

## LIFE HISTORY OVERVIEW No. 1

**A Life History Overview of the Largetooth Sawfish *Pristis pristis***

2013

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NERP Marine Biodiversity Hub Project 2.4

(Supporting Management of Listed and Rare Species)

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Email: [peter.kyne@cdu.edu.au](mailto:peter.kyne@cdu.edu.au)***Introduction***

The Largetooth Sawfish *Pristis pristis* is wide-ranging in tropical waters with distinct geographically-separated populations in the Western Atlantic, Eastern Atlantic, Eastern Pacific and Indo-West Pacific. It was until recently referred to as *P. microdon* (Freshwater Sawfish) in the Indo-West Pacific and *P. perotteti* in the Atlantic before research showed these to be synonymous with *P. pristis* (Faria *et al.* 2013). Northern Australia represents one of the last strongholds of a species not only once widespread in the Indo-West Pacific, but widespread in many tropical waters.

Here, the available life history information on the Largetooth Sawfish is compiled and summarised. Much of this was published under the previous names *P. microdon* and *P. perotteti*. The species' life history is characterised by parameters such as late age at maturity, long lifespan and low fecundity, which results in a low intrinsic rate of population increase (Simpfendorfer 2000;

Moreno Iturria 2012). This life history is generally consistent with that of many large elasmobranchs (sharks and rays).

For such a wide-ranging and conspicuous species, life history is poorly understood and available information is patchy. For example, the only dedicated reproductive studies were undertaken in the Lake Nicaragua-Río San Juan system in Central America (hereafter referred to as 'Lake Nicaragua') (Thorson 1976, 1982), and the vast majority of life history information originates from either Lake Nicaragua or northern Australia (northwest Western Australia and the Queensland Gulf of Carpentaria) (e.g. Tanaka 1991; Peverell 2005, 2008; Thorburn *et al.* 2007; Whitty *et al.* 2008, 2009). Many parameter estimations are based on small sample sizes, a lack of individuals from certain size ranges, or a lack of larger animals. Regional variation in some life history parameters is evident, and it is likely that the Lake Nicaragua population may not have been representative of the wider Western Atlantic due to the fact that individuals from this population may have spent much, or all, of their life cycle in freshwater (Thorson 1976, 1982).

Given the reduction or disappearance of the species in many parts of its previous range, there is little prospect of obtaining further detailed life history information from outside northern Australia. Even then, the rarity of the species and its protected status limits any further intrusive biological study. There have been some demographic analyses of *P. pristis* using available life history data (i.e. Simpfendorfer 2000; Moreno Iturria 2012), but further modelling would benefit from additional life history data.

### **Size**

Estimates of size at birth are generally consistent across the species' distribution: 73–80 cm total length (TL) in the Western Atlantic (Astorqui 1967; Thorson 1976) and 72–90 cm TL in the Indo-West Pacific (Peverell 2008).

In the Western Atlantic, size at maturity is by 300 cm TL for both males and females, with the onset of maturity at ~240 cm TL (Thorson 1976). However, Thorson (1976) sampled very few sawfish in the size class 240–299 cm TL (no females at all in that size class), and therefore the estimation of sexual maturity may not be completely accurate. In the Indo-West Pacific, size at maturity is ~300 cm TL for females and ~280–300 cm TL for males (Thorburn *et al.* 2007; Peverell 2008; Whitty *et al.* 2008).

Maximum size has been estimated to be up to 700 cm TL, although the largest reported size is 656 cm TL (Compagno & Last 1999). For Lake Nicaragua, Thorson (1982) estimated a maximum size of >430 cm TL, suggesting that this population may not have grown to the same large size as elsewhere.

### **Age and growth**

The growth rate of juvenile Largetooth Sawfish is high, although estimates are variable. Peverell (2008) reported 52 cm during the first year and 17 cm during the fifth year in the Gulf of Carpentaria. Tanaka (1991) reported 18 cm in the first year and 10 cm in the tenth year. Thorson (1982) reported 35–40 cm in the

first year, 12 cm in the tenth year and an average of 4.4 cm per year for larger individuals (361–394 cm TL) from Lake Nicaragua.

Peeverell (2008) reported that Largemouth Sawfish of 83–101, 119–140, 143–180, 170–219, 229–253 and 234–277 cm TL were of the age classes (years) 0+, 1+, 2+, 3+, 4+ and 5+, respectively. In northwest Australia, Thorburn *et al.* (2007) estimated that Largemouth Sawfish of 100, 140–160, 180–220 and 230–280 cm TL were of age 1, 2, 3 and 4 years, respectively.

Difficulties with sampling a wide range of size classes, together with population declines and recent rarity has restricted the calculation of growth parameters. The following von Bertalanffy growth parameters have been estimated: Tanaka (1991) (Australia and Papua New Guinea):  $L_{\infty}=363$  cm,  $K=0.066$  yr<sup>-1</sup>,  $t_0=-4.07$  yrs (observed data);  $L_{\infty}=398$  cm,  $K=0.047$  yr<sup>-1</sup>,  $t_0=-5.54$  yrs (back-calculated data); Peeverell (2008) (Gulf of Carpentaria):  $L_{\infty}=638$  cm,  $K=0.08$  yr<sup>-1</sup>,  $t_0=-1.55$  yrs (observed data);  $L_{\infty}=589$  cm,  $K=0.08$  yr<sup>-1</sup>,  $t_0=-1.84$  yrs (back-calculated data); and, Simpfendorfer (2000) based on data in Thorson (1982) (Lake Nicaragua):  $L_{\infty}=456$  cm,  $K=0.089$  yr<sup>-1</sup>,  $t_0=-1.98$  yrs.

Thorson (1982) estimated an age at maturity of ~10 years for Lake Nicaragua and Peeverell (2008) estimated 8–10 years in the Gulf of Carpentaria. Tanaka (1991) reported an age of 16 years for a 247 cm individual that was still immature.

Estimates of maximum age suggest that the Largemouth Sawfish is a long-lived species; Thorson (1982) estimated 30 years for Lake Nicaragua, Peeverell (2008) estimated 35 years for the Gulf of Carpentaria, and Tanaka (1991) estimated 44 years from a combination of Australian and Papua New Guinean specimens. The periodicity of vertebral bands has not, however, been validated. Peeverell (2008) estimated longevity of 80 years (for a 638 cm TL) and while true longevity remains unknown, the age at which asymptotic growth occurs (35 years at 606 cm TL) is a more reliable estimate.

### ***Reproductive biology***

Sawfishes are most likely lecithotrophic viviparous with two functional ovaries (Thorson 1976). Litter size is small; Thorson (1976) examined 67 gravid females captured in Lake Nicaragua with litters ranging from 1 to 13 (mean=7.3). The embryonic sex ratio was 0.86:1 (males:females) (Thorson 1976). Although Wilson (1999) cited a litter size of 1–12, and Moreno Iturria (2012) attributed a litter size of 6–12 to Peeverell (2005), the origins of these values cited for the Indo-West Pacific cannot be confirmed from the original literature. Peeverell (2005, 2008) examined two gravid individuals but specifies the litter size for only one which was carrying 4 full-term embryos.

Like many other elasmobranch species, there may be a correlation between maternal size and litter size in Largemouth Sawfish, however Thorson (1976) did not examine the relationship between these two parameters, so any correlation remains unknown.

Gestation period in Lake Nicaragua is about 5 months (Thorson 1976). The reproductive periodicity is uncertain, possibly every second year in the Western Atlantic (Thorson 1976), but every year in the Indo-West Pacific (Peeverell 2008).

In Lake Nicaragua, both mating and parturition seemed to occur in freshwater, at the beginning and the end of the wet season, respectively (i.e. May to July for mating, and October to December for parturition) (Astorqui 1967; Thorson 1976). In northwest Australia, parturition is reported to take place in the wet season (i.e. January to April) but probably occurs in brackish or saltwater (Whitty *et al.* 2008, 2009). In the Gulf of Carpentaria, Peeverell (2005) suggested that parturition occurs late in the wet season, and that the species 'appears to pup in freshwater'. After parturition, juveniles probably spend 4–5 years in freshwater before migrating to coastal and marine waters (Thorburn *et al.* 2007), although in Lake Nicaragua, Thorson (1976, 1982) suggested that individuals may spend their whole life in freshwater.

### ***Demography***

Using age-independent methods, Simpfendorfer (2000) estimated natural mortalities of 0.069–0.155 per year for the Western Atlantic, while Moreno Iturria (2012) estimated 0.138–0.154 per year for the Western Atlantic and 0.119–0.145 per year for the Indo-West Pacific. Moreno Iturria (2012) calculated age-specific natural mortality of 0.55 in the first year and 0.09 in the last year for the Western Atlantic and 0.68 in the first year and 0.09 in the last year for the Indo-West Pacific.

Simpfendorfer (2000), using aged-based demographic models on life history information from Thorson (1982) (Western Atlantic), estimated an intrinsic rate of population increase of 0.05–0.07 per year with population doubling times of 10.3–13.6 years. These rates were estimated under ideal conditions (i.e. no fisheries, no population fragmentation, no habitat modification and no inbreeding depression).

Moreno Iturria (2012) estimated an intrinsic rate of population increase of 0.03 per year, a population doubling time of 23.3 years and a generation time of 17.2 years for the Western Atlantic, and an intrinsic rate of population increase of 0.12 per year, a population doubling time of 5.8 years and a generation time of 14.6 years for the Indo-West Pacific.

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**Table I** Largetooth Sawfish *Pristis pristis* life history parameters.

Parameter	Region	Value	Reference
<b>Size at birth</b>	W Atlantic	73–80 cm TL	Astorqui (1967); Thorson (1976)
	Indo-W Pacific	72–90 cm TL	Peeverell (2008)
<b>Size at maturity</b>	W Atlantic	♀: 300 cm TL ♂: 300 cm TL	Thorson (1976)
	Indo-W Pacific	♀: 300 cm TL ♂: 280–300 cm TL	Thorburn <i>et al.</i> (2007); Peeverell (2008); Whitty <i>et al.</i> (2008)
<b>Maximum size</b>	W Atlantic	>430 cm TL	Thorson (1982)
	Indo-W Pacific	656 (possibly 700?) cm TL	Compagno & Last (1999)
<b>Age at maturity</b>	W Atlantic	~10 yrs	Thorson (1982)
	Indo-W Pacific	8–10 yrs	Peeverell (2008)
<b>Maximum age</b>	W Atlantic	30 yrs	Thorson (1982)
	Indo-W Pacific	35–44 yrs	Tanaka (1991); Peeverell (2008)
<b>Litter size</b>	W Atlantic	1–13 (mean 7.3)	Thorson (1976)
<b>Gestation period</b>	W Atlantic	5 months	Thorson (1976)
<b>Reproductive periodicity</b>	W Atlantic	Biennial?	Thorson (1976)
	Indo-W Pacific	Annual?	Peeverell (2008)
<b>Natural mortality (age-independent)</b>	W Atlantic	0.069–0.155 yr <sup>-1</sup>	Simpfendorfer (2000)
		0.138–0.154 yr <sup>-1</sup>	Moreno Iturria (2012)
	Indo-W Pacific	0.119–0.145 yr <sup>-1</sup>	Moreno Iturria (2012)
<b>Natural mortality (age-dependent)</b>	W Atlantic	First year: 0.55 Last year: 0.09	Moreno Iturria (2012)
	Indo-W Pacific	First year: 0.68 Last year: 0.09	Moreno Iturria (2012)
<b>Intrinsic rate of population increase</b>	W Atlantic	0.05–0.07 yr <sup>-1</sup>	Simpfendorfer (2000)
		0.03 yr <sup>-1</sup>	Moreno Iturria (2012)
	Indo-W Pacific	0.12 yr <sup>-1</sup>	Moreno Iturria (2012)
<b>Population doubling time</b>	W Atlantic	10.3–13.6 yrs	Simpfendorfer (2000)
		23.3 yrs	Moreno Iturria (2012)
	Indo-W Pacific	5.8 yrs	Moreno Iturria (2012)
<b>Generation time</b>	W Atlantic	17.2 yrs	Moreno Iturria (2012)
	Indo-W Pacific	14.6 yrs	Moreno Iturria (2012)

TL, total length.