

Avosetta is the local Venetian name for the Pied Avocet *R. avosetta*.

MONOTYPIC

FIELD IDENTIFICATION Length 40–48 cm; wingspan 70–80 cm; weight 310 g. Large wader with striking pied plumage, diagnostic chestnut head and neck, long bluish legs, and long slender upcurved bill. Slightly larger than Banded Stilt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predator behaviour of young When 1–5 weeks old, crouch and freeze, sometimes after running; or run and hide. In wild, fledged young also seen to freeze, then fly; or stand alert. **Parental anti-predator strategies** Alarm behaviour peaks during period of parental care; can be caused by vocalizations and behaviour of neighbouring conspecifics. Gives alarm call and flies at aerial predators; uses Distraction Displays towards ground predators. Behaviour recorded includes: incubating bird False-brooding or keeping well away from nest; BROKEN-WING DISPLAY: bird runs, giving loud yapping Alarm Calls; as intruder nears nest, adult holds wings out with primaries lowered towards ground; occurs mainly during incubation, but also when with chicks. When diving at intruders, silent during approach but give yapping Alarm Call during ascent; most common reaction to people. Perform Tilt Head as described above for Alarm; seen during incubation and early chick-rearing; usually accompanied by Aerial Alarm Call given by male only. AGGRESSIVE FLIGHT: when on nest or with young, fly at intruders and Australian Magpies *Gymnorhina tibicen* (Pierce 1982; Reed 1986). In wild, rarely gives Distraction Displays until late in incubation, and often not until hatching; gives Aerial Alarm Call as flies and swoops at Swamp Harriers as far as 120 m from nest, and usually joined by other Black and Black-winged Stilts (Pierce 1982). Juveniles chased away by parents before next breeding season.

VOICE Studied by Reed (1986) in captivity and in wild. This account by C.E.M. Reed. Most noticeable call, loud yapping Alarm Call, particularly during breeding. Similar but softer contact call. Eleven adult calls identified. Male yaps higher-pitched than those of female, difference difficult to hear. Staccato calls of pair selecting nest-site overlap in time. Calls similar to those of Black-winged Stilt and of Black x Black-winged hybrids but longer and more highly pitched; in pitch and length, calls of hybrids intermediate between those of Black and Black-winged Stilts.

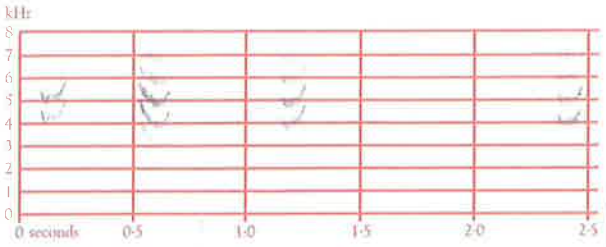
Adult BATHING CALL: soft *tw-ink* of one or two notes; fundamental frequency 2900 Hz, duration 23 ms. Given when raising head during bathing and repeated 2–7 times after Head-dips when bathing. ALERT CALL: short moderately loud *tip* of low frequency (555 Hz). Given in Alert Forward Posture. DISTRESS CALL: soft *ruh*; low frequency, moderately long (200 ms), repeated about twice per s. Given by captive adults under stress from human intrusion or capture. PARENTAL CALL: moderately loud *yark*; frequency 540–1000 Hz (higher at beginning, modulating at end), duration 120–160 ms. Contact call from adult to chick; given while guarding chicks. CONTACT CALL: *yak*; similar to Parental Call (*yark*) and Common Alarm Call (*yap*), but shorter and of lower frequency; lacks frequency modulation; quieter and not uttered as often. ALARM CALL: loud *yap*, frequency 770–1155 Hz (ascending then descending), duration 70–120 ms, with many harmonics (sonagram A). Given in response to predators and intruders. AERIAL ALARM CALL: *url*, frequency peaking early in call, some terminal pitch modulation. A graded call after and before *yap*, given in response to raptors, gulls or magpies overhead. HUMAN ALARM CALL: Long *eerr*, varying in duration; frequency peaking at start, but lower than in Aerial Alarm Call; pitch modulation throughout. Highly graded from *yap*. Evoked, in conjunction with Broken-wing Display, by human intrusion onto nesting territories during incubation or rearing of chicks. EXTREME ALARM CALL: very short double-note, repeated in quick succession, often two notes of similar frequency within 0.3 s, moderately loud. Graded in continuum, beyond *yap* and *eerr*. PRE-COPULATORY CALL: very soft *pit*; short (8 ms), 3/s. By female; given as female adopts horizontal Pre-copulatory Position and dips bill in water. NEST-SITE SELECTION CALL: soft to loud staccato calls, varying in length from extremely short to 100 ms. Given over prospective nest-sites by one of pair, increasing in intensity and volume on arrival of mate, which joins in, calls overlapping.

Young Soft high-frequency piping; 60 ms in duration; given by chick before hatching. Loud double-note *yip-yip* call; first note longer and of higher frequency; given as contact call by chicks away from parents. Very soft high-frequency *chip*, given as contact call when foraging near adults or when following them. Loud high-frequency *chap*, given in alarm by juveniles in same circumstances as yapping Alarm Call of adult.

BREEDING Well known. Detailed studies in wild by Pierce (1982, 1984b, 1986a) and in captivity by Reed (1986). Account based on contribution by C.E.M. Reed. Breed in simple pairs, solitarily, sometimes in colonies of Black-winged Stilts, with which it hybridizes.

Season First clutches laid Sept. to mid-Oct., a few early nests in Aug.; replacement clutches from mid-Oct. to Dec., occasionally Jan.; mean fledging date, 19–24 Jan. (Pierce 1982). Laying often delayed during floods or cold weather in spring (Pierce 1982; C.E.M. Reed).

Site Prefer streams, swamps or ponds, less often rivers; one recorded in a wet field; on stable shingle, grassy banks, mudflats, hummocks of sedge or tussock, or in loose sedge or rushes, sometimes between two stones, on or beside plants, including *Juncus effusus* and *Holcus lanatus*, but individual stems were widely spaced, not in dense vegetation where visibility impaired; usually on banks (52%) or islands (22%), preferring mounds of small vegetation, close to shallow feeding areas (Child 1958; Soper 1967; Pierce 1982; C.E.M. Reed). Two nests within 100 m; occasionally near colonies of Black-winged Stilts; one nest c. 27 m from Black-winged x Black Stilt pair, another within 50 m of Swamp Harrier (Soper 1967; Pierce 1982). MEASUREMENTS (cm): height of nests above water, 16–48; distance from water, 75–450 (n=27; Pierce 1982). High site-fidelity: usually re-nest at same site but may move >10 km (Pierce 1982). Will nest with Black-fronted Terns *Sterna albostriata* and Black-winged Stilts (Soper 1959). Both sexes select site; one pair lined three sites before choosing third (Pierce 1982).



A L. McPherson; near Mt Cook, Mackenzie Basin, NZ, Jan. 1982; P105

Plate 59

Red-necked Avocet *Recurvirostra novaehollandiae* (page 790)
1 Adult male; **2** Adult female; **3** Downy young
4 Juvenile, in fresh plumage; **5** Adult; **6** Adult

Banded Stilt *Cladorhynchus leucocephalus* (page 780)
7 Adult breeding (alternate); **8** Adult non-breeding (basic)
9 Downy young; **10** Juvenile; **11** Adult breeding (alternate)

A copy of: Bellchambers, K. & Carpenter, G. (1992). *Sudden life on Stilt Island.* Natural History 4:42-48.

Stilt Island, Lake Torrens, South Australia
Clive Minton

Sudden Life on Stilt Island

Rainfall in an arid land is a windfall for an Australian wading bird

by Keith Bellchambers and Graham Carpenter

Early in March of 1989, heavy rain fell across vast, arid stretches of inland South Australia. For the first time in some 100 years, 11,600-square-mile Lake Torrens, usually a bone-dry salt pan, filled with water. When such an event occurs, the lake is Australia's second largest. The water level ranged from an inch or two at its northern end to more than three feet in the south. The influx of fresh water stimulated long-dormant eggs of tiny crustaceans, such as brine shrimp, to hatch, grow, and reproduce. The lake became a highly nutritious saline "soup," attracting birds that quickly found out that Lake Torrens was a living lake once more.

About a month after Lake Torrens was resurrected, a huge breeding colony of banded stilts was discovered on small islands in the lake. With a total estimated population of 130,000 birds, banded stilts are the most numerous wading birds native to Australia, yet no scientific sightings of nesting stilts were made until 1930. Since then, only about two dozen breeding sites have been found, most in scattered ephemeral lakes in remote and inaccessible parts of the outback. Although the birds are common much of the year along Australia's southern and southwestern coasts, until 1989 they had been observed breeding in inland South Australia only once before, in 1931. For ornithologists, the discovery of the Lake Torrens colony was the opportunity of a lifetime, allowing them to learn more about the species' breeding biology and behavior in a month than in the entire previous time the bird had been known to science.

When the rains began in 1989, Ian May, of the South Australian National Parks and Wildlife Service, started a systematic aerial search of inland saline lakes, hoping to make just such a find. In mid-April, after sixty hours in the air without a single sighting of a stilt, he came upon the 100,000-strong Lake Torrens colony. Two weeks later, we boarded a helicopter and were dropped off on the salty outskirts of the lake to observe and make the first detailed records of how banded stilts went about nesting and rearing their young.

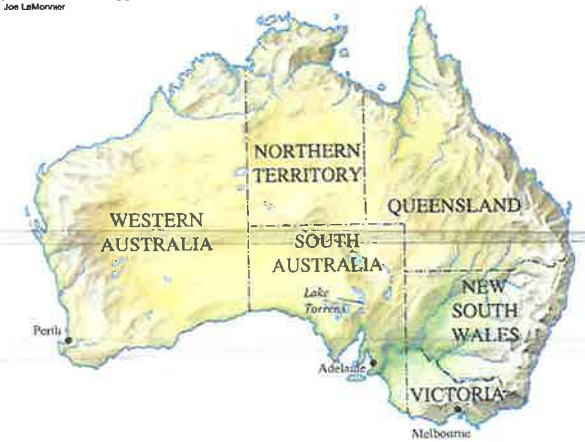
Our first sight of the colony was breathtaking. As we circled over the largest of the three breeding islands, we saw that the nesting birds were tightly packed on several low dunes along one side of the island. From the air, the brooding birds—looking like black and white dots—contrasted vividly with the red sand on which they nested and the green of the sparse vegetation that grew nearby. Once on the ground, we set up our camp about 200 yards from the colony. The stilts gave constant, soft, yapping calls, while circling silver gulls squabbled and screeched, eager to make an easy meal of any untended egg or chick.

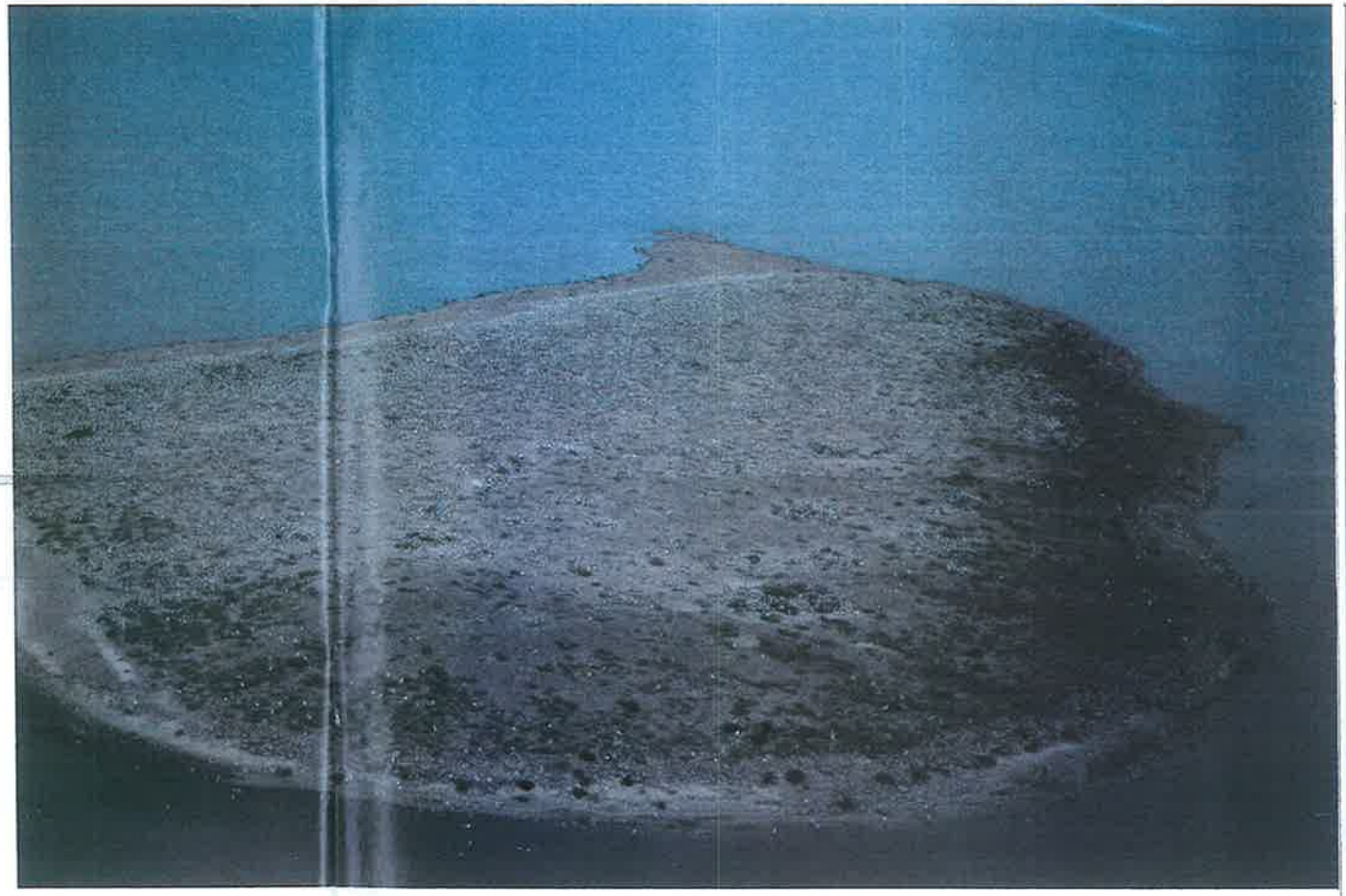
This bit of land, which we named Stilt Island, had been formed over many years as the precipitates of mineral-rich artesian groundwaters reached the surface and then hardened into a slab on the lake bed. Wind-driven sand built up on the south and west sides of this slab to form fringing two- to four-foot-high dunes. Sparse, salt-tolerant vegetation sprouted on these dunes, but the rest of the island was devoid of plants. The Stilt Island colony was located on and between the dunes. Because our attempts to enter the colony disrupted the brooding stilts and increased predation by the opportunistic gulls, we decided to retreat and study the colony through telescopes.

Keith Dellchambers and Graham Carpenter

Unlike other wading birds, banded stilts breed in dense colonies, placing their nest scrapes only about a foot apart, opposite page, bottom. The seclusion of an islet in the northern part of Lake Torrens, right, offers eggs and chicks protection from land-roving predators, such as foxes and dingoes.

Joe LeMonnier





We found that by the time of our arrival, breeding was already well advanced. About half of the estimated 100,000 birds Ian May had seen just two weeks earlier had left the island, along with their precocious chicks. However, May continued to conduct regular flights over the lake and soon discovered the beginnings of another colony on several islets sixty miles north, at the end of the lake. We rapidly broke camp and moved our field station there, hoping to observe breeding in this new colony from start to finish.

Two of the northern islands, each about twelve acres in area, were almost completely covered by new nests. In contrast to Stilt Island, these islands, characterized by stony expanses known as gibbers, supported a sparse, low saltbush shrubland. Various other wading birds, as well as terns, ducks, and swans, found the islands suitable for nesting, but they were greatly outnumbered by banded stilts. We estimated that about 50,000 stilts, or half the number that had been on the southern islands, were attempting to breed here. Again, predatory silver gulls patrolled the colony, so we opted to make most of our observations from an aluminum dinghy anchored some distance from the island. From there, we were able to witness the complete breeding cycle from courtship to egg hatch.

The differences between this northern colony and that on Stilt Island, separated by only a few weeks and sixty miles of water, were instructive and eventually gave us greater insight into the behavior and ecology of the bird, in particular the extreme efficiency of its breeding cycle.

Banded stilts probably do not nest annually but only when rainfall creates temporary inland saline lakes and encourages growth of their crustacean prey. Because of their irregular nesting schedule and their size—about sixteen inches tall—we suspect that banded stilts are relatively long-lived. In contrast to their closest Australian relatives, red-necked avocets and pied stilts, which nest in small, loose groups or in pairs, banded stilts breed in large, tightly packed colonies. These are usually located on islands or other isolated spots that afford some protection from ground-dwelling predators, such as dingoes, foxes, and feral cats.

To prepare its nest, a banded stilt makes a shallow scrape in the ground and sometimes lines it with a few dry twigs. Nests are spaced only about one foot apart, giving the birds just enough room to avoid constant bickering with brooding neighbors. Females usually lay a clutch of three or four eggs. Eggs vary between and within clutches in size, color (white to tan), and markings (blotches, swirls, and streaks). The eggs, similar in size to those of chickens, are relatively large for shorebirds, roughly 18 percent of the adult body weight of six to eight ounces.

Both clutch and egg size were smaller in the northern colony than on Stilt Island. Although we have no direct evidence, such as sightings of marked birds, we think that many of the birds breeding in this second colony may have been birds that had completed breeding earliest on the southern islands and that had enough time, energy, and confidence to renest. Our assumption is based purely on numbers. If 100,000 stilts nested in the south and another 50,000 in the north, this would exceed the total number of banded stilts in Australia. Some birds, therefore, must have nested twice.

Clive Minton

During our many hours of nest watching, we occasionally witnessed one parent bird relieving another on the nest. Because the sexes are alike in size and color, we were not able to determine who was relieving whom. Most of these nest changeovers were confused affairs, with the relieving bird acting somewhat uncertain about taking over the nest duties. Our observations of individual nests, combined with the birds' behavior, led us to believe that banded stilts sit on the nest for extended periods, as they regularly took the time to stand and stretch their wings and legs and walked away from the nest briefly. This left the nest vulnerable to the depredations of silver gulls. We observed two main

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Chicks emerge after a brief twenty-one days in the egg, below. As soon as their white down dries and fluffs, they are ready to leave the nest scrape and head for food-rich water. They join stilts from other nests, right, before beginning the trek. Late nesters, right, below, are invariably harassed by silver gulls and usually lose all their young to these bold predators.

Clive Minton

methods of attack. Most gulls lurked among the brooding stilts, waiting for one to make a careless move; then rushed in and attacked the nest contents. Often the ensuing melee displaced other stilts brooding nearby, leaving more unguarded nests open to attack and resulting in a widening area of impact. Some gulls used a bolder tactic, pulling brooding adults off the nests and then raiding them.

The period from egg laying to hatching is about twenty-one days, a very short time for a bird of this size. But quick, efficient breeding is an evolutionary necessity for a species that nests on lakes that suddenly appear and just as suddenly dry up, taking away the food supply.

The chicks, too, mature rapidly. Unlike the cryptically colored young of all other shorebirds, banded stilt chicks are covered with pure white down. They have well-developed legs and are capable of extraordinary physical feats within a few hours of hatching. Adults never feed their chicks; the young begin feeding themselves as soon as they reach the water's edge after a trek from the nest. This may explain the large egg, its nutrients being needed to sustain the chick until it reaches food-rich water. Soon after the last chick emerges from the egg, the family abandons the nest scrape and heads to good feeding grounds.

We noted that one adult, of unknown sex, guided each clutch of chicks. On leaving the nest, they sometimes joined other adults and chicks, presumably finding some safety in numbers. These groups were fluid, however, and tended to grow or shrink freely and frequently. Adults often attacked any strange chicks that blundered within their immediate reach.

On Stilt Island, the adults led their chicks across the barren limy slab—a distance of about 500 yards—before escorting them into the water and away from the island. We counted many thousands of chicks departing the islands on each of several days, most beginning their odyssey from midmorning to midday. All the while the adults maintained contact with their young with soft, clucking calls.

We tracked the birds that had left the nest on the northern islets from a light airplane and found them feeding in the northern part of the lake where brine shrimp were concentrated in only a few inches of water. Here the chicks grew rapidly and the adults replenished their strength. As soon as they reached water, chicks formed feeding "crèches" of up to several hundred birds. Accompanied by a few adults, the chicks worked their way across the shallows, their white downy bodies contrasting with the dirty brown water. From the air, crèches were visible over a huge expanse of the lake, their movements reflected in intricate patterns in the mud.

Crèching is an unusual behavior in shorebirds. In the case of banded stilts, it frees the majority of adults from parenting duties even before the young have fledged and gives them a chance to renest, should the usually short-lived lake water still be available. Precocial chicks, warm water, a relatively mild climate, and a vast and readily usable source of food may have fostered the development of crèching behavior in banded stilts.

At six weeks of age, the chicks were fully feathered, lacking only the chestnut breast band of the adults. Now capable of strong and sustained flight, these immature birds gathered in large flocks and

Keith Dalchambers and Graham Carpenter

often "buzzed" us in the dinghy as we went about our business on the lake.

Our observations suggest that banded stilts have much in common with other wading birds but also bear some striking similarities to flamingos, which are known in Australia only from fossil records. Like banded stilts, flamingos tend to nest on remote saline lakes when local conditions are favorable. Relatively large eggs, light-colored chicks, and the crèching of young birds are other traits banded stilts share with flamingos, but not with other waders. Our observations of ecological and behavioral similarities between these two species lend support to previous studies of their anatomy that suggest an ancient relationship between shorebirds and flamingos, via the banded stilt.

We found silver gulls to be main players

Clive Minton

On Stilt Island, below, adults shepherd chicks just a few hours old on a 500-yard, half-hour march to salty shallows, where they will feed for the first time. Right: Once in the water, the young form groups known as crèches and feed on tiny organisms, such as brine shrimp.

Keith Belchambers and Graham Carpenter

in the life of the colony. The few historical accounts of nesting banded stilts mention predation of eggs and chicks by crows and ravens and birds of prey, but not by silver gulls, even when the gulls were nesting at the same site. In the Lake Torrens colonies, silver gulls ate eggs, newly hatched young, and downy chicks, and we estimated that they preyed on the contents of 60 percent of nests. Once away from the nest, chicks were relatively safe, although we did see some plucked out of the water as they swam. At a hatching weight of about one ounce, chicks are slightly more than a mouthful for a single gull, but after being torn apart by a squabbling gang of gulls, they are easily consumed.

While egg laying was largely synchronous throughout a colony, some birds were inevitably late in starting their nests. Early nesters avoided the heaviest predation by completing nesting and chick rearing before gulls flocked to the vicinity. These birds also renested if conditions remained favorable. Late nests were largely wiped out by silver gulls. In the past, flooding or, conversely, a drop in water level has caused colonies to be abandoned. Enormous numbers of flightless young can die if the waters in which they feed dry up. On Lake Torrens, gradually declining water levels prevented many stilts from renesting, but predation by gulls was the factor that prematurely ended the life of each colony.

In recent years, numbers of silver gulls in coastal Australia have grown, probably because of the availability of food at rubbish dumps. In very wet years, they move inland en masse to nest. The eggs and chicks of terns, plovers, cormorants, and ducks are among their victims. Banded stilts are at the mercy of these marauders, their defense being limited to covering the eggs or chicks and halfhearted pecking at attackers. This lack of retaliatory tactics suggests that high levels of gull predation are a new danger to banded stilts, something they have not had to cope with in the past and that they are not evolutionarily equipped to combat. This raises concerns for the future well-being of the species.

The 1989 flooding of Lake Torrens was a rare event, one that Australian banded stilts put to full advantage. It also opened an ornithological window, giving us a chance to document the successes of, and the new threats to, these birds on their largely secret breeding grounds. Although the scene at Lake Torrens may not be replayed for another hundred years, we hope to be able to add to our knowledge of the elusive stilts when other salt pans come to life. □

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NATURAL HISTORY

APRIL 1992

COVER: *In the waters off Indonesia, a porcelain crab lives comfortably among the stinging tentacles of an anemone. Story on page 50. Photograph by Mike Severns.*

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In 1989, when 100,000 banded stilts where discovered nesting in South Australia, **Keith Bellchambers** and **Graham Carpenter** (page 42) were ready on short notice to investigate life in the huge colony. Although common along parts of the coast, the birds had never been studied in depth during their breeding cycle. Bellchambers and Carpenter flew to the colony by helicopter and were dropped off with a full month's supplies. They recorded, for the first time, the details of banded stilt nesting from courtship to the fledging of chicks. A technical officer for the Arid Zone Research Institute in Alice Springs, Northern Territory, Bellchambers, above, has assisted researchers in Papua New Guinea in studies of birds of paradise and bower birds. His main project, however, involves the reintroduction to the wild of an endangered Australian mammal, the bilby. Carpenter, below, a scientific officer with the South Australian Department of Environment and Planning in Adelaide, has long been interested in the ecology of wading birds. In addition to ornithology, he studies botany and is "a jaffle [a cross between a pie and a waffle] maker of some repute." He enjoys any opportunity to get out into the bush and combine the three interests. More information on banded stilts is available in *The Atlas of Australian Birds*, by M. Blakers, S. J. J. F. Davies, and P. N. Reilly (Melbourne: Melbourne University Press, 1984), and John Douglas Pringle's *The Shorebirds of Australia* (London: Angus and Robertson Publishers, 1987), with photographs provided by the National Photographic Index of Australian Wildlife.

Daphne Gail Fautin (page 50) has spent many hours underwater on coral reefs studying clownfish, which live under a sea anemone's protective umbrella. But the subject of her article, deep-sea hermit crabs and their anemones, which spin golden shells, arrived at her office in jars. Nevertheless, as an anemone taxonomist, she welcomed the chance to inspect this unusual symbiotic pair. Fautin, who received her Ph.D. from the University of California at Berkeley, recently moved from her job as director of research and associate curator of invertebrates at the California Academy of Sciences to the Snow Museum of the University of Kansas, where she is an adjunct professor. Although she lives far from the sea, Fautin travels frequently, pursuing her interest in marine life. She plans to extend her research to include the molecular evolution of sea anemones and corals. A licensed pilot, Fautin enjoys flying as well as gourmet cooking. For additional reading on hermit crabs and anemones, she recommends "The Hermit Crab's Special Forces," an article by Randy Brooks in *Sea Frontiers*, July–August 1990.

The two accommodating lions in this month's "Unnatural Moment" (page 76) rewarded tourists hoping for a close-up encounter with wildlife in South Africa's Kalahari Gemsbok National Park. The catch for the tourists was sharing the intimate look with vanloads of their fellows. Photographer **Thomas Dressler** captured the irony of the primal scene played out in traffic last June. A native of Germany, Dressler has lived in Spain for ten years and resides near Malaga on the southern coast. Before becoming a professional photographer five years ago, he led tours in Spain and North Africa. Dressler plans to travel to Australia next year and is currently working on a book of photographs of Africa.

A copy of: Bellchambers, K. & Carpenter, G. (1990). *Birds recorded at Lake Torrens during its 1989 flooding.* South Australian Ornithologist 31:1-6.

BIRDS RECORDED AT LAKE TORRENS DURING ITS 1989 FLOODING

KEITH BELLCHAMBERS and GRAHAM CARPENTER

INTRODUCTION

Lake Torrens is a large, normally dry, salt lake lying to the west side of the Flinders Ranges in the north of South Australia (Figure 1). Its catchment is the western face of the Flinders Ranges in the east and the low, rounded hills east of Andamooka and Roxby Downs in the west. When this area received extraordinary rainfall in March 1989 the temporary streams draining this area filled with floodwater which quickly emptied into Lake Torrens. During the 24 hours to 09.00 on 14 March 1989, Motpena Station *ca.* 22 km SW of Parachilna recorded 273 mm, accepted by the Bureau of Meteorology as the state record. Average rainfall for Parachilna for March is 15 mm and the annual average is 204 mm. While some parts of the lake have held small amounts of floodwater on a number of occasions in the past, it is thought that this flood episode filled the lake to a level not achieved for about 100 years (Ian May, pers. comm.). This incredible natural phenomenon was a significant stimulus for many species of birds to breed on or near the lake. The most notable was the Banded Stilt *Cladorhynchus leucocephalus* (article on its breeding in prep.).

The bird life of the Lake Torrens region is poorly known. The paucity of observations is probably attributable to a lack of visits by bird-watchers, which is in turn due to the upredictable nature of flooding of the lake McGilp (1949), visited the northern tip of the lake but made no mention of water nor of the local avifauna. Badman and May (1983), discuss wader distribution in northern South Australia, however, their records are from the area north of the lake. The observations of birds of Lake Torrens detailed below were made while the authors were resident upon two small island groups (see Fig. 1) from 9 May to 22 May and 27 May to 13 June 1989, studying the breeding biology of the Banded Stilt. These islands formed two distinct groups separated by approximately 100 km of water. The southern group were formed around a now extinct mound-spring whose out-flow area had hardened to a sheet of stone. Windblown sand has deposited on parts of this sheet and has been colonised by sparse low samphire vegetation.

The northern group were comprised of a heavy red clay capped with gibbers and vegetated with a moderate cover of mixed salt-bush species. The largest island in this group, Andamooka Island, was dissected by temporary creeks which supported Myall trees. Sandy areas supported shrubs of *Acacia* sp. and *Eremophila* sp.

ANNOTATED LIST

EMU *Dromaius novaehollandiae*

Several birds encountered foraging on Andamooka Island. Two nests located on 29 May and 13 June containing 11 and 8 eggs respectively. Both were constructed of fibrous vegetative matter placed directly on the gibbers and protected by low chenopods. Ian May (pers. comm.) observed, from the air, several birds thigh-deep in water some distance from the lake's edge.

HOARY-HEADED GREBE *Poliocephalus poliocephalus*

Infrequent observations of birds in several locations. Two birds noticed diving in approximately 50 cm deep water 300 m offshore from Stilt Island, five birds swimming in the channel separating Andamooka Island from the mainland and a group of 12 birds noted swimming in the main lake near North Colony Island.

AUSTRALIAN PELICAN *Pelecanus conspicillatus*

Ten birds were noticed roosting near Gull Island on 14 May. Birds noted late in evening and had departed by following morning. One bird seen in same area one week later.

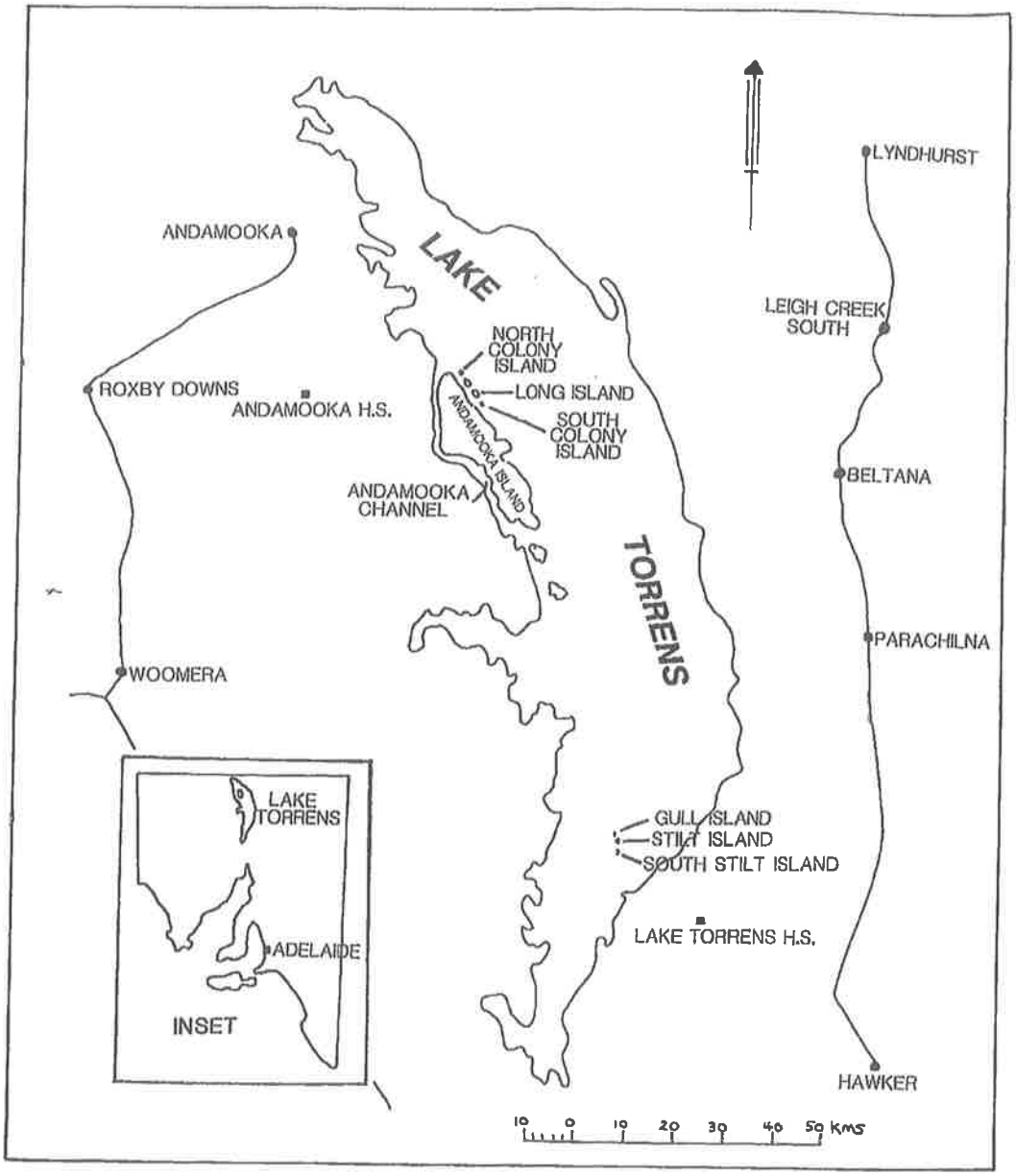

Figure 1: Location of Survey Sites in Lake Torrens.

WHITE-FACED HERON
Ardea novaehollandiae

A group of three birds were noticed over a period of several days around Stilt Island. A flock of nine birds circled Stilt Island on 17 May before settling for the evening. Neither of these groups were observed feeding.

BLACK SWAN *Cygnus atratus*

Two or three birds seen most days on or near Gull Island. A nest with five eggs on Gull Island on 12 May amongst dense colony of nesting Silver gulls. Nest of samphire twigs and down located directly on the sandy ground. Still sitting on 22 May. Several birds also seen flying along the channel between Andamooka Island and shore.

GREY TEAL *Anas gibberifrons*

A group of 5+ birds were heard calling overhead on Stilt Island during the night of 14 May. A pair of adults with eight downy chicks were observed on 29 May at the edge of Andamooka Island.

PINK-EARED DUCK
Malacorhynchus membranaceus

Two (and sometimes three) birds seen continuously on or near Gull Island where on 12 May they had a down-filled, and down-covered nest with two eggs. The nest was amongst a dense colony of nesting Silver gulls and located under samphire bushes. It was revisited on 21 May by which date it had been abandoned and the eggs missing.

On Andamooka Island up to 10 birds were seen or heard calling on most days along the channel separating the island from the mainland.

MANED DUCK *Chenonetta jubata*

Two birds were observed on 27 May resting on the protected shore of Andamooka Island with a group of Pink-eared Duck.

BLACK KITE *Milvus migrans*

One bird noted on 10 June soaring over the campsite on Andamooka Island. It circled a few times before moving off.

COLLARED SPARROWHAWK
Accipiter cirrhocephalus

One bird noticed near campsite on Andamooka Island on 7 June, being pursued by lone Little Crow. It was mostly uninterested in this harassment but occasionally it would roll in flight and present its talons to the pursuer.

WEDGE-TAILED EAGLE *Aquila audax*

One bird was observed soaring overhead on 9 May at Stilt Island. At Andamooka Island from 2–20 soaring birds were noticed on a number of occasions. Birds were observed feeding on the remains of dead (cause unknown) Red Kangaroos and a disused nest was found in the crown of a Myall on a temporary creekline.

SPOTTED HARRIER *Circus assimilis*

One adult bird flying over Stilt Island on 18 May was being harassed by several Silver gulls.

PEREGRINE FALCON *Falco peregrinus*

One bird was noticed on each of five consecutive days from 9–14 May around the Stilt colony on Stilt Island. On each visit to the island it succeeded in catching an adult Stilt. While it was observed hitting a low flying Stilt (which subseqently escaped) most attacks were on walking adult Stilts leading chicks across the island.

BROWN FALCON *Falco berigora*

Individuals noted on both island groups. On Stilt Island it was observed taking Stilt chicks being led across the island. The Falcon would fly in low, flushing the accompanying adult Stilt(s) and then catch an unguarded chick which it took away a short distance to eat.

AUSTRALIAN KESTREL *Falco cenchroides*

A pair of birds noticed soaring over Andamooka Island on 29 May.

MASKED LAPWING *Vanellus miles*

Several birds heard calling most nights from 12–18 May at Stilt Island, however, none were seen on or near any islands.

BANDED LAPWING *Vanellus tricolor*

Observed on both Stilt and Andamooka Islands. From two to five birds seen on Stilt Island (and heard calling overnight) and up to four birds seen on Andamooka Island. The birds on Andamooka Island were resident in an area of lignum on a small freshwater catchment.

RED-CAPPED PLOVER
Charadrius ruficapillus

A very common bird on all islands. There was *ca.* 100 birds on Stilt Island and approximately two birds per 100 metres of shore on Andamooka Island. They were breeding over the whole duration of our visits, with all stages of the breeding cycle from eggs to well-developed running chicks and juveniles observed.

BLACK-FRONTED PLOVER
Charadrius melanops

One bird only observed on the shore of Andamooka Island on 7 June.

INLAND DOTTEREL *Peltohyas australis*

One bird observed on Long Island on 30 May.

BLACK-WINGED STILT
Himantopus himantopus

One bird observed on 6 June feeding and resting on the edge of North Colony Island. It spent its time separated from nearby Banded Stilts.

BANDED STILT *Cladorhynchus leucocephalus*

Nesting colonies totalling an estimated 100,000 birds was present on the three southern islands (Gull, Stilt and South Stilt) but only a few adult birds were left by 22 May. A smaller nesting effort was underway on the three northern islands (North Colony, Long and South Colony) by 27 May with the Long Island colony being abandoned after a few days. A full account of the breeding biology of this species will be published shortly.

RED-NECKED AVOCET
Recurvirostra novaehollandiae

On Stilt Island a pair of birds visited most days to feed in shallow water close to the island but did not breed there. Breeding took place on the northern islands with approximately 50 nests being scattered amongst those of Banded Stilts on North Colony Island. They also bred on Long Island.

Nests were seen with three and four eggs from 27 May on and several groups of three or four runners or juveniles were observed feeding with their parents on mud flats or in shallow water around Andamooka Island.

GREENSHANK *Tringa nebularia*

Two or three birds visited Stilt Island to feed several times over a one week period. Two birds observed on 29 May feeding on the edge of the Andamooka Channel.

RED-NECKED STINT *Calidris ruficollis*

A flock of about 50 birds seen feeding in shallow waters on eastern side of Stilt Island over a one week period. Another group of about 50 birds were often seen in the evenings near North Colony Island flying around the island just above the water and occasionally accompanied by Curlew Sandpipers.

CURLEW SANDPIPER *Calidris ferruginea*

Approximately 20 birds seen on 10th and 12th May on Stilt Island, feeding in an area of shallow water on eastern side of island. A small flock of up to 10 birds often seen in evenings near North Colony Island with Red-necked Stints.

SILVER GULL *Larus novaehollandiae*

Approximately five thousand birds present around the nesting Banded Stilts on the southern islands. These had a severe predatory impact on eggs, newly hatched chicks and downy running chicks, especially as the colony began to wind down.

The gulls had apparently begun nesting on Gull Island as the Stilts left it, and as the Stilt colony receded down Stilt Island, the overflow of breeding gulls began nesting on Stilt Island too. Occasionally, gull nests were among scattered Stilt nests. We estimated a total of 1200 gull nests in this island group. The most advanced nests on Gull Island contained large downy chicks (up to

four) and must have been started soon after the adults arrived at the lake. However, no chicks were flying before the Stilts left this part of the lake. The gulls then shifted their diet to brine shrimps and also began preying on the contents of the nests of later nesting Silver Gulls which contained only eggs. These late nests were all either abandoned or predated while still at the eggs only stage.

About 1000 Silver gulls were present at the Stilt nests on North Colony Island. Again they caused heavy losses, but only two nests were made and no eggs laid because the stilts ceased nesting.

WHISKERED TERN *Chlidonias hybrida*

A flock of up to 20 birds heading north over Stilt Island on each day from 13 to 15 May. A flock of 10 birds noticed in the vicinity of Andamooka Island on 29 and 30 May.

GULL-BILLED TERN *Gelochelidon nilotica*

Two or three birds seen most days while at Stilt Island and on one occasion a bird was noticed carrying nesting material but no nesting occurred here.

Eight nests were found on an exposed rocky bank on the edge of North Colony Island on 27 May. It is not known if these birds were nesting here before the Stilt colony became established. Brooding adults were under pressure from Silver Gulls but remained very tight on the nest. This colony was abandoned about one week after our arrival in the area and we are not sure if this was due to our (careful) presence in the vicinity, gull pressure or some other factor.

Adults from this colony were observed drinking and bathing at a large freshwater pool in the sand dunes on Andamooka Island approximately 3 km from the colony.

CASPIAN TERN *Hydroprogne caspia*

One bird on 19 May and two on 20 May overhead at Stilt Island. Two birds noticed overhead at North Colony Island on 7 June.

CRESTED PIGEON *Ocyphaps lophotes*

Up to 50 birds roosting in the Myalls along creeklines and amongst low shrubs on the sandy soils of Andamooka Island.

GALAH *Cacatua roseicapilla*

A flock of 20 on 15 May and a flock of 10 on 19 May flying over Stilt Island at dusk, heading east. On Andamooka Island two birds noticed on 5 June and 7 June.

COCKATIEL *Nymphicus hollandicus*

A group of four birds noticed on Andamooka Island on 6 June.

BUDGERIGAR *Melopsittacus undulatus*

A flock of 20 birds passed over Stilt Island in the morning of 20 May heading east.

BLUE-WINGED PARROT *Neophema chrysostoma*

Two birds noticed overhead on Andamooka Island on 29 May and 1 June. Approximately 60 birds seen feeding together on the ground on Long Island on 30 May.

ELEGANT PARROT *Neophema elegans*

A single bird passing over Stilt Island on 13 May and another on 19 May. Both birds heading south.

PALLID CUCKOO *Cuculus pallidus*

A single bird noted on Andamooka Island on 29 May.

HORSFIELD'S BRONZE-CUCKOO *Chrysococcyx basalis*

Several birds noted on Andamooka Island on 29 May.

SPOTTED NIGHTJAR *Caprimulgus guttatus*

Two roosting birds flushed from ground on 5 June on Andamooka Island. Roosting under a 20 cm high saltbush plant.

WHITE-BACKED SWALLOW *Cheramoeca leucosternum*

Several birds noticed overhead on 5 and 6 June on Andamooka Island.

WELCOME SWALLOW *Hirundo neoxena*

On Stilt Island we recorded one bird on 14 May and two birds on 17 May, and on Andamooka Island we recorded two birds every day.

Interestingly, birds at both locations quickly learnt that our work tent was an excellent collector of insects and would spend some time each morning flying in and out or hanging from the walls catching insects.

TREE MARTIN *Cecropis nigricans*

A small flock of three birds noted over Andamooka Island on 29 May.

FAIRY MARTIN *Cecropis ariel*

A group of five birds observed on Stilt Island on 12 May and a single bird recorded on 18 May. Also observed overhead at Andamooka Island on 6 June.

RICHARD'S PIPIT *Anthus novaeseelandiae*

Observed amongst the saltbush shrubs on Andamooka Island on a number of days. Also recorded on Long Island.

BLACK-FACED CUCKOO-SHRIKE *Coracina novaehollandiae*

A single bird observed on Andamooka Island on 6 June.

RED-CAPPED ROBIN *Petroica goodenovii*

Several birds observed over a period of a week on Stilt Island. Our observations were of a single female on one occasion, a male and female on several consecutive days, and then two females several days later.

Also noted on Andamooka Island amongst saltbush shrubs.

WILLIE WAGTAIL *Rhipidura leucophrys*

A single bird noticed on 13 May snapping up insects on Stilt Island.

CINNAMON QUAIL-THRUSH *Cinclosoma cinnamomeum*

A common bird on Andamooka Island encountered every day amongst the sparse saltbush shrubs on gibber plain. Usually about 200 m between sightings.

BROWN SONGLARK *Cinclorhamphus cruralis*

A very common bird on Andamooka Island, found right across the saltbush shrubland on gibber plain. Males extremely vocal and displaying throughout our stay.

SPLENDID FAIRY-WREN *Malurus splendens*

One group living amongst Acacia shrubs on an area of deeper sand on Andamooka Island.

VARIEGATED FAIRY-WREN *Malurus lamberti*

Several groups found living in both the Acacia shrubland and amongst the sparse saltbush shrubs on the gibber plain.

WHITE-WINGED FAIRY-WREN *Malurus leucopterus*

The most common wren observed, with many groups found across Andamooka Island living in saltbush shrubland and small lignum thickets. Several groups were also resident on Long Island.

WESTERN FIELDWREN *Sericornis fuliginosus*

Found amongst the sparse saltbush shrubland on Andamooka Island. A nest with three tan-coloured eggs found on 7 June located close to the ground in a small *Sclearolena* sp. bush. Several birds were also recorded on Long Island.

SPINY-CHEEKED HONEYEATER *Acanthagenys rufogularis*

Found on Andamooka Island in areas of larger shrubs on sandy depressions. Feeding on nectar in *Eremophila* flowers and hawking for insects.

SINGING HONEYEATER *Lichenostomus virescens*

Found on Andamooka Island in similar habitat to Spiny-cheeked Honeyeater.

WHITE-FRONTED HONEYEATER *Phylidonyris albifrons*

Found in low numbers on Andamooka Island in the same area as above two species.

CRIMSON CHAT *Ephthianura tricolor*

Several pairs observed on the sparse saltbush shrubland of Andamooka Island.

ORANGE CHAT *Ephthianura aurifrons*

A pair over Stilt Island on 21 May. A very common species in the open saltbush shrubland of Andamooka Island, and several groups observed on Long Island.

WHITE-FRONTED CHAT *Ephthianura albifrons*

Several pairs observed on most days on Stilt Island. Also a common species on Andamooka Island throughout the saltbush shrubland.

MISTLETOEBIRD *Dicaeum hirundinaceum*

A single bird flying overhead at Stilt Island on 12 May.

BLACK-FACED WOODSWALLOW *Artamus cinereus*

Several birds soaring overhead at Andamooka Island on 29 May.

AUSTRALIAN MAGPIE *Gymnorhina tibicen*

Several birds on Andamooka Island on 7 June.

AUSTRALIAN RAVEN *Corvus coronoides*

Heard calling on Andamooka Island on 11 June.

LITTLE CROW *Corvus bennetti*

Up to 20 birds on Andamooka island, feeding on the carcasses of dead Red Kangaroos out on the gibber plains. Nest containing feathered young located in Myalls along temporary creek-line. A flock of nine birds circled the Stilt colony on North Colony Island on 6 June but were driven off by Silver Gulls and Red-necked Avocets.

DISCUSSION

A total of 64 species was observed, with nine species recorded only on the southern group of islands, 32 species recorded only on the northern group of islands and 23 species being common to both groups. This may be due to the larger size of the northern islands, the greater diversity of vegetation they supported and their proximity to the mainland (1 km compared with 13 km).

Evidence of breeding was recorded for 11 species; Emu, Black Swan, Grey Teal, Pink-eared Duck, Red-capped Plover, Banded Stilt, Red-necked Avocet, Silver Gull, Gull-billed Tern, Little Crow and Western Fieldwren. Although no direct evidence was collected other species which may have bred in the area include Brown Songlark and the three species of Chat.

The level of breeding on or near the lake was stimulated by the amount of easily exploited food resources available for both adults and chicks. The lake contained enormous numbers of protein rich brine shrimps and gastropods, while the island's vegetation was flowering and setting seed and attracting many insects. This breeding stimulus in an inland situation has been discussed previously by Chinner (1977). He observed an influx of "casually visiting" species to central Australia and attributed this and the incidence of breeding by resident species to the prolonged period of favourable weather conditions producing ample food supplies. While Chinner's observations were made over a three year period, our observations showed that the response of avian species to this filling of Lake Torrens was almost immediate, with species such as the Banded Stilt arriving at the lake and beginning to breed within weeks of the rains.

ACKNOWLEDGEMENTS

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REFERENCES

Badman, F. J. and May, I. A. 1983. Waders in northern South Australia. **S. Aust. Orn.** 29: 29–39.

Chinner, D. W. 1977. Observations on the effect of increased rainfall on birdlife in central Australia. **S. Aust. Orn.** 27: 188–192.

McGilp, J. N. 1949. Birds on the fringe of cattle country, N. E. South Australia. **S. Aust. Orn.** 19: 42–50.

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Extracts concerning BaSt from: Storr, G.M. (1986). *Birds of the South-eastern Interior of Western Australia.* Records of the Western Australian Museum, Supplement No.26.

Calidris ferruginea (Pontoppidan) Curlew Sandpiper

Status etc. Infrequent visitor (September-December), sometimes in flocks (up to 40). Recorded at Lake Brown, Kanandah and Kalgoorlie (Hannan Lake).

Recurvirostridae

Himantopus himantopus leucocephalus Gould Black-winged Stilt

Range. Western, east to Lake Brown and [Gunnadorah].

Status etc. Common in wet years; in ones, twos or small parties, occasionally in hundreds. Flooded claypans and saltlakes, also dams and sewage ponds. Breeding reports from Lake Barlee and near Kalgoorlie: August-October; C/4(8).

Cladorhynchus leucocephala (Vieillot) Banded Stilt

Range. Western, east to lake 21 km NW Laverton, Lake Raeside, Lake Rebecca, Lake Yindarlgooda and Lake Cowan.

Status etc. Moderately frequent visitor, sometimes in tens of thousands; most plentiful after heavy summer-autumn rains. Flooded saltlakes and claypans. Breeding reports from Lakes Barlee, Ballard, Marmion, Goongarrie and ? Cowan: ? winter 1904, 1963, June 1973, June 1974, April-May 1975, July-August 1980; C/2-5 (mostly 3 and 4).

Recurvirostra novaehollandiae Vieillot Red-necked Avocet

Range. North-western, south to Walgoolan, Southern Cross and Kalgoorlie, and east to Malcolm Dam and Lake Goongarrie. Casual further east (claypan 32 km SW Cosmo Newbery, dam 60 km NNW Naretha).

Status etc. Uncommon; in ones, twos or small flocks (up to 25). Flooded claypans and saltlakes. Breeding in March, August and November; C/2(1), 3(4), 4(34).

Burhinidae

Burhinus grallarius (Latham) Bush Stone-curlew

Status etc. Unknown but clearly rare. Only recorded from three western localities: Erlistoun (J. Rolfe), Station Creek (J.R. Ford) and Toomey Hills (B.J. Newbey).

Glareolidae

Stiltia isabella (Vieillot) Australian Pratincole

Rare visitor. Two at Kanandah in January 1971 (Brooker 1971, *West. Aust. Nat.* **12**: 21).

ABSTRACT

This paper is an annotated list of the 210 species of birds recorded from the South-eastern Interior. The region is located between lat. 28° and 32°S and long. 118°30′ and 129°E. It lies mainly in the arid zone.

INTRODUCTION

This is the sixth in a series of regional avifaunas covering Western Australia. Earlier papers dealt with the Kimberley (Storr 1980, *Spec. Publs West. Aust. Mus.* No. 11), the North-eastern Interior (Storr 1981, *Rec. West. Aust. Mus.* 9: 65-99), the Pilbara (Storr 1984, *Rec. West. Aust. Mus.* Suppl. No. 16), the Gascoyne (Storr 1985, *Rec. West. Aust. Mus.* Suppl. No. 21) and the Mid-eastern Interior (Storr 1985, *Rec. West. Aust. Mus.* Suppl. No. 22). The aim of the present work is the same as the others, i.e. to summarise for each taxon our knowledge of local distribution (localities outside the region are enclosed in square brackets), ecological status, abundance, habitat preferences, breeding season (i.e. the months eggs are laid in), clutch size* and movements. Taxonomic references cited in earlier papers are not repeated here.

The South-eastern Interior is defined as that part of the Eastern Land Division which lies south of lat. 28°S. In the east it is bounded by the South Australian border, in the south by the northern boundary of the Eucla Land Division, and in the west by the eastern boundaries of the North-West and South-West Land Divisions (see map, Figure 1).

The region is divisible on physiographic, climatic and vegetational criteria into four subregions.

1. South-eastern, comprising the western and northernmost parts of the Nullarbor Plain and its sparsely to lightly wooded fringes. Mean annual rainfall ranges from 15 cm in the east to 19 cm in the west with little seasonality. On the Nullarbor proper (the Western Australian sector of which lies almost wholly in the Eucla Land Division) the red clayey soil is extremely shallow over the limestone. Trees are virtually absent, and the vegetation is dominated by bluebush *Maireana sedifolia* (where not eradicated by sheep, cattle or rabbits). In low-lying areas (dongas), especially where the soil is deeper, saltbush *(Atriplex)* and tussock grasses *(Stipa, Danthonia)* appear.

   Westwards from the core of the Nullarbor, as the soil gradually deepens and the winter rainfall increases, low trees become more plentiful: myall *(Acacia papyrocarpa),* sugarwood *(Myoporum platycarpum)* and belar *(Casuarina cristata).* Northwards from the core it is summer-autumn rain that in-

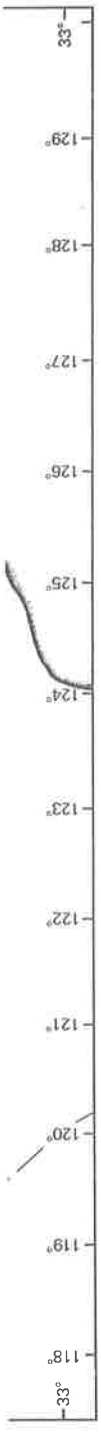

Figure 1 Map of the South-eastern Interior, Western Australia

* C/3(2), B/4(1) signifies, for example, two clutches of three eggs and a brood of four young out of the nest but still dependent.

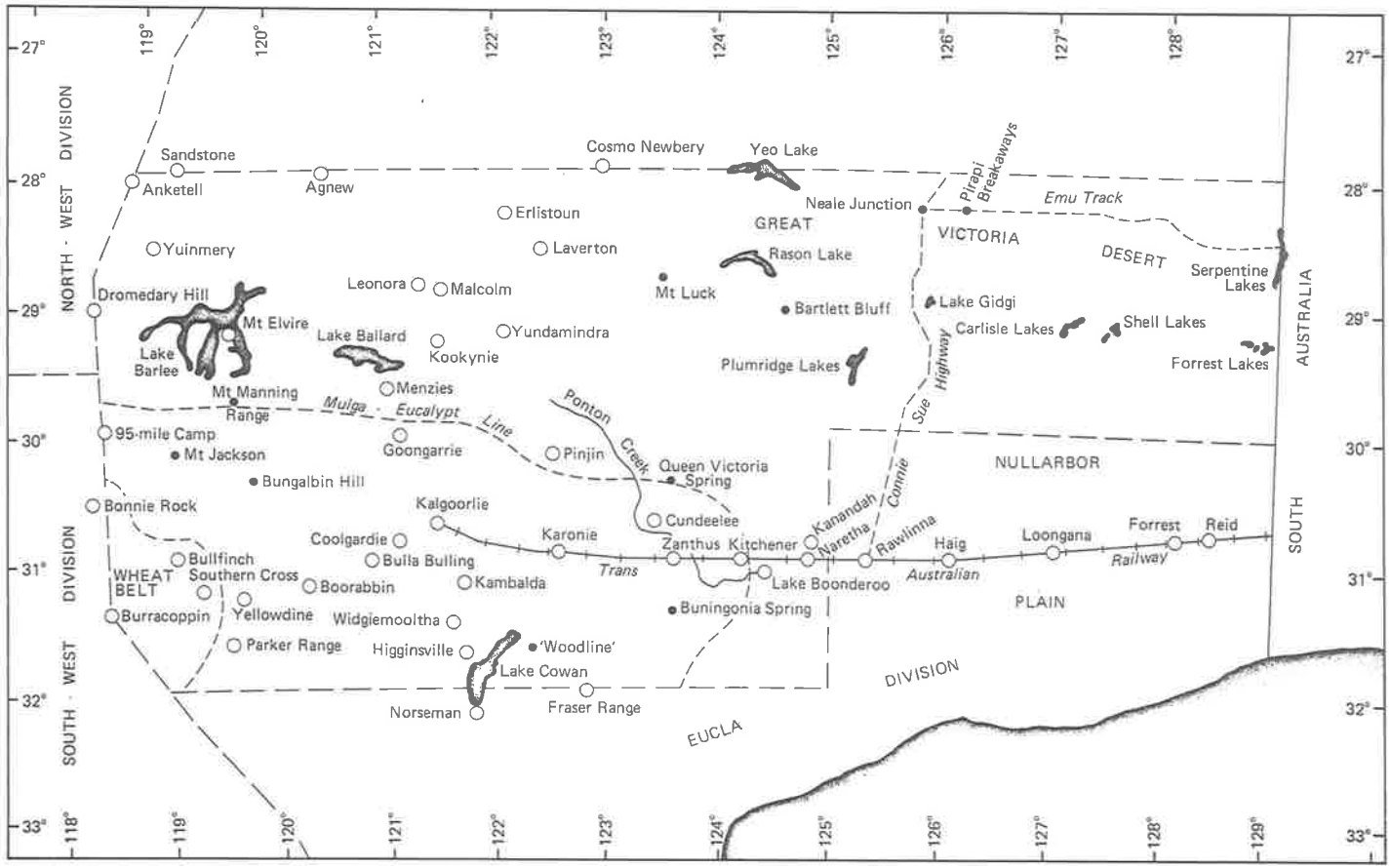

Figure 1 Map of the South-eastern Interior, Western Australia

creases, and in addition to myall and belar, mulga *(Acacia aneura)* and a mallee *(Eucalyptus oleosa)* become moderately plentiful.

There is a profuse growth of annual grasses and herbs after good rains. Surface water is ephemeral except at dams and stock troughs.

2. North-eastern, comprising the Great Victoria Desert. Annual rainfall ranges from 17 to 20 cm, most of it falling in summer and autumn. The soil is predominantly sandy, and the vegetation consists mainly of open woodlands of marble gum *(Eucalyptus gongylocarpa)* and very open mallee scrubs (especially *Eucalyptus youngiana),* with a ground layer mainly of spinifex *(Triodia).* The prevailing dunes and sandplains are interrupted by a few saltlakes and their surrounding flats of samphire, saltbush and other chenopods, and by a few breakaways and areas of heavy or stony soils dominated by mulga. Between the Desert and the Nullarbor there is a narrow east-west belt of dense mallee scrubs and more open mulga-mallee scrubs. Water is extremely scarce and confined to a few soaks and rockholes.
3. North-western, comprising the Precambrian plateau north of the mulga-eucalypt line. Annual rainfall ranges from 19 cm in the north-east (mostly in summer and autumn) to 23 cm in the south-west (mostly from late summer to early winter). The peneplains are broken only by a few low hills and breakaways. Soils are mainly red loams, and the vegetation is predominantly open to fairly dense mulga. Saltlakes are plentiful. There are several freshwater streams in the north; they are lined with river gums *(Eucalyptus camaldulensis).* The whole of the quarter is occupied by sheep stations. Grazing and browsing by sheep, feral goats and rabbits has removed much of the ground herbage or has replaced palatable chenopods with unpalatable shrubs. As well as river pools, soaks and rockholes, there are numerous dams and stock troughs.
4. South-western, comprising the Precambrian plateau south of the mulga-eucalypt line. Annual rainfall ranges from 20 cm in the north-east (mostly summer to early winter) to 33 cm in the far south-west (mostly autumn to early spring). Relief is gentle, but the soils and consequently the vegetation are far more varied than elsewhere in the region. Red clays and loams support eucalypt woodlands, especially of salmon gum *(E. salmonophloia),* gimlet *(E. salubris),* morrell *(E. longicornis)* and blackbutt *(E. lesouefi);* in the south and west, where rainfall is heavier and the soils more acid, the understory is dominated by sclerophyllous shrubs *(Melaleuca, Acacia* etc.); in the east, where rainfall is lower and the soils more alkaline, the understory is sparser and dominated by chenopods *(Maireana, Atriplex).* Stony or gravelly soils carry moderately tall scrubs of *Eucalyptus, Acacia, Allocasuarina* etc. On deep yellow sandplains there is a highly varied assemblage of low to medium-sized shrubs, including *Grevillea, Banksia* and other Proteaceae. Red sandplains carry open mallee *(E. oleosa)* and spinifex.

Part of the far south-west (delineated on map, Figure 1) has been cleared for agriculture. There are several sheep stations in the central zone, mainly about saltlakes and in the more open woodlands with chenopod understory. Surface

water in the form of dams and stock troughs is plentiful in agricultural and pastoral country; elsewhere it is scarce and confined to soaks and rockholes.

For a detailed account of the climate, geology and vegetation of the region see Beard (1974, 1975, 1976). For notes on the Great Victoria Desert see Ford (1971*a*). This paper is based on the collections of the Western Australian Museum, the literature (especially the papers cited under References) and the unpublished data of several naturalists, notably J.R. Ford, R.E. Johnstone, L.A. Smith, J. Dell, P.J. Fuller, G.M. Storr, W.H. Butler, W.L. Klau, B.J. Newbey, N. Kolichis, J.A. Smith, J.K. Rolfe, J. Reid, P. Coyle, L.J. Sylvester and P.M. Lambert.

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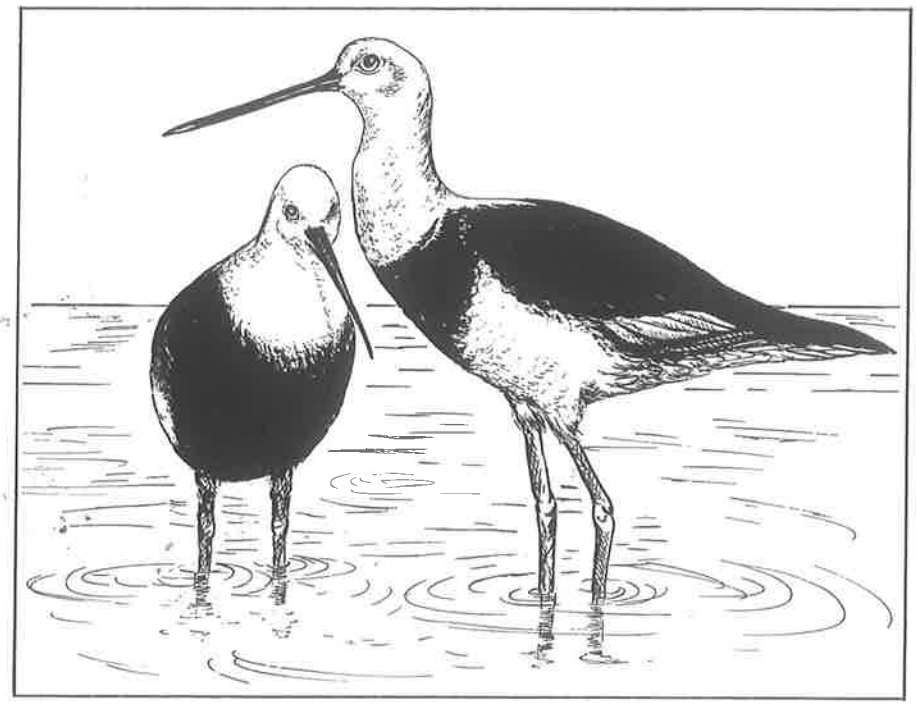
J. LANE

Records of the Western Australian Museum
Supplement No. 26

Birds of the South-eastern Interior of Western Australia



G.M. Storr

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Birds of the South-eastern Interior of Western Australia

G.M. Storr

Western Australian Museum
1986

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BANDED STILT BREEDING AT LAKE BARLEE, WESTERN AUSTRALIA

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SUMMARY

BURBIDGE, A.A. and P.J. FULLER, 1982. Banded Stilt Breeding at Lake Barlee, Western Australia. Emu 82: 212-216. A recently abandoned breeding colony of the Banded Stilt discovered at Lake Barlee, Western Australia, in September 1980, contained 179,000 nests and 255,000 addled eggs and dead chicks. Density of nests was as high as 18/m^2. Available data suggest that Banded Stilt colonies continue to be active for long periods while environmental conditions are favourable and that new nests are constructed in areas abandoned by running juveniles, hence the high density of nests.

INTRODUCTION

The Banded Stilt *Cladorhynchus leucocephalus* is an Australian endemic occurring in suitable habitat throughout the southern half of the continent. It breeds on islands and spits in large, remote salt lakes where its main food is the brine shrimps *Artemia salina* and *Parartemia* spp (Serventy & Whittell 1976). Nesting colonies are infrequently located and little is known of its breeding behaviour. The discovery of nests at Lake Barlee, Western Australia, in 1980, enabled information on breeding to be gathered.

METHODS

On 13 September 1980, while taking part in a biological survey of the Eastern Goldfields of Western Australia, we discovered flightless Banded Stilt chicks walking in the bush at Mt Elvire Station (29°22'S, 119°36'E) between 5 and 10 km from the shores of Lake Barlee, a large salt pan. We also saw a few three-quarter grown chicks feeding on brackish samphire swamps just north of Mt Elvire homestead. On subsequent days we searched the shoreline of Lake Barlee to the west, south-west and south-east of Mt Elvire homestead.

Between 24 and 26 September one of us (PJF) took part in an aerial survey of a number of lakes in the Eastern and North-eastern Goldfields. Most lakes between Kalgoorlie and Lake Carnegie and west to Lake Violet, Lake Barlee and Southern Cross (Fig. 1) were examined.

Nesting islands in Lake Barlee were inspected from the ground on 2 October 1980. The area of each island occupied by nests was calculated from measurements made with a 50 m tape. The number of nests on each island was estimated by counting nests in ten 1m^2 plots selected by throwing an egg over the shoulder and using the point of impact as the centre point of the plot. The number of addled eggs and dead chicks was also counted on two of the islands.

RESULTS

Lake Barlee filled after well above average rainfall in May and June 1980 (Table 1). Between 13 and 16 September the middle arm of the lake, west of Mt Elvire homestead,

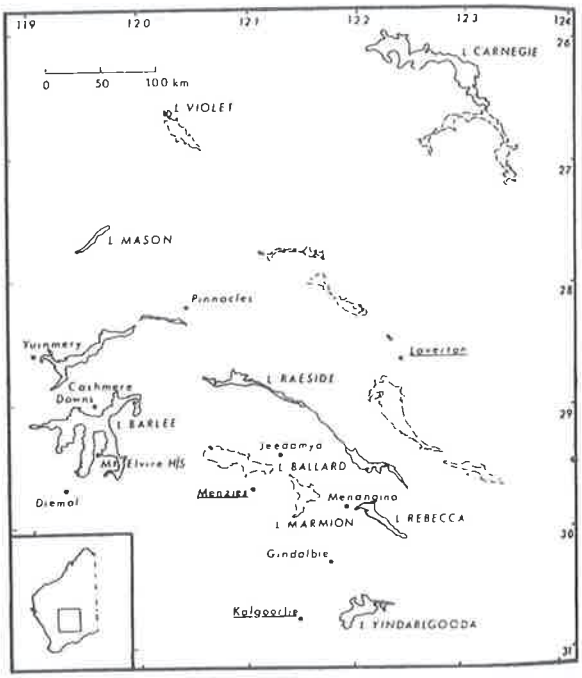

Figure 1. Eastern and North-eastern Goldfields of Western Australia showing lakes examined during aerial survey. Solid outlines represent lakes containing water on 24-26 September 1980 and dotted outline lakes were dry.

contained extensive sheets of shallow salt water. Depths within 300 to 400 m of the shore did not exceed 100 mm and the sheets of water were moving with the prevailing winds. On 16 September in an area 8 km south-west of the homestead we saw twenty-five live half-grown chicks and about 100 flying birds. Along the shore of the lake were more than 100 dead chicks varying in age from one or two days to fully fledged. The eastern arm of the lake, at a point 22 km south-east of the homestead, which was inspected on 18 September, also contained extensive sheets of shallow water, but no Banded Stilts were seen.

TABLE I

Rainfall (mm) near Lake Barlee, 1980

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total (Jan-Oct)	Annual Average
Diemal	57	14	1	20	120	135	36	8	1	4	396	251 (1970-1978)
Cashmere Downs	25	18	0	9	95	106	86	12	5	14	370	234 (1919-1978)
Menzies	12	33	0	17	79	68	81	3	4	8	305	243 (1896-1978)

Estimates of Banded Stilt obtained during the aerial survey were as follows:

Lake Carnegie – thousands,
Lake Violet – hundreds,
Lake Mason – thousands,
Unnamed, 21 km NW of Laverton – hundreds,
Unnamed, between Yuinmery and Pinnacles – tens of thousands,
Lake Raeside, several localities –
(a) 15,000 plus,
(b) 10,000 plus,
(c) hundreds,
(d) many thousands,
Lake Barlee – thousands,
Lake Rebecca – thousands,
Lake Yindarlgooda – thousands.

On 24 October we inspected from the ground some lakes between Yalgoo (28°21'S, 116°41'E) and Paynes Find (29°16'S, 117°41'E). On Mongers Lake we saw about 150 Banded Stilt and on an unnamed lake near Wownaminya Hill (28°27'S, 116°50'E) there were also about 150.

On 26 September, during the aerial survey, Lake Barlee contained significant amounts of water only in the north-eastern arm and adjacent central area. Most of the central and eastern arms were dry or nearly so. No sign of breeding was seen in the central arm (where previous observations on the ground indicated the presence of a colony) but three islands with nests and eggs were located in the eastern arm 11 km at 67° from Mt Elvire homestead. The nests appeared to be abondoned although a few Stilts were seen feeding in close proximity. Very shallow sheets of water surrounded these islands.

When inspected from the ground on 2 October 1980 the nests were abandoned. The only sign of life was twelve three-quarter grown chicks which ran away across the now dry lake bed. The islands were low, rising to about 1.5 m above the lake bed. Low scattered shrubs, primarily of samphire *(Halosarcia* sp) were the dominant vegetation. A few ephemerals were growing near the edges of each island.

The nests appeared to have been abandoned at least three to four weeks before our visit. A lot of the scrapes were empty but in some places up to thirty to fifty addled eggs were clumped against shrubs or in depressions, apparently having been blown there by the wind. Many dead chicks, varying in age from newly hatched to half grown, were scattered throughout the colonies.

The mean size of twenty eggs was 55.5 × 38.3 mm (range 51.5 - 68.0 × 35.0 - 41.4).

The number of nests in a 1 m² quadrat varied from zero to eighteen. Table II shows that the total number of nests on the three islands was about 179,000 and the number of addled eggs plus dead chicks on islands 2 and 3 (Table III) was about 216,000. If the weighted mean number of addled eggs and dead chicks from islands 2 and 3 is applied to island 1 the total number of addled eggs and dead chicks becomes 254,609.

DISCUSSION

The Banded Stilt population is known to concentrate on coastal lakes and estuaries when the inland lakes are dry (Serventy & Whittell 1976). The aerial survey data show that the species scatters over a wide area of inland Western Australia under suitable conditions. The data also reveal that in 1980 there were at least many tens of thousands of Banded Stilts in Western Australia. Doubtless our estimate is well below actual numbers; many flocks would not have been sighted and the larger flocks would probably have contained more birds than estimated.

Banded Stilts have been recorded breeding on various salt lakes in inland Western Australia and at Lake Callabonna is South Australia (Glauert & Jenkins 1931; McGilp & Morgan 1931; Jones 1945; Carnaby 1946, 1947; Fuller 1963; Jenkins 1975; Kolichis 1976; Serventy & Whittell 1976).

Previous estimates of the number of nests in a colony are as follows:

Lake Grace 1930 : one per square foot (930 cm²) over an area of nearly an acre (4,050 m²) in extent (Glauert & Jenkins 1931); about 1 foot (30 cm) apart covering three-quarters of an acre (3,000 m²) (Carnaby 1946); i.e. about 40,000 nests.

TABLE II

Number of nests at Lake Barlee

Island	Area (m^2)	Mean ± SE per m^2	Estimate mean and 95% Confidence Limits
1	3,180	9.3 ± 1.49	29,574 (18,857 - 40, 291)
2	4,730	11.1 ± 1.04	52,503 (41,388 - 63,619)
3	13,080	7.4 ± 1.16	96,792 (62,522 - 131,062)
All	20,990	8.52 ± 0.79	178,835 (143,991 - 213,678)

TABLE III

Number of addled eggs and dead chicks at Lake Barlee colony

Island	Area (m^2)	Mean ± SE per m^2	Estimate mean and 95% Confidence Limits
2	4,730	17.2 ± 2.15	81,356 (71,187 - 91,526)
3	13,080	10.3 ± 2.03	134,728 (108,172 - 161,276)
Both	17,810	12.13 ± 1.60	216,035 (155,125 - 276,946)

Lake Callabonna 1930 : 27,000 nests containing 81,000 eggs in an area of a little over 3 chains square (3,640 m^2) (McGilp & Morgan 1931).

Lake Grace 1946 : about 500 nests (Carnaby 1947).

Wagga Wagga Lake 1960 : 40 to 50 nests (Fuller 1963) (this colony was abandoned before egg-laying).

Lake Marmion 28-30 March 1975 : 50,000 pairs breeding in a very compact area 60 yards (54.8 m) wide by 100 yards (91.4 m) long with nests averaging 12 inches (30.5 cm) apart (G.A. Lodge, pers. comm.).

Lake Marmion late May 1975 : 2,500 nesting pairs plus 1,000 abandoned nests (Kolichis 1976).

None of these estimates approaches our figure of 178,835 ± 34,843 (95% confidence limits) at Lake Barlee, and it would appear that Banded Stilt breeding colonies can vary considerably in size. However, unless careful counts are made it is easy to underestimate nest numbers in colonial nesting species and it may be that some other authors have underestimated the size of colonies they saw. Kolichis (1976) described the Lake Marmion colony as consisting of nests 30 to 40 cm apart and covering an area of half a hectare but with "patches of unused ground throughout the rookery" (p 118). This suggests a colony of perhaps 20,000 or more, rather than 3,500 nests.

Previous authors have described Banded Stilt nests as being regularly spaced and about 30 cm apart (about 10/m^2). The photographs of the Lake Callabonna 1931 colony in McGilp & Morgan (1931) illustrate this well. The Lake Barlee colony differed considerably in having up to eighteen nests/m^2.

Nests at this density could not have all been occupied at the same time and the high density can only be explained by the same birds laying more than one clutch, each in a new nest, or more likely, successive waves of birds laying within the one colony. Evidence for this hypothesis is:

Lake Marmion colony, 1975. G.A. Lodge visited the colony on 28-30 March. In answer to our questions he stated (in litt.):

(i) nesting was at all stages from fresh eggs to fully fledged but non-flying young as well as flying birds with no chest band,

(ii) most nests in the centre of the colony were much more advanced (or empty) than nests at the edge of the colony,

(iii) fresh eggs were in nests around the perimeter of the colony or in new nests in the centre of the colony.

Kolichis (1976) visited the colony in late May. He also found breeding at all stages from fresh eggs to flying young. Kolichis stated that Lake Marmion filled from cyclonic rains in mid-February 1975, six weeks before Lodge's visit. The large fledged but non-flying young which Lodge saw suggest that breeding was underway before the mid-February rains. Rainfall during 1974 was high (Table IV) and the lake may well have held water for some time before.

Lake Ballard. Banded Stilt were reported breeding at Lake Ballard (60 km north-west of Lake Marmion) in July 1973 (Jenkins 1975), July 1974 (Serventy & Whittell 1976; Kolichis 1976) and May 1975 (Kolichis 1976).

This information confirms that Banded Stilts may continue breeding in a colony while environmental conditions remain suitable, and that new nests are constructed in the centre of a colony where older nests have been abandoned by running young.

Such behaviour could have high survival value in the environment in which the Banded Stilt breeds; where there is abundant food but usually only for a short space of time. Rains heavy enough to fill the inland salt lakes of Western Australia are infrequent and under these circumstances an ability to breed opportunistically (there is no site fidelity) and continously would be an advantage. The production of a larger egg than other Recurvirostridae (Table V) perhaps results in the hatching of precocial young better able to fend for themselves, releasing the parents to produce another clutch.

Whether the young Banded Stilts are fed by their parents is not known. A review of the literature suggests that *Himantopus* and *Recurvirostra* chicks leave the nest within hours of hatching and are not fed by their parents (von Frisch 1959, 1961; Hamilton 1975; Hale 1980). This may also be the situation in *Cladorhynchus*. McGilp & Morgan (1931) quote a letter from a Mr R. McKay who visited the Lake Callabonna colony as the eggs were hatching. He reported "When I drew near the island I first saw three old birds leading perhaps sixty young ones into the water. They appeared to be having some difficulty in enticing the little ones to enter the water, as they kept scampering back towards the nests. However, before I reached the island the old birds got them afloat, and once in the water the little ones showed no hesitation" (p 43). McKay took photographs (published by McGilp & Morgan) showing newly hatched chicks in the nest. Kolichis (1976) stated "As the rookery was approached we noticed the smallest chicks were closest to the nesting area and the largest chicks were furthest from the rookery, about 2 km away ... While several of the young were swimming they pecked at small black ostracod crustaceans floating on the surface of the water" (p 116), and "Adults were never seen feeding young birds" (p 118). Kolichis also published photographs of newly hatched chicks in the nest.

TABLE IV

Rainfall (mm) near Lake Marmion 1974, 1975.

	1974												1975		
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Menzies	9	22	98	68	27	44	48	22	50	5	44	-	3	242	3
Jeedamya	11	4	54	65	19	38	73	29	45	5	37	0	8	348	23
Menangina	5	67	97	46	18	35	72	15	66	5	26	18	3	279	8
Gindalbie	13	23	133	85	13	51	42	17	63	5	31	7	4	220	19

TABLE V

External dimensions of recurvirostrid eggs

Species	*dimensions (mm)*	*Reference*
Cladorhynchus leucocephalus	55.5 × 38.3	this paper
	55.3 × 39.6	McGilp & Morgan 1931
Himantopus himantopus	43 × 31	Serventy & Whittell 1976
	45 × 29	Beruldsen 1980
	43 × 32	Saunders 1927
Recurvirostra novaehollandiae	51 × 35	Serventy & Whittell 1976
	49 × 34	Beruldsen 1980
Recurvirosta avosetta	50.6 × 35.1	Witherby *et al.* 1941
	51 × 35	Saunders 1927

On the other hand G.A. Lodge (pers. comm.) stated that, at Lake Marmion, he estimated that the young stayed in the nest for one week before leaving to form creches at the edge of the colony. He also thought that chicks in creches were being fed by adult birds.

If feeding of the young occurs in the Banded Stilt it would be an advance in parental care compared to other recurvirostrids. Resolution of this point is of special interest in the light of recent documentation of the close relationship of Flamingos (Phoenicopteridae) to recurvirostrids and especially to *Cladorhynchus* (Olsen & Feduccia 1980). Parental care in Flamingos is marked and Berry (1972) has documented a case in which parent Lesser Flamingos *Phoeniconaias minor* flew round trips of up to 100 km to obtain food for chicks while the latter walked 80 km from their dried out breeding area to water. Banded Stilts certainly abandon their chicks to fend for themselves as lakes dry out. At Lake Barlee we saw many approximately half-grown chicks feeding in places where there were no adults. Unfortunately, we did not have the opportunity to observe young chicks.

Parent *Himantopus* and *Recurvirostra* do tend and defend the young for a time after hatching (Hamilton 1975; Hale 1980) but while small mixed broods may be tended by one or two adults they do not form creches like *Cladorhynchus*, behaviour reminiscent of flamingos.

At Lake Barlee breeding apparently continued for some time. There were approximately 255,000 addled eggs and dead chicks in the colony after it was abandoned, presumably because of falling water levels. Clutch size is three or four (McGilp & Morgan 1931; Glauert & Jenkins 1931; Kolichis 1976). With a mean of 3.5 eggs/nest, 179,000 nests would have contained over 600,000 eggs. This suggests that in the order of 350,000 young survived long enough to leave the islands. Doubtless, many chicks would have died before fledging, but even so breeding success must have been high.

ACKNOWLEDGEMENTS

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REFERENCES

BERRY, H.H. 1972. Flamingo breeding at Etosha Pan, South West Africa, during 1971. Madoqua 5 : 5-31.

BERULDSEN, G. 1980. A field guide to nests and eggs of Australian birds. Adelaide: Rigby.

CARNABY, I.C. 1946. A further nesting record of the Banded Stilt. Emu 46: 156–158.

—— 1947. Nesting of the Banded Stilt. Emu 47: 66–67.

FULLER, P.J. 1963. Breeding of aquatic birds in mid-Western Australia. West. Aust. Nat. 9: 9–12.

GLAUERT, L. & C.F.H. JENKINS, 1931. Notes on the Banded Stilt with a description of its eggs. J. Proc. Roy. Soc. West. Aust. 17: 1–6.

HALE W.G. 1980. Waders. London: Collins.

HAMILTON, R.B. 1975. Comparative behaviour of the American Avocet and the Black-necked Stilt (Recurvirostridae). Orn. Monogr. No. 17, 1–98.

JENKINS, C.F.H. 1975. Nesting of Banded Stilts at Lake Ballard. West. Aust. Nat. 13: 94–95.

JONES, J. 1945. The Banded Stilt. Emu 45 : 1-36

KOLICHIS, N. 1976. New breeding records of the Banded Stilt in Western Australia. West. Aust. Nat. 13: 114–119.

McGILP, J. & A.M. MORGAN. 1931. The nesting of the Banded Stilt. S. Aust. Orn. 11: 37–53.

OLSEN, S.L. & A. FEDUCCIA. 1980. Relationships and evolution of flamingos (Aves: Phoenicopteridae). Smithsonian Contributions to Zoology No. 316. Washington D.C.: Smithsonian Institution Press.

SAUNDERS, H. 1927. Manual of British Birds. 3rd Ed. London : Gurney and Jackson.

SERVENTY, D.L. & H.M. WHITTELL. 1976. Birds of Western Australia. 5th Ed. Perth: University of Western Australia Press.

VON FRISCH, O. 1959. Zur judendentwicklung, Brutbiologie und vergleichenden Ethologie der Limcolen. Z. Tierpsychol. 16: 545-583.

——. 1961. Zur judendentwicklung und Ethologie des Stelzenlaufers *(Himantopus himantopus)* und der Brachschwalbe *(Glareola pratincola)*. Z. Tierpsychol. 18: 67-70.

WITHERBY, H.F., F.C.R. JOURDAIN, N.F. TICEHURST & B.W. TUCKER. 1941. Handbook of British Birds Vol. IV. London: H.F. and G. Witherby Ltd.

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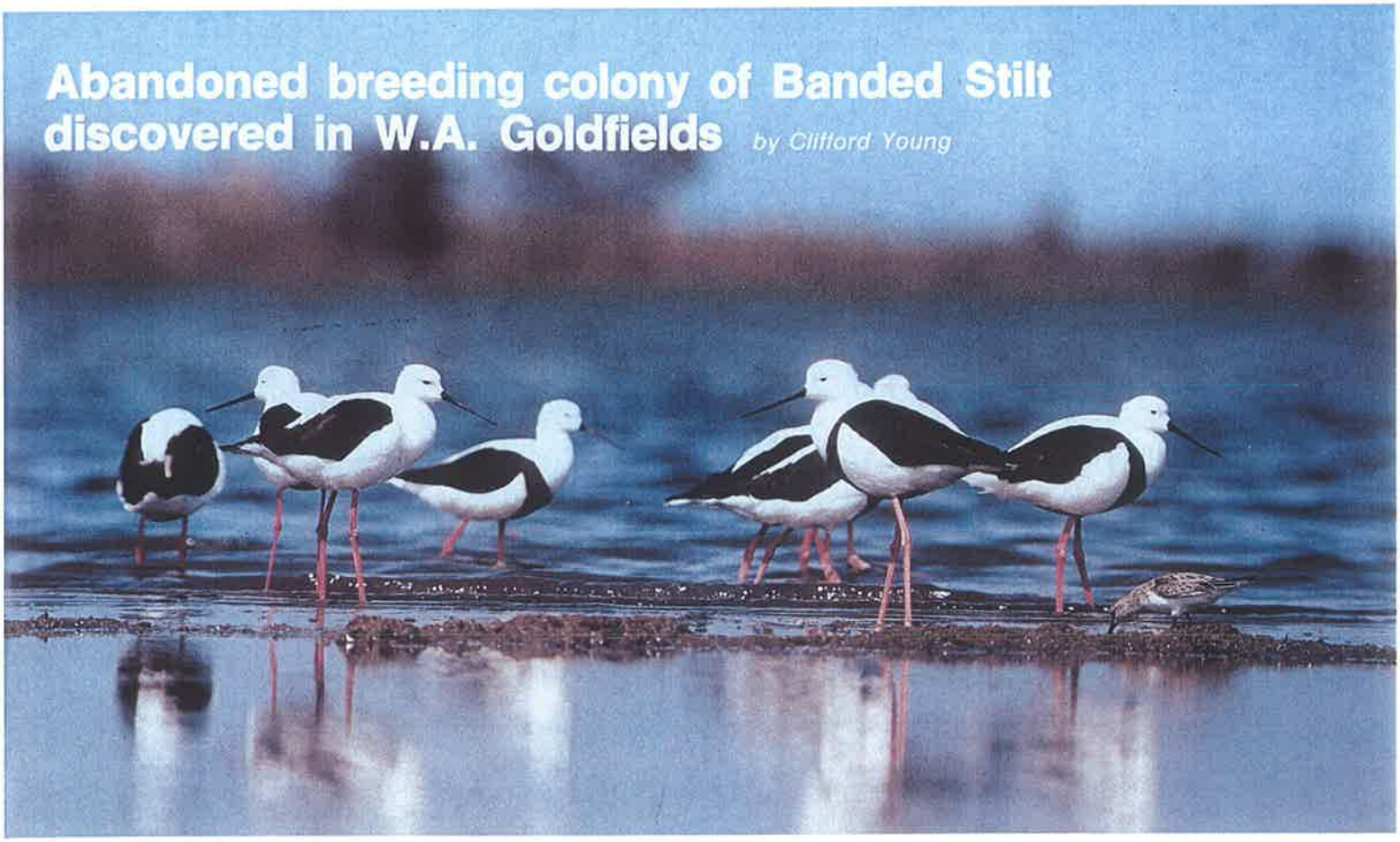
Abandoned breeding colony of Banded Stilt discovered in W.A. Goldfields

by Clifford Young



Although the Banded Stilt or Rottnest Snipe *(Cladorhynchus leucocephala)* is a relatively common bird found on salt lakes and brackish estuaries throughout the southern portion of Australia, until August, 1930 the bird provided one of Australia's most intriguing ornithological mysteries. Where did it nest, and what were its eggs like?

The Banded Stilt was first scientifically described in 1816 from a skin probably collected in southern Australia by the French expedition of *Le Geographe* and *Le Naturaliste* between 1800-1804. Then from about 1880 onwards the species became more and more often reported until the absence of nesting records for a species not found outside the Australian continent began to draw comment from many quarters. Except for false or mistaken claims of eggs found belonging to the bird which, in almost all instances turned out to belong to another species of stilt—the White-Headed Stilt, and an unsubstantiated report from Norseman in 1904 of black and white birds with black and white eggs nesting in large numbers, it was not until 1930 that the mystery was solved. In that year the birds were found nesting in large numbers at Lake Grace in Western Australia's eastern wheatbelt. By a remarkable coincidence, another nesting colony was located later the same year at Lake Callabonna in South Australia.

Since that time however, there has only been a handful of sightings of the bird nesting and ornithologists still have much to learn about its habits. It was therefore of great interest when Dr A. Burbidge and Mr P. J. Fuller from the Western Australian Wildlife Research Centre discovered a recently abandoned breeding colony of Banded Stilts at Lake Barlee while conducting a biological survey of the Eastern Goldfields in September last year.

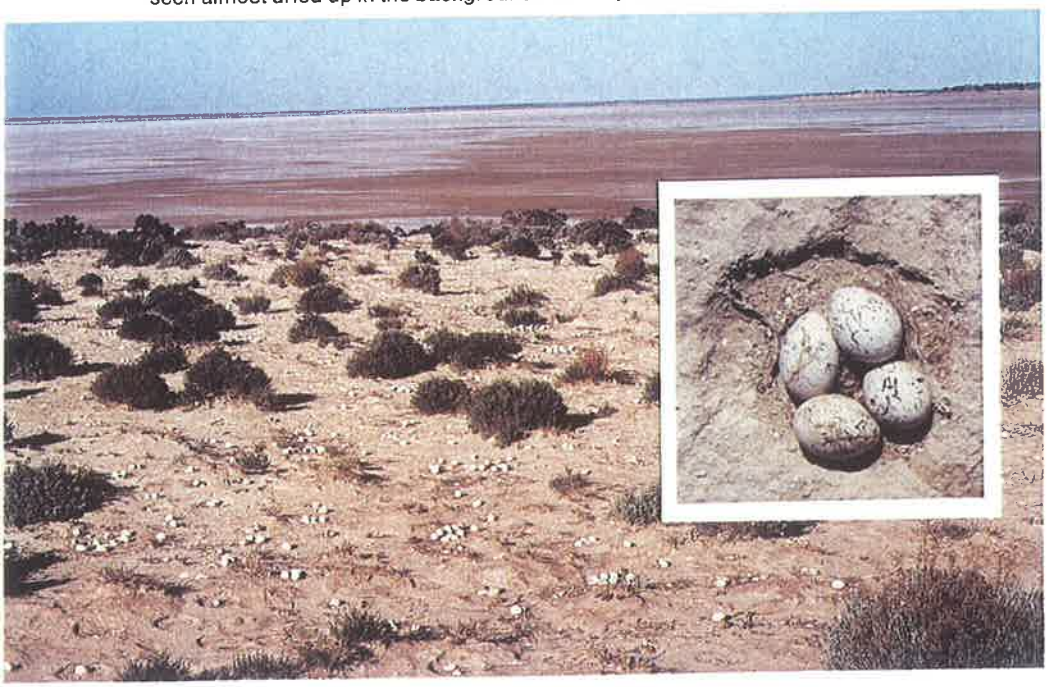
The colony was the largest yet recorded, and was estimated to contain 179 000 nests and more than 255 000 addled eggs and dead chicks.

Mr Fuller, who visited the abandoned colony said "it appeared to have been abandoned at least 3-4 weeks before his visit". Many nest scrapes were empty but in some places up to 30-50 addled eggs were clumped against shrubs or in depressions, presumably having been blown there by the wind, and dead chicks, varying in age from newly hatched to half-grown, were scattered throughout the colony. The only sign of life was 12 three-quarter grown chicks which ran away across the now dry lake bed.

Dr Burbidge said the expedition found the colony after seeing flightless Banded Stilt chicks walking through the bush near Mt Elvire Station, about 5-10 kilometres from the shores of Lake Barlee. This led the men to search the shorelines of the Lake to the west, south-west and south-east of the Mt Elvire homestead. The middle arm of the lake, west of the homestead, contained extensive sheets of shallow salt water with depths within 300-400 metres of the shore not exceeding 10 cms. In an area 8 km south west of the homestead about 25 live half-grown chicks were seen together with about 100 flying birds and along the shore of the lake were more than 100 dead chicks varying in age from 1-2 days to full-grown. The eastern arm of the lake was also inspected but although this also contained extensive sheets of shallow water, no Banded Stilts were seen.

▲ The expedition found many clumps of eggs at the base of vegetation. They had been blown there by the wind. Photo by P. J. Fuller.

▼ Abandoned eggs were scattered over three small islands on Lake Barlee which can be seen almost dried up in the background. Photo by P. J. Fuller.



▼ Banded Stilt Photo—Copyright A. G. Wells

It was not until an aerial inspection of the lake was undertaken that the large nesting area on three islands in the central arm of the lake was found, and this observation was followed up by a ground inspection on 2 October.

The area of each island was calculated and the number of nests on each island was estimated by counting nests in ten plots, each of one square metre, selected by throwing an egg over the shoulder and using the point of impact as the centre point of the plot. The results showed the three islands held about 179 000 nests and about 255 000 addled eggs and dead chicks.

However, as the clutch size is usually three of four, 179 000 nests would have contained over 500 000 eggs. This suggests that about 250 000 young survived long enough to leave the island. Even considering that many of these chicks would have died before being able to fly, the colony's breeding success must have been significant.

The density of nests on the islands was extremely high, up to 18 nests per square metre being recorded. Nests at this density could not have all been occupied by incubating birds at the same time so it would appear that breeding may have been continuous at this site for some time.

Heavy rain fell in the Lake Barlee area in May and June, 1980, with follow-up rains in July and breeding probably started soon after the lake filled. The birds may then have continued breeding as long as the environmental conditions remained suitable. The abandonment of the colony was probably triggered by a fall in the level of the lake which would have disrupted their food supplies. The Banded Stilt feeds mainly on small crustacea such as the Brine Shrimp *(Artemia salina)* and the related *Parartemia*. Both these crustacea are found in water high in salt content and their eggs are capable of surviving long periods of drought. They develop rapidly after heavy rains fill the lakes where they are found and crowds their lifetime into the brief time available in the shallow short-lived pools.

Dr Burbidge and Mr Fuller suggested that the high density of nests at Lake Barlee could only be explained by the same birds laying more than one clutch, each in a new nest, or successive waves of birds laying within the one colony. Available data also suggest that the parents do not feed the young for long but leave them to fend for themselves. Such behaviour has high survival value in the environment in which the Banded Stilt breeds—a place where there is abundant food, but for a very short time. Rains heavy enough to fill the inland salt lakes of Western Australia only occur, on average, every 5 years or so, and under these circumstances the Banded Stilt has, Dr Burbidge believes, developed a reproductive strategy based on high fecundity and minimal care of the young. The large egg it lays and the large well developed young are adaptions to this strategy.

Brief Nesting History of The Banded Stilt in W.A.

Australia is the only continent which does not have flamingoes—that flamboyantly colourful wading bird. Interestingly enough, however, fossil flamingoes have been found in Central Australia but apparently these died out millions of years ago. Recent research by scientists in the U.S.A. has shown that the Australian Banded Stilt is the closest living relative of the flamingoes.

The Banded Stilt *(Cladorhynchus leucocephala)* is a striking black and white bird and is often found in its thousands feeding in shallow inland salt lakes. In contrast, the birds' nesting habits, type of eggs and young remained a well guarded secret until 1930 when a colony was found nesting at Lake Grace on the edge of Western Australia's eastern wheatbelt. However, in the light of that discovery and a subsequent accurate description of the bird's unusual egg—a large, lustreless egg varying in colour between deep fawn and pure-white with black or deep brown markings forming twisting and turning lines over the surface—it would appear the Banded Stilt had been observed nesting earlier but not recognised at the time: A West Australian ornithologist, Mr F. Lawson-Whitlock wrote—"In the year 1904 I was in the Norseman district. The winter was exceptionally wet and Lakes Dundas and Cowan presented vast sheets of water. I saw Banded Stilts on Lake Dundas...Later in the year I met a young fellow who had been prospecting farther north on Lake Cowan. He told me he had come across a large colony of long-legged, long-beaked, black and white birds nesting on a sandy beach. He described the eggs as white with black markings. I was greatly puzzled as I held the view that the Banded Stilt probably migrated to a distant country to breed and I dismissed the probability that these birds were of that species. In the light of recent discoveries I now think that this was a colony of these remarkable birds."

In addition to its unusual egg (which is unlike the egg of any other wader and, according to Dr D. L. Serventy and H. M. Whittell in *"Birds of Western Australia"* approaches the pattern of eggs of the oyster catchers or Crested Tern), the Banded Stilt's young, when first hatched, are covered with pure-white down—the only such instance in the order of wading birds.

In the same year that the birds were first "officially" discovered nesting at Lake Grace, there was an unconfirmed report of Banded Stilts nesting in the Menzies area, north of Kalgoorlie, by Mr T. Smith of Kalgoorlie. Mr Smith said there was a huge migration of young birds from a large lake in the Menzies area—"almost as soon as they were hatched they started to walk toward the coast. I doubt if any reached there. I would be quite safe in saying they must have died by the hundred-thousand, for a strip of country about 30 miles wide was literally white with the dead birds."

Since the report of the original discovery at Lake Grace, further evidence was gathered that the birds had also nested at the same time at Lake King, 80 kilometres to the east.

No further nesting was reported until 1945 when an attempt was made again at Lake Grace followed by another attempt in 1946—both failed due to flooding. In November, 1960, preparations for nesting were found at Wagga Wagga Lake in the Yalgoo District, but this also failed—this time due to the lake drying up. Adult birds with young were encountered along the Canning Stock Route in 1971 and it was presumed nesting had taken place that year at Lake Disappointment. In 1973 and again in 1975, nesting was observed at Lake Ballard, north-west of Menzies. Also in 1975, 50 000 nesting pairs were seen at Lake Marmion, 35 kilometres east of Menzies.

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Director of Fisheries and Wildlife B. K. Bowen. B.Sc.

The support of the public is an essential component in any conservation or reserve management programme—but an informed, educated public is needed to ensure its continuing success.

This publication is designed as a medium by which the various organisations, individuals, and wildlife management personnel may be kept informed of the work being carried out by this department, of departmental policies and directions: and for promoting a better understanding and appreciation of Western Australian wildlife and the role it plays in maintaining a suitable environment in which man can live.

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COVER PHOTO: by G. R. Barron

The Western Grey Kangaroo *(Macropus fuliginosus)* is so similar to the Eastern Grey Kangaroo that they were only separated with certainty as a result of studies on breeding biology and blood characteristics in 1966. The animal has a distinctly grey fur, although ocassionally showing browner tones, and normally dwells in eucalypt woodland and sclerophyll forest. (see page 20 for details of the Grey Kangaroo management programme).

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