A review of Australian Painted-snipe records from the Hunter Region, 1966-2020

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Records of Australian Painted-snipe *Rostratula australis* from the Hunter Region were analysed and 37 occurrences were identified from 18 locations over the period 1966-2020. The majority of records were from the spring-summer period, with only a few records during autumn and winter. There have not been any winter occurrences since 1984. The annual pattern of occurrence for the region was the same as for the state as a whole.

Most of the records were from the Lower Hunter sub-region although possibly that reflects greater survey effort in that sub-region. Occurrences in the Upper Hunter sub-region were associated with watercourses. There is only one known record for the Northern Hunter sub-region.

Drought and drought-breaking rains were identified as important drivers for occurrences in the Hunter Region. Short-term flood events that recharge local wetlands were found to be a factor contributing to favourable conditions. The study has highlighted the importance of the region in providing a refuge for the species during periods of extended drought in New South Wales.

Australian Painted-snipe have been recorded more frequently in the Hunter Region in recent times. In the period spanning 1966-1997 there were 0.33 occurrences per year on average. For the period 1998-2020, there were 1.08 occurrences per year on average.

Details are provided for a breeding event in 1972 at Lenaghans Swamp. Although that is the only confirmed breeding by Australian Painted-snipe in the Hunter Region, there have been several instances of pre-breeding behaviour during the main New South Wales breeding period of October-February.

INTRODUCTION

The Australian Painted-snipe *Rostratula australis* is a nomadic waterbird that is now recognised as endemic to the Australian mainland (Lane & Rogers 2000; Baker *et al*. 2007; Christidis & Boles 2008). It was previously considered to be a subspecies of the Greater Painted-snipe *Rostratula benghalensis* which occurs in Africa and Asia.

The species is listed as endangered under the New South Wales (NSW) *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is also listed as Endangered by the International Union for the Conservation of Nature (Herring & Silcocks 2014).

The Australian Painted-snipe mainly frequents shallow, ephemeral, freshwater wetlands. It has been reported over much of mainland Australia but is more common in eastern Australia. Although it has never been abundant, the population is reported to have experienced a substantial decline throughout most of its range, possibly by as much as 90% since the 1950s (Lane & Rogers 2000; Oring *et al*. 2004). The most recent population estimate is of 1,000-2,500 birds (Herring & Silcocks 2014). It is unclear why the population has declined, although wetland habitat loss and degradation through drainage and diversion of water for agriculture and other human uses were suggested as likely causes (Oring *et al*. 2004; Herring & Silcocks 2014).

The decline in numbers in NSW is reflected in recent Reporting Rates (RR; defined as the number of surveys in which the species was recorded divided by the total number of sites surveyed, expressed as a percentage). During the decade 1970-1979 when the first Atlas of Australian Birds was being compiled, the RR in NSW was 0.61% and in the period 1990-1998 it had fallen to 0.127% (Lane & Rogers 2000). In 2005 the RR for

Australian Painted-snipe in NSW was only 0.08% (Cooper *et al*. 2016).

Before the 1950s, Australian Painted-snipe was regularly recorded in the Riverina area of NSW / Victoria, where it often bred. Subsequently, that area has seen the greatest decline in numbers (Lane & Rogers 2000). Painted-snipe have also been reported in small numbers from elsewhere across NSW, in particular the Paroo wetlands, Lake Cowal, Macquarie Marshes, the Gwydir watercourse and along the east coast. Important coastal locations are wetlands around the Hawkesbury River and the Clarence and Lower Hunter valleys (Office of Environment and Heritage 2004). During the 2012-2013 season, relatively large numbers were reported to be temporarily using rice fields in the Riverina, indicating that the species has the ability to adapt to the changed landscape (Herring & Silcocks 2014). These authors imply that following two wet years in 2010-2012, the Riverina became an important area for the species' recovery.

Cooper *et al*. (2016: 13) describe its status as follows: 'For many years the Australian Painted-snipe was thought of as rare and declining, but since widespread rain in 2010 there was an increase in sightings in NSW, with groups of up to 70 birds being reported. This indicates that this is a 'boom and bust' species able to cope well with Australia's climate extremes by reproducing rapidly after rain, but limiting breeding activity during periods of drought'. The species is cryptic, calls rarely, feeds mainly at night, roosts in dense vegetation during the day and often freezes when disturbed (Menkhorst *et al*. 2017). These behaviours undoubtedly contribute to the low RR.

Movement patterns of the species are poorly understood and its occurrence is irregular and infrequent. Lowe (1963) stated that it appeared nomadic and its movements were largely dependent upon seasonal conditions. Comparison between winter and summer records in the Atlas of Australian Birds (Blakers *et al*. 1984), the New Atlas of Australian Birds (Barrett *et al*. 2003) and the Atlas of Birds of NSW and ACT (Cooper *et al*. 2016) indicates that the species exhibits regular seasonal movements. There are many more records across NSW from spring and summer than during autumn and winter. There is, however, uncertainty as to where the birds move to during the cooler months. Black *et al*. (2010) suggested there may be regular seasonal migration of part of the population between south-eastern Australia and central and north coastal Queensland wetlands between February and August, to exploit favourable seasonal conditions. Movements have been attributed to be in response to a number of weather-related events including moving to more productive flooded areas, moving away from drying wetlands and moving away from regions affected by drought (Lowe 1963; Schodde & Tidemann 1988; Marchant & Higgins 1993; Menkhorst *et al*. 2017).

Breeding in NSW is reported to occur from mid-August to February, mostly from October onwards. The birds form small flocks (of both males and females) during the breeding season and disperse subsequently (Marchant & Higgins 1993). The species has a particular preference for breeding habitat, choosing ephemeral freshwater wetlands, especially after heavy rains or flooding. The preferred wetlands are characterised by complex shorelines with low fringing vegetation, areas of exposed mud and very shallow water (Oring *et al*. 2004; Purnell *et al.* 2014; Rogers *et al*. 2005). This allows the birds and their young to exploit the productivity boom that follows receding floodwaters (Menkhorst *et al*. 2017). Nests are usually located among tall, rank tussocks of grass, reeds, rushes or samphire, frequently on small, muddy islands or mounds surrounded by shallow freshwater and sometimes on the shores of swamps or banks of channels (McGilp 1934; Lowe 1963; Purnell *et al*. 2014). During the non-breeding season, the species prefers a wider range of habitats including permanent freshwater, or sometimes brackish wetlands, and occasionally they are found among tall reeds (Oring *et al*. 2004).

In the Hunter Region, the Australian Painted-snipe is classified as rare (Williams 2019). The earliest record of the species in the region is from the spring of 1832, near Merriwa when an expedition led by Lieutenant Breton passed through the area. Breton noted 'In the creek we shot ducks, teal, widgeon and a few snipe, amongst which may be included the painted snipe, larger, and far handsomer than the common one' (Breton 1833). Gould (1848) recorded the species as 'tolerably plentiful in the district of the Upper Hunter, particularly in the flats of Segenhoe, Aberdeen and Scone' following heavy, widespread rain in 1839. Another early record is a skin specimen collected at Terragong, near Merriwa, in May 1905 and held in the Ornithological Collection at the Australian Museum (Australian Museum 2020). Both records are from the Upper Hunter. D'Ombrain (1944) reported an injured Painted-snipe found at West Maitland in October 1943.

The objective of this review is to:

(i) summarise and describe the known occurrences, numbers, locations and temporal distribution of records for the Hunter Region; and

(ii) determine if occurrences are related to identifiable weather events in inland NSW and/or the Hunter Region.

The Hunter Region and its sub-regions were defined by Stuart (2018) as follows:

- The area managed by Local Governments of Newcastle, Lake Macquarie, Maitland, Cessnock and Port Stephens (Lower Hunter sub-region)
- The area managed by Local Governments of Dungog and MidCoast (Northern Hunter sub-region)
- The area managed by Local Governments of Muswellbrook, Scone and Singleton and the area formerly managed by Local Governments of Merriwa and Murrurundi (Upper Hunter sub-region)
- The ocean within 100km of the coastline.

METHODS

Records of sightings of Australian Painted-snipe within the Hunter Region were obtained from the following sources: BirdLife Australia Birdata database (BirdLife Australia 2020); Eremaea Birdline; Birdline New South Wales (Eremaea Birdline 2020); Hunter Bird Observers Club (HBOC) Annual Bird Reports (Stuart 1993-2018); The Cornell Lab of Ornithology eBird online database (The Cornell Lab of Ornithology 2020); and historical records from the NSW Bird Report and HBOC Record Book (A. Stuart pers. comm.). Records were also obtained for Ornithological Collection items from the Australian Museum, Sydney (Australian Museum 2020). Occurrences were treated as being confirmed if there were reports from multiple observers and/or by obtaining information from the original observer.

The records that were considered acceptable were sorted by location and date. The number of birds recorded and the number of records for each location was compiled. When there were multiple records over time at some locations, each record was allocated to a discrete occurrence. A discrete occurrence is defined as being one or more birds recorded on one or more occasions at a single locality on a single date or a number of closely grouped dates. The discrete occurrences were sorted into monthly records and charted. The total number of birds recorded each year was also calculated and charted, with records of birds 'Present' treated as records of single birds.

Australian Painted-snipe occurrences for the Hunter Region were also sorted into records from each of the three sub-regions, for further analysis.

To determine if occurrences in the Hunter Region were related to local weather events, or to periods of drought in inland NSW, annual rainfall records were obtained from the Bureau of Meteorology (Bureau of Meteorology 2020a) for Williamtown (representing the Lower Hunter sub-region), Narrandera and West Wyalong (both representing inland NSW). Rainfall data were charted together with the number of occurrences for each year from 1966 to 2020. The linear average rainfall for the period for Williamtown and West Wyalong was calculated and plotted on the chart. The major drought periods for NSW were also plotted, these being 1972-73, 1982-83, 1991-95, 2002-09 (Millennium drought) and 2017-19 (Smith 2002; Bureau of Meteorology 2020b).

RESULTS

The earliest record found with a specific location and date was in December 1966. Throughout the Hunter Region, there have been 152 reports of Australian Painted-snipe between December 1966 and February 2020. However, many of those records were repeat observations of the same bird(s); when taking this into account there have been 37 discrete occurrences from 18 different locations. The list of locations and the dates of occurrences are summarised in **Table 1**. The majority of the locations were clustered in the Lower Hunter sub-region. There were only two occurrences in the Upper Hunter sub-region, both of them in 2012, and one occurrence in the Northern Hunter sub-region, at Tea Gardens in 2020. The two Upper Hunter records involved birds present along watercourses.

In the Lower Hunter sub-region, four locations have had multiple occurrences. The location with the longest history of Australian Painted-snipe occurrences is Kooragang Island with eleven occurrences spanning 1972-2017. Pambalong Nature Reserve has had six occurrences spanning 1984-2011 and Hexham Swamp four occurrences from 2006-2013. There have been two occurrences at Lenaghans Swamp, in 1972 and 2006. Fourteen other Lower Hunter sub-region locations have had single occurrences. The longest period for a single occurrence was seven weeks, at Pambalong Nature Reserve from August to October 1984. The number of birds present at an occurrence has varied from single birds, on many occasions, to a maximum count of 19 birds which was at Tumpoaba Reserve, Maryland in October 2012.

Table 1. Locations, dates, numbers of birds and records for Australian Painted-snipe occurrences, Hunter Region, 1966-2020.

Location	Date(s) of occurrences	No. of birds	No. of records
Lower Hunter sub-region			
Awabakal Reserve, Dudley	20/01/2003	1	1
Bunnings Swamp, Wallsend	7/01/2014 - 15/01/2014	1-11	19
Chisholm Wetlands, Maitland	24/01/2011 - 26/01/2011	1	3
East wetland, Cooranbong	29/09/2017	1	1
Ellalong Lagoon, Congewai	18/11/2011 - 21/11/2011	2	2
Grahamstown Dam, Raymond Terrace	15/07/1976 - 25/07/1976	2	2
Hexham Swamp, Hunter Wetlands National Park	11/10/2006 - 12/11/2006	1-2	2
	6/01/2009 - 19/02/2009	1-4	9
	22/01/2012 - 5/02/2012	3-4	4
	26/01/2013 - 9/02/2013	1-4	4
Irrawang Swamp, Irrawang	4/01/2003 - 6/01/2003	2	2
Kooragang Island, Hunter Wetlands National Park	22/12/1972	2	1
	31/03/1973	1	1
	12/11/1977	2	1
	10/12/1996	1	1
	16/02/2004	1	1
	2/11/2004 - 27/12/2004	1-2	12
	2/11/2011 - 4/11/2011	1-7	5
	18/01/2012 - 2/03/2012	1	7
	26/01/2013	1	2
	4/12/2013 - 27/12/2013	2	3
	13/09/2017	1	1
Lenaghans Swamp, Minmi	26/10/2006 - 17/12/2006	1-4	9
	19/11/1972 - 16/12/1972*	5-17	4
Pambalong Nature Reserve, Minmi	18/08/1984 - 5/10/1984	1-2	8
	7/09/1986	2	1
	20/12/1997 - 23/12/1997	1	2
	26/12/2000 - 3/01/2001	1-2	12
	13/10/2006 - 12/11/2006	1	5
	24/11/2011	1	1
Toronto	26/12/1966	1	1
Tumpoaba Reserve, Maryland	26/10/2012 - 28/10/2012	6-19	2
Wallis Creek Wetlands, Louth Park	11/01/1992 - 15/02/1992	1	1
Windeyer Swamp, Heatherbrae	15/10/1972 - 1/12/1972	1-8	3
Upper Hunter sub-region			
Sandy Creek, Castle Rock	29/11/2012	1	2
Widden Brook, Widden	14/11/2012	1	2
Northern Hunter sub-region			
Myall Quays, Tea Gardens	11/01/2020 - 6/02/2020	1	15

* Two nests with eggs recorded at Lenaghans Swamp, December 1972

The 37 discrete occurrences comprised records for 55 separate months but with 14 of the occurrences extending over two or more months. The distribution of monthly records is presented as a histogram in **Figure 1**. Records have been more frequent for the period from September-February (with a total of 51 records) and there has been a distinct peak for the November-January period. The highest numbers of monthly records have been in January and November (with 12 occurrences in each of those months). There have been two occurrences in March and single occurrences in July and August. Since 1966 there have been no records for the April-June period.

A total of 117 Australian Painted-snipe have been recorded in the Hunter Region since 1966. The annual distribution is presented as a histogram in **Figure 2**. The peaks have been in 1972 (with a total of 27 birds recorded in the region) and 2012 (with a total of 26 birds). For the period 2011-2014 there was a cluster comprising records for a total of 55 birds, while 2002-2009 had a smaller cluster totalling 17 birds.

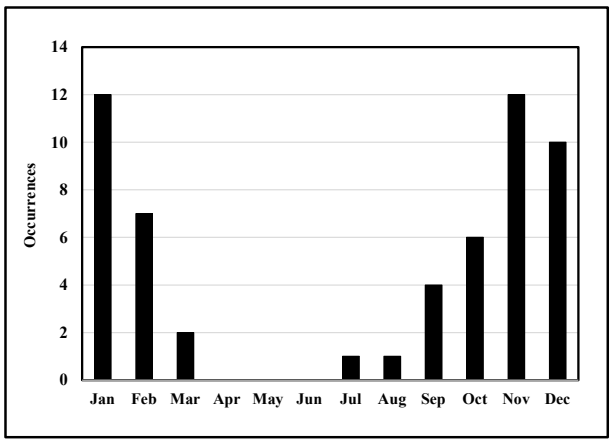

Figure 1. Monthly records of Australian Painted-snipe in the Hunter Region 1966-2020.

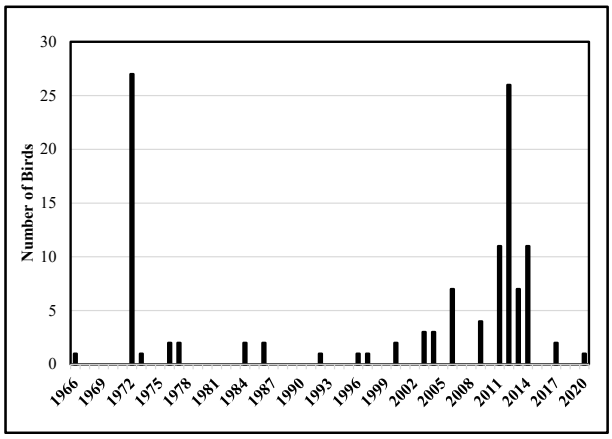

Figure 2. Annual numbers of Australian Painted-snipe in the Hunter Region 1966-2020.

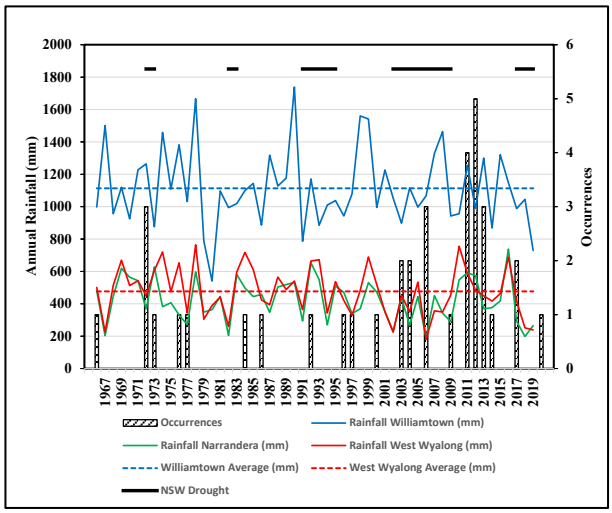

Figure 3. Australian Painted-snipe occurrences in the Hunter Region, annual rainfall records for Williamtown, Narrandera and West Wyalong and NSW drought periods, 1966-2020.

Figure 3 presents the annual Australian Painted-snipe occurrences and the corresponding rainfall records for the Lower Hunter sub-region (as measured at Williamtown) and inland NSW (at Narrandera and West Wyalong). The NSW drought periods are also shown.

The three discrete occurrences in 1972 (involving 27 birds) were during the 1972-73 drought. Over this period there was above-average rainfall in the Lower Hunter sub-region and slightly below-average rainfall in inland NSW. There were no occurrences of Australian Painted-snipe in the Hunter Region during the 1982-83 drought. There was a single occurrence during the 1991-95 drought and additional single occurrences in each of the following two years. Below-average rainfall was recorded in the Lower Hunter sub-region and inland NSW during this period.

The 2002-2009 Millennium drought produced an influx of birds into the Hunter Region. There were eight occurrences (involving 17 birds) over that period, during which there was below-average rainfall in both the Lower Hunter sub-region and inland NSW. In the years immediately after the breaking of the Millennium drought there was another influx of birds in the region, with 13 occurrences (involving 55 birds) over 2011-14. The 2017-19 drought produced a single occurrence, which was in the Northern Hunter sub-region in early 2020.

Breeding record

A single breeding episode was identified, at Lenaghans Swamp in November-December 1972 (**Table 1**). On 19 November 1972, five birds were found roosting amongst water buttons *Cotula coronopifolia* and swamp oak *Casuarina glauca* around a shallow, seasonal fresh-water swamp. A subsequent survey on 10 December recorded at least 13 birds in the same area including a male that flushed from a nest which had four eggs. On another survey on 16 December, which recorded 17 birds, the original nest and eggs were still present and a male flushed from a second nest, which contained three eggs. The latter nest had been constructed within a clump of grass growing from a cow pat. On 20 December, when ten birds were recorded, there were large fragments of shell alongside the original nest. Although no chicks were seen, it was concluded that there had been a successful hatching. However, the nest with three eggs appeared to have been abandoned. On a follow-up visit on 10 January 1973, the wetland had dried out and no painted-snipe were detected (D. Gosper pers. comm.; G. Stevens pers. comm.).

DISCUSSION

A notable aspect of the Australian Painted-snipe occurrences is the clustering of locations in the Lower Hunter sub-region. There were 15 locations, compared with two locations in the Upper Hunter sub-region and one in the Northern Hunter sub-region. This imbalance in distribution of sites is probably because the majority of the larger Hunter Region wetlands are on the Hunter River floodplain where the wetlands are permanently maintained by coastal rainfall and occasional flooding from up-river. Furthermore, many of those wetlands are close to the major population centres and are readily accessible; hence they have been surveyed more often than wetlands elsewhere in the region. Some wetlands such as those on Kooragang Island have been surveyed for more than 40 years. This imbalance in effort may have resulted in a bias of records towards the Lower Hunter sub-region compared with the Upper and Northern Hunter sub-regions. The historic records from around the Merriwa, Segenhoe, Aberdeen and Scone areas and the more recent records from Widden and Castle Rock shows that the species frequents the Upper Hunter. The painted-snipe is probably under-reported in that sub-region because of the distance from major population centres and the consequent lack of regular survey effort. The single record from Tea Gardens could reflect a similar situation in the Northern Hunter sub-region.

Both of the Upper Hunter sub-region records were of birds present along watercourses. So too was the 1832 record from near Merriwa (Breton 1832). This indicates that birds visiting the Hunter Region do not necessarily restrict their presence to open wetlands if conditions are favourable.

The data also reveal an increased frequency of occurrences from the mid-1990s onwards. In 1966-1997 there were 0.33 occurrences per year on average whereas for 1998-2020, they increased to 1.08 per year on average. The latter period corresponded with the start of the Second Australian Bird Atlas (in 1998) and the subsequent establishment of the Birdata and eBird databases, all of which may have contributed to increased survey effort and introduced an element of bias. Consequently, it is unclear whether or not painted-snipe numbers have increased in the Hunter Region. However, the combination of increased frequency of occurrence and increased numbers of birds does suggest that there has been a change over the past 20 years.

The monthly records for the Hunter Region show the same pronounced seasonal pattern as for the whole of NSW. The absence of winter records for the region after 1984 may indicate a change in the species' pattern of movements, or that conditions in the Hunter Region are no longer suitable during winter. Another explanation is that there has been an overall decrease in the Australian Painted-snipe population.

Droughts and floods

As the Australian Painted-snipe is a nomadic bird with a small population spread over much of mainland Australia, single occurrences of one or two birds probably are not significant. However, multiple occurrences in a single year or clusters of occurrences over several consecutive years can be interpreted in relation to weather-related events. The 1972 influx occurred during a period of drought in NSW but with heavy rain locally at times. As measured at Williamtown, 532.6 mm of rain fell over December 1971 to January 1972 (Bureau of Meteorology 2020a). The rain produced a significant flood with a 5-10-year Average Recurrence Interval (ARI) rating in the Williams and Paterson Rivers (D. Williams pers. comm.). Both rivers are tributaries of the Hunter River. The December-January rain was followed by another 279 mm in October-November 1972. Lenaghans Swamp would have been recharged by those rain events.

Windeyer Swamp is located at Heatherbrae, immediately below the confluence of the Williams and Hunter Rivers. It also would have been recharged by the 1972 rain events. Up to eight birds were reported there over October-December 1972, dispersing from the site by the time it had dried up in January 1973.

The influx of birds during the 2002-2009 Millennium drought indicates that when severe, long-term drought affects inland NSW, Australian Painted-snipe use coastal wetlands as a drought refuge. Purnell *et al*. (2014) reported that 58% of all records of Australian Painted-snipe from 2002-2009 in eastern Australia were at permanent coastal and near-coastal wetlands. The local records seem to support that conclusion. The influx into the Hunter Region after the Millennium drought correlates with an increase in records across NSW at that time (Cooper *et al*. 2016; Purnell *et al*. 2014; Herring & Silcocks 2014). The influx accords with painted-snipe dispersing from inland ephemeral wetlands after breeding, in search of more permanent wetland habitat

(Marchant & Higgins 1993). In the period 2010-2014, only 25% of painted-snipe records in eastern Australia were from coastal and near-coastal wetlands. By comparison, between October 2010 and July 2011 high numbers were recorded at inland wetlands in the Murray-Darling basin (Purnell *et al*. 2014). The influx of numbers into the Hunter Region in 2010-2014 was in stark contrast to the reduced numbers at other coastal wetlands, which highlights the importance of the Hunter Region to the species when conditions are favourable.

In the Lower Hunter sub-region, there was a sequence of four 2-5-year ARI flood events, in December 2010, June 2011, November 2011 and March 2012 (D. Williams pers. comm.). These would have recharged the estuarine wetlands. The annual rainfall data in **Figure 3** do not reflect these shorter-term events.

The occurrences at Widden and Castle Rock in the Upper Hunter sub-region in 2012 were part of the influx of birds to the Hunter Region following the Millennium drought. The records from the Segenhoe, Aberdeen and Scone areas in 1839 also were following widespread rain (Gould 1848).

The 2020 Tea Gardens bird's disappearance coincided with a significant rainfall event commencing 7 February 2020 across much of NSW. Over the ensuing several days, Williamtown recorded 141 mm, West Wyalong 95 mm and Narrandera 61 mm (Bureau of Meteorology 2020a).

Breeding

The 1972 breeding episode at Lenaghans Swamp accords with the species' known breeding behaviour of exploiting the productivity boom around ephemeral wetlands following receding floodwaters, and then dispersing (Menkhorst *et al*. 2017).

Although there has only been one recorded breeding event in the Hunter Region, 86% of all the painted-snipe occurrences have been from the period October-February, which is the main breeding period in NSW (Marchant & Higgins 1993). Also, several of those occurrences have involved gatherings of multiple birds, males and females, which is a known pre-breeding behaviour (Marchant & Higgins 1993). Therefore, it seems likely that birds have bred in the Hunter Region on other occasions. The painted-snipe's small population and cryptic nature possibly have led to an under-recording of local breeding episodes.

CONCLUSIONS

The occurrence of Australian Painted-snipe in the Hunter Region reflects the pronounced seasonal pattern exhibited in other areas of the state, with the species recorded dominantly in spring-summer and rare winter occurrences. The rate of occurrence in the Hunter Region has increased since the mid-1990s but this may in part, be the result of increased survey effort in key areas of habitat. There have been very few occurrences in winter, the last such record being from 1984.

This present study has shown that significant weather-related events such as long-term drought and drought-breaking rains provide drivers for most occurrences of Australian Painted-snipe in the Hunter Region. It also highlights the importance of permanent wetlands in the Lower Hunter as refuges for the species during drought and for breeding when conditions are suitable. Short-term flood events that recharge the wetlands may also be a factor contributing to favourable conditions.

The Australian Painted-snipe is probably under-recorded in the Hunter Region, particularly in the Upper and Northern Hunter sub-regions where visits by observers are irregular. In contrast, regular surveying of more permanent, readily accessed wetlands in the Lower Hunter sub-region may have produced a bias in records. The presence of flocks containing male and female birds between October and January on several occasions and records of nests associated with one such flock suggests that breeding in the Hunter Region may occur more frequently than recognised to date. There are no indications that local wetlands are unfavourable for breeding under the appropriate weather conditions. For better understandings about local breeding activity, it is recommended that whenever flocks are found in suitable habitat in the period from October to February, they be closely monitored. Watercourses in the Upper Hunter should also be surveyed more closely when conditions are favourable.

The small population, nomadic behaviour, cryptic nature, mainly nocturnal foraging and rare vocalisation are factors which make study of the Australian Painted-snipe difficult. However, the availability of online sites, such as Birdata, and

blogs such as Hunterbirding to report local sightings, provide tools that could be used to disseminate sightings details in real time and facilitate more regular, longer-term observation of future occurrences.

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