Eramurra Sawfish Survey

Interim Field Report

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Version Register

Version	Status	Author	Reviewer	Change from Previous Version	Authorised for Release (signed and dated)
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1. Introduction

Leichhardt Salt Pty Ltd (the Proponent) proposes to develop the Eramurra Solar Salt Proposal (the Proposal) in the Cape Preston East area, Western Australia (WA) (Figure 1). The Proposal will produce high purity industrial grade sodium chloride salt from seawater via a solar evaporation and crystallisation operation. Supporting infrastructure includes seawater intake, bitterns outfall, desalination plant and groundwater bores, power supply and other infrastructure. A short summary of the Proposal is presented in Table 1.

The Proposal has been referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Part IV of WA's *Environmental Protection Act 1986* (EP Act) and will be assessed under a Bilateral Agreement. The Environmental Scoping Document (ESD) highlights the relevant State and Commonwealth matters which may be impacted by the Proposal and provides recommendations to address these. Marine Fauna have been identified as a key environmental factor.

Sawfish are conservation significant species, protected at the State and Commonwealth levels (see section 2.1), and have been identified as being potentially at risk by habitat modification. A workshop to identify the key risks posed to sawfish from the Proposal was undertaken in early 2022 which involved participation of subject matter experts, including sawfish scientists from the Freshwater Fish Group and Fish Health Unit at Murdoch University Harry Butler Institute (HBI). The green sawfish was identified as having the highest likelihood of occurrence within the project area and has the greatest risk of impacts by the Proposal. The green sawfish population that occurs in the Pilbara appear to be genetically distinct from the other populations across the world. Information gaps were identified which formed the basis of a field survey designed and implemented by HBI (David Morgan, Karissa Lear, Travis Fazeldean and Kurt Krispyn) and O2 Marine (Daniella Hanf and Ben Jones).

This document presents the interim results from the sawfish field survey and outlines next steps for data collection that will help to better predict, avoid and mitigate impacts to sawfish (and other species), and identify information gaps.

Table 1 Short summary of the Proposal

Proposal Title	Eramurra Solar Salt Proposal
Proponent Name	Leichhardt Salt Pty Ltd
Short Description	Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop a solar salt project in the Cape Preston East area, approximately 55 kilometres (km) west-south-west of Karratha in Western Australia (WA) (the Proposal). The Proposal will utilise seawater and evaporation to produce a concentrated salt product for export. The Proposal includes the development of a series of concentration ponds, crystallisers and processing plant. Supporting infrastructure includes bitterns outfall, drainage channels, product dewatering facilities, desalination plant, pumps, pipelines, power supply, access roads, administration buildings, workshops, laydown areas, landfill facility, communications facilities and other associated infrastructure. The Proposal also includes dredging at the Cape Preston East Port and both offshore and onshore disposal of dredge spoil material.

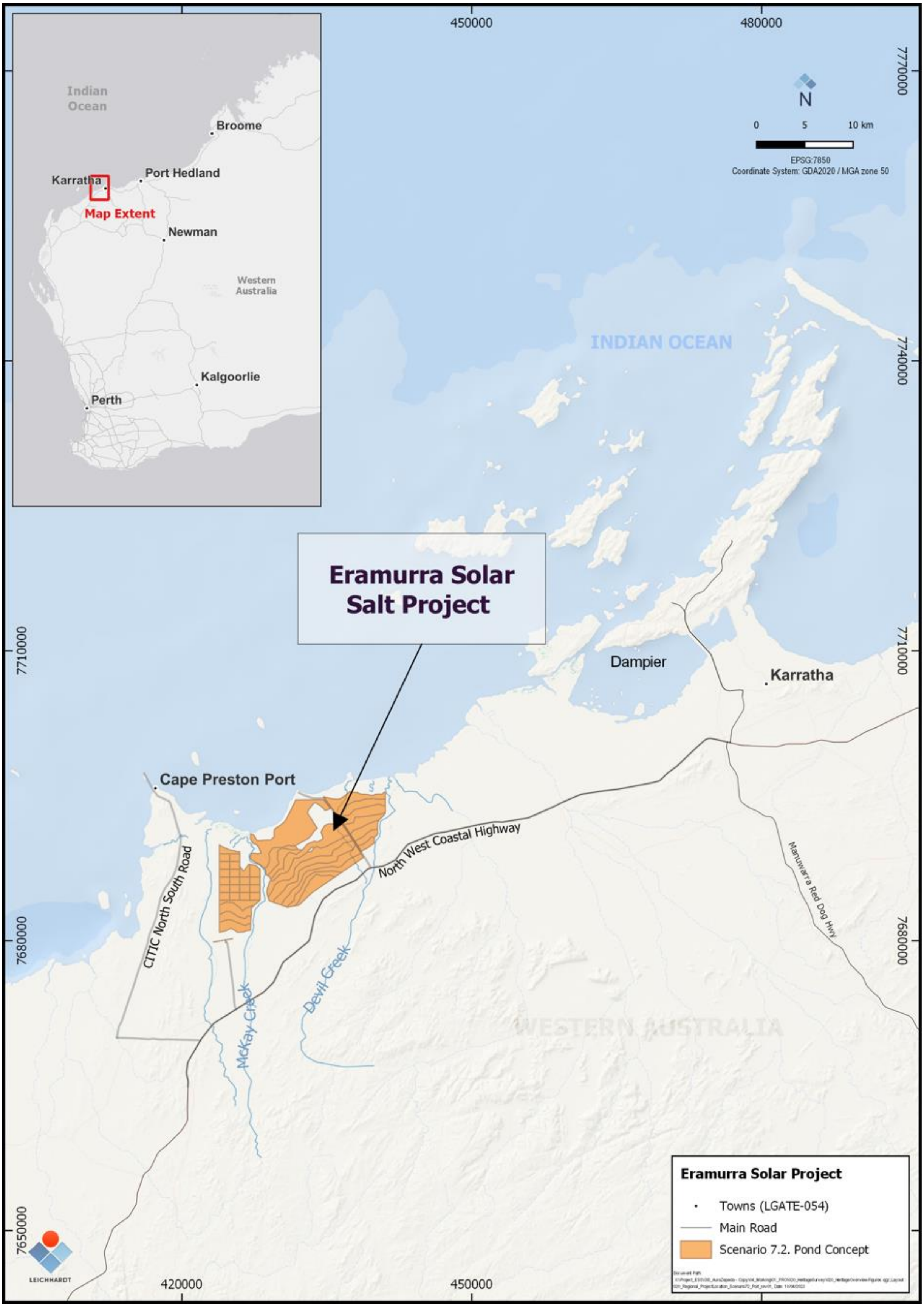

Figure 1 Regional location of the Proposal

1.1. Survey Objectives

The survey aims were to examine which species of sawfish are present in the tidal creeks within the immediate vicinity of the Eramurra Solar Salt Project and determine the population demographics of the different species and their movement patterns and degree of site fidelity within the broader region (i.e., 'central Pilbara').

The specific objectives were:

- Identify sawfish species presence;
- Identify potential sawfish prey species presence; and
- Understand movement of sawfish from the Onslow area to Eramurra and investigate whether an anthropogenic barrier exists at Cape Preston.

2. Background

Of the chondrichthyan fishes, those that are large-bodied and occur in shallow waters are at the greatest risk of extinction (Dulvy et al. 2014). The most threatened family of chondrichthyans is the Pristidae (sawfishes), which is a unique family of batoid rays that are some of the largest bodied chondrichthyans (Last & Stephens 2009; Dulvy et al. 2014, 2016). Most pristids have declined globally (e.g., Simpfendorfer 2000; Fernandez-Carvalho et al. 2014; Leeney & Poncelet 2015; Moore 2015; Dulvy et al. 2016), and all five species currently have a (non-statutory) listing as either Critically Endangered or Endangered by the International Union for the Conservation of Nature (IUCN). Although the susceptibility of their rostrum to entanglement in fishing nets is a major reason for their decline, other threatening processes have also contributed to their imperilment. Among these processes are loss of nursery habitats (Simpfendorfer 2000), barriers to migration and reduction in habitat quality as a function of river regulation (Thorburn et al. 2007), targeted fisheries (Thorson 1982) including for cultural purposes (McDavitt 1996) and taking of rostra as curios (Seitz & Poulakis 2006; Morgan et al. 2011, 2016).

The importance of identifying nursery habitats and examining site fidelity for endangered species is crucial for conservation efforts. Pristid nurseries are located in relatively shallow coastal waters including, in the case of freshwater sawfish (*Pristis pristis*), freshwaters and estuaries (Simpfendorfer 2000, Seitz & Poulakis 2002, Peverell 2005, Thorburn et al. 2007, 2008, Whitty et al. 2009, Morgan et al. 2011), while green sawfish (*Pristis zijsron*) have recently been found to occupy estuaries, mangrove creeks and river mouths for their first few years of life (Morgan et al. 2015, 2017). These habitats are often subjected to human development along with high levels of commercial and recreational fishing activity (Nagelkerken et al. 2015). Consequently, the effective conservation of pristids at the species and population level is likely to depend in part on the identification and protection of nursery habitats from these activities (e.g., Whitty et al. 2009, Simpfendorfer et al. 2010; Morgan et al. 2015, 2021). An understanding of the ontogenetic habitat partitioning within species and migration patterns to and from nurseries is also critical to sustainably managing pristid populations along developed and developing coastlines. Specifically, the offshore emigration of late juvenile phase pristids and the return of philopatric females for pupping (e.g., Morgan et al. 2015, Phillips et al. 2016) are likely to be critical life history stages and understanding them is crucial for developing effective management strategies.

Barriers to movement through habitat degradation and modification have been identified as adverse impacts on sawfish by the Commonwealth Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015) for freshwater and estuarine species. The Ashburton River mouth and tidal creeks to the north and south (near Onslow, Figure 2) have been identified as a global hotspot for green sawfish. The area is a deltaic, mangrove-dense environment which is highly productive and acts as a crucial nursery area for many fish and invertebrate species. There is a lack of knowledge regarding sawfish distribution, habitat use or movement between Onslow and Karratha, largely because of the remote nature of that coastline. Eramurra tidal creek mouths are likely to be a foraging area for post-nursery and pre-maturation green sawfish individuals which are transient and moving along the coastline. Such linkages require further investigation, as identified during the sawfish risk assessment workshop (O2 Marine 2022).

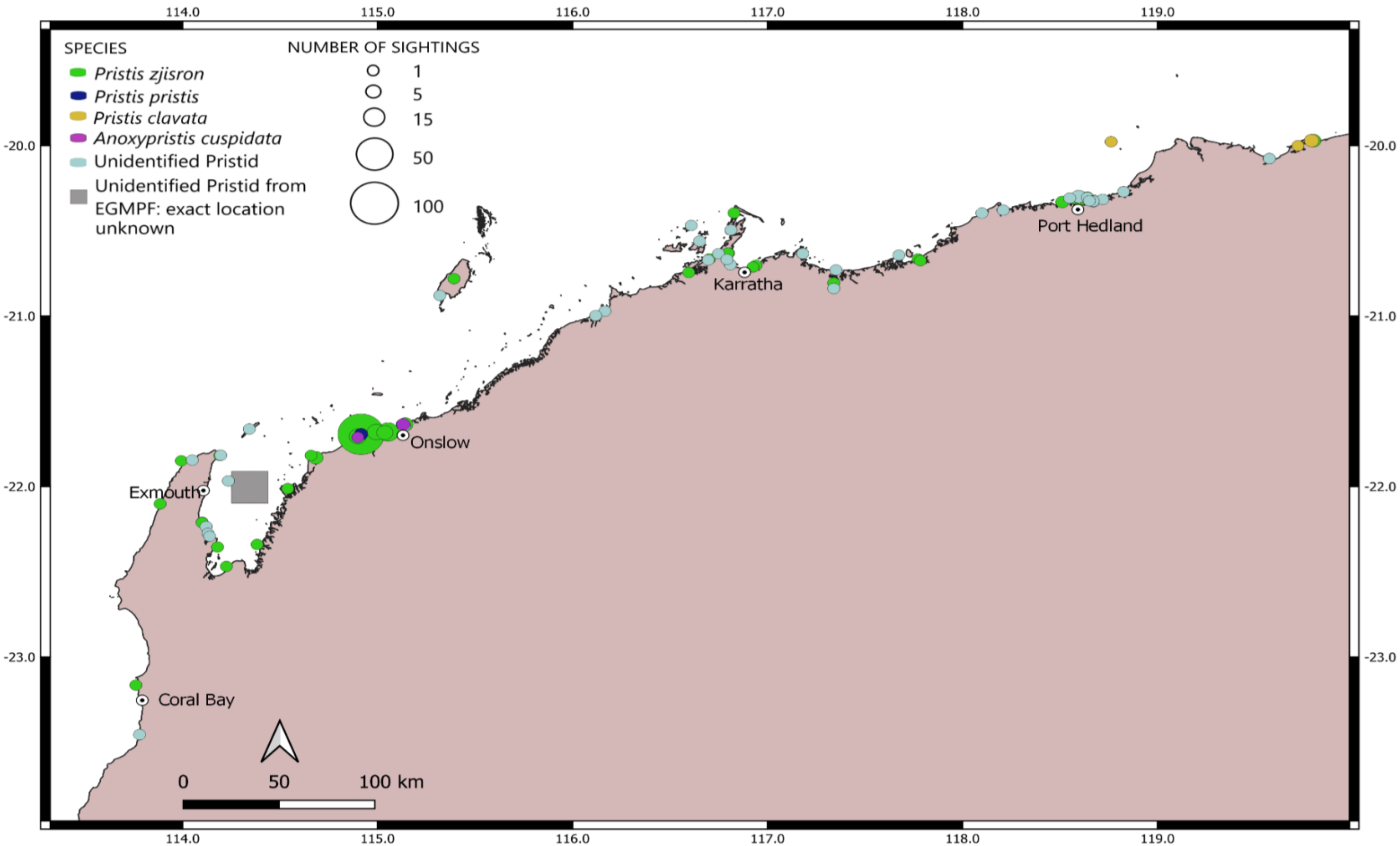

Figure 2 Sawfish occurrence records of green (*Pristis zijsron*), largetooth (*Pristis pristis*), dwarf (*Pristis clavata*), narrow (*Anoxypristis cuspidata*) and unidentified sawfish species in the Pilbara (Murdoch University, 2022, unpublished data).

3. Methods

Survey planning and implementation was undertaken in partnership by HBI sawfish experts and O2 Marine, with methods following Morgan et al. (2017) for fish sampling and tracking using acoustics.

Measurements of salinity (ppt), dissolved oxygen concentration (DO, mg L-1) and temperature (°C) were recorded at the surface, mid-water column and bottom of the water column either side of Cape Preston (Shoal Bay and Second Creek), using a Yellow Spring Instrument 556 Handheld Multiparameter Instrument (YSI Incorporated, Yellow Springs, Ohio, USA).

3.1. Fish sampling

Fish sampling was undertaken on and between 23 to 25 August 2022, under the *Fisheries Resource Management Act 1994* research permit 251023722 using gill and seine nets from south of Cape Preston to Dampier Archipelago (Figure 3 and Table 2). Sampling included the setting of gill nets comprised of 150 mm monofilament stretched mesh. Nets used were 60 m in length and with a depth of 2 m. Sawfish searches were also conducted by observers from the bow of the boat. It was planned to conduct observations using a DJI Phantom 4 remotely piloted aerial system (RPAS, 'drone') as this can support the placement of cast or gill nets to capture sawfish. However, as high wind speeds prevented the safe pilotage of the drone, this did not occur.

Netting for sawfish prey species was conducted by seine netting in shallow banks in Second Creek (S1-2), Shoal Bay (S3-5) and 40 Mile Beach (S6-8). Potential prey sampling utilised a combination of seine nets (41.5 m net which contained a 1.5 m wide bunt made of 9 mm mesh and two 20 m long wings comprising 25 mm mesh and swept an area of 274 m^2) and composite gill net of 60 m length that contained 20 m sections of 50, 100 and 150 mm mesh. Gillnets were set perpendicular to the shoreline and checked at regular intervals or whenever evidence suggested that a fish had become entangled. Seine nets were deployed in a semicircle from the bank and pulled in immediately following deployment. Seine and cast netting occurred in the interval between the setting and retrieval of gill nets.

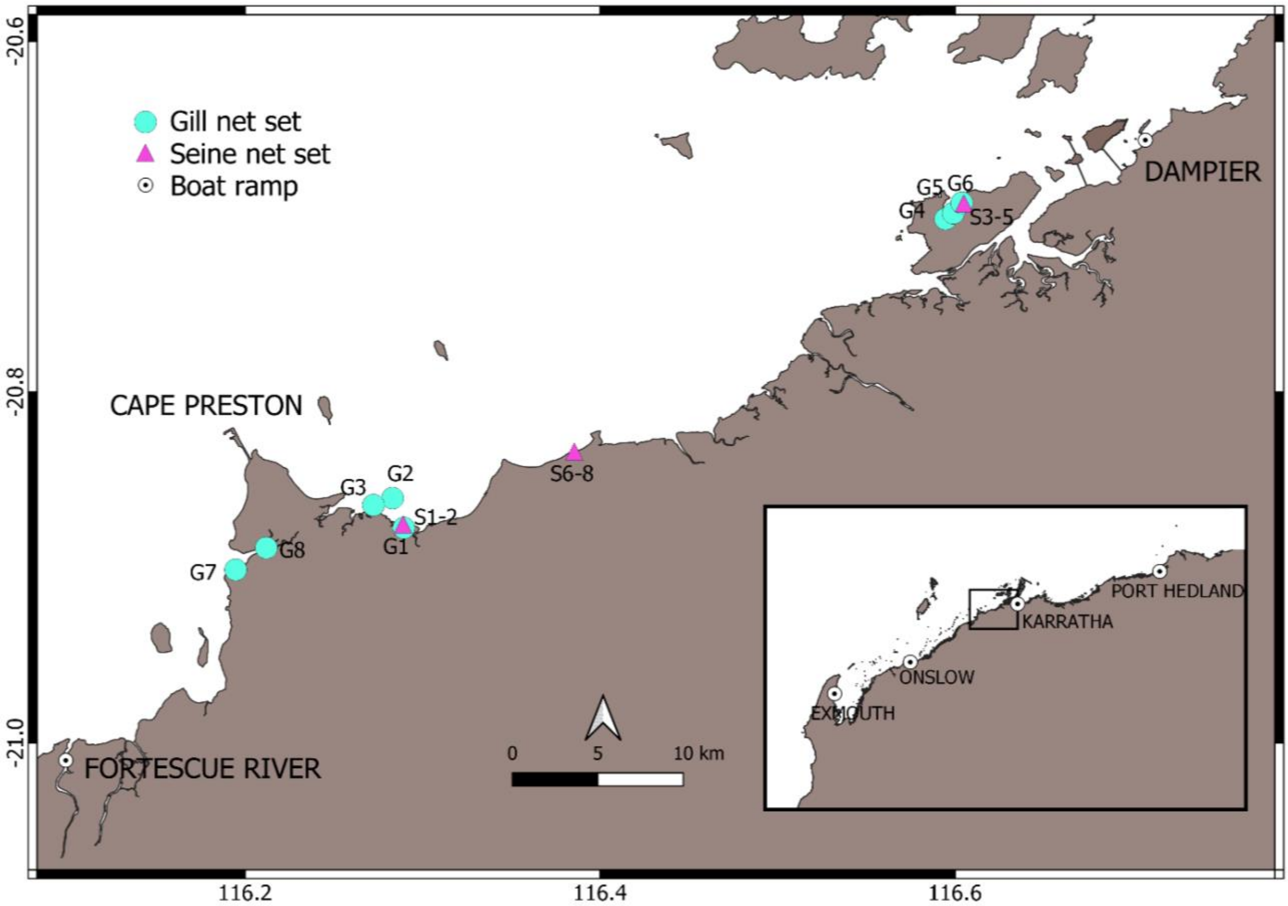

Figure 3 Seine and gillnet sampling locations

Table 2 Seine (S1-2: Second Creek; S3-5: Shoal Bay; S6-8: 40 Mile Beach) and gill (G1-8) netting site locations

Seine nets		Gill nets	
Location	Spatial co-ordinates	Location	Spatial co-ordinates
S-1	20.875°S, 116.289°E	G-1	20.875°S, 116.290°E
S-2	20.875°S, 116.289°E	G-2	20.860°S, 116.283°E
S-3	20.692°S, 116.605°E	G-3	20.864°S, 116.272°E
S-4	20.692°S, 116.605°E	G-4	20.701°S, 116.595°E
S-5	20.692°S, 116.605°E	G-5	20.698°S, 116.599°E
S-6	20.834°S, 116.385°E	G-6	20.692°S, 116.604°E
S-7	20.834°S, 116.385°E	G-7	20.901°S, 116.195°E
S-8	20.834°S, 116.385°E	G-8	20.888°S, 116.212°E

3.2. Acoustic array and acoustic tagging

An acoustic array of nine InnovaSea VR2W-69 kHz, single-channel receivers was installed prior to the fish sampling, to record sawfish that were tagged during, and prior to, this sampling effort. They continuously monitor for and record tags emitting individual 'pings'. The array was distributed across the central Pilbara, from Mardie Creek in the south to east of Gnoorea Point (Figure 4; Table 3), in areas likely to be utilised by sawfish. They were installed in shallow waters, avoiding depths that would be dry during periods of low tide. They were attached to a standard mooring design of a concrete block, a 10 kg anchor and 4 to 8 m of galvanised chain attached to a rope and buoy. An additional receiver was deployed in the mouth of the Fortescue River (21.0039°S, 116.09974°E) on 23 August 2022 (serial number 112988) and a HOBO light and temperature logger (SN20633267) was attached to the mooring rope, immediately prior to this survey.

Two green sawfish were tagged with Innovasea V13TP acoustic tags (120 to 180 s interval, 584 d battery life) with pressure and temperature sensors (range of 5 to 35°C), in the mouth of the nearby Fortescue River on the 21 August 2022 (i.e., prior to receiver deployment for this project.) (Table 3). Tags were internally implanted into the body cavity of the sawfish following the protocol of Whitty et al. (2017) (e.g., Figure 5). Acoustic tags were disinfected in an antiseptic solution prior to implantation to reduce the risk of infection. Tags were inserted into the peritoneal cavity via a small incision on the ventral surface of the sawfish, anterior to the pelvic fins. The incision was closed with two or three interrupted sutures. Before deployment, each transmitter was tested using a VR2W acoustic receiver.

Receivers were serviced and data downloaded between March 20 – March 21 2023. All receivers were fully functional so capable of recording data from tagged sawfish through out the period from which they were deployed.

Figure 4 Acoustic receiver locations

Table 3 Acoustic receiver locations

Location	Spatial co-ordinates	Serial number
E1	21.135°S, 115.883°E	137851
E2	21.117°S, 115.890°E	137854
E3	121.152°S, 115.869°E	137850
E4	21.175°S, 115.858°E	137858
E5	21.173°S, 115.838°E	137853
E6	21.067°S, 115.923°E	137852
E7	21.083°S, 115.925°E	137857
E8	21.252°S, 115.818°E	137859
E9	21.232°S, 115.805°E	137856

Figure 5 Tagged adult green sawfish

4. Results

4.1. Environmental conditions

Weather, distance from launch site and tidal conditions impacted the allowable time for sampling the target sites at Cape Preston. Water temperature at the sites sample in the vicinity of Cape Preston ranged from 19.5-19.8°C (mean = 19.68 + 0.04 °C). Dissolved oxygen ranged from 74.2-93.9% saturation (mean = 83.53 + 1.86) and 5.48-6.88 mg/L (mean = 6.14 + 0.13), while salinity was consistent across sites and was, on average, 39.82 (+ 0.03) ppt. Tidal variation was lowest at 1.30 m and highest at 3.57 m, the greatest variation on 25 August with > 2 m differential between high and low.

4.2. Sampling effort and catch

A total of eight gill net and eight seine replicates totalling 14.5 hours and 5.25 hours, respectively, were conducted during the sampling period (Table 4). This occurred over three days, at various times from morning until late afternoon (Table 5).

Table 4 Summary of sampling effort

Net type	Effort (hours)	Effort (20m net hour equiv.)
Gill (60 m length)	14.4	43.5
Seine (41.5 m length)	5.25	10.5

Table 5 Summary of gill and seine netting locations and times

<table>
<tr><th>Deployment date</th><th>Net type</th><th>Time period</th></tr>
<tr><td rowspan="4">23 August 2022</td><td>Gill</td><td>10:00 – 12:00</td></tr>
<tr><td>Seine</td><td>11:40 – 12:00</td></tr>
<tr><td>Gill</td><td>12:55 – 14:00</td></tr>
<tr><td>Gill</td><td>14:40 – 16:15</td></tr>
<tr><td rowspan="5">24 August 2022</td><td>Gill</td><td>10:00 – 12:30</td></tr>
<tr><td>Gill</td><td>12:30 – 14:30</td></tr>
<tr><td>Seine</td><td>12:30 – 14:30</td></tr>
<tr><td>Gill</td><td>14:40 – 16:00</td></tr>
<tr><td>Seine</td><td>14:40 – 16:00</td></tr>
<tr><td rowspan="3">25 August 2022</td><td>Gill</td><td>07:45 – 12:45</td></tr>
<tr><td>Seine</td><td>12:00 – 12:45</td></tr>
<tr><td>Gill</td><td>12:45 – 15:30</td></tr>
</table>

4.2.1. Sawfish

No sawfish were captured or tagged over the three-day survey period. However, three animals were caught and tagged south of the study site, immediately prior to this survey (see 4.3, below).

In total over all creeks and net sets, we fished for 39.6 x 20 m net hours. In comparison, a similar trip in October 2021 in the Onslow region averaged a Catch Per Unit Effort (CPUE) of 0.15 sawfish caught per 20 m of net per hour, equating to approximately six sawfish caught in the amount of gillnet effort conducted during this study.

It was not possible to fly drones in support of netting operations because of high wind speeds. Drones are not necessary to conduct sawfish sampling. Although they have proven useful in detecting sawfish during studies, their effectiveness is reduced during periods of high turbidity, cloud cover and sea state as well as in depths >1 m in the region (D Morgan unpublished data).

4.2.2. Other species

The netting captured a total of 2,193 individual fish, representing 25 species: 19 teleost species and six elasmobranch species (Table 6).

Species captured by seine net

Seine netting mostly captured small teleosts. The most abundant teleosts were from the Atherinidae family: North-west hardyhead (*Craterocephalus capreoli*) (n=1,244) and spotted hardyhead (*Craterocephalus mugiloides*) (n=247), which comprised almost 70% of the entire seine net catches (Table 6). Seine netting also caught several other species in relatively high abundance, including Vachell's glassfish (*Ambassis vachellii)* (n=221), blue sprat (*Spratelloides delicatulatus*) (n=155), tropical garfish (*Hyporhamphus affinis*) (n=60) and blacktip silverbiddy (*Gerres oyena*) (n=57). Seine netting captured a single elasmobranch species, the broad cowtail ray (*Pastinachus ater*) (n=5) as well as representatives from the Chanidae, Platycephlidae, Serranidae, Sillaginidae, Carangidae, Haemulidae, Sparidae, Mugilidae and Gobiidae families (Table 3). Seine netting also captured green mud crabs (*Scylla serrata*).

There was a significant difference between the three main sites sampled using seine netting (Figure 6; Figure 7; Figure 8). The highest species diversity was recorded from Shoal Bay. The highest abundance was recorded at Second Creek, which was based on the large number of North-west hardyhead individuals, although it was the least speciose site. 40 Mile Beach supported a high abundance of spotted hardyhead and was found to have greater variation in species composition compared to the other sites. Figure 6 shows total number of each fish species (T), percentage contribution (%C) and total length range (LR) in mm of each species recorded in the seine and gill nets. Dasyatidae lengths are disc width.

Table 6 Fish captured in seine and gill nets.

Family	Scientific name	Common name	Seine		Gill		
			T	%C	T	%C	LR
Carcharhinidae	*Negaprion acutidens*	Lemon shark			4	8.89	765-1,175
	Carcharhinus brevipinna	Spinner shark			1	2.22	810
	Carcharhinus cautus	Nervous shark			20	44.44	640-1,140
Glaucostegidae	*Glaucostegus typus*	Giant guitarfish			1	2.22	795
Dasyatidae	*Himantura* sp.	Australian whipray			4	8.89	~800-1,500
	Pastinachus ater	Broad cowtail ray	5	0.23			~400-500
Chanidae	*Chanos chanos*	Milkfish			1	2.22	480
Clupeidae	*Spratelloides delicatulus*	Blue sprat	155	7.22			30-52
Hemiramphidae	*Arrhamphus sclerolepis*	Snubnose garfish	2	0.09			110-185
	Hyporhamphus affinis	Tropical garfish	60	2.79			175-293
Atherinidae	*Craterocephalus capreoli*	North-west hardyhead	1,244	57.91			20-66
	Craterocephalus mugiloides	Spotted hardyhead	247	11.50			30-60
Platycephalidae	*Platycephalus australis*	Bartail flathead			1	2.22	400
Serranidae	*Epinephelus malabaricus*	Blackspotted rockcod			1	2.22	701
Ambassidae	*Ambassis vachellii*	Vachell's glassfish	221	10.29			27-45
Sillaginidae	*Sillago burrus*	W. trumpeter whiting	129	6.01			30-175
	Sillago schomburgkii	Yellowfin whiting	2	0.09	1	2.22	180-216
Carangidae	*Scomberoides commersonnianus*	Giant queenfish			2	4.44	625-689
	Carangid sp.	Carangid sp.	1	0.05			20
Haemulidae	*Diagramma pictum labiosum*	Painted sweetlip			4	8.89	642-780
Gerreidae	*Gerres oyena*	Blacktip silverbiddy	57	2.65			24-105
Sparidae	*Acanthopagrus morrisoni*	W. yellowfin bream	9	0.42			15-123
Mugilidae	*Ellochelon vaigiensis*	Diamondscale mullet	1	0.05	3	6.67	173-515
	Moolgarda (Valamugil) buchanani	Bluetail mullet			2	4.44	410-430
Gobiidae	*Favonigobius melanobranchus*	Blackthroat goby	15	0.70			16-122
	Total number of species		14		13		
	Mean number of fish per sample		268.38		5.75		
	Total number of fish		2148		45		

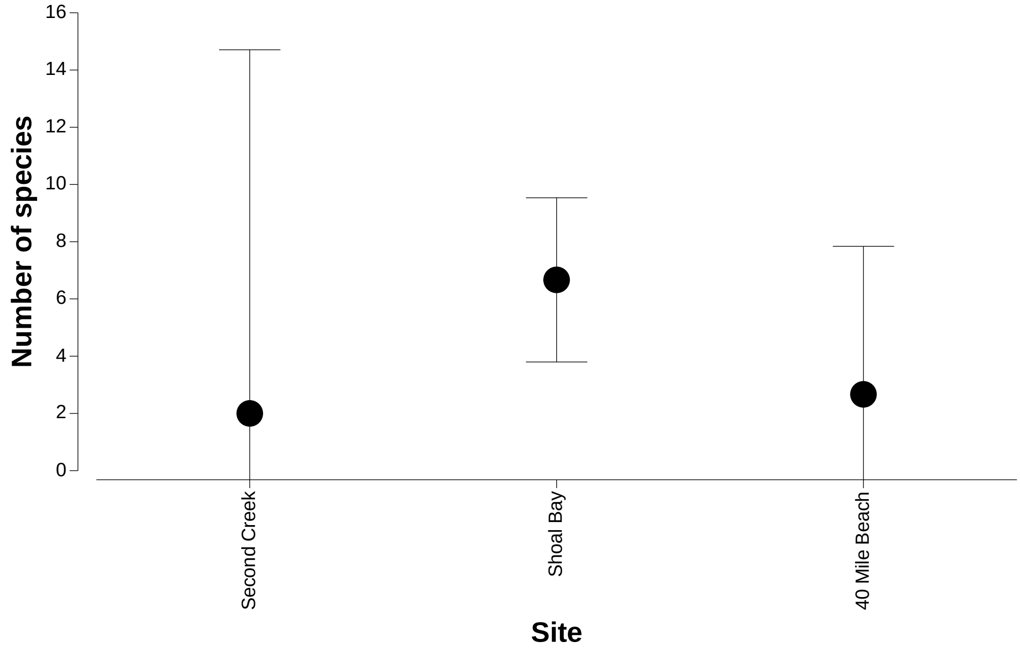

Figure 6 Mean (+ SE) number of fish species caught by replicate seine net deployments at each location

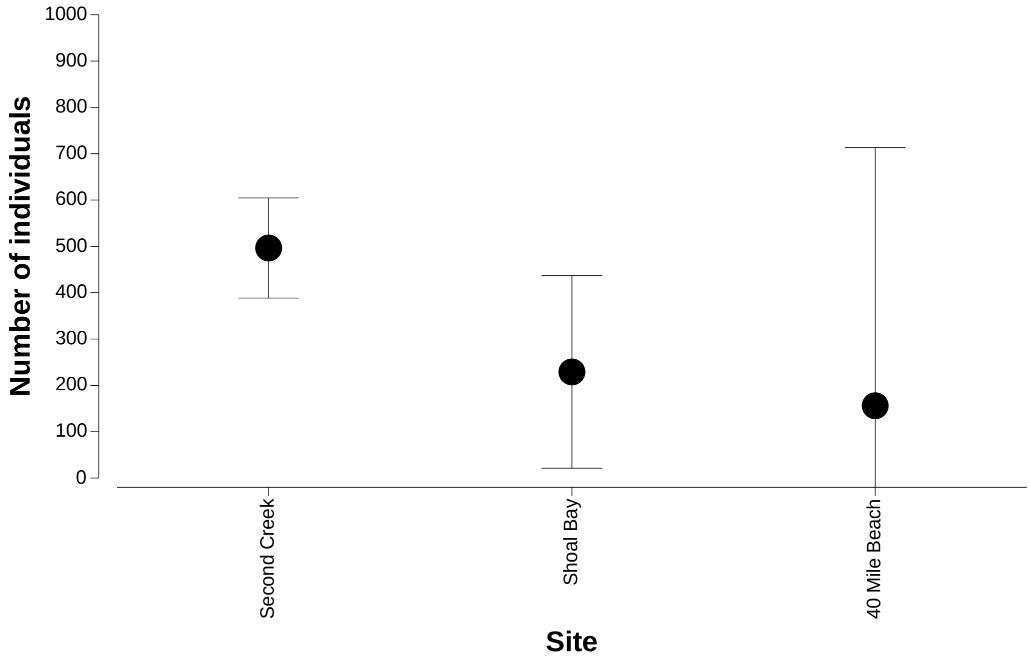

Figure 7 Mean (+ SE) number of fish individuals caught by replicate seine net deployments at each location

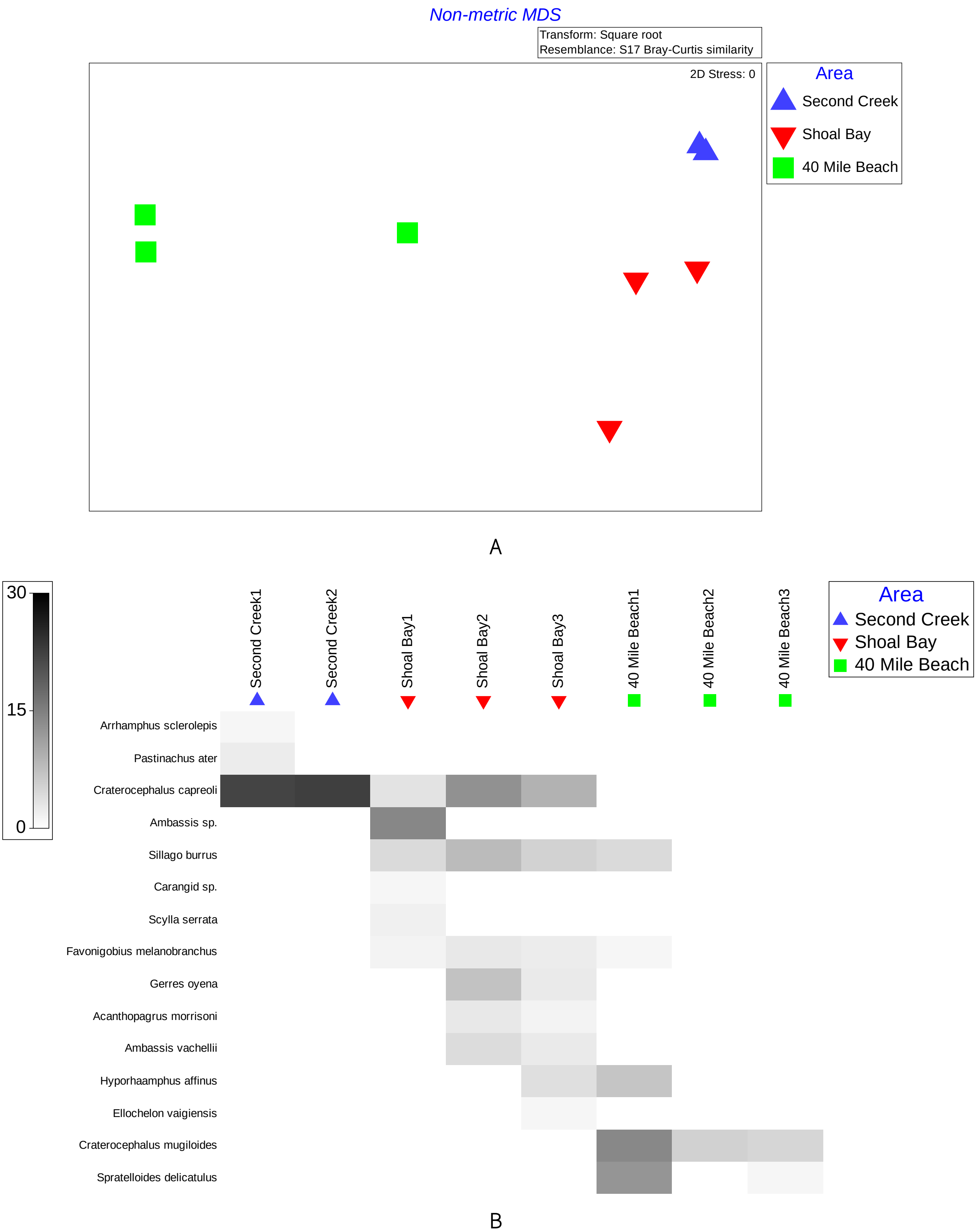

Figure 8 Comparison of fish species caught across sites.

Clusters of sites share a similar pattern of species composition or spatial distribution, as shown in Figure 8 A) Principal Component Analysis using Bray-Curtis dissimilarity index and Figure 8 B) shade plot constructed from the square-root transformed densities of each of the 14 fish species (and the green mud crab) caught in 41.5 m seine nets at the 8 sites sampled.

Species captured by gill net

Gill netting captured 13 fish species, including five elasmobranch (three shark, one guitarfish and one stingray) species (Table 6). Of these, the nervous shark (*Carcharhinus cautus*) was numerically (n=20) most abundant and captured in all net sets (except the single composite gill net set). Lengths ranged from 640 to 1140 mm TL. Although only a single giant guitarfish (*Glaucostegus typus*) was captured, many were observed in the shallows.

Gill nets captured fauna other than fish, being a single blue swimmer crab (*Portunus armatus*) and two green turtles (*Chelonia mydas*); with several others hitting the nets but not getting entangled.

Opportunistic observations

Additionally, visual observations were noted, although the windy and turbid conditions prohibited extensive visual surveys or drone operation. Visual observations included many (20+) juvenile broad cowtail rays and 10 spotted whiprays (*Himantura* sp.), as well as 15 neonate (~40-60 cm) giant guitarfish. In some locations, neonate (40-60 cm) nervous sharks and neonate-juvenile (70-100 cm) lemon sharks were also common, with 10 nervous sharks and six lemon sharks observed.

Juvenile green turtles were abundant in all areas surveyed, with approximately 40 sighted during the survey, all with carapace length of ~30-60 cm (i.e., of juvenile size class). No adult green turtles or turtles of other species were observed, though turbid and windy conditions sometimes made identification difficult.

4.3. Tagged sawfish

Immediately prior to the study, three green sawfish were captured at the mouth of the Fortescue River. One individual was a newly born male pup of 790 mm TL; the remaining two were both males and were 2001 mm and 2015 mm in TL. The latter two individuals were tagged internally with acoustic transmitters (see Table 7). These transmitters will send acoustic signals randomly between 120 and 180 seconds for period of ~580 days which is the life of the battery. At this location, a VR2W acoustic receiver was deployed on 23 August 2022, which may help to understand sawfish movements along the central Pilbara coastline, including connectivity with sites at and around Eramurra. Each sawfish had a uniquely numbered t-bar tag inserted below the first dorsal fin (Figure 9).

Table 7 Tagged sawfish at Fortescue River

Acoustic tag	t-bar tag	Spatial co-ordinates	Date	Sex	TL (mm)	SRL	LRT	RRT
NA (animal too small)	1576	21.001°S, 116.100°E	20-08-2022	M	790	197	26	27
1399252/6181	0012	21.002°S, 116.101°E	21-08-2022	M	2,001	459	28	27
1399253/6183	0026	21.002°S, 116.001°E	21-08-2022	M	2,015	469	26	26

TL: total length; SRL: standard rostrum length; LRT: left rostral teeth count; RRT: right rostral teeth count.

Figure 9 T-bar tag on a juvenile green sawfish tagged at the Fortescue River mouth.

Of the five Eramurra receivers surrounding Cape Preston and the Erramurra site, only one (137851; to the west of Cape Preston) had an acoustic detection. This was a single detection of a tagged adult lemon shark (*Negaprion acutidens*) originally tagged at Ningaloo Reef in 2016. No Eramurra receivers had recorded detections from sawfish tagged to the south of the study area (Lear and Morgan 2023).

The Murdoch University receiver in the Fortescue River mouth had received more than 13,000 detections from the two sawfish tagged there in August 2022 (Figure 10). One of these sawfish (Pz02), showed near constant residency to the Fortescue River mouth, while the other sawfish (Pz03), showed more sporadic residency but continued to return to the Fortescue River mouth up to the point of receiver download (Figure 10).

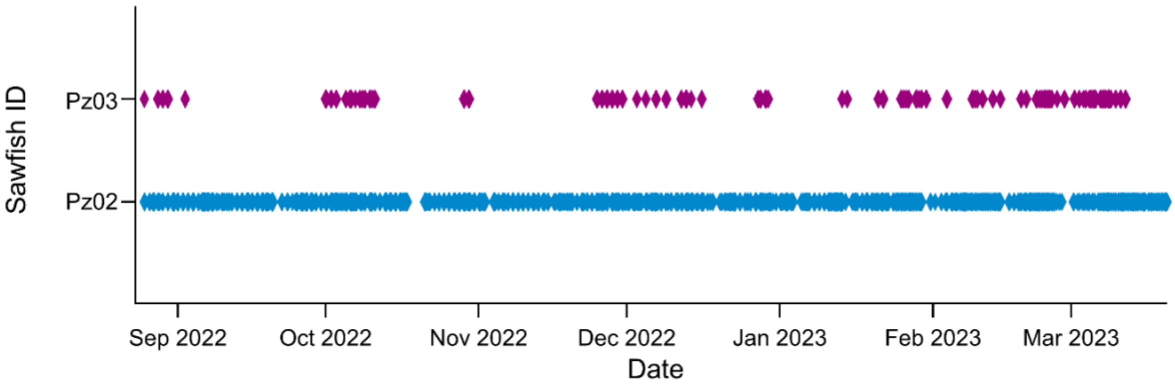

Figure 10: Detection map from the two sawfish tagged in the Fortescue River estuary in August, 2022 (Lear and Morgan 2023).

5. Discussion and Initial Conclusions

5.1. Potential sawfish nursery habitat

The habitats surveyed during this project included mangrove creeks and mud flats that appeared to be ideal sawfish habitat, similar to habitats where sawfish are found elsewhere in the region. The lack of sawfish recorded during these netting surveys indicates that the area may not be a major habitat or a pupping ground for any sawfish species.

Three green sawfish were captured immediately prior to the study at the mouth of the Fortescue River; two of which were tagged with acoustic tags. These animals did not enter the Eramurra acoustic array. These individuals, which were greater than 2 m TL, are of the size that have been shown to have a large home range (Morgan et al. 2017).

The consistent presence of two larger juvenile green sawfish in the Fortescue River estuary indicates that this location is likely an important secondary (and probably also primary) nursery location for this species. Tracking studies in the Onslow area have shown movements of similar size juveniles spanning approximately 20 km of coastline (Morgan et al., 2017), indicating that the area and creeks surrounding the Fortescue River may also be important areas for late-stage juvenile sawfish. The sawfish pup captured at the mouth of the Fortescue River immediately prior to this survey suggests that there may be a slightly earlier pupping period there, than the more southerly Onslow population (generally October to December; Morgan et al. 2015).

The lack of detections from sawfish on the receivers closer to the Eramurra site is not necessarily indicative of a lack of use of this area by sawfish, considering no sawfish were tagged in the area. The absence of detections from the Fortescue River sawfish on these receivers could indicate that this area is not commonly used as a secondary nursery by sawfish pupped in the Fortescue area, although the small sample size and short recording duration to date precludes making conclusions about this. The lack of detections on Eramurra receivers from sawfish originally tagged in the Onslow area is not surprising, considering many of these animals were only tagged in the last year, and would have to traverse a minimum of approximately 170 km of coastline to reach the southern/western most Eramurra receiver; extended monitoring times are necessary to determine if sawfish from the Onslow area use the Eramurra area as subadults or adults. Additionally, further survey and tagging of sawfish closer to the Eramurra site is necessary to determine sawfish presence in and use of the area.

5.2. Potential sawfish foraging habitat

The occasional sightings of green sawfish in the general region and abundance of this species in nearby nursery habitats (e.g., Ashburton River and Fortescue River) suggests that this area is likely an occasional foraging habitat along the migratory corridor for juvenile and sub-adult green sawfish. This species is known to reliably pup each year in October near the Ashburton River mouth, and juveniles and sub-adults (up to ~3 m total length) migrate along the coastline to other tidal creeks during their development (see Morgan et al., 2015, 2017). It is hypothesised that Cape Preston (and Dampier Archipelago in general) may act as a bottleneck for migrating sawfish, in much the same ways as has been shown the migrating green turtles (see Ferreira et al. 2021). The high abundance of potentially suitable prey species captured in the seine nets suggests that the area would sustain sawfish, however there is considerable variation between the locations surveyed but it is not too dissimilar to the prey found elsewhere in green sawfish habitats (see Wells and Morrison 2010).

5.3. Other species of note

Giant guitarfish were captured and regularly sighted throughout the study area. The species is a large ray (to almost 3 m TL) listed as Critically Endangered on the IUCN Red List (Kyne et al. 2019), but not of conservation significance in Australia or at the WA State level. It is found in high abundance along the Pilbara coast to the Exmouth Gulf (D. Morgan, K. Lear and R. Bateman-John, unpublished data). Newborn pups use the extreme shallows of the intertidal zone of mangrove creeks, river mouths and marine embayments to forage and reduce potential shark predation, before moving offshore to coastal habitats (R. Bateman-John, D. Morgan and K. Lear, unpublished data). After attaining sexual maturity, they may move to deeper waters and are thought to be philopatric, only returning to shallow waters to give birth.

Nervous sharks were the most commonly caught elasmobranch species. They are small coastal sharks often found amongst mangroves whose diet largely consists of small bony fishes. A lemon shark was detected by the array, which had been tagged at Ningaloo Reef in 2016. Lemon sharks occur in inshore and offshore waters to depths of 90 m and associate with coral reefs, lagoons, mangrove flats and embayments . Neither species are of conservation significance at Australian or WA State levels. Internationally, nervous sharks are listed as data deficient and lemon sharks are listed as Vulnerable by the IUCN.

Juvenile green turtles were abundant in all areas surveyed, which could indicate that the creeks support important foraging habitat for this age class. Green turtles are listed as Vulnerable, Marine and Migratory under the EPBC Act at the Australian level, and Vulnerable under the BC Act at the WA State level. WA is recognised as supporting one of the largest populations of green turtles, globally (DoEE 2017).

5.4. Recommendations

Indications that this area may not be pupping ground for sawfish suggest that underwater noise in the area is unlikely to interfere with pupping, and that seasonal restrictions on timing of dredging would not be necessary for this purpose.

Pregnant females may move through the area as part of their migration from offshore waters to river/tidal creek mouths to give birth. It is also likely that this coastline is part of a migratory corridor for juvenile-subadult green sawfish, based on past studies and sightings including that of the newborn pup captured at the Fortescue River mouth on 20 August 2022, and the two larger juveniles captured on 21 August 2022. Previous studies found that freshwater sawfish migrate along the central Pilbara coastline, with several sightings of adults to the south of the study site that were likely pupped in the Fitzroy River area of the Kimberley. Previous research has also suggested that juvenile sawfish do not readily migrate past solid barriers along the coastline which would force them to swim into deeper water (D. Morgan and K. Lear, unpublished data). Therefore, engineering decisions should favour avoidance of physical structures immediately along the coastline that could hinder migration, at all opportunities.

The acoustic array is currently in place for a further six months, from servicing in March 2023, which will record the movements of previously tagged sawfish that may move further along the coastline. Increasing the deployment time of the array would gather a larger dataset which could increase the chance of captured tagged individuals and account for seasonal variability. A larger dataset could allow the determination of sawfish abundance and residency patterns at the study site. Further, the sawfish pup captured at the mouth of the Fortescue River suggests a slightly earlier pupping period than the Onslow population further south, which is generally from October to December (Morgan et al. 2015). As the life of the acoustic tags deployed in green sawfish on the 21 August 2022 is 584 days, and that approximately ten green sawfish were acoustically tagged south of the study area near Onslow in recent times, it is recommended that acoustic monitoring be undertaken for a minimum period of twenty months. Such a period would be able to document seasonal movements for several sawfish species along the coastline (see Morgan et al. 2017).

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