Whale Shark (Rhincodon typus)

The Whale Shark is the world's largest fish, and one of only three filter-feeding shark species, along with the Basking Shark (Cetorhinus maximus), and the Megamouth Shark (Megachasma pelagios). Data on the lifespan of the Whale Shark is limited. Taylor (1994) indicates that based on the late age of sexual maturity in Whale Sharks (estimated at around 30 years of age), the Whale Shark may be one of the longest living animals in the world, with an estimated lifespan of over 100 years. There have been two reviews of Whale Shark growth rates ie Wintner (2000) and Uchida (2000). In both data has come from studies of captive individuals held in aquaria, as well as from the vertebrae of stranded Whale Sharks from South Africa. Wintner (2000) studied the growth rate of two animals held in aquaria and found that growth rates of Whale Sharks kept in captivity were 1.1 -1.3 times higher than would be expected from an animal in the wild, possibly due to the reliable availability of food in an aquarium. Uchida (2000) notes life span in aquaria range from three to 2056 days, with mean growth rate in the latter specimen at 29.5cm per year. Norman (2004) reports on another juvenile Whale Shark with a growth rate of 46cm per year over the 630 days while held in captivity. It is likely that due to their very small size at birth (~ 0.5m) (Joung et al., 1996) and hence lack of defence to predation in the early stages of life, Whale Sharks grow very fast initially and then the rate of growth would decline (Norman, 1999). Some evidence of this rapid growth has been collected from a newborn Whale Shark that grew 143cm over 143 days while in captivity in a Taiwanese aquarium (Chang et al., 1997).

This species is highly migratory and its longevity is uncertain, but may be as much as 100 years (Compagno, 2001).

**Diet**

The Whale Shark is primarily a suction filter feeder (Compagno, 1984). It feeds on a wide variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes such as sardines, anchovies and mackerel, and occasionally on small tuna and squid (Compagno, 1984; Last and Stevens, 1994). Whale Sharks at Ningaloo Reef have been observed actively feeding on swarms of the tropical krill *Pseudeuphausia latifrons* (Taylor, 1994; Norman, 1999). On a separate occasion, a Whale Shark was seen sucking the surface slick of coral spawn into its mouth while orientated at 450 to the surface (Norman, 1999). At Christmas Island, Indian Ocean the Whale Sharks have been observed feeding on localised concentrations of mysids (*Anisomysis spinata*) and crab magalopa (*G. natalis*) (Norman, 1999).

Three faecal samples analysed by Norman (1999) revealed exoskeletal remains of calanoid and harpacticoid copepds, larval decapods and the scales of small fishes. A further two Whale Shark faecal samples from Ningaloo Reef contained eyes, legs, and fragments of exoskeleton from crustacean prey, namely *P. latifrons*, suggesting that Whale Sharks aggregating seasonally off Ningaloo Reef feed predominantly on this tropical krill (Wilson & Newbound, 2001). Whale Sharks have been observed feeding passively by swimming forward with mouth agape, and feeding actively by opening their mouths and sucking in prey. Whale Sharks are also reported as hanging vertically in the water while feeding (Colman, 1997a).

They locate concentrations of planktonic organisms, there is little doubt that whale sharks aggregate at seasonal plankton blooms and invertebrate mass spawnings, this has been observed for coral spawn, snapper spawn, megalopa of a terrestrial crab and schools of anchovy (Taylor, 1994, 1996; Colman, 1997; Wilson et al., 2001; Duffy, 2002; Graham and Roberts, 2007). Observations by Clark and Nelson (1997) suggest that whale sharks alter their swimming behaviour to remain within areas with high concentrations of plankton, although whether this is mediated by vision, chemical concentration, bioelectric stimuli, and/or other cues is not known. Details of whale shark behaviours during feeding, categorised

as passive and active feeding, are discussed in this volume by Nelson and Eckert (2007) and Taylor (2007).

**Ningaloo:** Large numbers of whale sharks congregate offshore from the Ningaloo Reef, Western Australia (Fig. 1) during the autumn of each year (Taylor, 1989, 1994, 1996). The majority of whale sharks encountered at Ningaloo Reef are not observed feeding. The diurnal surface feeding of the whale sharks on the euphausiid, *P. latifrons* is a rare occurrence, and has only been seen by the author in 1991. Reports from other dive operators have been received in 1992 and 1993. Based on plankton collections alongside whale sharks, it appears that during nocturnal active feeding the principal prey species were

Portuniid crab larvae, and Stomatopods. Similarly, during the diurnal active surface feeding, the krill *P. latifrons* was targeted and during passive feeding chaetognathia and copepods were targeted. Hence, it is possible that whale sharks might at times feed on coral spawn slicks (Taylor, 2007).

#### Reproduction

The Whale Shark is a livebearer with an ovoviviparous mode of development (Joung et al., 1996). It may be the most fecund of all live bearing sharks. The only pregnant female found to date measured 10.6m, weighed 16t, and contained 307 embryos. The embryos measured between 42 and 63 cm in length (Joung et al., 1996).

There is scant information on the age at which Whale Sharks become reproductive, although Norman (1999) presents evidence (collected during an intensive study of this species at NMP between 1995-97) that the length at maturity of male Whale Sharks is approximately 8.6m TL. Alternatively, examination of two female Whale Sharks (TL = 7.9 and 8.6m) by researchers in India revealed immature ovaries in each specimen (Pai et al., 1983; Satyanarayana Rao, 1986 in Colman, 1997). Taylor (1994) indicates that the Whale Shark may not reach sexual maturity until 30 years of age. There is currently limited evidence with which to accurately determine age at maturity or the maximum age for this species (Wintner, 2000).

Information on the frequency at which Whale Sharks are able to reproduce is not available. Likewise, it is not known where Whale Shark mating takes place, although it is considered likely in the waters surrounding Taiwan, Philippines and India where sightings of juvenile Whale Sharks have been recorded (Norman, 2004).

Neonate and juvenile whale sharks (55–93 cm TL)

adolescent and adult whale sharks (4–10m TL)



Logistic curve (±95% confidence intervals) reflecting the size at maturity of male whale sharks at Ningaloo Reef. (Norman and Stevens, 2007)

|  |  |
| --- | --- |
| **prey item** | **probability of consuming** |
| ZME Zoo | 0.3 |
| COR Coral (spawn) included in plankton | 0.1 |
| ZKL | 0.3 |
| SAL | 0.3 |

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