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Status of the Endangered Yellow Chat *Epthianura crocea tunneyi* on the western South Alligator River floodplain, Kakadu National Park

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Abstract. The current status of the Endangered Yellow Chat Alligator Rivers subspecies *Epthianura crocea tunneyi* is poorly known. A survey of Kakadu National Park floodplains, Northern Territory, in 2004 identified the western floodplain of the South Alligator River as a key population area. To provide preliminary information on the status of the subspecies in Kakadu National Park, this floodplain was intensively surveyed over a 4-day period in September 2014 and compared with the 2004 survey, which was undertaken at a similar time of year (late dry season: October–November). Despite covering considerable areas of floodplain habitat over nearly 40 hours of surveying, Yellow Chats were recorded in only one area in 2014; 27 Yellow Chats from nine observations were recorded over 2 days, with a minimum number of 17 individual birds (16 adult and 1 juvenile) observed. This compared with a total of 65 Yellow Chats from 2 days of surveying in 2004, clustered around five areas of the western floodplain of the South Alligator River. Habitat in 2014 comprised predominantly dry floodplain lagoon, consistent with previous surveys. Feral animals (in particular Feral Pigs *Sus scrofa*) were regularly observed throughout the surveys, as was significant feral-animal damage to wet floodplain areas. Although these results suggest a possible decline on the western South Alligator River floodplain over a 10-year period, a comprehensive survey is required of all floodplains within the subspecies' range to assess overall population status. This could inform the establishment of annual monitoring sites in order to evaluate long-term population trends, essential data for management of threatened species.

Introduction

The Australian endemic Yellow Chat *Epthianura crocea* consists of three subspecies occurring in northern and central Australia (Higgins *et al.* 2001). The non-threatened nominate subspecies *E. c. crocea* has a widespread but patchy distribution from the Kimberley region of Western Australia through to western Queensland (Higgins *et al.* 2001). The Capricorn subspecies *E. c. macgregori* has a low population size and a restricted range on the central Queensland coast near the Fitzroy River (Houston *et al.* 2009, 2013), and is currently listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), although the latest assessment of its status considers it to be Endangered (Garnett *et al.* 2011). The Alligator Rivers subspecies *E. c. tunneyi* is listed as Endangered under the EPBC Act, also on account of its restricted range and low population size (Garnett *et al.* 2011). This subspecies is restricted to alluvial coastal and subcoastal grassy floodplains from the Adelaide River to the East Alligator River in the Northern Territory (Higgins *et al.* 2001; Armstrong 2004). Its core distribution comprises the floodplains of the Van Diemen Gulf drainages within Kakadu National Park (NP) (Armstrong 2004).

The Alligator Rivers subspecies occurs primarily around sparsely vegetated floodplain lagoons, depressions and channels, and in the late dry season aggregates at remaining waterholes and drying lagoons (Armstrong 2004). This floodplain habitat is dynamic, being subject to seasonal flooding during the northern Australian wet season (generally November–April) and to frequent fire during the dry season (generally May–October). Garnett *et al.* (2011) listed the key threat to the subspecies as habitat degradation resulting from introduced weeds, grazing, Feral Pigs *Sus scrofa*, altered fire regimes and saltwater intrusion from rise in sea-level. The exact impact of many of these factors on Yellow Chats is unclear and requires further investigation. Physical damage to habitat by pigs may be a key threat, particularly in Kakadu NP (Armstrong 2004), where pigs are the dominant feral ungulate on the floodplain (Jambrecina 2010).

The only dedicated surveys for the Alligator River subspecies of the Yellow Chat were by Armstrong (2004), who surveyed Kakadu NP floodplains and recorded 32 observations totalling 96 individuals over a ~2-week period (25 October–5 November 2004) in the late dry season. The latest assessment of the subspecies' status considers it to consist of a single subpopulation of an estimated 500 mature individuals inhabiting an area of occupancy of 170 km^2, with both area of occupancy and number of mature individuals decreasing (Garnett *et al.* 2011). However, there remain many critical gaps in knowledge of ecology, threats and status, with no surveys undertaken in the last decade.

The Kakadu NP Threatened Species Strategy (Woinarski & Winderlich 2014) outlines the need to survey and assess the status, distribution, seasonal movements and habitat requirements of the subspecies, and to establish robust monitoring. With this in mind and considering the 2004 surveys (Armstrong 2004) as a baseline, we aimed to survey accessible areas of the South Alligator River western floodplain in Kakadu NP for Yellow Chats.

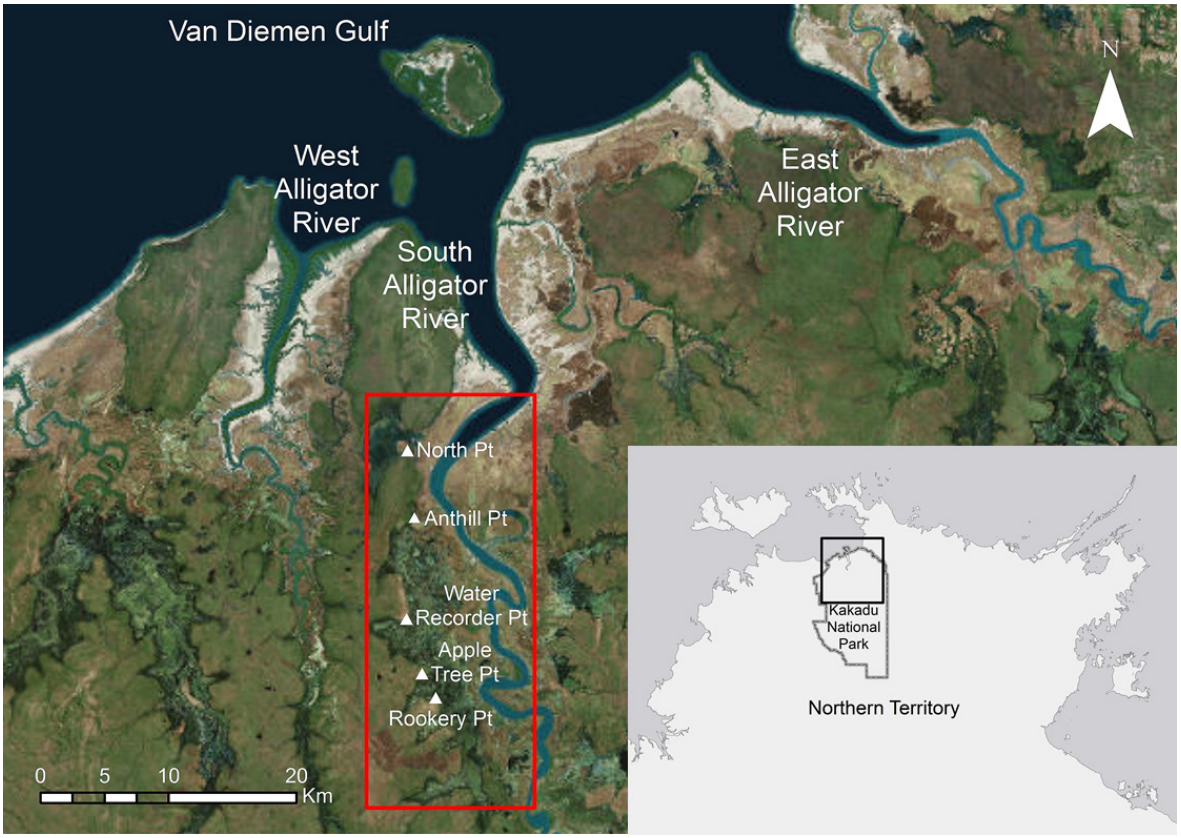

Figure 1. Major rivers of the Alligator Rivers Region of Kakadu National Park, Northern Territory; survey area (red box) for Yellow Chats on the western floodplain of the South Alligator River and sites referred to in the text are shown.

Study Area and Methods

Study area

The Van Diemen Gulf located in the Top End region of the Northern Territory is characterised by several river systems with extensive floodplain habitats including the Alligator Rivers (Figure 1). The South Alligator River (Arnhem Highway bridge: 12°39'42"S, 132°30'25"E) and accompanying floodplains are contained entirely within Kakadu NP. The western floodplain of the South Alligator River was selected as the study site for these surveys as most Yellow Chat records from the Armstrong (2004) surveys were contained in this area (26 of 32 observations/65 of 96 individuals recorded), which would allow for a comparison with this baseline, and because the floodplain is accessible in the late dry season. A scoping trip was undertaken on 11 September 2014 to determine land access to the floodplain edge, which was found to be possible by conventional four-wheel-drive (4WD) vehicle at Anthill Point, Water Recorder Point, and Rookery Point ('Boatshed') (Figure 1).

Surveys

Surveys were undertaken using 4WD Polaris Ranger vehicles, conventional 4WD vehicles or on foot (or by a combination of these) each morning from 23–26 September 2014. Surveys commenced at dawn or as soon as possible thereafter. Three separate survey teams were deployed on the first three mornings, and one was deployed on the final morning to take advantage of available helicopter time, which was used to locate and access more remote areas of floodplain habitat (i.e. North Point; Figure 1). Each survey team consisted of a leader experienced in bird-survey techniques and familiar with local bird fauna, and one or two additional participants. Each day focussed on accessible floodplain areas with previous Yellow Chat records and suitable habitat (Table 1, Figures 1–3).

Survey teams travelled across accessible floodplain areas with the aim of covering as much suitable habitat as possible on each morning. Suitable habitat (sparsely vegetated shallow seasonal floodplain lagoons, channels and depressions, and thickets of the scrub genus *Sesbania*) were extensively searched for the presence of Yellow Chats. Given that Armstrong (2004) noted Yellow Chats typically occurring within ~20 m. of *Sesbania*, any thickets visually observed were investigated during surveys. In addition, sites where there were positive records from the 2004 surveys (Armstrong 2004; Figure 3) were incorporated into the 2014 surveys.

Development of digital data collection and mapping for the surveys followed methods established through the North Australian Indigenous Land and Sea Management Alliance Limited I-Tracker program (NAILSMA 2014). An I-Tracker data collection application was designed using CyberTracker™ software (Cape Town, South Africa) to record survey effort, observations of Yellow Chats and of feral animals and habitat assessments. CyberTracker™ uses a sequential, multiple-choice approach and data entry is done using a touch screen. The application was loaded onto Getac (Baoshan, Taiwan) PS236 rugged

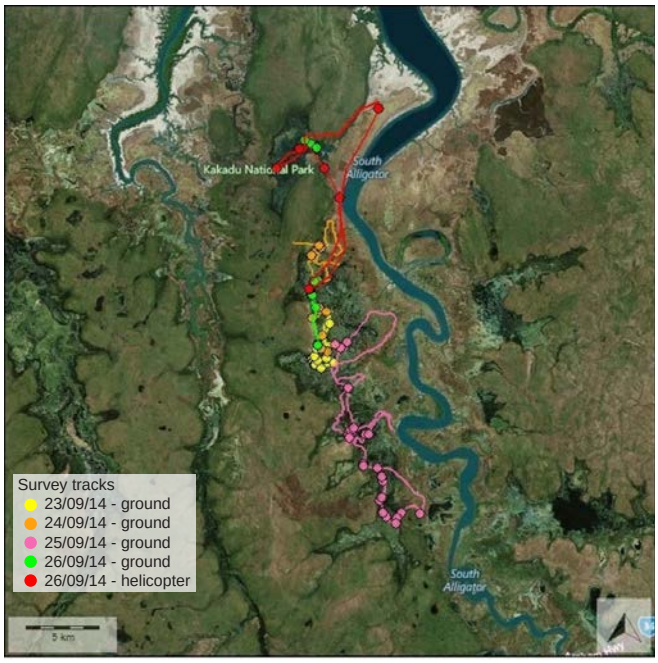

Figure 2. Combined daily Yellow Chat ground survey tracks and helicopter flights. Lines show the survey tracks and flights; dots show a data record (i.e. Yellow Chat observation, feral animal observation).

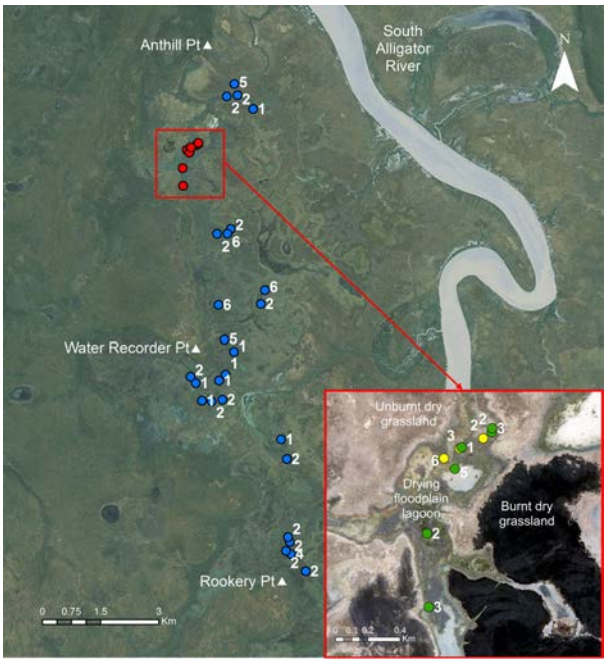

Figure 3. Yellow Chat records on the western floodplain of the South Alligator River from the November 2004 surveys (Armstrong 2004) (blue dots; n = 65 from 26 sites) compared with the 2014 surveys (red dots). Red box depicts area of insert with Yellow Chat records from 24 September 2014 (yellow dots; n = 11 from 3 sites) and 26 September 2014 (green dots; n = 16 from 6 sites). Group size is shown for each record. Note that all 2014 sightings (insert) were on the drying floodplain lagoon (burnt and unburnt dry grasslands are not representative of the time of the 2014 survey).

personal digital assistants that include inbuilt GPS, camera and voice recorder, and provided to each survey team.

The I-Tracker application recorded a GPS waypoint for every observation (i.e. of Yellow Chats and feral animals), and a GPS reading was taken every 1 minute to record the track of the survey team. For each survey, the application recorded the distance covered and the total time spent between the start and end of the survey. The application also contained a series of field maps that allowed users to view their present location and tracks from any time during the survey to assist with navigation and route planning. Before the surveys, each team leader was trained in the use of the I-Tracker application, and all survey participants were briefed on Yellow Chat identification (including sexing and ageing) and calls, survey methods and data collection.

Observations of Yellow Chats

For each observation of Yellow Chats, the user was prompted to record: number of male, female and juvenile Yellow Chats; habitat type; density of feral-animal damage at the observation site; and evidence of fire at the observation site. The habitat, feral-animal damage and fire parameters were recorded for the immediate vicinity (~10 m radius) of the birds. Habitat categories were: unburnt dry grassy floodplain, burnt dry grassy floodplain, floodplain lagoons, channels and depressions (this category encompassed: wet, drying and dry lagoons, channels and depressions), *Sesbania* thicket, mangroves, samphire, saline mudflat and *Melaleuca* woodland. Extent of feral-animal damage was recorded in one of four categories: very severe (>50% damage to the ground and vegetation within ~10 m radius of where Yellow Chats were sighted); severe (10–50%); some (1–9%); or minimal to no damage (<1%). The user was also prompted to photograph the observation site and provide comments about the observation. The application included digital images of Yellow Chats and habitat types for easy reference during data collection and to assist with standardising observations across survey teams. When Yellow Chats were sighted, particular care was taken to note size and composition of each group, and direction of movement of the birds to minimise the possibility of double-counting individuals.

Assessment of macro-habitat

At the end of each survey, the user was prompted to perform a habitat assessment for the whole survey by recording: percentage of each habitat type (categories as above), the overall extent of feral-animal damage on floodplain lagoons, channels and depressions (categories as above), and any comments on the survey.

Observations of feral animals

For each observation of a feral animal(s), the user was prompted to record the species of animal (Horse *Equus caballus*, Feral Pig, Cattle *Bos taurus*, Water Buffalo *Bubalus bubalis*) and how many individuals there were

Table 1. Overview of Yellow Chat survey areas and survey type, South Alligator River western floodplain, September 2014. Refer to Figure 1 for the location of areas referred to in the table. * = Area was accessed by car, ^ = area was accessed by helicopter

Date	*Area*	*Number of surveys*	*Survey type*	*Distance covered (total km/day)*	*Survey time (total hours/day)*
23.9.14	Water Recorder Point	3	Foot*	15.12	10.45
24.9.14	Anthill Point	2	Polaris/foot	36.15	11.48
	Water Recorder Point	1	Car/foot		
25.9.14	Rookery Point	3	Polaris/foot	62.66	13.71
26.9.14	Water Recorder Point	2	Car/foot	13.01	3.78
	North Point	1	Foot^		
Totals		**12**		**126.94**	**39.42**

Results

Survey effort and overall survey habitat assessments

Ground surveys covered 126.9 km over a total survey effort of 39.4 hours (Table 1). Plotted combined daily survey tracks are shown in Figure 2. Two helicopter flights were used to locate and access a more remote area of the floodplain (rather than actively survey for Yellow Chats from the air). These flights covered 38.3 km over 0.7 hours flying time, which allowed for the identification of an area of floodplain north of North Point for a ground survey.

Habitat assessments for each survey are provided in Appendix I. Although not the primary focus of the surveys, a considerable amount of dry grassy floodplain (unburnt: 10–88%, average 53.69%, or burnt: 0–35%, average 8.62%) was covered during vehicle and foot surveys while moving between areas of suitable Yellow Chat habitat. Floodplain lagoons, channels and depressions comprised 3–90% (average 24.54%) of surveys, with the following habitats more minor components of surveys: *Sesbania* thickets (0–15%, average 2.92%), *Melaleuca* woodland (0–7%, average 1.38%), saline mudflats (0–7%, average 0.69%), and mangroves (0–4%, average 0.46%). No samphire habitat was surveyed.

The helicopter flights (*n* = 2; habitat assessment pooled across the two flights) covered: 35% unburnt dry grassy floodplain, 45% burnt dry grassy floodplain, 10% floodplain lagoons, channels and depressions, and 10% saline mudflats.

Table 2. Yellow Chats recorded in this study between Water Recorder and Anthill Points, South Alligator River western floodplain, Northern Territory, September 2014: number of adult males, adult females and juveniles in each group, and feral-animal damage to the habitat in the immediate vicinity of these observations. Feral-animal damage is rated as 'severe' for 10–50% and as 'some' for 1–9% of habitat damaged.

Date	*Adult males*	*Adult females*	*Juveniles*	*Feral-animal damage*
24.9.14	4	1	1	Severe
24.9.14	2	1	0	Severe
24.9.14	1	1	0	Some
26.9.14	3	2	0	Some
26.9.14	2	0	0	Some
26.9.14	1	2	0	Some
26.9.14	1	0	0	Some
26.9.14	0	2	0	Some
26.9.14	1	2	0	Some

Records of Yellow Chats

Yellow Chats were observed on one area of drying floodplain lagoon, between Anthill Point and Water Recorder Point (12°26′S, 132°21′E) [Figure 3, in which records have been plotted along with those from Armstrong (2004) for comparison].

Three observations were made on 24 September 2014, comprising 7 adult males, 3 adult females and 1 juvenile (totalling 11 individuals) (Table 2; Figure 3). The greatest distance between observations was 270 m. The area was revisited on 26 September 2014 to further survey the drying lagoon system. Six observations were made, comprising 8 adult males and 8 adult females (totalling 16 individuals) (Table 2; Figure 3). Group size ranged from one to six birds (average 3.0 birds ± standard deviation 1.6) (Table 2), which is similar to the observations of Armstrong (2004): (range 1–6 birds, average 2.5 ± 1.7). The greatest distance between observations was 1140 m. It is likely that at least some of the same individuals were observed over the 2 days, hence the minimum number of *adults* observed was 16, and the maximum was 26 (plus a single juvenile).

Yellow Chat habitat

The habitat where all Yellow Chat observations were made was a predominantly dry floodplain lagoon with cracking clay, patchy vegetation and decaying *Eleocharis* species; there was minimal remaining water in the lagoon area. Vegetation was dominated by patches of the perennial grasses *Hymenachne acutigluma* and *Pseudoraphis spinescens*, with sparse *Eleocharis* (annual or perennial sedges; species unidentified) and interspersed thickets of the shrub *Sesbania* (unidentified, but likely *S. burbidgeae*) (Figure 4). Also noted were the perennial herbs *Ludwigia ascendens* and *Persicaria attenuata*, and sedges of the genus *Cyperus*.

Figure 4. Yellow Chat habitat on the western floodplain of the South Alligator River, Northern Territory. (a) Aerial view of predominantly dry floodplain lagoon with burnt dry grassland in the foreground; note pig damage on dry lagoon edge; (b) very severe feral pig damage (Water Recorder Point); (c) ground view of habitat showing *Hymenachne acutigluma, Pseudoraphis spinescens* and *Eleocharis*; (d) *Sesbania* thicket; (e) adult male Yellow Chat foraging amongst short *Eleocharis* and *Pseudoraphis spinescens*; (f) adult male and female Yellow Chats perched on *Sesbania*. Photos: a–d Peter M. Kyne, e–f Micha V. Jackson

Yellow Chats were observed actively foraging amongst short vegetation (*Pseudoraphis spinescens* and *Eleocharis*), on decaying *Eleocharis* and on dry mud surfaces along the edge of vegetation. They frequently flew between vegetation and mud patches, and were regularly observed perched on *Sesbania* thickets, the tallest vegetation feature of the floodplain (Figure 4f).

For two out of nine Yellow Chat observation sites, feral-animal damage was described as 'severe' (10–50%); for the remaining seven sites, it was described as 'some' (1–9%). There was no evidence of fire in the immediate vicinity of the Yellow Chat observations (although there was on adjacent dry grassy floodplain areas).

Other bird species observed in the immediate vicinity (~10 m radius) of Yellow Chats were Little Curlew *Numenius minutus*, Australian Pratincole *Stiltia isabella* and Zitting Cisticola *Cisticola juncidis*.

Observations of feral animals

Feral animals were observed on all four survey days. One hundred and forty-three feral animals were recorded across 27 separate observations, comprising 12 Horses, one Water Buffalo and 130 Pigs.

Within the overall habitat assessment at the end of each survey, across 12 ground survey tracks and a combined helicopter track (combining the two flights), feral-animal damage (Figure 4b) was recorded as 'very severe' three times (23% of survey tracks), as 'severe' six times (46%) and as 'some' four times (31%) (Appendix I). 'Minimal to no damage' was never recorded.

Discussion

Status and ecology

Given observations of the floodplain landscape made from two helicopter flights, extensive ground surveys and an earlier scoping trip, it is reasonable to consider that the majority of suitable habitat (sparsely vegetated shallow seasonal floodplain lagoons, channels and depressions) on the western floodplain of the South Alligator River north of the Arnhem Highway was surveyed in 2014. Where Yellow Chats were observed, they were conspicuous, regularly flushing to the highest vantage point available (most often *Sesbania* thickets), suggesting that they are not easily overlooked when present.

During the only previous dedicated surveys for Yellow Chats in Kakadu NP, Armstrong (2004) observed 65 Yellow Chats at 26 sites on the western floodplain of the South Alligator River north of the Arnhem Highway over 2 days in 2004. Armstrong's (2004) records were clustered around five areas of the floodplain: Rookery Point, an area between Rookery Point and Water Recorder Point, southern Water Recorder Point, northern Water Recorder Point and Anthill Point (Figure 3). All 26 sites where Yellow Chats were recorded in 2004 were incorporated into the 2014 survey tracks without a single Yellow Chat being observed at any of them. Armstrong (2004) provided no detail of survey effort (in terms of hours surveyed) so it is difficult to make direct comparisons of observations per unit of effort. However, the 27 birds observed at nine sites (on one predominantly dry floodplain lagoon) during the 2014 surveys from nearly 40 hours of ground-survey effort over 4 days is considerably less than the 65 birds observed at 26 sites over 2 days during the 2004 surveys on the same floodplain (noting that for the 2014 surveys, 27 is most likely higher than the true number of individual birds seen since 11 and 16 birds, respectively, were seen on two separate days at the same location).

Armstrong (2004) noted that the 2004 surveys did not provide any evidence of a change in the status of Yellow Chats in Kakadu NP, with survey results largely consistent with the occurrence and distribution of historical records. Although the 2014 surveys do suggest a change in status, with fewer birds observed across more survey effort than in 2004, a comprehensive survey of all areas with suitable Yellow Chat habitat would be required to confirm this. The establishment of annual monitoring sites on the South Alligator River floodplain would assist in understanding if population fluctuations or declines are responsible for changes in locally observed abundance.

The location where all Yellow Chats were recorded during surveys in the present study was a predominantly dry shallow floodplain lagoon on the western edge of the floodplain, adjacent to dry grassy floodplain and *Melaleuca* woodland (Figure 4). This site is part of an extensive floodplain lagoon and channel system running from Anthill Point to Water Recorder Point. Armstrong (2004) recorded Yellow Chats at several sites along this system, to the north and south of the 2014 records (Figure 3). These records combined highlight the potential importance of this system for Yellow Chats on the western floodplain of the South Alligator River. Importantly, all Yellow Chat records in 2014 were within close proximity of *Sesbania* thickets, the affinity to which was previously noted by Armstrong (2004), and this may be a key aspect of the subspecies' habitat.

Of interest was the observation during the surveys of a begging juvenile bird which was fed by an adult male (A. O'Dea & M. de Krester pers. comm.). Nests of the Alligator Rivers subspecies have been recorded in the crown of low mangroves, with an egg recorded in April (Armstrong 2004), but that is the extent of information available on the timing of breeding in the subspecies. Houston (2013) examined breeding of the Capricorn subspecies with respect to rainfall and inundation of nesting habitat, and found a summer–autumn dominance but with the ability to breed in response to out-of-season rainfall events. Breeding of the Alligator Rivers subspecies may be synchronised with the annual wet–dry monsoonal cycle, and the resultant availability of different habitats and food resources, and is an area requiring further research.

Management issues

Habitat degradation resulting from feral animals, introduced weeds, and altered fire regimes are key threats to the Alligator Rivers Yellow Chat (Garnett *et al.* 2011) and the Kakadu NP Threatened Species Strategy (Woinarski & Winderlich 2014) specifies these as key management issues for threatened species on Kakadu's floodplains more broadly. For the Yellow Chat, controlling pigs near critical habitat is a priority. To be effective, control needs to be broad-scale, highly co-ordinated and maintained in the long term, with a regional approach (to limit recolonisation from unmanaged areas outside Kakadu NP) (Jambrecina

2010). Complementary fire and weed management will also benefit habitat condition and availability.

Feral ungulates, predominantly pigs, were recorded on eight out of 12 ground surveys, as well as during the helicopter flights. Pigs were most often observed rooting and wallowing in wet floodplain areas where considerable damage to the habitat was noted (Figure 4b). As floodplains dry out and wet areas become more restricted, the overlap between Yellow Chat habitat and pig habitat increases (Armstrong 2004), potentially decreasing the amount of available dry-season habitat for Yellow Chats. Armstrong (2004) noted that Yellow Chats were never observed on floodplain areas where there was evidence of extensive pig damage. Both pigs and horses were recorded along the lagoon and channel system where Yellow Chats were recorded during the 2014 surveys, and pig damage was evident, particularly around the edges of the lagoon habitat. During the 2014 surveys, Yellow Chats were sighted only in areas assessed to have pig damage impacting ≤50% of the area, and more often ≤10%. This suggests that there may be a damage threshold after which habitat becomes too degraded to be suitable for Yellow Chats.

Introduced weeds are potentially threatening to Yellow Chats because of their ability to alter available habitat. Small patches of Olive Hymenachne *Hymenachne amplexicaulis* were observed during the Yellow Chat surveys. This grass is recognised as a weed of national significance that can cause significant impacts, particularly on wetland areas where it smothers native vegetation and can reduce or prevent water flow (Hunter *et al.* 2010), and is subject to active management on the South Alligator River floodplain. The continued successful control of *Mimosa pigra* in Kakadu NP (Hunter *et al.* 2010) is also essential for maintaining floodplain habitat. Exotic pasture grasses including Olive Hymenachne and Para Grass *Brachiaria mutica* are also noted as potential threats to the Capricorn subspecies by Houston *et al.* (2004). Capricorn Yellow Chats were, however, relatively abundant at one site dominated by Para Grass, which may even have enhanced the habitat by providing tall cover (Houston *et al.* 2013).

The native grass *Hymenachne acutigluma* also has potential for habitat alteration; this grass can form a monoculture, choking wetlands and resulting in loss of habitat and biodiversity (Lawson *et al.* 2010). Although Armstrong (2004) had numerous records of Yellow Chats at the southern end of Water Recorder Point (see Figure 3), much of that area during the 2014 surveys was thick *Hymenachne acutigluma* (PMK pers. obs.) and no Yellow Chats were located there. It is possible that these areas no longer represent suitable habitat as Yellow Chats were never recorded in areas of thick wet grass by Armstrong (2004) or in the present surveys. It is recognised that fire is an important management tool to avoid *Hymenachne acutigluma* monoculture (Lawson *et al.* 2010). The interrelationships between native flora, weeds, fire and feral-animal impacts (including rooting, wallowing, grazing and seed dispersal) is complex and poorly understood in terms of habitat availability for Yellow Chats. For example, the spread of weeds is related to feral animal and livestock presence, with animals spreading their seed (Hunter *et al.* 2010); conversely, the removal of Water Buffalo can allow the spread of native *Hymenachne acutigluma* (Corbett *et al.* 1996).

Future surveys and monitoring

Although the floodplains of the Alligator Rivers are extensive in area, the total habitat available to Yellow Chats is more restricted towards the end of the dry season when large floodplain areas are dry. Although habitat will vary inter-annually, depending on the extent of the previous wet season, this does allow the establishment of targeted surveying and monitoring sites during the dry season. Both the 2004 (Armstrong 2004) and 2014 surveys of the Alligator Rivers floodplain for Yellow Chats suggest that critical late-dry-season habitat is sparsely vegetated shallow seasonal floodplain lagoons, channels and depressions, and this should be the focus of survey efforts and the establishment of monitoring sites.

Garnett *et al.* (2011) noted that the relative importance of floodplains across the range of the Alligator River Yellow Chat is unknown, as is any temporal variation in the relative use of respective floodplains. The 2014 surveys focussed only on the western floodplain of the South Alligator Rivers. Hence, there are extensive areas of potential habitat that were not surveyed in 2014. It will be necessary to survey all floodplains of the Alligator Rivers region of Kakadu NP (East, West and South Alligator Rivers, and Wildman River) to establish the overall population status of the Yellow Chat in Kakadu NP.

A comprehensive floodplain survey can inform the establishment of annual monitoring sites, which should include the lagoon and channel system between Anthill Point and Water Recorder Point on the western floodplain of the South Alligator River (where Yellow Chats were observed during both the 2004 and 2014 surveys). Furthermore, it would be informative to undertake surveys of other locations outside Kakadu NP where Yellow Chats have been recorded previously, such as the Mary River floodplain. This would better inform the overall conservation status, and also better define the significance of Kakadu NP for the subspecies. In conjunction with these surveys, habitat assessments aimed at quantifying potential threats such as abundance and impacts of feral animals on wetland habitats and the extent of introduced and native wetland-associated grasses should be undertaken. Finally, it is imperative to investigate the population dynamics of the subspecies in terms of potential movement between floodplains.

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References

Armstrong, M. (2004). The Yellow Chat *Epthianura crocea tunneyi* in Kakadu National Park. Unpublished Report to Parks Australia (North).

Corbett, L., Hertog, A.L. & Muller, W.J. (1996). An experimental study of the impact of feral swamp buffalo *Bubalus bubalis* on the breeding habitat and nesting success of magpie geese *Anseranas semipalmata* in Kakadu National Park. *Biological Conservation* **76**, 277–287.

Garnett, S.T., Szabo, J.K. & Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Melbourne.

Higgins, P.J., Peter, J.M. & Steele, W.K. (Eds) (2001). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 5: Tyrant-flycatchers to Chats*. Oxford University Press, Melbourne.

Houston, W.A. (2013). Breeding cues in a wetland dependent Australian passerine of the seasonally wet-dry tropics. *Austral Ecology* **38**, 617–626.

Houston, W.A., Black, R.L. & Elder, R.J. (2013). Distribution and habitat of the critically endangered Capricorn Yellow Chat *Epthianura crocea macgregori*. *Pacific Conservation Biology* **19**, 39–54.

Houston, W., Jaensch, R., Black, R., Elder, R. & Black, L. (2009). Further discoveries extend the range of Capricorn Yellow Chat in coastal central Queensland. *Sunbird* **39**, 29–38.

Houston, W., Porter, G., O'Neill, P. & Elder, R. (2004). The ecology of the Critically Endangered Yellow Chat *Epthianura crocea macgregori* on Curtis Island. *Sunbird* **34**, 10–23.

Hunter, F., Ibbett, M. & Salau, B. (2010). Weed management in Kakadu National Park. In: Winderlich, S. (Ed.). *Kakadu National Park Landscape Symposia Series 2007–2009. Symposium 2: Weeds Management. 27–28 November 2007, Jabiru Field Station, Supervising Scientist Division, Kakadu National Park,* pp. 22–28. Internal Report 565, Supervising Scientist, Darwin.

Jambrecina, M. (2010). Feral animal management in Kakadu: Current and future directions. In: Jambrecina, M. (Ed.). *Kakadu National Park Landscape Symposia Series 2007–2009. Symposium 5: Feral Animal Management, 3–4 December 2008*, pp. 25–40. Internal Report 568, Supervising Scientist, Darwin.

Lawson, V., Jambrecina, M. & Atkins, S. (2010). Yellow Water and Red Lily wetland burning. In: Atkins, S. & Winderlich, S. (Eds). *Kakadu National Park Landscape Symposia Series 2007–2009. Symposium 3: Fire Management, 23–24 April 2008, Aurora Kakadu (South Alligator), Kakadu National Park,* pp. 73–79. Internal Report 566, Supervising Scientist, Darwin.

NAILSMA (2014). *Looking After Country: The NAILSMA I-Tracker Story*. North Australian Indigenous Land & Sea Management Alliance Limited, Darwin.

Woinarski, J.C.Z. & Winderlich, S. (2014). *A strategy for the conservation of threatened species and threatened ecological communities in Kakadu National Park 2014–2024*. National Environmental Research Program Northern Australia Hub, Darwin and Kakadu National Park, Darwin.

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Appendix 1. Habitat assessment and feral-animal damage for 12 Yellow Chat ground surveys and two helicopter flights (combined), South Alligator River western floodplain, September 2014. Refer to Figure 2 for areas. Feral-animal damage to the habitat was assessed as 'very severe' (>50% damage), 'severe' (10–50%), or 'some' (1–9%).

Survey date	*Area*	*Habitat (% of survey track)*								*Overall habitat impacted by feral animals*
		Unburnt dry grassland	*Burnt dry grassland*	*Floodplain lagoons, channels & depressions*	Sesbania *thicket*	*Mangroves*	*Samphire*	*Saline mudflat*	Melaleuca *woodland*	
23.9.14	Water Recorder Point	75	0	10	15	0	0	0	0	Some
23.9.14	Water Recorder Point	25	2	70	3	0	0	0	0	Some
23.9.14	Water Recorder Point	80	0	15	5	0	0	0	0	Severe
24.9.14	Anthill Point	82	10	3	1	4	0	0	0	Very severe
24.9.14	Anthill Point	53	20	15	3	0	0	7	2	Some
24.9.14	Water Recorder Point	50	10	30	3	0	0	0	7	Severe
25.9.14	Rookery Point	65	23	10	0	1	0	1	0	Very severe
25.9.14	Rookery Point	88	2	6	2	1	0	1	0	Very severe
25.9.14	Rookery Point	30	35	30	1	0	0	0	4	Severe
26.9.14	Water Recorder Point	60	10	25	3	0	0	0	2	Some
26.9.14	North Point	10	0	90	0	0	0	0	0	Severe
26.9.14	Water Recorder Point	80	0	15	2	0	0	0	3	Severe
26.9.14	*Helicopter flights*	35	45	10	0	0	0	10	0	Severe