

## Discovery of a pupping site and nursery for critically endangered green sawfish *Pristis zijsron*

D. L. MORGAN\*<sup>†</sup>, M. G. ALLEN\*, B. C. EBNER\*<sup>‡§</sup>, J. M. WHITTY\* AND  
S. J. BEATTY\*

\*Freshwater Fish Group & Fish Health Unit, Centre for Fish & Fisheries Research, School of Veterinary & Life Sciences, Murdoch University, Murdoch, WA 6150, Australia, <sup>‡</sup>CSIRO, Land and Water Flagship, Maunds Road, Atherton, Qld 4883, Australia and <sup>§</sup>TropWATER, James Cook University, Townsville, Qld 4811, Australia

(Received 17 December 2014, Accepted 16 February 2015)

A pilot study targeting sawfishes in the southern Pilbara region of Western Australia, which is undergoing a major expansion in human activity, was conducted using gillnets during April and October 2011 in the Ashburton Estuary and adjacent mangrove creeks. Catch per unit effort was greatest in the Ashburton Estuary in October, due to an influx of green sawfish *Pristis zijsron* pups, and was orders of magnitude higher than previously reported for any Pristidae; the study sites contained *P. zijsron* up to almost 3 m total length. This study identified the first pupping site for *P. zijsron* in Western Australia, and the most southerly known nursery area for the species in Australian waters, and is potentially the most important globally.

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Key words: Ashburton River; endangered species; fish; fishing; mangrove; Pristidae.

The Pristidae is a unique family of batoids that has declined globally, and most species are considered to be extirpated in at least some parts of their former range (Simpfendorfer, 2000; Leeney & Poncet, 2013; Moore, 2014; Fernandez-Carvalho *et al.*, 2014). All species have now been listed as either endangered or critically endangered by the International Union for the Conservation of Nature (Simpfendorfer, 2013).

Unfortunately, Pristidae remain poorly understood, with very little known of their ecology, or even their contemporary distribution and habitat use. This is particularly true for the green sawfish *Pristis zijsron* Bleeker 1851, which is the least studied and largest extant pristid (maximum size 7 m total length,  $L_T$ ) (Compagno & Last, 1999). The historical range of *P. zijsron* once included the Indo-West Pacific from South Africa northwards along the east coast of Africa, through the Red Sea, Persian Gulf, south-east Asia, China and Taiwan to Australia, but there are few reliable contemporary records for the species (Dulvy *et al.*, on-line; Moore, 2014). The species is presumed extirpated from the Pacific coast of eastern Australia and the Australian range is poorly reported

<sup>†</sup>Author to whom correspondence should be addressed. Tel.: +61 89360 2813; email: fish@murdoch.edu.au

(Dulvy *et al.*, on-line). Peverell (2005; unpubl. data) reported on 19 individuals that were captured in the Gulf of Carpentaria (Queensland) off the northern Australian coast. Phillips *et al.* (2011) demonstrated, based on nucleotide sequence variation in a portion of the mitochondrial control region that was extracted from rostra held in various collections, that the species is genetically sub-divided across northern Australia, with significant structure found between the species in the eastern Indian Ocean coast of the Pilbara and southern Kimberley region of Western Australia and the Gulf of Carpentaria. Morgan *et al.* (2011) speculated that pupping of *P. zijsron* may be widespread along this north-western Australian coast, and is probably prevalent in the southern Pilbara region. This supposition was based on numerous small (<30 cm total rostral length) *P. zijsron* rostra from private collections that originated from this area, and from four small individuals (1000–1110 mm  $L_T$ ) captured by Stevens *et al.* (2008) in the northern Pilbara.

To elucidate the presence and relative abundance of Pristidae in the southern Pilbara, Western Australia, pristids were surveyed during April and October 2011 near the town of Onslow, within and adjacent to the Ashburton River, which flows into the eastern Indian Ocean (Fig. 1). Sampling at the study sites consisted of setting gillnets (100 or 150 mm monofilament stretched mesh, 60 m length) perpendicular to the bank, although the channel within some sites was narrower than 60 m and thus the length of net deployed varied slightly, as it did with tidal influence affecting channel width. Nets were generally set off sandy shores or within mangroves and fished the entire water column including the extreme shallows. A total of 44 net sets soaked for a total of 128 h pooled across all sites and seasons, including 13, 28 and 22 h in Four Mile Creek, Hooley's Creek and the Ashburton Estuary, respectively, in April (late wet season), and 15, 17 and 32 h in those respective localities in October (late dry season). All pristids captured were measured for  $L_T$ , sexed and fitted with an identification tag using the methods of Thorburn *et al.* (2007).

A total of 39 *P. zijsron* were captured during the study, including seven males and three females in April, and 14 males and 15 females in October 2011 (Fig. 2). The  $L_T$  of *P. zijsron* ranged from 1122 to 2447 mm in April, and from 767 to 2933 mm in October. Fourteen individuals were recaptured at least once during the study, some in different seasons.

Several distinct size classes were observed (767–972, 1350–1526 and >1990 mm) in October, whereas, apart from a group of small individuals, there were no clear cohorts of larger-sized individuals in April (Fig. 2). Uncalcified claspers indicated that all the captured males were sexually immature. Most within the smallest cohort in October (*i.e.* *P. zijsron* of 767–972 mm  $L_T$ ) had open or partly healed yolk-sac wounds, with one possessing the remnants of a yolk sac and rostral teeth that had just begun to emerge from the rostral sheath. In April, however, all yolk-sac scars found on the smallest captured individuals were completely healed.

Catch per unit effort (CPUE; mean  $\pm$  s.e.) of *P. zijsron* in both Four Mile Creek and Hooley's Creek was higher in April ( $0.121 \pm 0.130$  and  $0.036 \pm 0.028$  individuals in 20 m net  $h^{-1}$ , respectively) than in October ( $0.075 \pm 0.087$  and 0 individuals in 20 m net  $h^{-1}$ , respectively). In contrast, CPUE in the Ashburton Estuary was higher in October ( $0.441 \pm 0.191$  individuals in 20 m net  $h^{-1}$ ) than in April ( $0.052 \pm 0.029$  individuals in 20 m net  $h^{-1}$ ). The high CPUE of *P. zijsron* in the Ashburton Estuary in October was due to recent pupping presumably at, or in close proximity to, the site, with neonates making up almost half the individuals caught at that time.

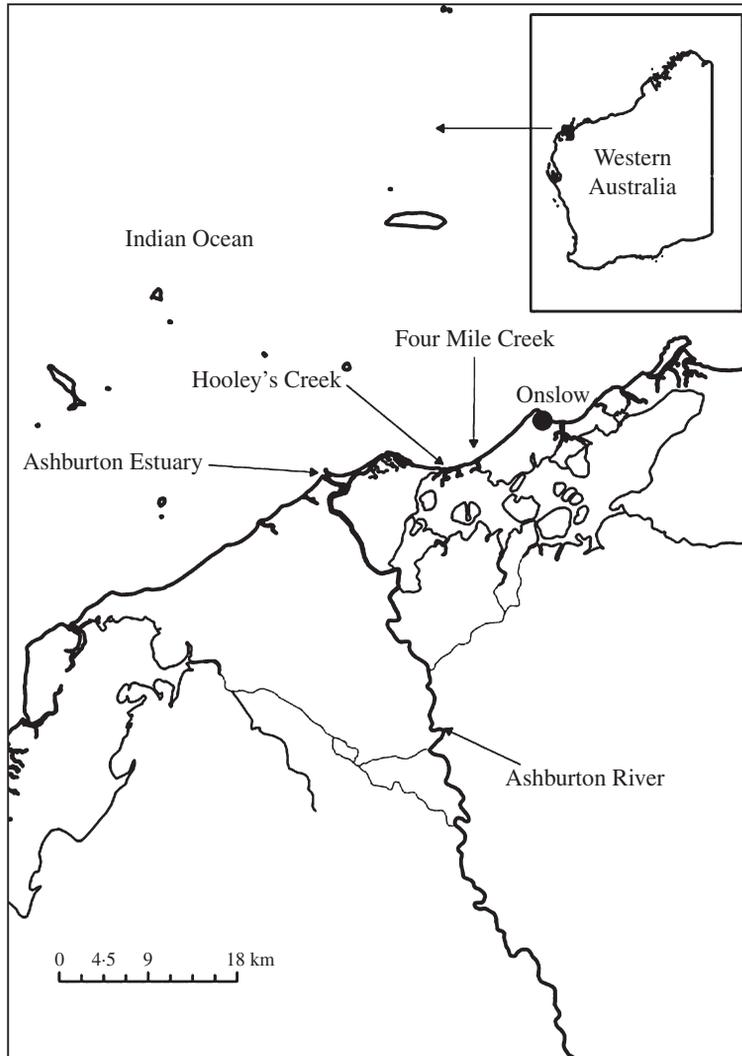


FIG. 1. Sample sites for Pristidae on the southern Pilbara coast of Western Australia near the town of Onslow, including the Ashburton Estuary and two tidal mangrove creeks.

This study is the first to confirm that the remote southern Pilbara region of the Australian continent houses a globally threatened pristid, with previous distribution reports being either speculative and based on patchy distributional data (Dulvy *et al.*, on-line), from the location of origin of rostra in private collections (Morgan *et al.*, 2011; Phillips *et al.*, 2011), or from deeper waters as by-catch in commercial fisheries (P. Stephenson & J. Chidlow, unpubl. data). The captures represent the majority (58%) of all published records of whole specimens of *P. zijsron* from the eastern Indian Ocean coast of Australia (Morgan *et al.*, 2011).

Heupel *et al.* (2007) defined an elasmobranch nursery area as: (1) an area in which sharks (used in a general sense) are more common than in surrounding areas,

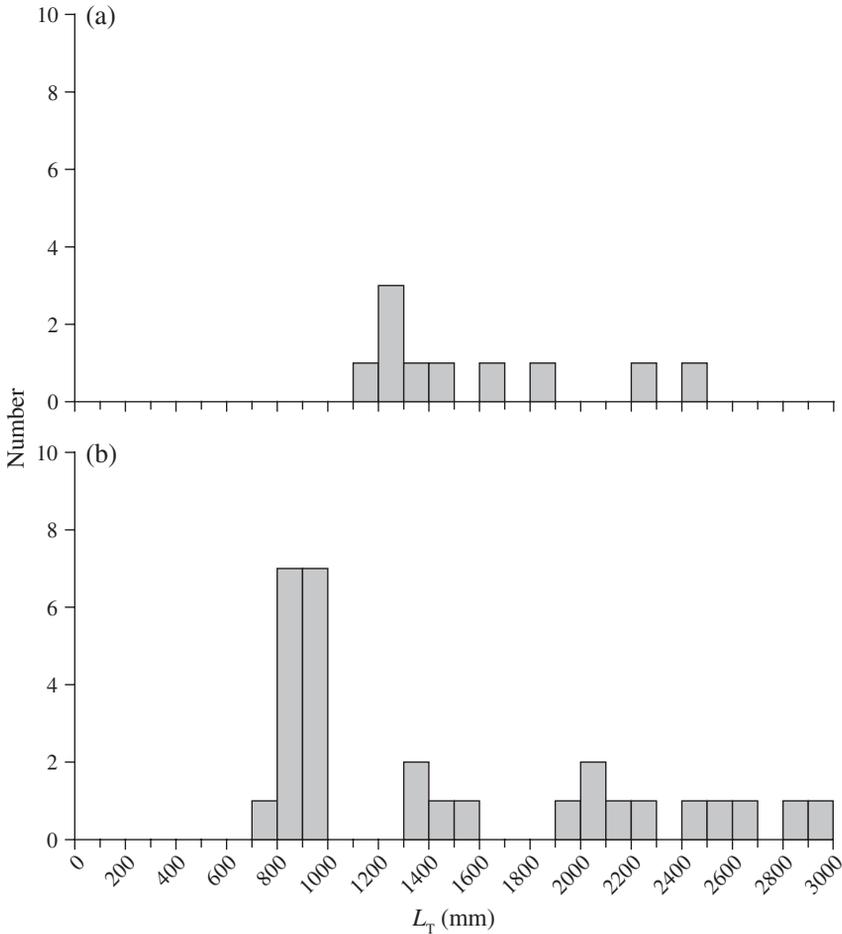


FIG. 2. Total length ( $L_T$ )-frequency histograms of the *Pristis zijsron* captured in the study region during (a) April and (b) October 2011.

(2) an area in which sharks remain or frequently visit and (3) an area that is used during successive years. Following Heupel *et al.*'s (2007) definition, the presence of immature *P. zijsron* in the Ashburton Estuary and the surrounding tidal mangrove creeks suggests that these habitats act as a nursery for the species. In April, the size classes were less distinct, with the individuals measuring from 1122 to at least 1317 mm  $L_T$  probably being older representatives of the 0+ year age class (S. C. Peverell, unpubl. data). The largest individual recorded during the study was a 2933 mm  $L_T$  immature male. *Pristis zijsron* is thought to mature at *c.* 3000 mm  $L_T$  (Last & Stevens, 2009), but there are no data to substantiate this claim. This study therefore suggests that the Ashburton Estuary houses all early life-history stages of *P. zijsron*, from neonates to sub-adults.

Although the juvenile nursery habitats in Western Australia are not subjected to commercial fishing, sub-adults and adults that move into deeper waters of the Pilbara are captured in the Pilbara fish trawl fishery with records indicating that 4 t of the species were caught in 2001 (P. Stephenson & J. Chidlow, unpubl. data). Similarly, in

the northern Pilbara, it was estimated that between 2000 and 2004, *P. zijssron* as trawl fishery by-catch ranged from 5.3 to 9.6 t (McAuley *et al.*, 2005).

The location of pupping grounds and nursery habitats of nearshore elasmobranch species is a crucial knowledge gap hindering effective conservation planning, especially in areas that are heavily affected by anthropogenic disturbances. Kinney & Simpfendorfer (2009) suggest, however, that in the absence of management of older juveniles and mature individuals that typically live outside of such nursery areas, a well-managed and well-protected nursery area may have little direct benefit to the overall conservation of the species. Therefore, further exploration of the wider region should be conducted to identify key adult habitats as well as other nurseries for the species in order to better inform conservation planning and management.

This project was funded by Chevron Australia Pty Ltd. Technical and logistical support was provided by URS. We express gratitude for the tremendous assistance given to the project by J. Keleher (Murdoch University), M. Fraser and T. Hurley (URS), G. Young, T. Roupael, N. Page, S. Moore and C. Morgan (Chevron) and G. Herbert and A. Slater (Scubaroo Dive). This work was conducted under permits from the Department of Fisheries, Department of Environment and Conservation, the Department of Transport and the Murdoch University Animal Ethics Committee.

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