Sawfishes (Pristidae) from the Queensland Gulf of Carpentaria, Australia: a summary of fishery derived data

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Synopsis

Pristis microdon, *P. zijsron*, *P. clavata* and *Anoxypristis cuspidata* were found to be distributed throughout the northern, southern and western regions of Queensland's Gulf of Carpentaria. *A. cuspidata* was the most commonly caught sawfish and was recorded in the inshore and offshore set net fisheries. The size distribution of *A. cuspidata* suggested that the foreshore area maybe the preferred habitat for juveniles of this species. *P. microdon*. *P. zijsron,* and *P. clavata* were recorded in the inshore fishery with catches dominated by immature animals. *P. zijsron* was only recorded on the foreshores whilst *P. clavata* inhabited both estuarine and foreshore habitat. *P. microdon* only interacted with the inshore fishery in the wet season and was found to inhabit freshwater and estuarine environments. Observations on reproductive staging and postnatal pup development suggest that in all four pristidae species, pupping occurs during the monsoonal wet season. This is significant as a seasonal set net closure for the barramundi and shark fisheries has been in place since 1980 over the monsoonal wet season.

Introduction

Sawfish (Family Pristidae) are highly distinctive members of the Superorder Rajomorphii (Hamlett, 1999) being characterised by an extended rostrum with lateral teeth (Bigelow and Schroeder, 1953). The family comprises the two genera *Pristis* and *Anoxypristis,* and currently between 4 and 7 species are known from Australia (Last & Stevens, 1994). Sawfish occur worldwide in shallow coastal waters and river systems in the tropics where they attain large sizes, often in excess of two metres and occupy marine, hypersaline and freshwater habitats (Last and Stevens 1994).

There is a lack of information on the life history, biology and demography of Pristidae, however it is assumed that like most elasmobranchs they are long lived, produce few offspring and mature later in life than most bony fishes (Walker, 1998). If correct, this life history strategy would make them vulnerable to overexploitation (Bonfil, 1996). Concerns have been expressed over this lack of biological information for Pristidae (Simpfendorfer; 2000, Compagno and Cook, 1995; Zorzi, 1995; Tanaka 1991; and Thorson, 1982).

Pristidae populations have been declining worldwide (Stevens et al., 2000). Declines in Pristidae populations have been quantified in North America (Simpfendorfer, 2000), and reported in Central America by Thorson, (1982). The extent of population decline is difficult to quantify due to a lack of reliable historical data on sawfish. Anecdotal reports suggest declines throughout the Indo-West Pacific (Compagno and Cook, 1995). Demographic analysis of the available sawfish data (Thorson 1976, 1982 - Lake Nicaragua, Bigelow & Schroeder, 1953 – species reference notes) on *Pristis perotteti* and *Pristis pectinata* by Simpfendorfer (2000) suggested that Western Atlantic populations have been significantly depleted, but are undergoing a slow recovery. Sawfish have significant cultural and spiritual relevance to indigenous Australians within the entire Gulf of Carpentaria (GoC) [1], but the extent of the indigenous fishery is currently unknown. The status of sawfish populations in Australia is also unknown.

Simpfendorfer (2000) identified commercial net fishing as the key threatening process to sawfish survival in America waters. A combination of pristid's shallow water coastal distribution and teethed rostrum, make all size classes vulnerable to capture within net fisheries. The capture of sawfishes within Australian commercial net fisheries has been poorly reported but they are taken as bycatch in set net operations along the Queensland (QLD) GoC and east coasts[2]. Northern Territory Museum records demonstrate that the distribution of the four sawfish species extend along the Northern Territory coastline of the GoC although no detailed distribution information is available (Dr Helen Larson Northern Territory Museum pers com., 2003).

Another threat to the survival of Pristidae is that posed by aquarium and museum specimen collectors (Cook *et al*., 1995). In addition, there is some evidence of the capture of Pristidae by recreational line fishers. Nelson (1994) referred to sawfish as a target sport fish within GoC rivers and estuaries, and landings of sawfish have been recorded in recreational fishing competitions in the GoC [3]. Another significant factor that maybe influencing the global decline

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[1] McDavitt, M.T. (2001). Abstract: Sharks in land. The symbolism of freshwater sharks and sawfishes in north Australian Aboriginal societies. American Elasmobranch Society 2001 Annual Meeting State College, Pennsylvania. The American Elasmobranch Society Web Homepage.

[2] Gribble, N.A., 1999. Tropical Resource Assessment Program- technical report. Department of Primary Industries Project Report. 110 pp.

[3] Helmke, S.A. 1999. Survey results of the 1998 Normanton and Burketown Fishing Competitions. Project report to Queensland Fisheries Management Authority. The State of Queensland, Department of Primary Industries, QO99004.

of sawfish populations is habitat loss or degradation (Simpfendorfer 2000, Camhi *et al*., 1998, and Zorzi, 1995).

There are a number of reports of the occurrence of Pristids in QLD GoC waters. Based on museum records, Last and Stevens (1994) identified the occurrence of *P. microdon*, *P. zijsron*, *P. clavata*, *P. pectinata* and *Anoxypristis cuspidata* within the GoC. *P. zijsron* and *A. cuspidata* are known bycatch species in the northern prawn fishery (NPF), which operates throughout the GoC, (Stobutzki *et al* 2002). These two species have also been recorded in a creek in the western GoC, from Arthurs Creek, a coastal estuarine system (QLD Museum records). *P. microdon* has been recorded from the Gilbert River (Tanaka, 1991) and Norman River (QLD Museum records). A QLD based commercial aquarium collector (L. Squires Cairns Marine, pers com 2003) reported capturing *P. microdon* in the Wenlock , Flinders, Bynoe, Norman and Gilbert Rivers and *P. clavata* and *P. zijsron* in the Pine River (see Figure 1). There are currently unconfirmed records of *P. pectinata* inhabiting the GoC.

Pogonoski *et al.* (2002) identified northern Australia as possibly one of the only remaining geographical regions where viable populations of pristids remain. The International Union on the Conservation of Nature (IUCN) shark specialist group[4] categorised all four species of sawfish as endangered on the basis of their rapid decline in range.

This preliminary paper will offer some contrast to other published literature from the northern hemisphere regarding Pritidae abundance and biology. The primary objectives of this study were to: collate sawfish catch data available from the QLD GoC set net fisheries; use this

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[4] Anon. 2000. IUCN shark specialist group red list assessments [Internet] Available from <http://www.flmnh.ufl.edu/fish/Organizations/SSG/redlist.htm< [Accessed 5/503]

information to map the spatial distribution and frequency of occurrence of *P. microdon*, *P. zijsron*, *P. clavata* and *A. cuspidata* in the GoC; and report on the collected biological data. This study is the first albeit preliminary assessment conducted on sawfish distribution, relative abundance and biology in Australia.

Methods

Study area

The GoC is located in northern Australia and is a very extensive, relatively shallow embayment of approximately 320 000 km^2 (see Figure 1). The QLD sector of the GoC covers 270 000 km^2 and supports a diverse commercial fishing industry worth approximately AU$67 million annually (Lew Williams Queensland Fisheries Service, pers com 2001). The penaeid prawn trawl fishery is the major commercial fishery worth 55 million Australian dollars annually. The other important commercial fisheries in the GoC are for barramundi (*Lates calcarifer*), shark (*Carcharhinidae* spp.), mackerel (*Scomberomorus commerson* and *S. semifasciatus*), polynemid threadfins (*Eleutheronema tetradactylum* and *Polydactylus macrochir*) and mud crab (*Scylla serrata*).

Within the QLD managed sector of the GoC, ninety-two inshore commercial set net fishing licences and six offshore commercial set net fishing licences are currently operational (Mark Doohan Queensland Fisheries Service *pers com* 2003). The areas of operation for these fisheries are presented in Figure 1. Both inshore and the offshore commercial set net fisheries have a closed season set in accordance with the lunar cycle for spawning barramundi (Garrett, 1987), a period of approximately four months over summer. The data presented in this paper only examines fishing days within the boundaries of the commercial fishing season and area of operation.

The inshore set net fishery (known as the N3 fishery) is a multispecies finfish fishery predominantly targeting barramundi (*L. calcarifer*) and threadfin salmon (*Polynemidae* spp.) from the shoreline seaward to 7 nautical miles (QFMA, 1999). A number of area closures, mainly governing the freshwater reaches of rivers, and cultural areas of significance to indigenous owners have been gazetted (see Figure 2). The offshore commercial set net fishery (the N9 fishery) is predominantly a shark (especially *Carcharhinus tilstoni* and *Carcharhinus sorrah*) and grey mackerel (*S. semifasciatus*) fishery extending from 7 nautical miles offshore out to 25 nautical miles.

The GoC is influenced by a warm, moist north-west monsoonal circulation from December to March each year and a cooler, drier south-east trade wind period from May to October [5]. This pattern produces monsoonal "wet" and "dry" seasonal changes. The southern and western regions of the GoC offshore to 25 nautical miles are shallow (consistently less than 18m) and have extensive mudflats. This promotes high water turbidity due to tidal run and wind induced wave action. The inshore and offshore waters of the northern region are characteristically clearer and with a steeper shoreline gradient than the south. Typically the north has sandy beaches and rocky headlands. The foreshores have steep beaches with sand dunes vegetated with *Casuarina* trees.

The southern region has extensive mangrove fringed foreshores and silty undulating mud/sand bars. The western region is commonly shallow with wide firm mud bars extending well offshore. The foreshores are lined with mangrove forest fringing salt flats, which are

[5] Staples, D.J. 1983. Environmental Monitoring: Climate of Karumba and Hydrology of the Norman River Estuary. South-east Gulf of Carpentaria. CSIRO Marine Laboratories Report 156.

periodically inundated by tide. The substratum of the offshore set net fishery is predominantly mud/sand with rubble beds and isolated shoaly reefs to a depth of 40 metres (Jason Stapley QLD Fisheries Service pers com, 2002).

The river catchments of the southern and western regions of the GoC are larger than those from the rivers in the north region. Open savannas are a feature of both the later regions with the north region possessing shallow and stony soils with dominant Eucalypt woodland vegetation (Ryan, *et al*., 2002). All river systems are mangrove lined on coastal estuarine ends and the southern and western rivers have extensive seasonal wetlands. All rivers are subject to the monsoonal “wet” and “dry” seasonal pattern of flow.

Data collection

The information collated in this report was obtained from research observer surveys of catches made by commercial fishing vessels, voluntary observer surveys and research netting surveys. Observations were made throughout the fishing season; no observer information could be collected for the four months from October to February due to the barramundi spawning season closure. The fishing apparatus surveyed in the inshore set net fishery consisted of monofilament gillnets of between 162.5 and 245 millimetres stretched mesh with an approximate mesh drop (depth of net) of between 3 and 6 meters. The offshore fishery used 162.5 millimetres mesh nets consistently with an approximate mesh drop of 13 meters. Use of hydraulic net hauling devices is permitted in both fisheries, and are used principally within the offshore fishery where longer and deeper nets are fished.

Research observer surveys

Research observer surveys were undertaken in both the inshore and offshore set net fisheries on an opportunistic basis as often as possible when time and space on board vessels was available. The mandate of the research observer was to collect total catch information focusing on the target species. All sawfish captures were recorded. Sawfish were identified with the sawfish taxonomic key published in Last and Stevens (1994). Information recorded included morphometric measurements, reproductive staging, genetic sampling, tagging of released animals and core vertebrae sample from deceased animals.

Voluntary observer surveys

The fifteen inshore commercial fishers that assisted in the research observer program provided information about their catches of sawfish. These commercial fishers fished throughout all of the regions during this study and were trained in sawfish identification and biological sampling procedures whilst the author was onboard their vessels during research observer surveys. Training in biological sampling included the reproductive staging of male specimens, genetic sampling and, on deceased animals, a vertebrae core sample. In addition, a formal training workshop with sawfish specimens was held in 2001 to further improve fishers identification and reporting skills. A sawfish identification guide[6] with photographs that highlight key morphological features was circulated to all inshore and offshore set net fishers. Validation of species identification was undertaken by using disposable cameras and deceased specimens being forward onto the research observers.

[6] Peverell, S.C. 2002. Queensland sawfish identification guide. The State of Queensland, Department of Primary Industries, QIO3038

Research Netting Surveys

As part of a QLD government funded long term monitoring program of fisheries resources that obtains fisheries independent data on the status of barramundi stocks in the GoC inshore fishery all sawfish catches were recorded. The area of operation included the Flinders River, Staaten River, Mitchell River and the Archer River during the post wet season months of March and April. This barramundi study is part of a multi-species ongoing monitoring project undertaken by the Queensland Fisheries Service in several fisheries. Research fishing apparatus for the barramundi surveys to capture a broad range of fish sizes include the use of 50, 100 and 150-millimetre monofilament net of 33 mesh drop. In total to date 30 barramundi research survey netting days have been recorded in the GoC, ten per year since 2000. Sawfish information recorded was as per the research observer surveys.

Biological Sampling Strategy

The catches of sawfish in the GoC are often sporadic and seasonal, unlike traditional catch sampling of finfish where large densities of animals are encountered (QLD fisheries observer observations). As such, all efforts were made by the research observers to obtain all biological information from specimens that became accessible. The collection of this information in a systematic way was restricted due to field conditions and logistics involved in dealing with large and potentially dangerous animals.

In consideration of the conservation concerns for Pristidae, all animals examined were tagged and released alive where possible. Morphological measurements (nearest 5mm) were taken that included total length (T_L),, lower jaw to total length (LJT_L) and lower jaw to fork length. Where specimens were dead or deemed not to be in condition for release, approximately 8 vertebrae were extracted from below the first dorsal fin for an independent age and growth study. Tissue samples of either muscle or fin for all sawfish recorded in the research observer and netting surveys was preserved in dimethyl sulfoxide (DMS) for future DNA genetic analysis. Gender was determined by observing external genitalia, that is presence or absence of claspers, and reproductive staging was recorded using the technique described in Stevens & McLoughlin (1991).

Sawfish CPUE

Catch per unit of effort (CPUE) was recorded as number of animals caught per net shot day. The term net shot is used to standardise the fishing effort to a set measurement of net that is 500 metres. These data were assigned to a thirty-minute (a 30 by 30 nautical mile grid) commercial grid reference for mapping purposes. This scale of data presentation is necessary to comply with confidentiality provisions of QLD commercial logbook reporting. The data was pooled for the years between 2000 and 2002 and between fisheries for ease of reporting. The differences in fishing gear between the inshore and offshore set net fisheries were deemed to be similar between years. The location of each net shot was recorded using a Garmin® GPS 12 or the 6 minute grid reference as documented in the Queensland Fisheries Service commercial logbook program [7]

Sawfish CPUE is discussed in reference to GoC commercial fishing regions, that is northern region (12° to 14° S, 140° to 142°30’ E), southern region (14° to 18°30’ S, 142° to 140°E) and western region (14° to 18°30’ S, 138° to 140°E). The three fishing regions are distinguished on the basis of habitat characteristics as described earlier. CPUE data for each sawfish species was displayed in MapInfo® GIS software with graduated symbols.

Fishing effort varied between research observer, voluntary and the research netting surveys. The offshore set net fishery utilises a hydraulic net hauling device (net reel), a more efficient technique than the traditional hand haul method. A net reel apparatus allows operators to shoot and haul their gear several times a day, thereby covering a greater area than the hand haul method used in the inshore set net fishery.

For the purpose of this study, where multiple net shots were recorded spanning two or more 30 minute commercial grids per day, each grid reference was referred to as one observer day. Multiple nets that were set within close proximity to each other (no greater than 2 nautical mile as for netting in the inshore fishery) were standardised to one observer day for each 24 hour period the gear was being fished.

Data analysis

Sawfish records were collated in a Access® database with preliminary analysis be conducted in Excel®. Analysis of size distribution data between the inshore and offshore set net fishery for *A. cuspidata* was conducted in Genstat® using a Kruskal-Wallis 1-way analysis of variance. Regression analysis was used to determine if a significant relationship existed between the morphometric measurements of LJT_L to T_L, for all four sawfish species examined (Table 1). This was undertaken in order to standardise length measurement within this study and other published literature.

[7] Annon. 1988. Queensland commercial fishery information system logbook program grid reference. The State of Queensland, Department of Primary Industries

Results

Fishing effort

Over the period 2000 to 2002, commercial fishing effort was observed over approximately 70% of the available fishing area for the inshore set net fishery and 66% for the offshore set net fishery. This coverage was evenly spread geographically (see Figure 3). In this study the research observer and volunteer fishing effort coverage accounted for 3.3% and 12.6% of the total fisher days reported in the inshore and offshore fisheries respectively. All fishing licences within the offshore set net fisheries and approximately 7% of inshore licences were surveyed. In total 582.72 km and 256.8 km of net was observed in the inshore and offshore Set net fishery respectively.

Geographic distribution and relative abundance

Pristis microdon, *P. clavata* and *P. zijsron* were recorded in the inshore fishery and not in the offshore fishery. *A. cuspidata* was recorded in both fisheries (Table 2). Sawfish distribution and relative abundance varied considerably within GoC regions and between commercial logbook grids. *P. microdon*, *P. clavata*, and *P. zijsron*, were each recorded in the northern, southern and western regions of the GoC. *A. cuspidata* was recorded in the northern and southern regions of the GoC. *Anoxypristis cuspidata* and *P. clavata* possessed the highest CPUE, 1.6. sawfish per shot/day. The lowest CPUE for all sawfish species was zero.

Anoxypristis cuspidata displayed the greatest range being recorded in considerable more commercial logbook grids than the other sawfish species. The greatest catch rate of *A. cuspidata* was recorded in the northern region of the GoC. *Pristis clavata* and *P. zijsron* had more localised concentrations in comparison to *A. cuspidata. Pristis zijsron* recorded a maximum

CPUE of 0.4 sawfish per shot/day the lowest out of all of the sawfish species. *Pristis zijsron* was recorded in more commercial logbook grids than *Pristis clavata*.

Pristis clavata and *P. zijsron* were both patchy in their distribution (Figure 4). Catch rates of these two sawfish species varied approximately fourfold from each other. *Pristis zijsron* appears to be more abundant in the northern and western regions of the GoC than in the southern GoC. The abundance of *P. clavata* appears to be stronger in the western region of the GoC although it range is very patchy (Figure 4).

P. microdon was widely distributed along the eastern side of the GoC, and the maximum catch rate recorded was 0.79 sawfish per shot/day. It appears the distribution of *P. microdon* occurred mainly in the commercial logbook grids that encompassed the mouths of the major rivers such as the Mitchell, Gilbert, Archer, Nassau and Staaten Rivers (see Figure 1). Analysis of the catch dates for *P. microdon* records showed that 95% of the catch was recorded in the months February to May.

Size distribution and Sexuality

The size distribution of specimens of *P. microdon*, *P. clavata*, *P. zijsron* and *A. cuspidata* caught in the set net fisheries of the GoC was highly variable with size classes ranging from pre birth to adult (Figure 4). There appears to be a consistent pulse in the 700 to 1200 mm T_L size class for each sawfish species. This range in size class was classified as immature in all species of sawfish. The size distribution pattern for *P. microdon* and *A. cuspidata* are multi-modal, however it is impossible to attribute this trend to individual age cohorts as there is insufficient data.

The size distribution of *A. cuspidata* suggests a shift in size classes from smaller or to larger between the inshore and offshore fisheries. The non-parametric Kruskal-Wallis 1-way analysis of variance had a value of H = 62.61 and the Chi-square p-value was less than 0.001, which indicates the relationship between the size distributions for *A. cuspidata* in the inshore and offshore set net fisheries is highly significant. The largest *A. cuspidata* was recorded in the offshore set net fishery at 3300 mm T_L and the smallest in the inshore set net fishery at 750 mm $T_{L.}$

The sex ratio of male to female was consistent among all sawfish species for the inshore fishery. The sex ratio of *A. cuspidata* in the offshore set net fishery was dominated by female animals at a ratio of two point one females to one male (Table 2). Of the 72 *A. cuspidata* recorded in the offshore fishery, 16 male and 15 female specimens were reproductively staged and were identified as being sexually mature. All female specimens possessed large yolky egg sacs. These animals were examined in the month of August for the years 2000 and 2001.

Pristis species specimens taken in the inshore set net fishery were predominantly immature except for four individuals: a female *P. zijsron* caught in May (2001) of 3800mm T_L (post partum); a male *P. clavata* of 3060 mm T_L (long rigid claspers); and two female *P. microdon* of 6000 mm (with full term embryos) and 3030 mm T_L (full term embryos, pupping when caught) respectively. These mature *P. microdon* were taken in the months of March and April 2002 coinciding with large freshwater flows at the river mouths of two major GoC river systems following the annual wet season.

Thirteen *Pristis microdon* in postnatal development were captured in January to early April 2001-2002. Umbilical scaring was identified on the underside of these juvenile *P. microdon* ranging size classes 720 to 930 mm (± 0.94) T_L. During the months of February to April *P. microdon* was taken more frequently in the creeks and estuaries and *P. clavata* and *P. zijsron* along the foreshore flats and bays.

Discussion

Spatial distribution and CPUE

Only preliminary findings can be presented for GoC sawfish populations due to the remote area, difficult logistics and the low numbers of sawfish caught. The analysis that could be undertaken of available data is limited. Despite this constraint a number of trends have been identified in sex and size ratio distribution for the four GoC sawfish species. The inshore fishery interacts with *P. microdon, P. clavata, P. zijsron* and *A. cuspidata*, however, the only sawfish species recorded by the research observer program in the offshore fishery was *A. cuspidata*.

Pristis microdon

Little is known about the biology or life cycle of the freshwater sawfish. Last & Stevens (1994) documented the range of this species as extending to all GoC river systems and provided a brief description of the species biology based on a small number of juvenile specimens. In the current study, *P. microdon* was recorded in all three sections of the GoC and the CPUE was highly variable with catch rates restricted predominantly to the wet season months of January to April. Captures of *P. microdon* records were concentrated in the commercial grid references that include the river mouths of the Archer, Nassau, Staaten, Mitchell and Gilbert Rivers (see Figure 1). This finding is likely the result of the animal's biology and preference for freshwater habitats experienced during this time of the year.

The peak catch rates for *P. microdon* correspond with the monsoonal wet season, when the salinity levels at the river mouths and along the foreshores are very low. However, *P. microdon* are known to inhabit tidal waters and will tolerate salinity levels similar to those in a marine environment. Several authors believe (Last & Stevens 1994, Compagno 1984) that this species is euryhaline; inhabiting and breeding in freshwater or weakly saline water (Last & Stevens 1994, Compagno 1984).

At the present, there are no records of this species from an offshore environment in the GoC. There is however growing evidence to suggest the freshwater environment is the preferred habitat for only immature *P. microdon* with no mature animals recorded upstream of river mouths in Australia. Preliminary results from this study indicate that the peak pupping months for *P. microdon* are from December through until March, which supports the notion that the pupping biomass has been partially protected from set net fishing in the GoC for over two decades because of seasonal closures.

Anecdotal information obtained from commercial net fishers and traditional owners (indigenous) from the GoC suggest that monsoonal patterns in weather are believed to be the environmental cue responsible for triggering sawfish pupping with freshwater flows being the catalyst. In this study *P. microdon* pupping was observed on two occasions in the inshore set net fishery during the wet season with the animals measuring 6000 mm and 3030 mm T_L respectively. Determining the distribution of mature *P. microdon* during the dry season months requires further study. Based on the data currently available, the interaction of *P. microdon* in the inshore and offshore set net fisheries of the GoC appears to be limited to the wet season months. Stobutzki *et al.* (2002) has suggested other processes threatening the mature element of the *P. microdon* population in the GoC might include commercial fish trawling and prawn trawling through direct mortality.

Pristis clavata

Pristis clavata is referred to as the dwarf sawfish, a small robust animal that has been reported to attain a length of 1400 mm T_L (Last and Stevens 1994). In this study, a male specimen of 2960 mm T_L was recorded as a mature animal and a female of 2100 mm T_L was immature. Based on these data, this animal probably attains a maximum size approaching 3500 mm T_L. This study shows that the distribution of *P. clavata* extends into all regions of the QLD GoC with its relative abundance being low everywhere and highly variable. Catches of *P. clavata* were made during the post wet season months, however only along the coastal foreshores where the waters are brackish to salt at this time of the year. During the dry season months, this species could be found ranging upstream of river mouths to a distance of 20 kilometres.

Pristis zijsron

In this study *P. zijsron* was not recorded in the commercial net fishery areas during the first three months of the commercial fishing season however this species is known to inhabit freshwater environments (Compagno and Cook, 1995) and supported by GoC traditional owners. The catch records show that *P. zijsron* inhabits all regions of the GoC with a pattern of relative abundance to that of *P. clavata* ie; in low numbers and with highly variable frequency of occurrence. *Pristis zijsron* was caught only along the coastal foreshores. A mature female specimen in post partum measuring 3800 mm T_L was recorded in May 2001. A collaborative study into the sustainability of Australian sharks and rays by CSIRO, Western Australia , Northern Territory and QLD has recorded a *P. zijsron* pupping in January (Rory McAuley WA

Fisheries *pers comm*., 2003). This very scant dataset suggests pupping for this species may occur during the wet season, as has been suggested earlier for *P. microdon*.

Anoxypristis cuspidata

Anoxypristis cuspidata was the most abundant of all sawfish species recorded in this study. This species is regarded as being a marine sawfish (Taniuchi and Shimizu 1991, Gleoerfelt-Tarp and Kailola 1984) and was recorded in the inshore and offshore fisheries of the GoC. The CPUE of *A. cuspidata* varied considerably with observed catch rates being greater in the northern region of the GoC.

The northern region is characteristically deeper than further south, and has clearer water, sandy beaches and rocky headlands. *A. cuspidata* is also the most commonly caught sawfish within the NPF, (Stobutzki *et al.* 2002) and it is most likely trawled off the bottom as opposed to being captured during setting and retrieving the fishing gear. By comparison the offshore set net fishery sets surface nets and *A. cuspidata* is part of the incidental catch. These results suggest that this species not only inhabits the sea floor but the mid water column as well. As such *A. cuspidata* can be best referred to as a benthopelagic animal.

No mature *A. cuspidata* were recorded in the inshore fishery out of the total of 54 specimens recorded in 2000 – 2002. This finding suggests that the inshore set net fishery area in the GoC maybe an area of critical juvenile habitat. The size classes of *A. cuspidata* are significantly different in the inshore and offshore set net fisheries with the offshore set net fishery predominantly catching large mature animal. Female *A. cuspidata* were found to be in reproductive stage four (yolk eggs present) in August (the dry season). If this species has a gestation period of six to eight months, a similar biological arrangement to that of *P. microdon* (Carpenter and Niem, 1999) then it is likely that pupping occurs over the monsoonal months.

Management Implications

This study has contributed to the knowledge of biology and distribution of sawfish in Australia. For all four pristid species, their relative abundance is low and variable. *P. microdon* was the only species found to exhibit a more inshore interaction with the inshore fishery in response to increased river flows; all other species were caught throughout the year. Analysis of size class distribution revealed that the area covered by the inshore set net fishery in the GoC may serve as a juvenile habitat for *A. cuspidata. Pristis clavata* and *P. zijsron* was both predominantly caught on the foreshores, but the numbers observed of both species were very low. The limited information on sawfish reproduction suggest that the pupping in all four species has some co-incidence with the monsoonal wet season.

Given the relative rarity of Pristidae and the remoteness of the GoC as a study area, it will be challenging to obtain the necessary life history information such as stock structure and age and growth, which is required to model sawfish population dynamics. However, the GoC pristids may represent one of the best conserved sawfish populations internationally. This is due to a number of factors including relatively minor coastal development and low levels of habitat degradation, and a multitude of fishing closures which help reduce levels of commercial set net finshing activities. Management initiatives, introduced in the 1980s (Garrett, 1987) to protect other fisheries resources can provide additional protection for sawfish over the critical monsoonal wet season. All set net fishing ceases in the QLD GoC during this four-month period.

It is expected that the study of the GoC sawfish will continue, and a better picture of the population dynamics and interactions will be built up over the next decade. In the meantime this preliminary report adds to the international body of literature on this rare and, in many places of this world, endangered group of elasmobranchs.

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Tables

Table 1: Parameters of the regression relationships between lower jaw total length (LJTL) and total length (TL) in the form of TL = a * LJTL+ b for pristis species of the GoC

Species	**Regression parameters**					
	a	**(s.e)**	**b**	**(s.e)**	**R^2**	**n**
Pristis microdon	1.47	0.044	-5.71	6.550	0.99	12
Pristis clavata	1.2	0.009	8.75	0.993	0.99	14
Pristis zijsron	1.56	0.040	-12.63	5.818	0.99	17
Anoxypristis cuspidata	1.41	1.638	2.98	0.018	0.99	10

Table 2: Pristidae sex ratio (M - male, F – female) and frequency of maturity for all records in the inshore and offshore fisheries of the GoC. Total lengths (maximum/minimum) were only provided for mature animals.

		Male			**Female**		
Species	**Sex ratio M:F**	**Min $T_{L\ (mm)}$**	**Max $T_{L\ (mm)}$**	**% Mat (n)**	**Min $T_{L\ (mm)}$**	**Max $T_{L\ (mm)}$**	**% Mat (n)**
P. microdon (inshore)	1:1.05	722	2765	0% (41)	723	6000	7% (28)
P. clavata (inshore)	1:0.91	912	2960	8% (12)	1019	2435	0% (10)
P. zijsron (inshore)	1:1.33	872	4492	7% (13)	830	3800	7% (13)
A. cuspidata (inshore)	1:1.15	750	2010	0% (27)	845	2300	0% (27)
A.cuspidata (offshore)	1:2.1	219	277	100% (16)	261	315	100% (15)

Figures

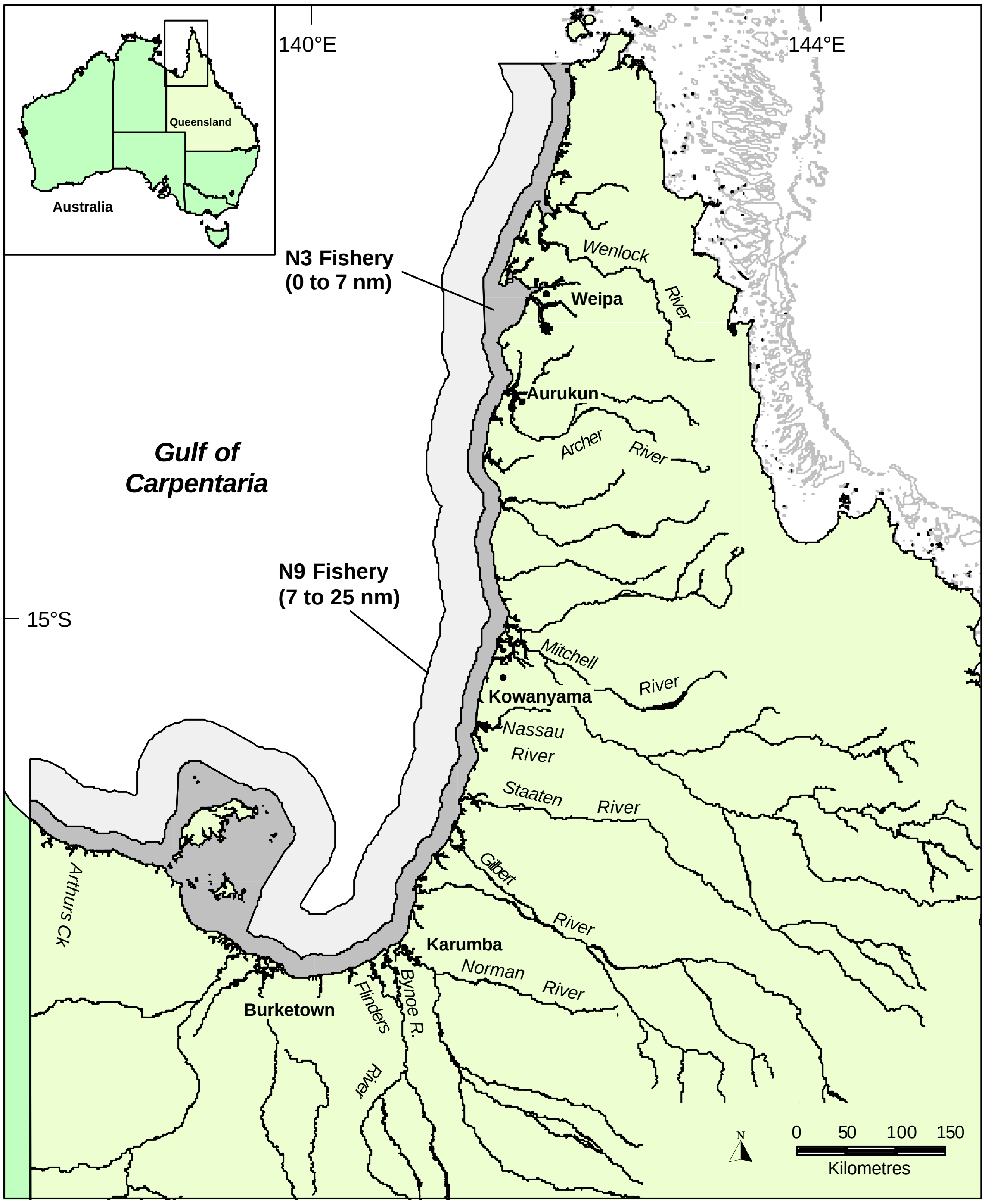

Figure 1: Area of operation for inshore (N3) and offshore (N9) set net fisheries and major river systems of the Queensland GoC Australia

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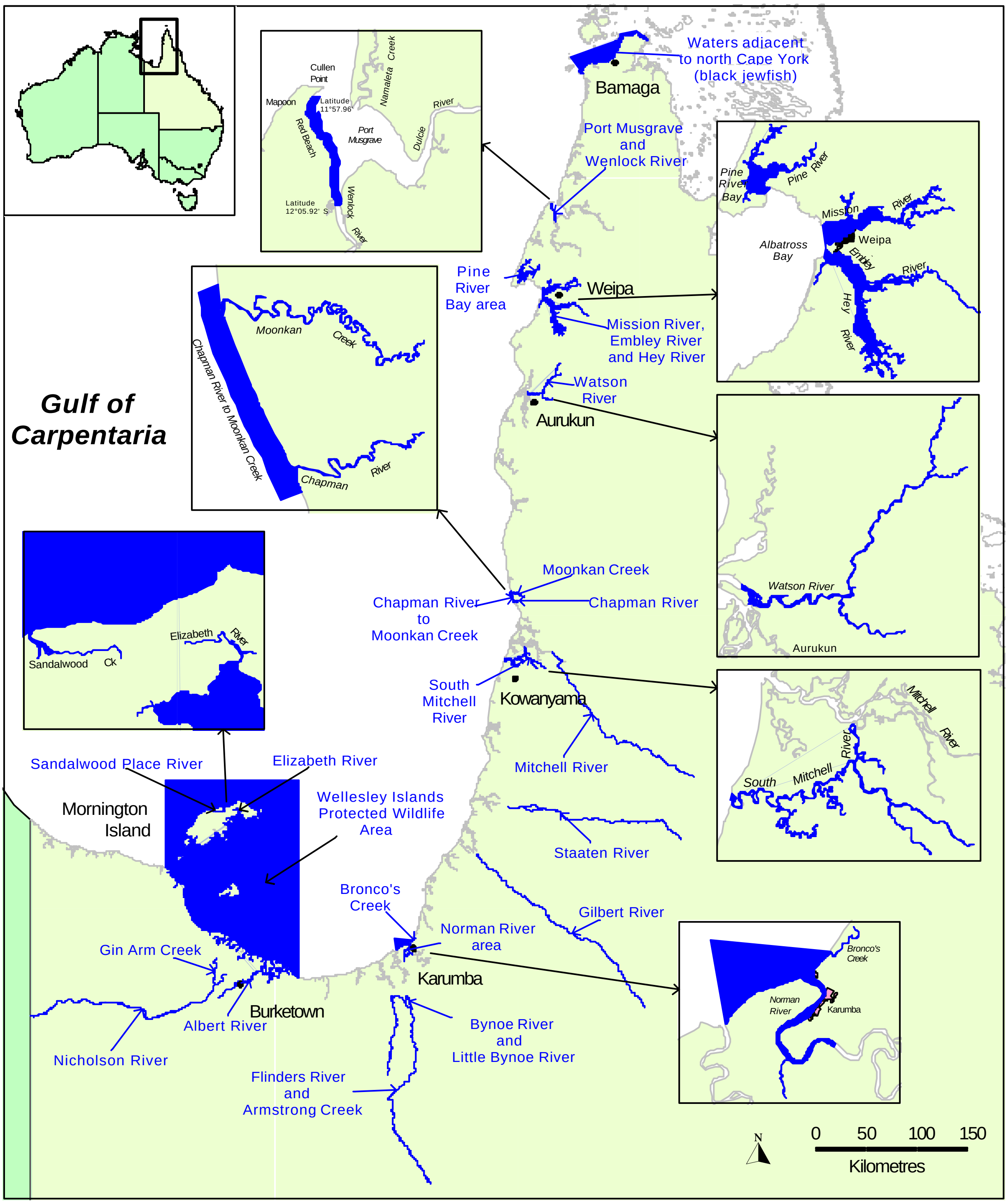

Figure2: Map of the QLD GoC showing river systems and area closed to set net fishing. Note the Mornington Island area is currently a fish habitat area but could be upgraded to closed to commercial fishing in the future

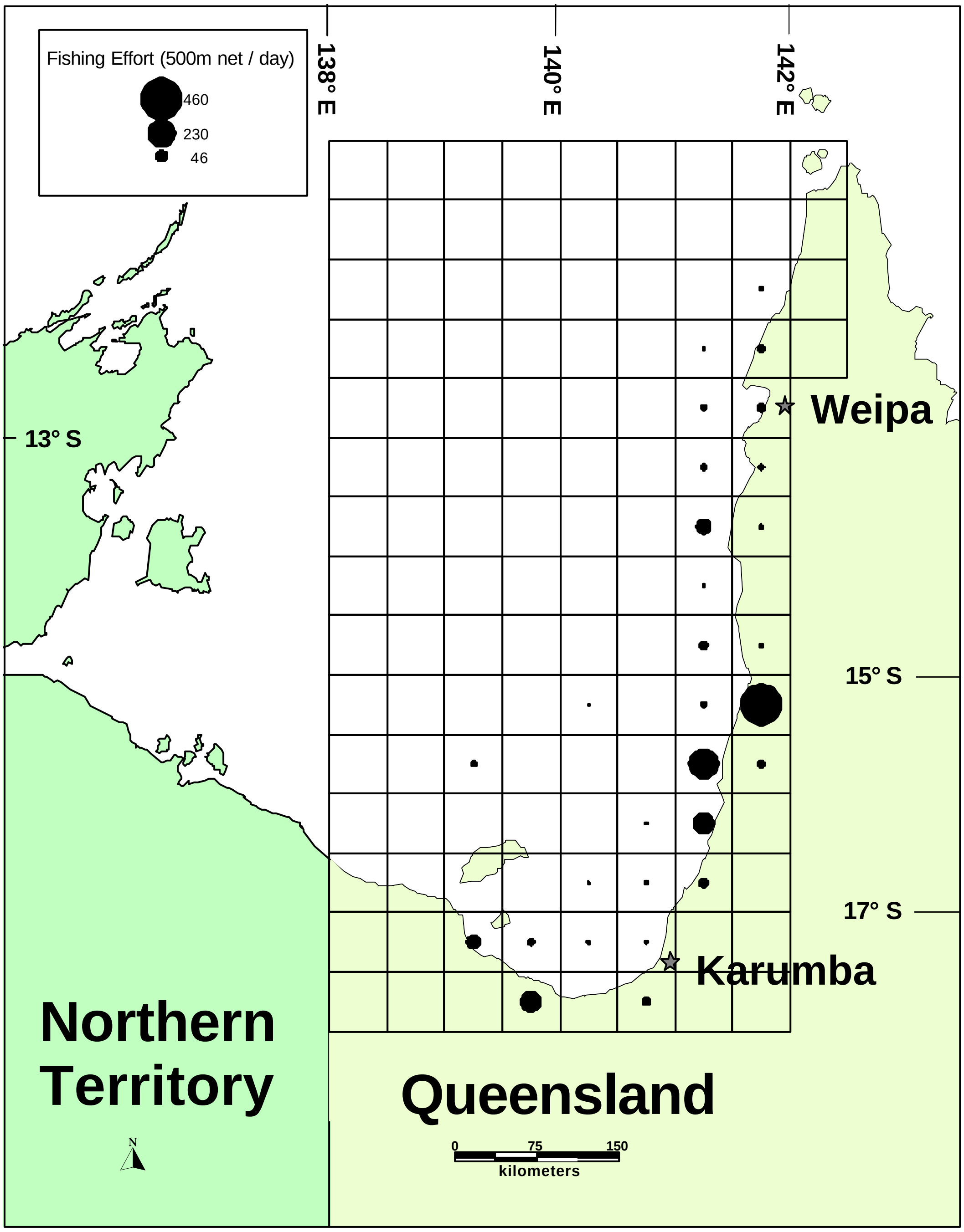

Figure 1: Distribution map of fishing effort for the inshore and offshore set net fishery (500m net/day) per 30 minute commercial logbook grid reference for the pooled years between 2000 and 2002.

5

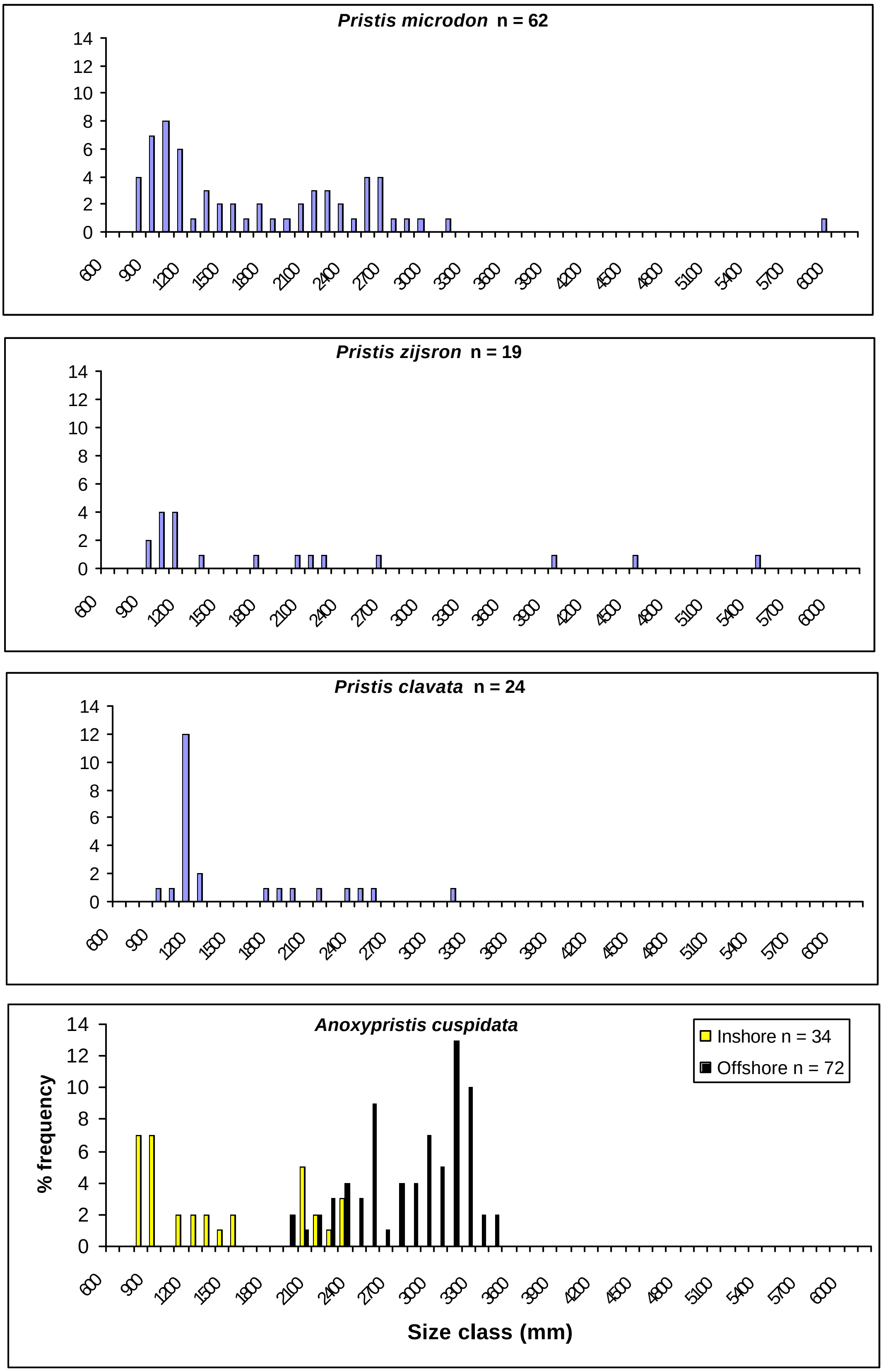

Figure 4: Sawfish size frequency (T_L mm) records pooled for the inshore and offshore set net fisheries between the years 2000 – 2002 for the GoC.

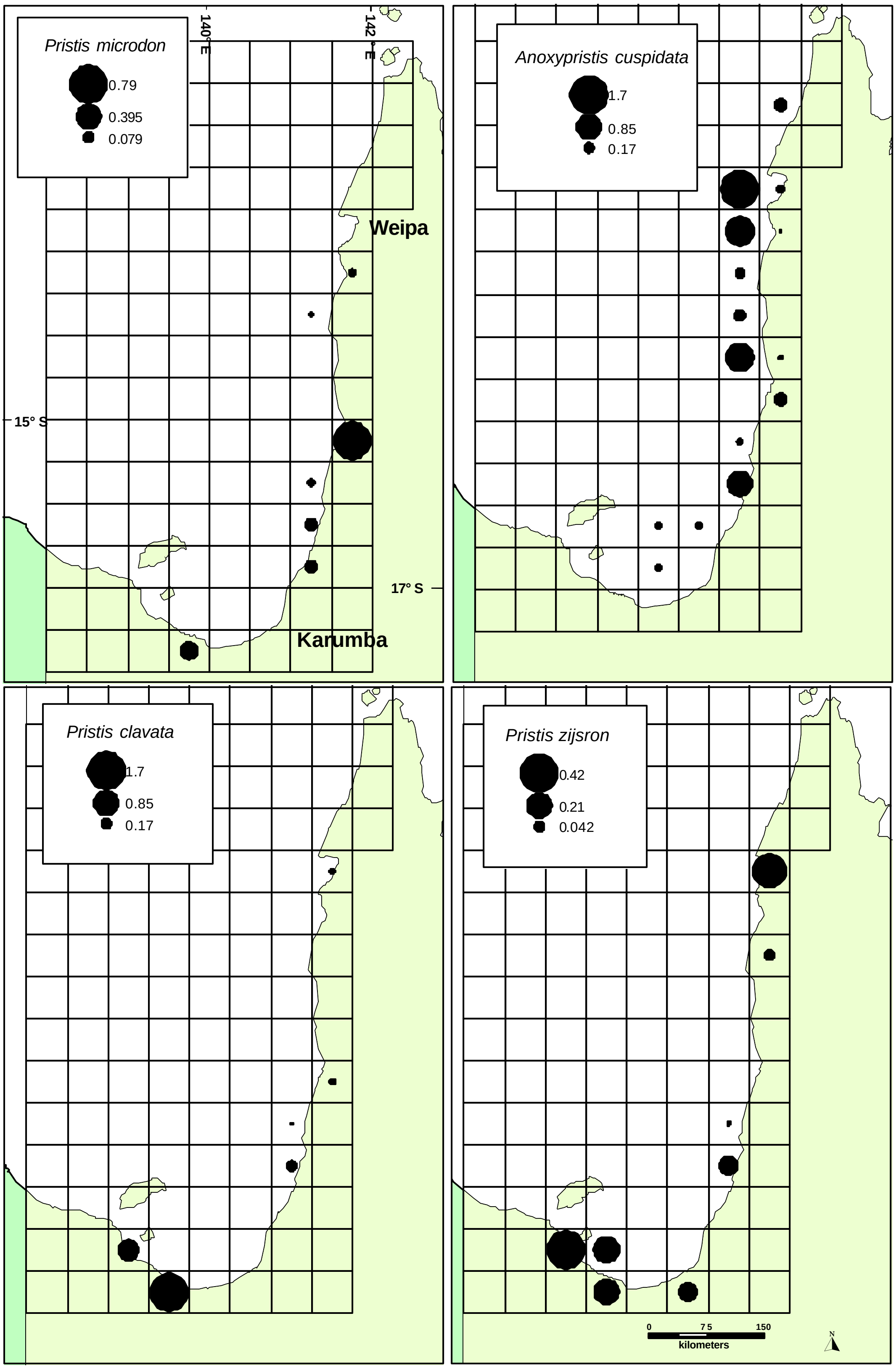

Figure 5: Sawfish CPUE (sawfish/500m/day) as pooled for the fishing seasons 2000 to 2001 and between the inshore and offshore set net fisheries.