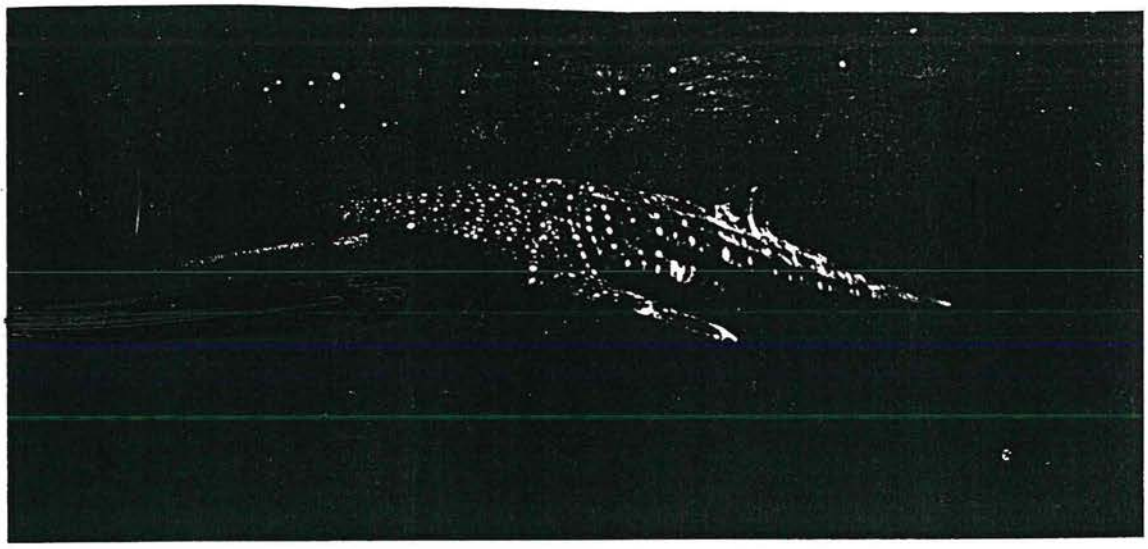
THE WHALE SHARKS OF NINGALOO REEF

A booklet of interpretive materials
for guides and tour operators in the whale shark
interaction industry



Produced by the
Department of Conservation and Land Management

Compiled and Researched by Ric Karniewicz

Your Boat
Crew
Equipment
Locations of Emergency Equipment etc
Emergency Proceedures

Dive Preparations
Drop Proceedures
Diving / In Water Proceedures
Retrieval Proceedures
ETC

Some Reasons for an Interpretive Talk to Passengers

1. To fulfil one of the fundamental requirements of a true "ecotourism operation".
ie, "....Ecotourism is nature based tourism that involves education and interpretation of the natural environment....." (excerpt from definition of ecotourism, National Ecotourism Strategy, Commonwealth Dept. of Tourism)

2. To enhance your passengers experience.
Through supplying information on whale shark biology and ecology, research, interaction guidelines, management etc they gain knowledge and understanding of the animal, its behaviour, management and interaction issues and requirements giving the participant a sense of involvement and understanding, raising their confidence and preempting their desire for an educational facet to their experience.

3. To relax and orientate your passengers.
On the trip out most passengers will be excited, tense with anticipation, possibly apprehensive and disorientated and generally emotionally charged. An interesting brief at this time will help distract and relax them, raise their knowledge and consequently their confidence, allay any fears they may have, establish the competence and professionalism of your crew and operations thereby also reassuring them and will generally assist in normalising the atmosphere on board.

To prevent harassment of the whale sharks thereby protecting the whale sharks and the industry.
Strongly stating the importance of not herding, touching , riding etc whale sharks (possibly imposing the penalty of being restricted from further diving if so observed) should be an integral part of your talk. You can not only point out the potential for this to cause a shark to sound and depart, spoiling the experience for your own group, but also the potential for these irresponsible actions to ultimately condition the whale sharks to totally avoid human contact on Ningaloo Reef.

5. Safety
If your passengers are well briefed on boat and diving procedures and requirements, interaction protocol, whale shark behaviour and hazards, accidents will be avoided (and possibly resultant liability proceedings).

6. To assist logging boat and biological data and research and management generally.
Well informed passengers, who consequently have an enhanced interest in the animals, are generally not only eager to assist in the collection and recording of such data, but consider it a bonus experience and privilege to be allowed to participate and contribute to such conservation related work.

7. To compete in a world market.
Ecotourism and diving tourism are a highly competitive world market. If the whale shark interaction industry is to successfully compete for this market consideration to your passengers expectations and desires for information and education is essential. Although Ningaloo Reefs whale shark aggregation is relatively unique there is evidence to suggest that similar aggregations may be identified elsewhere in the world in the future.

A Note from the Author

This booklet was compiled in an attempt to comprehensively summarise the basic information required for a professional passenger briefing for whale shark interaction tours, including extensive background material that should equip you to answer most questions that your passengers may put to you. The material provided is a summary of the most credible and authoritative material available, but time and resource constraints restricted my research to predominantly scientific summaries of biological data, rather than wading through the hundreds of individual reports.

I trust you will appreciate the value of this information package to your operations and use it to maximum benefit to the industry and its reputation.

Ric Karniewicz.

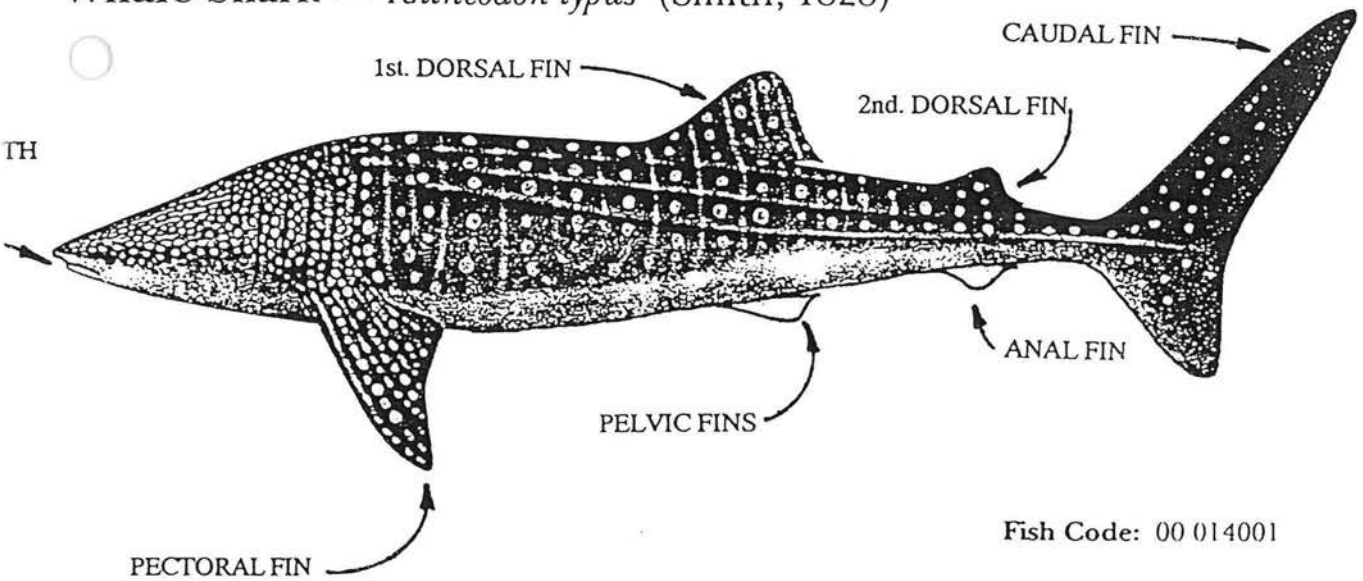
THE BIOLOGY AND ECOLOGY OF THE WHALE SHARK

NAME AND SCIENTIFIC CLASSIFICATION

Common Name:	Whale Shark	(French– Requins baleine; Spannish– Tiburones ballena)
Species:	Rhincodon typus	(Smith, 1828, by original designation– use of species name typus)
Genus:	Rhincodon	(Smith, 1828) * Rhiniodon, Rhineodon & Rhinodon have been used.)
Family:	Rhincodontidae	(Muller & Henle, 1839, amended)
Order	Orectolobiformes	(Carpet Sharks)
Infra–class	Selachii	(Sharks)
Sub–class:	Elasmobranchii	(Sharks & Rays)
Class:	Chondrichthyes	(Cartilaginous Fish)
Sub–phylum	Vertebrata	(Vertebrates)
Phylum	Chordata	(Chordates)

NB; Rhinodonte means 'rasp tooth'
Orectolobiformes means ' extended tail lobes'

Whale Shark — *Rhincodon typus* (Smith, 1828)



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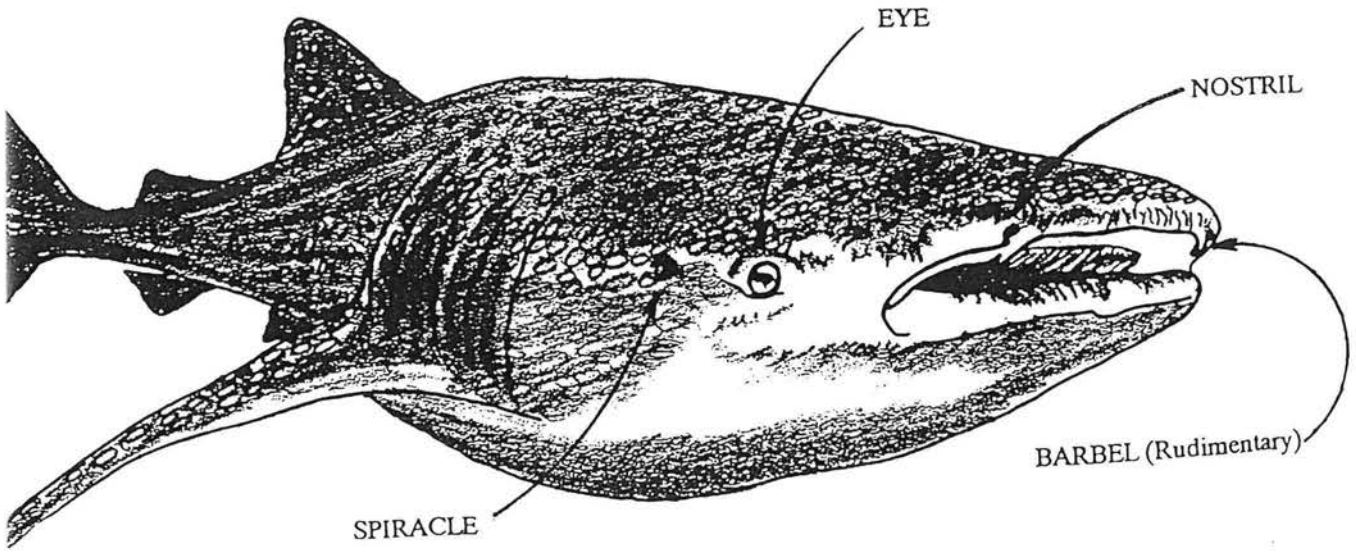
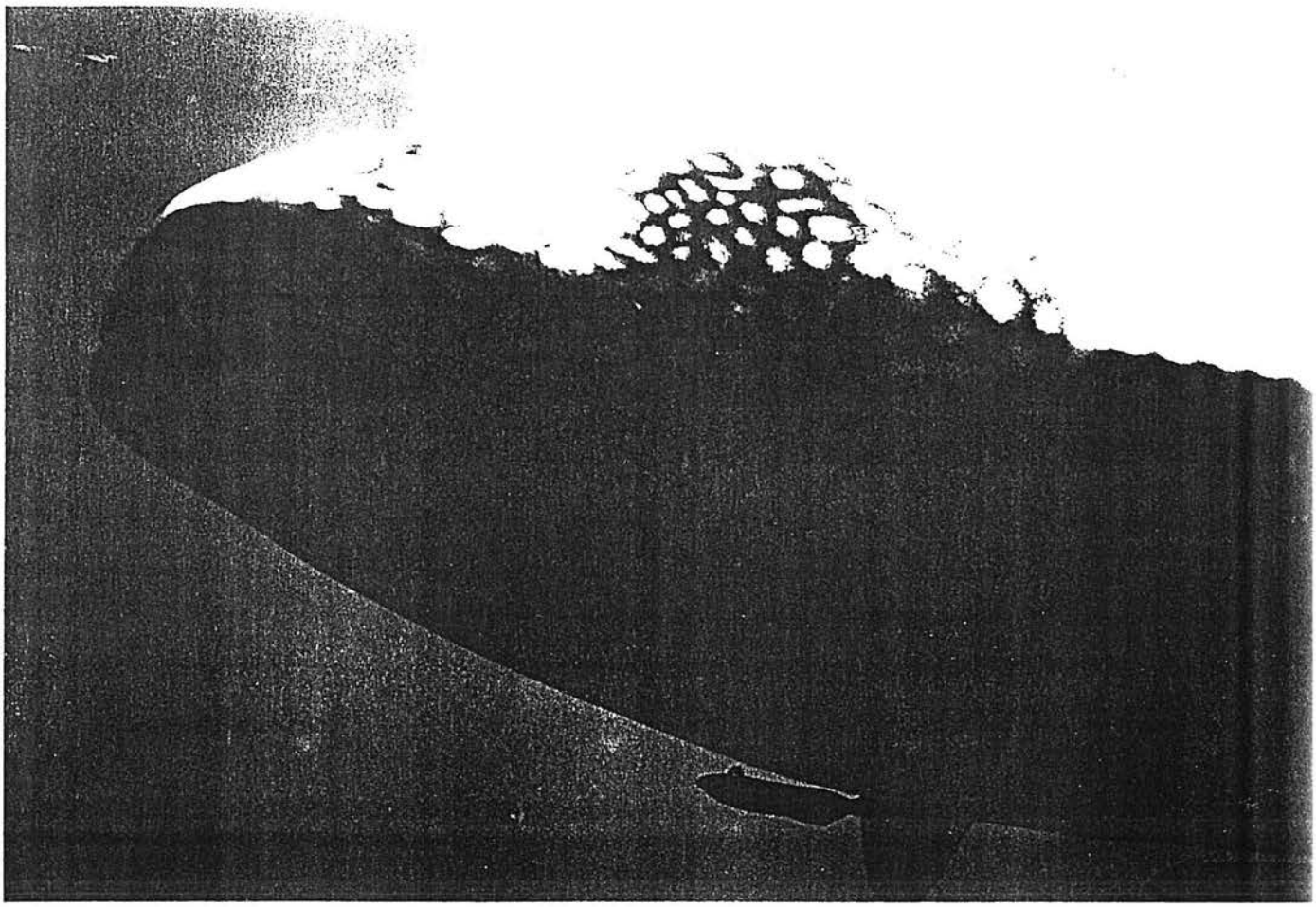




Above : Whale shark head clearly showing the eye and spiracle and also the barbel adjacent the nostril on the snout.

Below : Gill slits 'flapping' as water is filtered through them

Photos – Ron Campbell

TAXONOMY / ANATOMY

Field Characters

An unmistakable huge, filter feeding shark with broad, flat head, truncated snout and near terminal mouth in front of the eyes.

Upper body surface a unique checkerboard pattern of creamy white spots, between pale, horizontal and vertical stripes on a dark, greyish, bluish or brownish / bronze background (white ventrally ie, to underside of body). Prominent ridges on the sides of the body with the lowest one expanding into a prominent lateral keel on each side of the caudal peduncle (ie, trunk of the tail).

A large first dorsal fin. Small second dorsal and anal fin. Lunate or semi–lunate caudal fin (though in small juveniles the upper lobe is longer). Extremely numerous, minute teeth and unique filter screens on internal gill slits.

Distinctive Features

Body	Cylindrical / fusiform (ie, Spindle shaped) or moderately depressed with prominent longitudinal ridges on its upper flanks.
Fins	First dorsal fin much larger than the second dorsal fin, set posteriorly on the body. Origin well anterior of the pelvic origins (ie, start of 1st. dorsal is well in front of the point below where the pelvic fins start). The insertion (ie, where the back edge of the fin meets the body) is over the pelvic fin bases. Second dorsal fin much smaller than first. Slightly smaller than pelvic fins and similar size to anal fin. Pectoral fins are very large, relatively narrow and falcate (ie, hooked or sickle shaped) and much larger than pelvic fins. Pelvic fins are smaller than first dorsal but slightly larger than the second dorsal and anal fins. Anal fin similar size to second dorsal fin Caudal fin upper lobe set at a steep angle above the body axis. Less than a third of the length of the entire shark. Caudal peduncle has prominent lateral keels on each side and a distinctive upper precaudal pit.
Head	Depressed, very broad and flattened with truncated snout.
Mouth	Extremely large, near terminal and transverse.
Teeth	About 300 rows of minute teeth, comprising a single hooked cusp.
Nostrils	With rudimentary barbels and no circumnarial (ie, around the nostril) folds or grooves.
Eyes	Situated laterally on the head, well behind the mouth. Without sub–ocular sockets.
Spiracles	Much smaller than eyes, behind but not below them.
Vertebrae	Total at least 153 ; precaudal 81 .

SIZE

Max. Length	Possibly to a length of 18. 0 metres. Most commonly between 4.0 and 12.0 metres.
	Largest ever accurately measured was 12.18 metres though 13.7 metres is often stated as the maximum measured.
	This is by far the largest fish in the ocean also making it the largest cold blooded animal in existence.
Min. Length	The smallest free–living (presumably shortly after birth / hatching) are from 0.55 to 0.56 metres length. A near full term whale shark embryo of 0.36 metres length was collected from an eggcase. This suggests a birth size of 0.4 to 0.5 metres.
Weight	The 12.18 metre animal weighed 11 tonnes.
Mouth Width	The 12.18 metre animals mouth was 1.36 metres wide
Dorsal Fin	The 12 18 metre animals dorsal fin was over 1.37 metres high.
Pectoral Fins	The 12.18 metre animals pectoral fins were over 2.0 metres long.
Skin	A 9.0 metre animals skin was found to be 102 mm. thick.

Interest to Fisheries

Small harpoon fisheries exist in Indonesia, Pakistan and India; It may be taken in China and has been captured and utilised in Senegal; it is eaten by people either fresh or dried salted and is used to treat boat hulls in Pakistan.

Two Taiwanese fisheries , according to Uchida (1984), bring in 60 and 100 whale sharks annually, although they are only taken when more desirable species are not available and interest is limited to specimens small enough to handle without to much difficulty. The species is often used as an aggregator / indicator of good fish with purse seiners in the Gulf of Guinea routinely seek out and set nets on them, though damage to nets and fishing gear elsewhere causes other fishermen to particularly avoid them. Apparently the flesh is very soft and bland. A small fishery also existed in the Maldive Islands, taking about 20 whale sharks a year, but the species is now protected there.

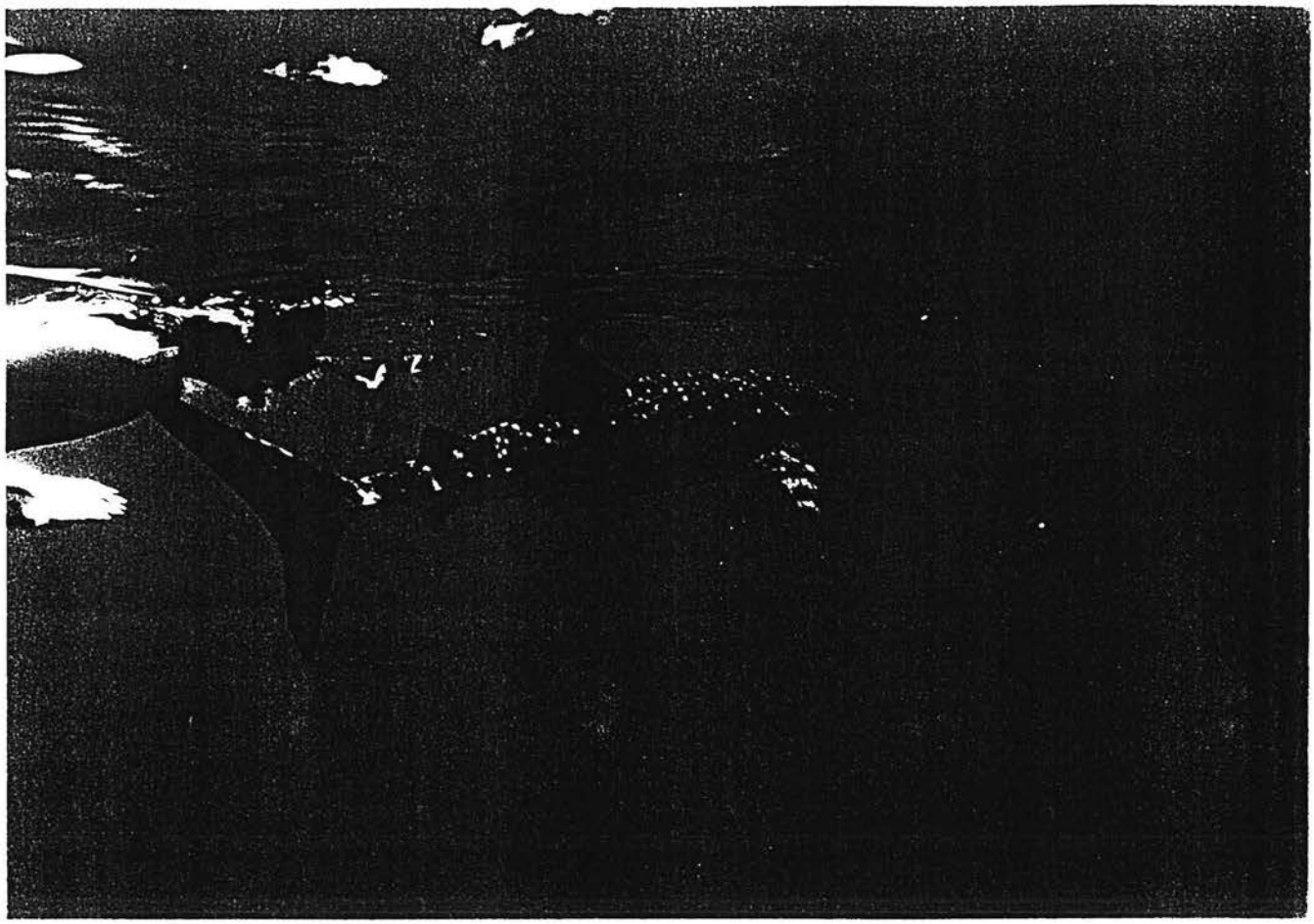
In Captivity

A young whale shark was kept in captivity for several years in an oceanarium in Japan.

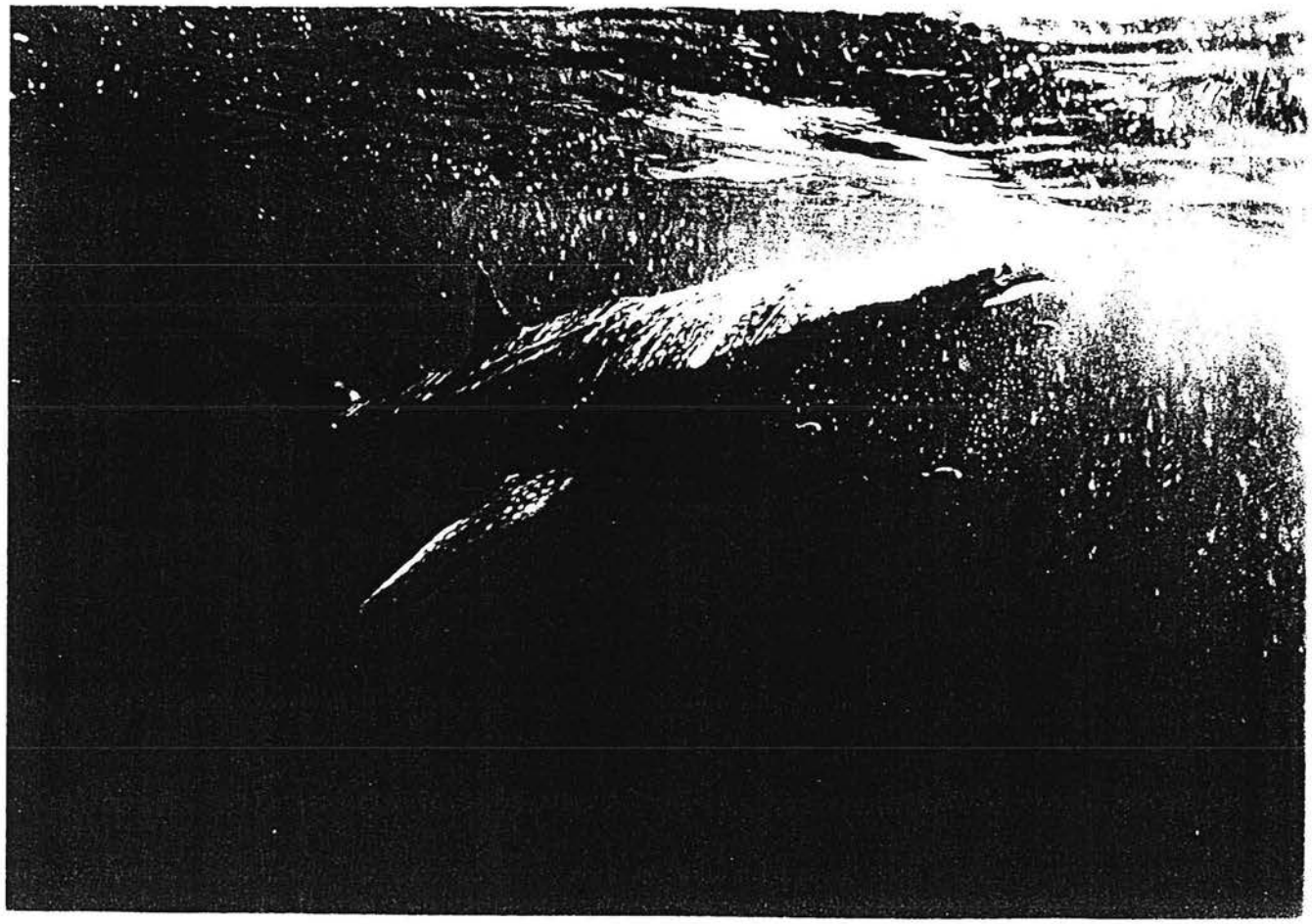
Other Human Encounters

In 1981 Dr. Fay Wolfson of the Hubbs Marine Research Institute in San Diego, US documented and collated all the 320 sightings of whale sharks that had been reported to the scientific community. She summarised these reports as being 30% fishery related, 10.3% underwater observations, 10.3% captured specimens, 8.4% beachings and 26% chance observations (ie; someone happening to be looking at the water from a passing vessel etc).

Certainly a large number of whale sharks were the victims of collisions with vessels, often being impaled on the bows of ships. The incidence of these reports is apparently becoming rarer, though whether this is due to declining numbers of whale sharks, the collisions being considered less 'news worthy' or some other factor is unknown.



Above and below, 6.0 metre Male Whale Shark, off Tantabiddi Passage, 24th. April 1994.
Photos - Ric Karniewicz



LIFE CYCLE / REPRODUCTION

The knowledge of the development of whale sharks is still uncertain. Either oviparous (producing eggs which hatch outside the mothers body after being layed on the ocean floor), or ovoviviparous (hatching from eggs while inside the mothers body and then expelled).

If ovo–viviparous it is likely that this would be through retention of the eggcase in utero until the eggcase hatches, ultimately giving birth to free–swimming young, though it is possible that the eggcase is retained in utero for most of the embryos development, then ejected at a late stage of development, with young 'hatching' from the eggcase on the sea floor.

An eggcase trawled up in the Gulf of Mexico in 1953 contained a live baby whale shark 0.36 metres long. This suggested that the whale shark is oviparous, unless the eggcase was aborted before normal term. Despite this find, scientific thought is, that it is more likely that the whale shark is actually ovo–viviparous. This opinion is due to the rarity of 'free–living' eggcases being found, the extreme thinness and lack of tendrils (which anchor the eggcase to the sea bottom) on the only known eggcase, the considerable yolk and only partially developed gill sieve in the only known embryo and the occurrence of umbilical scars found on a free–living juvenile specimen 0.55 metres long.

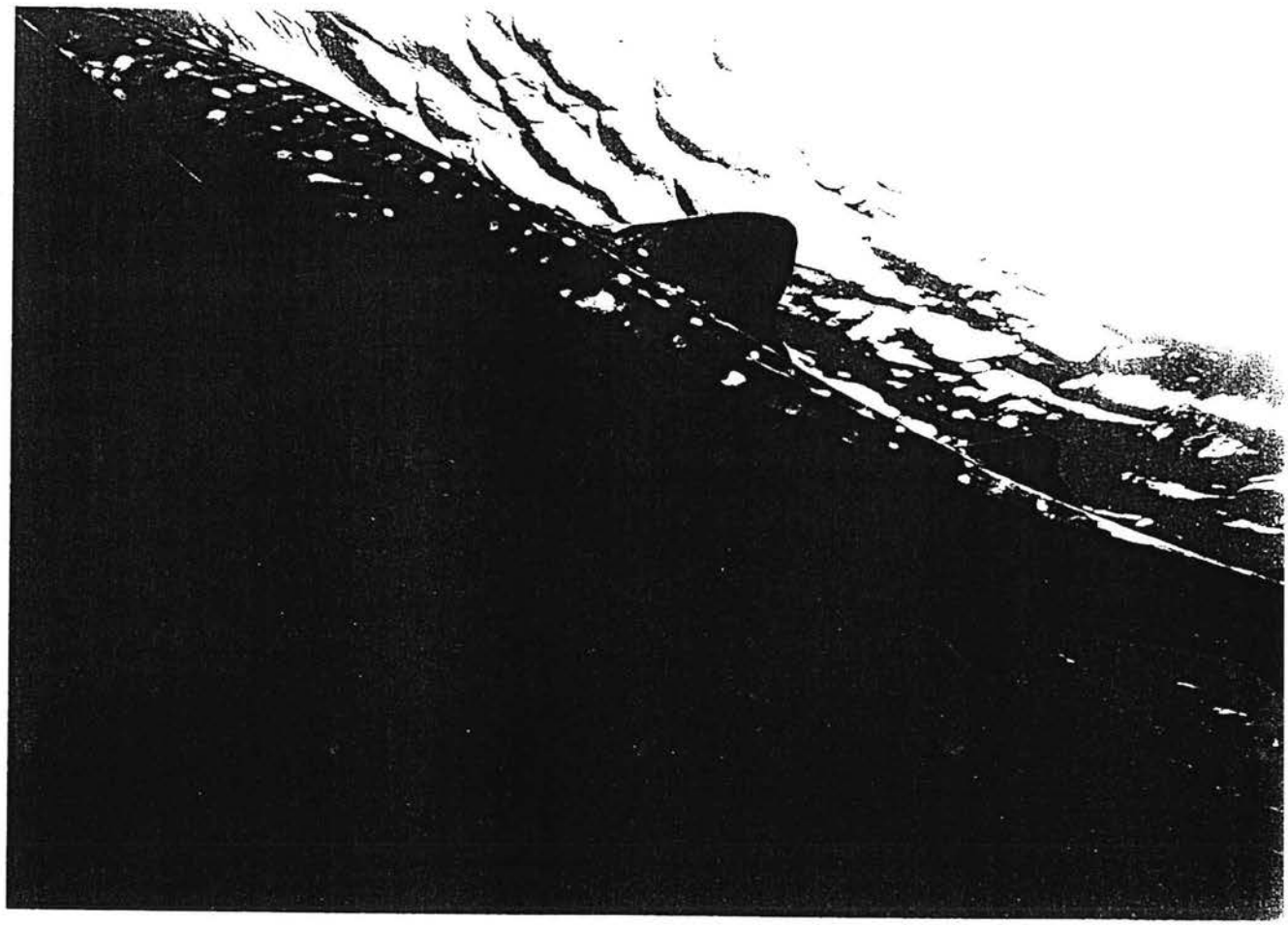
Information on the life cycle of the whale shark is sketchy at best and can be summarised as below;

0.36 metres.	Near full term embryo in eggcase trawled from a depth 55.0 m. in the Gulf of Mexico in 1953.
* 0.36– 0.55 metres.	NO CONFIRMED RECORDS. Suggests a birth size of 0.4–0.5 metres.
* 0.55–0.63 metres.	Newborn whale sharks from the Persian Gulf, Atlantic and Pacific Oceans, the Gulf of Guinea and the Central American Coast.
* 0.63–approx.3.0 metres	NO CONFIRMED RECORDS. Unconfirmed Record. # approx. 1.0 metre animal observed on the surface by tour operator, Tom Jaeger 9 km. off Exmouth, 1993.
* approx. 3.0 metre.	Whale sharks observed feeding in Sea of Cortez in 1993.
* 3.5–12.18 metre	Animals encountered around the world.
* 4.38–5.62 metre	Females are immature (per FOA Species Catalogue).
* 6.0–7.5 metre	Males commonly observed on Ningaloo Reef to be sexually immature.

* An animal observed to have dorsal fin grown 8.5 cm. (from 54 cm. to 62.5 cm.) between 1986 and 1993 by G. Taylor at Ningaloo. He speculated that this indicated that this shark was ' ..... at least 25 years old.' and went on to surmise that as 'The only sexually mature male shark seen at Ningaloo Reef has been estimated at over 9 m .....it appears that whale sharks do not reach sexual maturity until they are over 30 years of age. .... .IT also suggests.....with a life span of over 100 years not unlikely.'

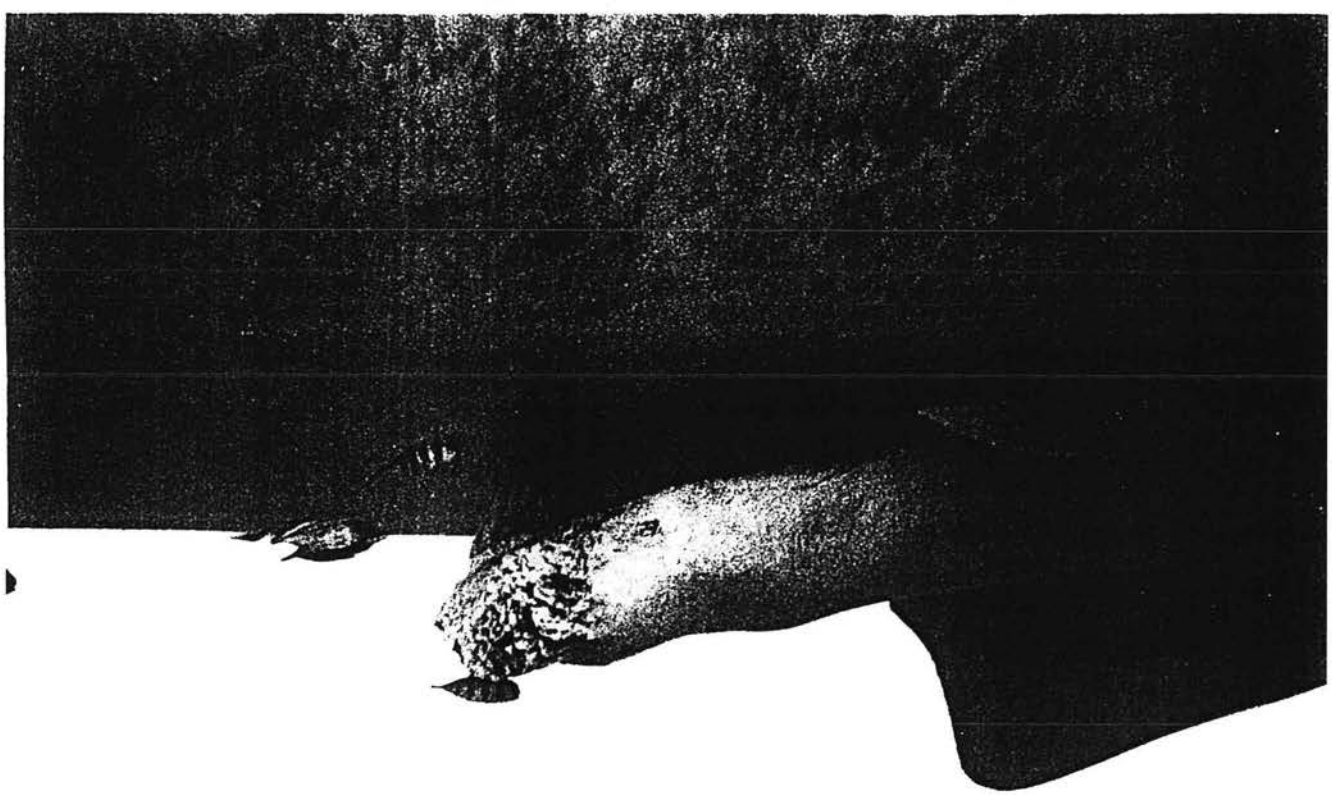
NB; Presumably this was calculated by correlating the proportionate growth rate of the one animal to the other. It is most unlikely that such a simple correlation exists, but does at least present a speculative guesstimate.

* Female adult recorded as having 16 eggcases in its uteri (per FOA Species Catalogue).



Above ; Pelvic fins / region of a female whale shark. Note that no claspers present
Photo – Ric Karniewicz

Below ; Claspers of a sexually active male whale shark. Note the scaring to the clapers resulting from copulation. Photo – Ron Campbell



DISTRIBUTION AND HABITAT

A band around the equator between 30 degrees north and 35 degrees south latitudes approximates its distribution range. Found in all the major oceans of the world except the Arctic and Southern Oceans and apparently the Mediterranean Sea. Circumglobal in tropical and warm temperate seas, oceanic and coastal.

Found in the Western Atlantic from New York to Central Brazil, including the Gulf of Mexico and the Caribbean. The Eastern Atlantic from Senegal, Mauritania, Cape Verde Islands and the Gulf of Guinea. The Indo-west and Central Pacific from South Africa and the Red Sea to Pakistan, India, Sri Lanka, Malaysia, Thailand, China, Japan, the Philippines, Indonesia, Papua New Guinea, Australia, New Caladonia and the Hawaiian Islands and the Eastern Pacific from Southern California to Northern Chile.

Reports of sightings display extremes of their range at 41^ north and 36.5^ south latitudes.

Mainly occurs off northern West Australia, the Northern Territory and Queensland in Australian waters, though isolated reports have been recorded from New South Wales, Victoria, South Australia and the western fringe of the Great Australian Bight.

Commonly encountered around the Seychelles, Mauritius, Zanzibar, Madagascar, Mozambique, Northern [illegible]tal and Ningaloo Reef in the Indian Ocean. In the western Pacific it is common in the Kuroshio current in [illegible] skipjack fishing grounds. Reportedly abundant from Cabo San Lucas to Acapulco in the eastern Pacific, and in the Caribbean and Gulf of Mexico in the western Atlantic.

The whale shark apparently prefers areas where the surface temperature is 21 to 25 degrees C. with cold water of 17 degrees or less upwelling into it and a salinity of 34 to 34.5 ppt. These conditions are likely optimal conditions for the production of the plankton and small nektonic organisms that are prey to the whale sharks.

OCCURRENCE ON NINGALOO REEF

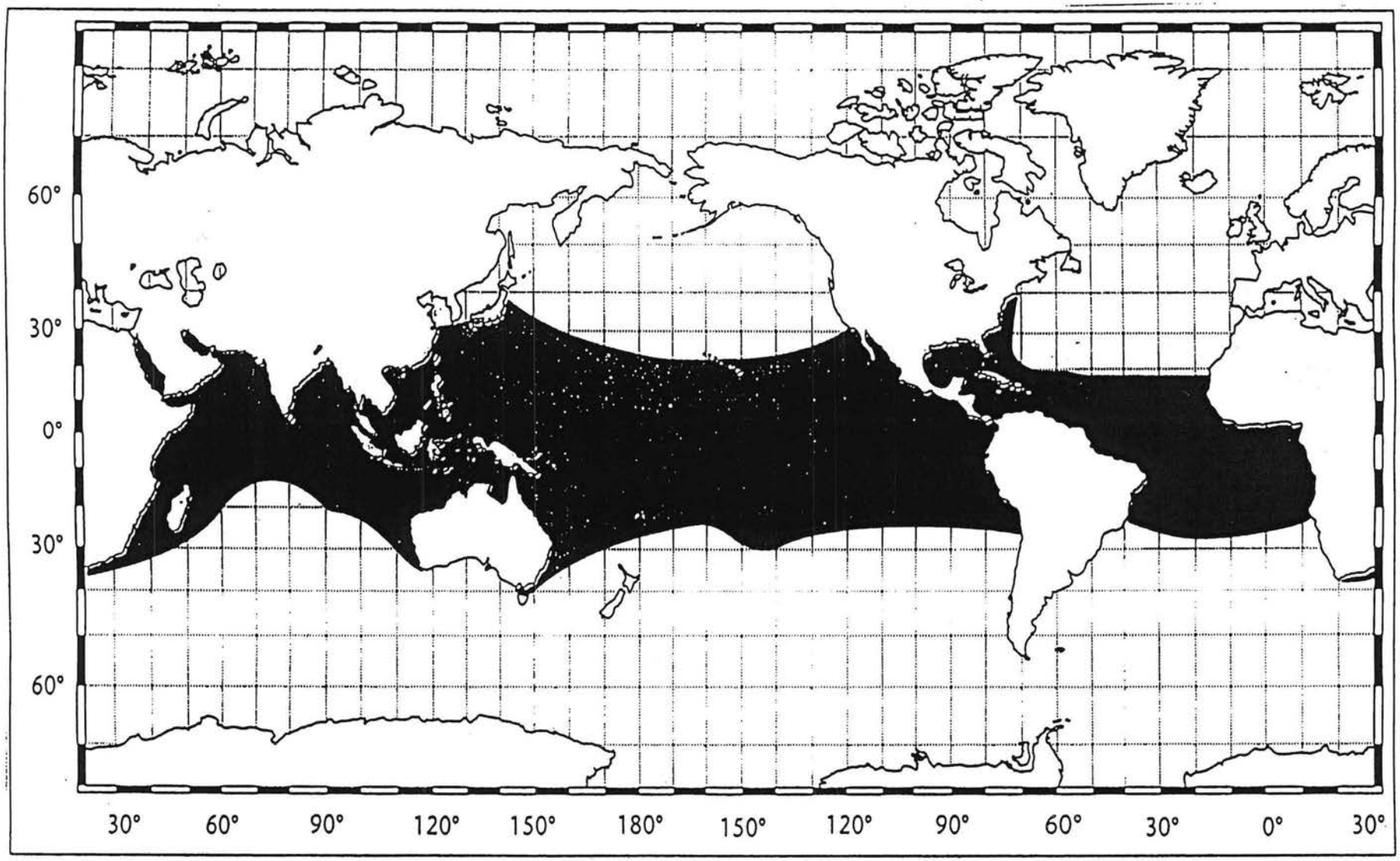
To date the reasons for the aggregation of whale sharks on Ningaloo Reef from March to May – June each year can only be speculated on.

Their appearance coincides with the annual mass spawning of corals (7 – 9 days after the first full moon in March) and other invertebrate spawning that occur on and about this time. The resulting concentrations of prey seems to principally explain the phenonomen but it is still uncertain whether the coral spawn itself, other spawn and planktonic larvae or the resulting concentrations of small fish and other spawn predators are the major food target.

[illegible]as been speculated that the whale sharks may possibly be loosely resident to the area but not commonly seen at other times of the year as they may just move offshore to the deeper waters adjacent the continental shelf and / or spend more time, particularly during daylight hours at greater depth. Scientific thought, though generally recognising that whale sharks are seen on Ningaloo Reef year round, considers the species as highly migratory and it is more likely that their occurrence on Ningaloo Reef is one part of an annual migratory pattern. Hopefully one of the archival tags fitted to several animals, when retrieved, will provide the answers to the question of their movements.

The possibility of their aggregation also being related to breeding behaviour has been raised. The data collected to date does exhibit some curious trends with the proportions of the sexes on Ningaloo Reef (though much of this data is considered biased for various reasons).

There does appear to be a high proportion of immature / juvenile male animals at the beginning of the season with females and mature males appearing to arrive later in 'the season' but much more investigation into this area is required.



WORLDWIDE DISTRIBUTION OF THE WHALE SHARK

BEHAVIOUR

General

Generally encountered on or near the surface, though this probably is a better indication of the limitations of human observations rather than the habits of the sharks!

Prefers areas of less than 17 ˚C upwelling to surface temperatures of 21 – 25 ˚C and salinities between 34 and 34.5 ppt.

Apparently highly migratory with appearances often correlating to aggregations of planktonic organisms, small fish and other prey and temperature changes in water masses. Despite this several individuals have been reputed to be resident for periods of several days to 50 years.

At Ningaloo Reef

Information to date suggests a whale shark population on Ningaloo Reef during the 'season' of between 200 and 400 animals (Taylor.,1994). Predictable aggregations occur on Ningaloo Reef between March and June each year. The peak of their numbers seems to be the 1 to 2 weeks after the main annual coral spawning event in March–April.

They are generally observed gently cruising along the reef front, on occasion passively feeding. They have also been observed actively feeding in the late afternoon and night, sometimes in large numbers and / or aggressively ploughing through prey schools.

Although there is great speculation that Ningaloo may also be a breeding area no conclusive evidence of this has yet been evident. Fluctuations in the ratios of sexes observed and several behavioural observations do give some support to the possibility.

With Humans

The majority of whale sharks at Ningaloo Reef essentially ignore the divers in the water with them, possibly considering them an oversized pilot fish, though at times they do appear to be less amenable, repeatedly sounding shortly after contact with a boat or divers. Individual animals do have definite 'characters' with many individuals frequently being resighted and noted as consistent in their reaction, whether 'friendly', inquisitive, indifferent or shunning contact.

The vast majority will sound and or react strongly when touched, held or herded, obviously harassed by such activity. They also appear nervous when divers swim below their belly, often banking gently to allow themselves to keep an eye on the diver. Many seem to dislike the sound of scuba bubbles while others have been reported to have actually seemed interested in them. They have often been reported to have displayed interest in drifting boats, frequently nosing up to marlin board of a boat, and are known to occasionally scrape their backs on floating objects including boats.

Feeding

The whale shark is a versatile suction filter feeder. This means the whale shark is not dependant on forward motion to operate its filters and consequently capture its prey. The likely high water intake velocities enable it to capture active nektonic prey that 'dynamic' filter feeders such as the basking shark cannot, though has the disadvantage of filtering far smaller volumes of water, possibly making it more dependent on high concentrations of prey being available.

Whale sharks feeds on a wide variety of planktonic and nektonic organisms including small crustaceans (krill, crab larvae, copopods), squid, jellyfish, small fishes such as sardines, anchovies and mackerel and even small tuna and albacore.

They feed at or near the surface either passively feeding (cruising with mouth agape) or actively feeding (ploughing through the surface waters with mouth agape , jaw distended and sometimes moving from side to side 'vacuuming' in prey rich seawater and /or aggressively cutting swathes through schools of prey).

It has been speculated that the distinctive patterning of whale sharks may be to act as daytime camouflage in the midst of schools of prey. They will often assume a vertical / near vertical position (mouth above) and have been seen apparently 'supping' small concentrations of prey from the surface in this attitude. They are also often seen periodically 'gulping' captured food, concentrated on their gill rakers, while feeding.

Cruising

They are commonly observed simply casually cruising along the reef front, generally parallel to the reef. It is most likely they are searching for concentrations of food but may also be following some more general cyclic or migratory pattern.

Basking

At times whale sharks have been seen lolling on the surface apparently basking.

Site Specific Aggregations

It has been noted that different areas seem to be preferred at different stages of the season by the whale sharks, though even with these concentrations it is not common to see 2 whale sharks together. During some late afternoon and nightime feeding activity groups of about 6 –8 are common and occasionally much larger groups gather.

Immature / adolescent males have been observed in a group of 5–6 animals engaged in what was described as 'sniffing each others tails' and likened to a pack of young male dogs establishing a pecking order when a bitch is in heat.

CODE OF CONDUCT

Whale sharks are fully protected under the Wildlife Conservation Act, and also have specific complimentary protection under the CALM Act and Fisheries Act. The increasing public interest in whale shark watching has resulted in an emergence of commercial tours and increased numbers of private individuals and groups interacting with the creatures. To prevent the animals from being harmed or disturbed, the following code of conduct has been prepared.

Contact Zone

** An exclusive contact zone of 250 metres radius applies around any whale shark.

** Only one vessel at a time may operate within the zone for no more than 90 minutes, at a speed of 8 knots or less.

** The first vessel within that zone will be deemed to be ' in contact '. The second vessel to arrive must keep a distance of 250 metres from the shark, and any other vessels must be 400 metres from the shark.

Boat Operators in the Contact Zone

** Must not approach closer than 30 metres! THIS INCLUDES TENDER VESSELS!

** Should approach from ahead of the direction of travel when dropping people in the water.

** Must display the special whale shark contact flag when in the contact zone and the dive flag (International 'A' flag) when divers are in the water.

Swimmers in the Contact Zone

** MUST NOT ATTEMPT TO TOUCH OR RIDE A WHALE SHARK , block a shark from its chosen direction of travel or approach closer than 1 metre from the head or body and 4 metres from its tail.

** Are limited to a maximum of 10 people in the water at any one time.

** Must not use any powered swimming or diving aid or be towed by any vessel in the contact zone, nor undertake any flash photography of whale sharks.

WATCHING WHALE SHARKS

Whale sharks are fully protected under the Wildlife Conservation Act and the CALM Act. Although they appear to be 'gentle giants', they are wild animals that can inflict serious injury if they strike a swimmer with their body, tail or fins. To minimise the risk of injury and to prevent the animals from being harmed or disturbed, the following code of conduct has been prepared for passengers on commercial tours.

SWIMMERS IN THE CONTACT ZONE:

- must not attempt to touch or ride on a whale shark, block a shark from its chosen direction of movement or approach closer than one metre from the head or body and four metres from its tail;
- must not undertake flash photography or use motorised propulsion aids;
- are limited to a maximum of 10 people in the water at any one time.

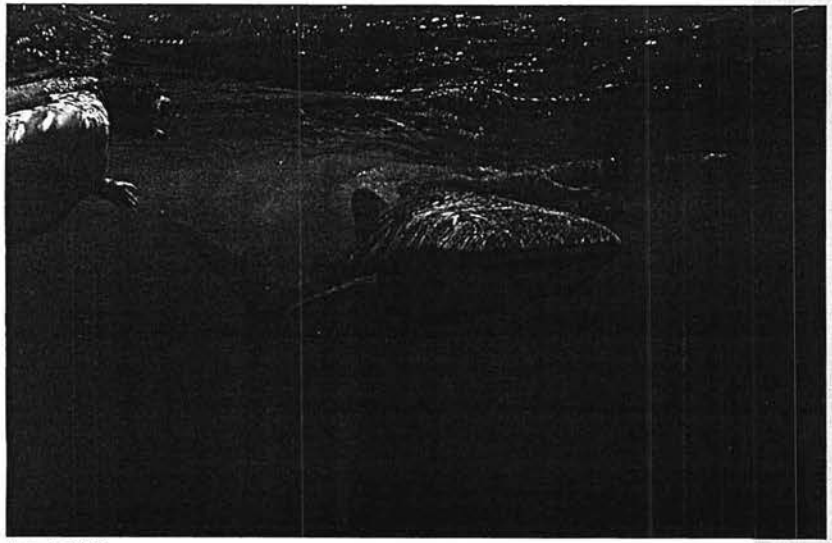
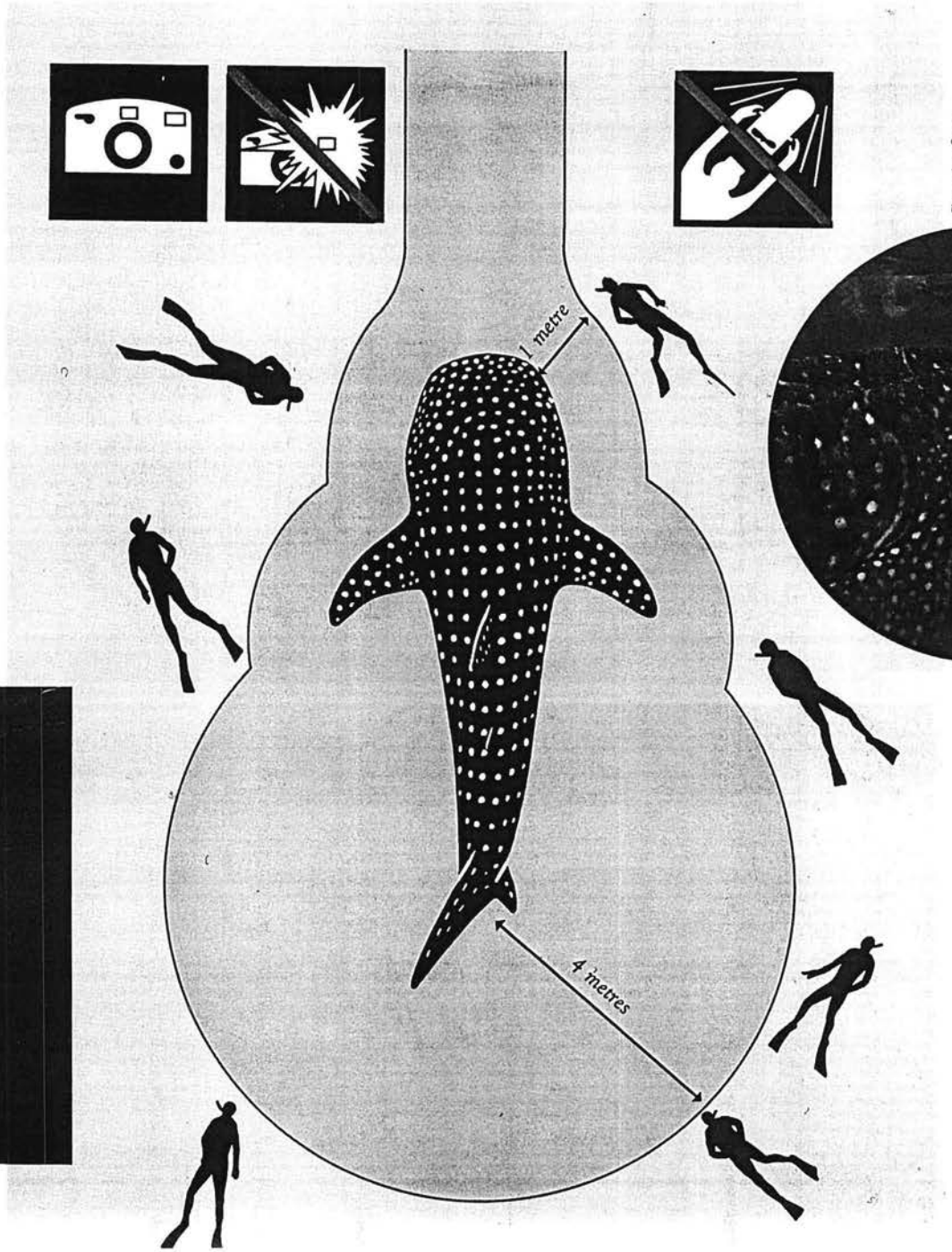


Photo – Pip O'Dell



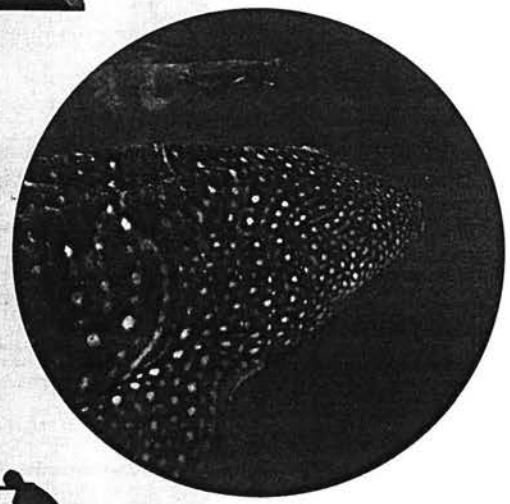


Photo – Anne Storrie

LEGISLATION

Within Ningaloo Marine Park whale sharks are afforded special protection through the following legislation.

Wildlife Conservation Act 1950–1980

The Wildlife Conservation (close Season for Whale Sharks) Notice 1995 gives specific regulations relating to whale shark / human interaction over a close season to 1st June 1995. (and prevails if inconsistent with the 1992, Fauna of Ningaloo Marine Park Notice). These are primarily applicable under sections 14 and 16 of The Act, with provision for fines of up to ~~$10,000~~ $5,000 for convictions. See following pages for a copy of these.

The Wildlife Conservation (Fauna of Ningaloo Marine Park) Notice 1992 gives specific protection to whale sharks throughout the park at all times. This is primarily applicable under sections 14 and 16 of The Act, with provision for fines of up to ~~$10,000~~ $5,000 for convictions.

Conservation and Land Management Act 1984.

The Conservation and Land Management Amendment Regulations 1992 addresses the licensing and conditions and restrictions of commercial operations on CALM estate. Within the scope of this legislation is provision for $ 2000 fines for operating without a licence, $ 1000 for contravention or failure to comply with licence conditions and restrictions and $ 100 for failure to produce a licence for inspection when requested.

Fisheries Act 1905 or the Fish Resources Management Act 1994 (whichever is the operative enactment at the time)

Whale sharks (also Manta Rays, Potato Cod, Queensland Grouper and almost all Mollusc's) given full protection within Ningaloo Marine Park (notice # 503 in the Gov't Gazette #126, 11/10/91). This legislation has provision for fines of $ 50 – $250 for a first offence and $250 – $750 for subsequent offences.

NB: The above Acts also contain general legislation encompassing such things as departmental / executive authority, vesting of estate, the powers of departmental officers, general offences, regulations etc. Potentially some sections are relevant to incidents that could be associated with whale shark interaction. Eg; Counterfeiting of any licence, damaging property, signs or notices, threatening or refusing to comply with a lawful direction or attempting to bribe an officer with provision for fines of up to $10,000 and imprisonment for 1 year for some offences.

Responsibility for compliance with this legislation is the responsibility of all individuals engaging in interaction or incidentally encountering an animal, whether with an organised tour or not.

Commercial licensees are also responsible for the actions of their staff and passengers.

CONSERVATION AND LAND MANAGEMENT

CM301

WILDLIFE CONSERVATION ACT 1950

WILDLIFE CONSERVATION (CLOSE SEASON FOR WHALE SHARKS) NOTICE 1995

Made by the Minister under section 14 (2) (a).

Citation

1. This notice may be cited as the *Wildlife Conservation (Close Season for Whale Sharks) Notice 1995*.

Object of this notice

2. The object of this notice is to allow limited interaction between humans and whale sharks in State waters, while protecting whale sharks from disturbance and molestation, by setting out acceptable approach distances, etc., for vessels, swimmers and divers when in proximity to a whale shark, and to prevent some other activities that may disturb whale sharks.

Interpretation

3. (1) In this notice —

"contact vessel" means a vessel, and any tender vessel accompanying the vessel, within a contact zone;

"contact zone" means the area within a radius of 250 metres of any whale shark that is in State waters;

"whale shark" means the fauna *Rhincodon typus*.

(2) It is the responsibility of the person in charge of a vessel to comply with a requirement placed on that vessel by this notice.

Declaration of a close season

4. Subject to clauses 5 to 14, a close season is declared in respect of whale sharks in all State waters for the period commencing upon publication of this notice in the *Government Gazette* to 1 June 1995.

Restriction on number of vessels in or near contact zone

5. (1) A vessel must not enter a contact zone if another vessel is in the contact zone.

(2) If a vessel is in a contact zone and a second vessel is within 400 metres of the relevant whale shark, any other vessels must maintain a distance of at least 400 metres from that whale shark.

Restriction on period in contact zone

6. A contact vessel must not remain in the same contact zone for longer than 90 minutes.

Restriction on vessel speed in contact zone

7. (1) Subject to subclause (2), a contact vessel must not exceed 8 knots in a contact zone.

(2) If, for reasons of safety, a contact vessel must exceed 8 knots in a contact zone, that vessel must leave the contact zone as soon as is practicable.

Proximity of contact vessel to whale shark

8. A contact vessel must at all times maintain a distance of at least 30 metres from the nearest whale shark

RESEARCH

Historic

The first whale shark specimen encountered by scientists was an 4.6 metre animal captured by harpoon in Table Bay on the Cape of Good Hope, South Africa in 1828. Between this time and the 1980's research was limited to anatomical studies of captured / stranded specimens by several museums and the collection and collation of reports of incidences they were encountered.

In the early part of the 20th century Dr. Eugene W. Gudger, a scientist who became Curator of Fishes at the American Museum of Natural History, ultimately published 47 papers on the species, collecting reports from all over the world. More recently Dr. Fay Wolfson, of the Hubbs Marine Research Institute in San Diego, US, similarly documented reports from all over the world and published a bibliography of whale sharks.

Previous studies at Ningaloo Reef; 1994

G. Taylor / ANPWS (now ANCA); 1982 – 1991 (– Present)

Initially collected and compiled informal sighting records of the occurrence of whale sharks on Ningaloo Reef, confirming an 'aggregation season' and speculating on the reasons and timing for this event.

Later, with funding from ANPWS, conducted preliminary population surveys, investigated correlations between the coral spawn, the Leeuwin Current, aggregations and movement patterns, attempted to identify the animals local target food sources, made and collected biological observations, investigated the feasibility of identifying individual animals through scars and deformities and the unique patterns of dots and stripes (of the lateral body, behind the gill slits) and made the first attempts at radio and satellite tracking of whale sharks.

Although much of this work had only limited success, it effectively 'trailblazed' whale shark research on Ningaloo Reef and provided other researchers a substantial foundation of experience and baseline data upon which to build. To date this work still represents the only formal library of individual identification records.

CALM; 1993,1994 and ongoing

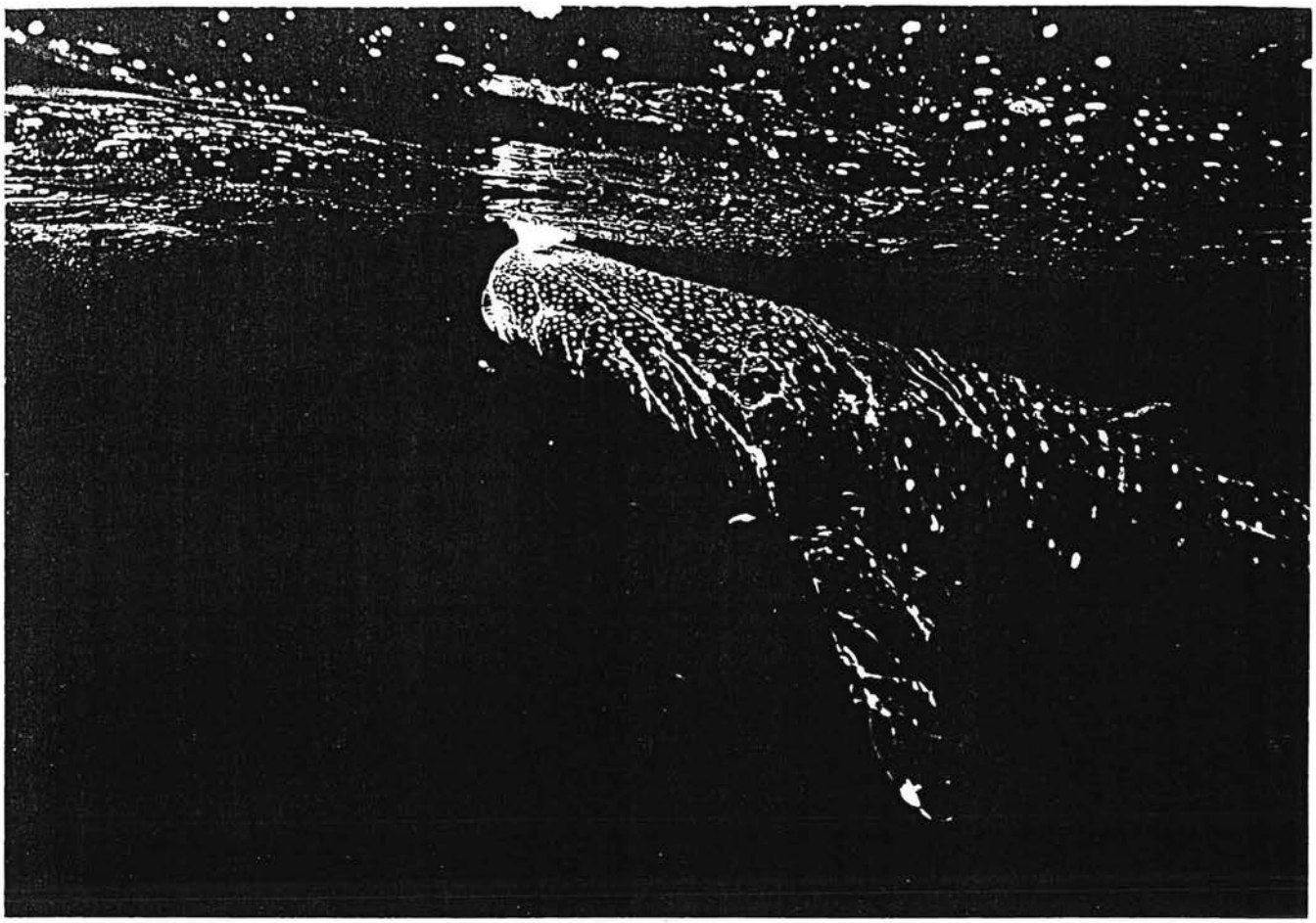
Data relating primarily to the management of the human interaction with the whale sharks has been collected and correlated using aerial observations from spotter planes, logs from commercial tour boats and logs and observations from CALM officers. The resulting information includes local population, distribution, sex and size ratios, boat / shark / human interaction frequency and commercial effort, and a large amount of supplementary identification and biological data is also obtained.

CSIRO; 1994

J. Gunn and J. Stevens, from the CSIRO Division of Fisheries in Hobart, using acoustic telemetry, tracked a 5 metre whale shark for 26 hours. Data on swimming depth and water temperature was collected at 3 second intervals and the sharks position determined by GPS (CSIRO has successfully used the system to track tuna and marlin previously).

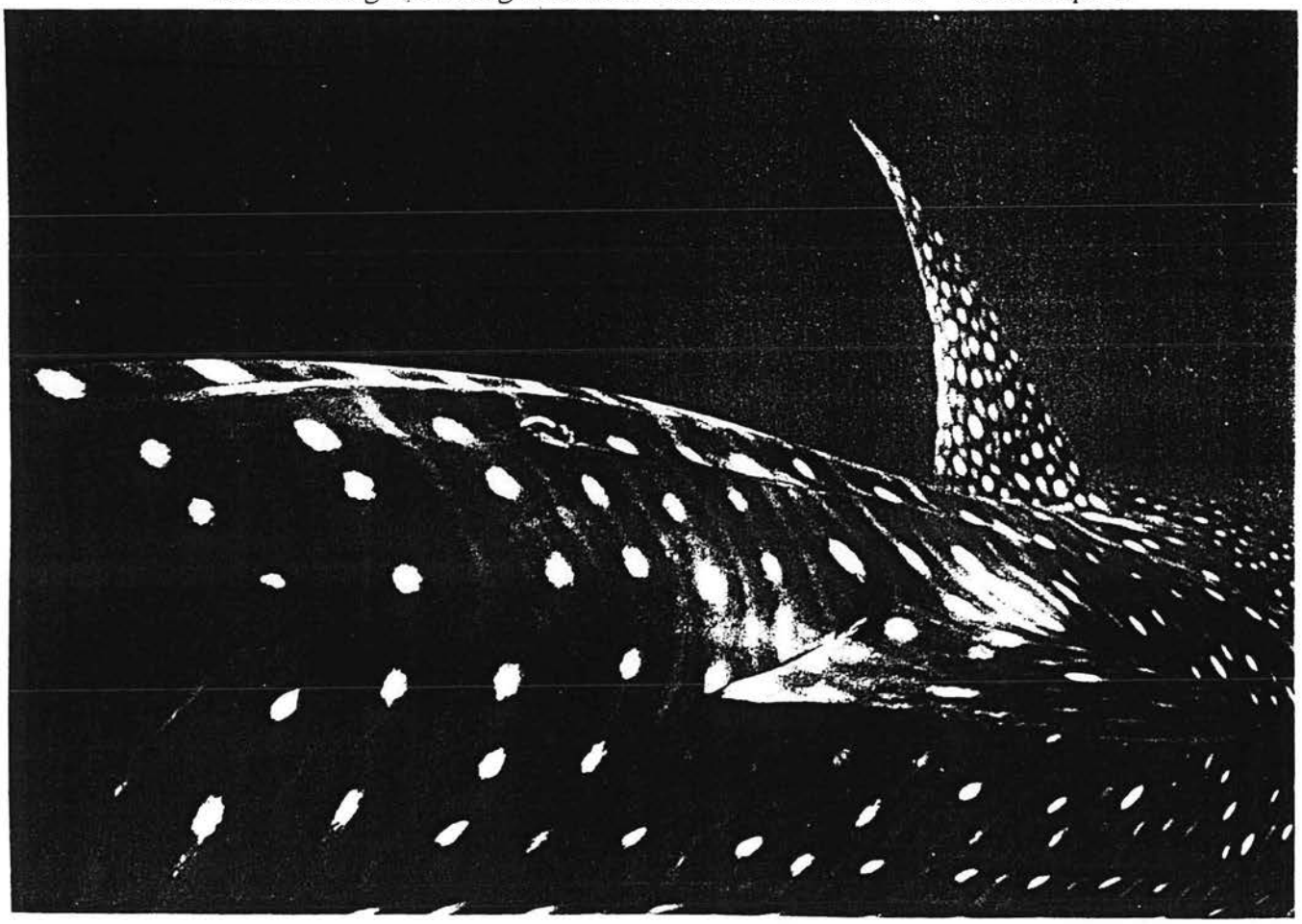
The whale shark spent more than half the time on the surface and the rest of the time diving to the bottom for up to 40 minutes at a time and to depths up to 70 metres. At about 2100 hours the animal began feeding on the surface. It generally appeared to be swimming in loops around the outside of the reef as if searching for food in a current eddy.

The scientists also attached archival tags to 6 animals (see 'ongoing studies'). One tag was removed after 24 hours and showed the depth of the sharks dives increased from sunset to 0300 hours when it was at a depth of 90 metres.



Above ; Whale shark with large deformity / 'hole' at the top of the last gill slits that will make it easy to identify this shark from others. Photo – Ric Karniewicz

Below ; A 'gamefish' type tag, newly attached by G. Taylor. The tags quickly become covered in algae, making them more difficult to see. Photo – Ron Campbell



CURRENT AND ONGOING STUDIES AT NINGALOO REEF

CSIRO:

Scientists John Gunn and John Stevens, from the CSIRO Division of Fisheries in Hobart attached archival tags (sometimes called 'smart' tags) to 6 whale sharks in the 1994 season. These high–tech tags have an accurate time clock as well as depth, light and temperature sensors. Shark movements can also be determined through calculating the lat.–longs from the times of sunrise and sunset. The tags can collect data for up to 5 years and store it for up to 20 years. Should one or more of these tags be retrieved, scientists will have a huge amount of information on the distances travelled, depths dived where the sharks go and probably many clues to their behavioural patterns.

CSIRO HAS OFFERED A $200 REWARD FOR RECOVERED 'SMART TAGS' but they SHOULD ONLY BE REMOVED BY PEARSONS WHO HAVE BEEN INSTRUCTED AS TO THE METHODS FOR SAFE REMOVAL OF THE TAG.

Please alert the divemaster or crew of your vessel immediately if you see such a tag on a whale shark so they may recover it on your behalf. Alternately immediately contact the nearest CALM wildlife officer so they can effect a retrieval.

REEF COOPERATIVE RESEARCH CENTRE / JAMES COOK UNIVERSITY / SOUTHERN CROSS UNIVERSITY:

Scientists Dr. Alastair Birtles and Derrin Davis are undertaking joint studies on recreational diving, tourism and whale sharks in the Coral Coast region to (a) better understand why people dive with whale sharks (b) assess the economic value of this activity and (c) assist in the planning and management of the whale shark tourism industry.

A survey questionnaire is being used to gather data for these purposes. Filling out the questionnaire should take only 10 – 15 minutes. The survey is strictly confidential, and questionaries can be returned free in reply paid envelopes. Please contribute to the research effort by completing a survey form.

A specimen questionnaire is attached opposite, and a Japanese version is also available. Questionnaires and envelopes have been distributed to boats, dive shops and hotels in Exmouth and additional copies can be obtained from the CALM office.

CALM / MURDOCH UNIVERSITY / BRAD NORMAN

Brad is a post graduate conducting a study on Whale Shark Ecotourism on Ningaloo Reef. The study will run over 1995 and 1996 and covers 4 main areas.

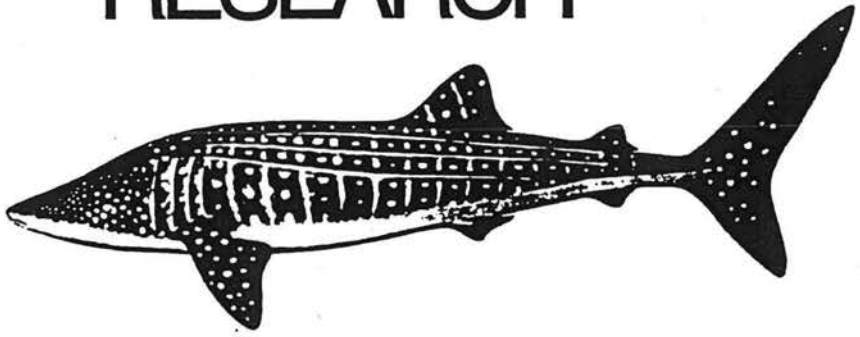
A literature review, to summarise past research current management regimes; impacts of human interactions, which will determine a repertoire of shark behaviours, undisturbed and disturbed; Review of survey techniques, to determine if the data obtained from commercial pilots is sufficient for management purposes and a review of photo library techniques, to determine the best method (s) for identification and how and where this should be maintained and analysed.

This work is primarily to review the various management responsibilities and resources of the industry and determine the best, most cost effective and efficient management practices. Due to the broad range of this study and the often qualitative subject matter Brad will be looking to investigate all facets of the industry. Please assist Brad however you can, whether this be just discussing your own experiences or filling in the occasional data sheet.

Southern Cross University

CRC Reef Research Centre

WHALE SHARK RESEARCH

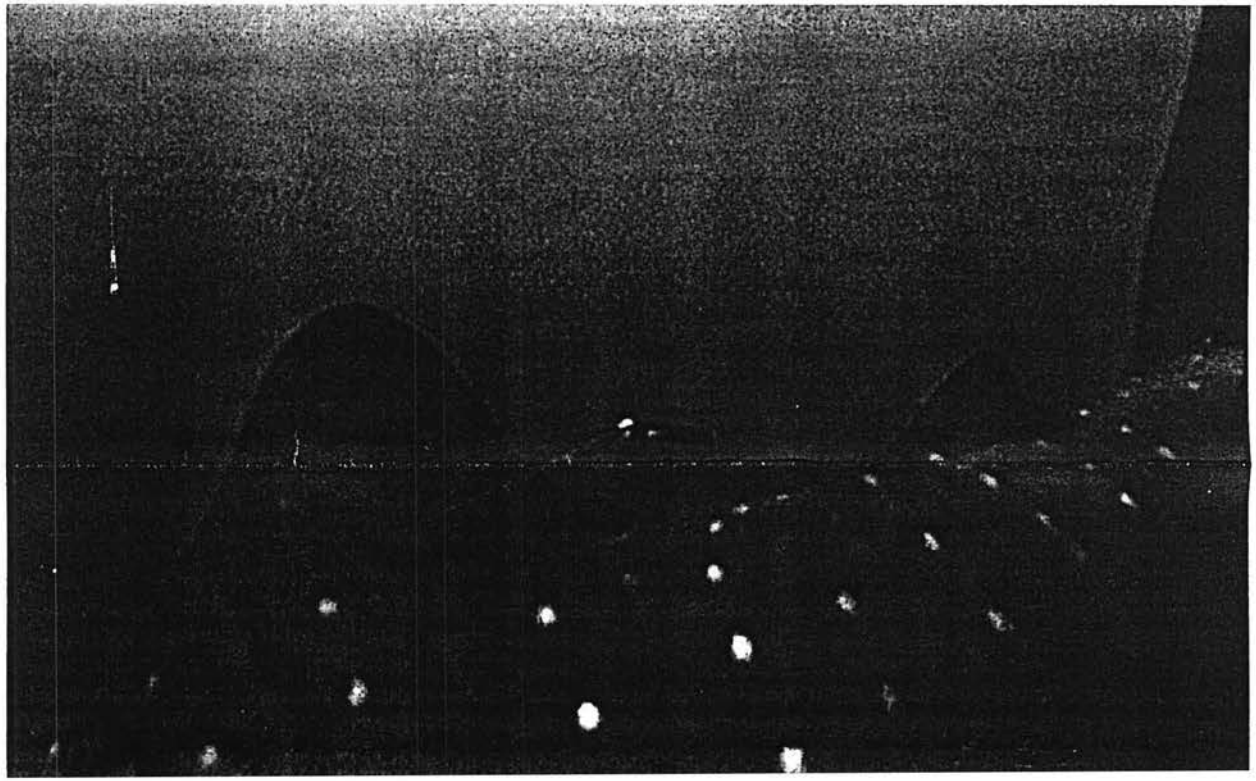


LOOK OUT FOR SHARK TAGS AND EARN A $200 REWARD

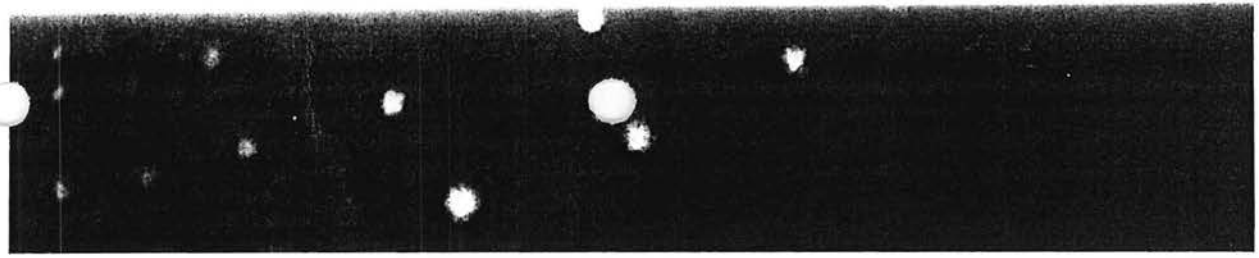
In 1994, CSIRO Division of Fisheries scientists attached high-tech archival tags to five whale sharks at Ningaloo Reef.

These miniature computers collect and store data on the migration and diving behaviour of the sharks and the water temperature.

The experiment aims to find out where the sharks go and how they behave when they leave Ningaloo



when they leave Ningaloo at the end of autumn.



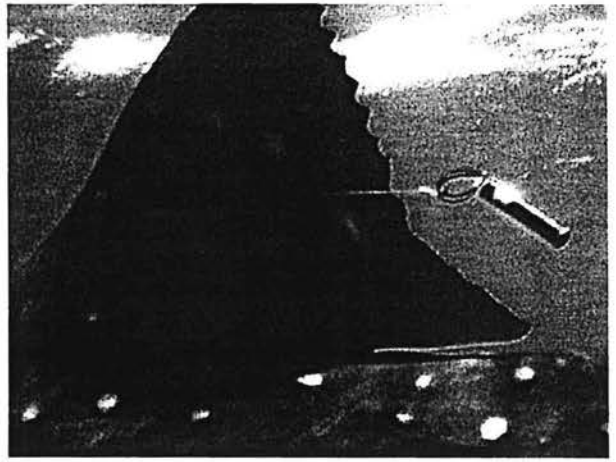
A whale shark with a tag attached to its dorsal fin

HOW YOU CAN HELP

If you see a shark with a tag trailing from its fin, please alert the crew of your vessel immediately. Do not attempt to remove the tag yourself. Dive boat crews have already been instructed in the safe removal of the tags, without harming the shark.

WHEN A TAG IS RECOVERED

If you recover a tag, please contact John Gunn or John Stevens at the CSIRO Marine Laboratories in Hobart on 002 32 5222 (reverse the charges). They will arrange for the tags to be sent to Hobart ... and send you a $200 reward!



A close-up view of a tag attached to a shark's dorsal fin

CSIRO
AUSTRALIA

DIVISION OF **FISHERIES**

ARCHIVAL TAGS IN SOUTHERN BLUEFIN TUNA

Archival tags are electronic devices used to collect information on a fish's environment and behaviour. The tag's main circuit board is located inside the body cavity of the fish, just forward of the vent, and cannot be removed without making a small cut along the gut. Temperature and light sensors are located in a pod outside the body.

The SBT tags are programmed to measure the depth at which a fish is swimming, the temperature of the water, time and light levels for periods of up to nine years. By accurately monitoring light levels it is possible to calculate the position of the fish. Thus, using the tags it will be possible to examine in detail the migration routes of SBT as they move around the Southern Ocean and to study how their movement is related to the environment.

In 1993, 100 juvenile SBT will be fitted with archival tags in Australian waters. More tags will be released in the future. Fish with archival tags are easily recognised by the 30 cm sensor pod that trails behind the vent.

What to do if you find an archival tag

Please remove the tag carefully. **DO NOT** pull the tag out using the sensor pod cable.

The tag is well protected in an epoxy case, so after removal please wash it in fresh water and store it in a safe place. When you return to port, please contact the address below as soon as possible.

It is essential that all tags recaptured are returned quickly to CSIRO .

Attention Mr Wade Whitelaw: CSIRO Division of Fisheries, P.O. Box 1538, Hobart, Tasmania, AUSTRALIA, 7001. Phone 002-32 5222 Fax 002-32 5000

$ A REWARD OF $ WILL BE PAID FOR EACH ARCHIVAL TAG RETURNED $

CURRENT AND ONGOING STUDIES AT NINGALOO REEF

CALM:

1. Since the 1993 season management related data from commercial vessel logs, aerial observation logs from spotter aircraft and CALM monitoring / enforcement staffs logs and notes has been collected and analysed. This work is aimed at determining the population, distribution and availability to commercial vessels of whale sharks in Ningaloo Marine Park.

Also biological data, and both human and the sharks behaviour while interacting are also collected and analysed. It is primarily this material that is used in determining the number of commercial boats and people that can be reasonably allowed to interact, and how they may interact with the whale sharks of Ningaloo Reef, without unacceptable impacts on the animals.

Your assistance through ensuring all logs are completed accurately and passing on any other data, observations, photos etc will greatly assist in maintaining responsible management of our whale sharks and the commercial tour industries, and furthering scientific knowledge of the sharks.

2. Combined with the CALM whale shark brochure of 1995 is a brief survey questionnaire designed to identify the type of individuals coming to see whale sharks in Ningaloo Marine Park and the facilities they need and expectations. They can be mailed free of charge anywhere in Australia. Please encourage all who come to NW Cape to see whale sharks to contribute by completing the survey form.

MURDOCH UNIVERSITY / G. TAYLOR

At the time of production of this booklet, unfortunately details of Geoffs work were not yet available to the author.

It is understood that he will be continuing previous ongoing studies and will certainly be most grateful for any reports of animals with his small gamefish tags (photos showing tag location will greatly assist individual identification), reports and photos of scarred sharks and photos of the lateral markings of animals for ID.

NB: Photos have little value other than to say 'this animal was on Ningaloo Reef this year' unless they have other information noted also.

ie;
- DATE
- TIME
- LOCATION (as accurate as you can)
- APPROX. LENGTH
- SEX
- BEHAVIOUR AND MOVEMENTS
- ANY SCARS, TAGS OR IDENTIFYING CHARACTERISTICS
- VESSEL NAME / NUMBER

REFERENCES

Compagno, L.J.V. 1984, FAO Species Catalogue. Vol. 4 Sharks of the World, FAO Fisheries Synopsis No125, vol. 4, part 1. Produced by Food and Agricultural Organisation of the United Nations.

Exmouth Expression 1993 In search of *Ikan Iuh Bodoh* (the Whale Shark) for dinner! Exmouth Expression, April 1993; page 9; quoting an article from the Garuda Airlines in– flight magazine.

Last, P.R. & Stevens, J.D. 1994, Sharks and Rays of Australia. produced by CSIRO; ISBN 0 643 05143 0

Osborne, S.& Williams, M.R. 1993 Summary Analysis of Whale Shark Sighting Data : Ningaloo Marine Park 1993. Unpublished report of the Dept. of CALM

Osborne, S. & Williams, M.R. 1994 Whale Shark Tourism in Ningaloo Marine Park 1994 Unpublished report of the Dept. of CALM

Osborne, Sue & Williams, Matthew Russell 1995 Monitoring of Whale Shark Tourism in Ningaloo Marine Park produced by the Dept. of CALM

Readers Digest 1986 Sharks, Silent Hunters of the Deep Readers Digest Services. ISBN 0 86438 014 3

Taylor, G. 1994, Whale Sharks, The Giants of Ningaloo Reef published by Angus & Robertson; ISBN 0 207 18498 4.

Taylor, G. 1991 Whale Sharks of Ningaloo Reef Report for Australian National Parks and Wildlife Service; Nov. 1991.

Taylor, G 1990, The Whale Shark Australian Natural History, Vol. 23, No. 4, Autumn 1990.

Thomson, C. and Stevens, J 1995, A Whale of a Shark Landscope Vol. 10, No 2 Summer Issue 1994 – 1995.

Taylor, G. 1987, Whale Sharks of Ningaloo Reef, A Preliminary Study. Unpublished report.

Wolfson, Fay H. 1986, Occurrences of the Whale Shark, *Rhincodon typus*, Smith excerpt from Indo–Pacific Fish Biology: Proceedings of the Second International Conference on Indo–Pacific Fishes, edited by T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura, pp. 208–226, Ichthyological Society of Japan, Tokyo

FURTHER READING

Andrewartha, B. 1993 The Whale Sharks of Ningaloo Reef
Sportdiving (magazine); Aug. / Sept. 1993; No. 39, 110 – 112.

Arnbom, T & Papastravrou, V. 1988 Fish in association with Whale Sharks, *Rhiniodon typus* , near the Galapagos Islands. Noticias De Galapagos, No. 46, 13–15.

Australian National Parks and Wildlife Service. 1990 Ningaloo Marine Park (Commonwealth Waters) – Management Plan; ANCA (Commonwealth of Australia)

Baughman, J. L. 1955 The oviparity of the whale shark, *Rhiniodon typus,* with records of this and other fishes in Texas waters. Copeia, No. 1, 54 – 55.

Brown, B. 1992 Whale Shark – *Rhincodon typus*,, Smith, 1929
Tribulus, No 2 (1), 22.

Compagno, L.J.V. 1984, FAO Species Catalogue. Vol. 4 Sharks of the World.
FAO Fisheries Synopsis No125, vol. 4, part 1. Produced by Food and Agricultural Organisation of the United Nations

Chidambaram, L. 1986 Note on a Whale Shark, *Rhincodon typus* , Smith, landed at Pondicherry
Marine Fish Information Service Technical & Extension Series, No. 66, 36.

Doiphode, P. V. 1986 On the landing of a Whale Shark, *Rhincodon typus,* Smith, at Anjuna, Goa. Marine Fish Information Service Technical & Extension Series, No. 66, 29.

Exmouth Expression 1993 In search of *Ikan Iuh Bodoh* (the Whale Shark) for dinner!
Exmouth Expression, April 1993; page 9; quoting an article from a Garuda Airlines in flight magazine.

Ganapathy, A. 1986 On the landing of *Rhincodon typus,* Smith, along Adirampatinam Coast, Tanjore District, Tamil Nadu. Marine Fish Information Service Technical & Extension Series, No. 66, 37.

Gilbert, P. W. 1981/2 Patterns of shark reproduction.
Oceanus, Vol. 24 (4), 30 – 39.

Gudger, E. W. 1915 Natural History of the Whale Shark, *Rhineodon typus,* Smith.
Zoologica, Vol. 1 (19), 345 – 389.

Gudger, E. W. 1932 The Whale Shark, *Rhineodon typus,* among the Seychelles.
Nature, Vol. 130, 160.

Gudger, E. W. 1933 The Whale Shark in the waters around Ceylon.
Nature, Vol. 131, 165.

Gudger, E. W. 1934 The geographical distribution of the Whale Shark, (*Rhieodon typus*).
Proceedings of the Zoolgical Society of London, Vol. 4, 863 – 893.

Gudger, E. W. 1941 The food and feeding habits of the Whale Shark (*Rhiniodon typus*)
.Journal Elisha Mitchell Scientific Society, Vol. 57 (1), 57 – 72.

Grupta, A. C., Pur andhara, C., & Appayanaik, R. 1991, On landing the whale shark, *Rhincodon typus* , Smith, off Malpe, Dakshina Kannada Coast. Marine Fish Information Service Technical & Extension Series, No. 110, 10, 16.

Herre, A. W. C. T. 1932 The Whale Shark on the coast of Borneo
Science, Vol. 75, 413.

Herre, A. W. C. T. 1942 The Whale Shark in the Philippines.
Scientific Monthly, Vol. 55, 151 – 158.

Hoffman, W., Fritts, T., & Reynolds, R. 1981 Whale Sharks associated with fish schools off South Texas.
North – East Gulf Science, Vol. 15 (1), 55 – 57.

James, D., Nammalwar, P., & Srinivasarengan, K., 1986 On two juvenile Whale Sharks, *Rhincodon typus*, Smith, caught at Madras. Marine Fish Information Service Technical & Extension Series, No. 66, 21.

Karbhari, J., & Josekutty, C. 1986 On the largest Whale Shark, *Rhincodon typus*, Smith, landed alive at Cuffe Parade, Bombay. Marine Fish Information Service Technical & Extension Series, No. 66, 31 – 35.

Kulkarni, C. V. 1948 Outsize Whale Shark in Bombay waters.
Journal Bombay Natural History Society, Vol. 47, 762 – 763.

Kuthalingam, M. D., Luther, G., Livingstone, P., & Murty, V. S. 1973 Further occurrences of the Whale Shark (*rhincodon typus,* Smith) in the Indian coastal waters. Indian Journal of Fisheries, Vol. 22 (1), 646 –651.

Last, P.R. & Stevens, J.D. 1994, Sharks and Rays of Australia.
produced by CSIRO; ISBN 0 643 05143 0

Lazuras, S., Joel, J., Phillippose, K., & Vincent, s., 1988 On five Whale Sharks landed along the Trivandrum – Kanyakumari Coast. Marine Fish Information Service Technical & Extension Series, No. 88, 19 – 20.

McCann, C. 1954 The Whale Shark, *Rhincodon typus* (Smith).
Journal Bombay Natural History Society, Vol. 52, 326 –333.

McIllree, Janice 1994 Swimming with the largest fish in the sea (The whale sharks of Ningaloo Reef); Australian Wellbeing (magazine); No. 57, 1994

Pillai, P. K. M. 1972 On the landing of a Whale Shark, *Rhincodon typus* (Smith) at Tuticorin. Journal Marine Biological association (India), Vol. 14 (1), 408 – 409.

Prater, S. H. 1942 The Whale Shark (*Rhineodon typus*, Smith) in Indian coastal waters, with notes on its wandering in other areas. Journal Bombay Natural History society, Vol. 42, 255 – 279.

Readers Digest 1986 Sharks, Silent Hunters of the Deep
ISBN 0 86438 014 3

Reid, G. K. 1957 External morphology of an embryo Whale Shark (*Rhincodon typus*), Smith. Copeia, No. 2, 157 – 158.

Silas, E. G. 1986 The Whale Shark (*Rhincodon typus* , Smith) in Indian coastal waters: Is the species endangered or vulnerable? Marine Fish Information Technical & Extension Series, No 66, 1 – 8.

Sivadas, M. 1991 Note on a Whale Shark, *Rhincodon typus,* landed at Beypore, Cailcut. Marine Fish Information Service Technical & Extension Series, No. 110, 11 & 17

Steel, R. 1985 Sharks of the world.
Dorset: Blanford Press.

Stevens, J. D. (Ed) 1987 Sharks
Sydney: Intercontinental Publishing Corp Ltd.

Taylor, G. 1994, Whale Sharks, The Giants of Ningaloo Reef
published by Angus & Robertson; ISBN 0 207 18498 4

Taylor, G 1990, The Whale Shark
Australian Natural History, Vol. 23, No. 4, Autumn 1990.

Taylor, G. 1989 Whale Sharks of Ningaloo Reef, W. A. –A preliminary study.
Western Australian Naturalist, Vol. 18 (1), 7 – 12.

Taylor, G. 1987, Whale Sharks of Ningaloo Reef, A Preliminary Study
Unpublished report.

Tubb, J. A. 1948 Whale Sharks and Devil Rays in North Borneo.
Copeia, No. 3, 222.

Wolfson, F. H. 1987 The Whale Shark, *Rhiniodon typus,* Smith 1928, off Baja California, Mexico. Memorias Del 5 Simposium de Biologica Marina, 5, 103 – 108.

Wolfson, Fay H. 1986, Occurrences of the Whale Shark, *Rhincodon typus*, Smith
excerpt from Indo–Pacific Fish Biology: Proceedings of the Second International Conference on Indo–Pacific Fishes, edited by T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura, pp. 208–226, Tokyo, Ichthyological Society of Japan, Tokyo.

Wolfson, F. H. 1983 Records of seven juveniles of the Whale Shark (*Rhiniodon typus*).
Journal of Fish Biology, Vol. 22, 647 – 655.

PLEASE NOTE: MANY OF THE BOOKS AND PAPERS LISTED ABOVE ARE AVAILABLE FOR PERUSAL AT THE MILYERING VISITOR CENTRE IN CAPE RANGE NATIONAL PARK AND / OR AT THE CALM EXMOUTH OFFICE.

Acknowledgments

I would like to express my sincere appreciation for the assistance given to me in compiling and researching this booklet;

To Ron Campbell for his most generous donation of slide material for some of the illustrations and his in–water knowledge of whale shark behaviour.

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To Doug Myers (CALM, Exmouth) for his support in the compilation of the booklet and patience with the demands on my time and resources.

To the multitude of researchers, scientists, divers, skippers, pilots, wildlife officers and rangers, filmmakers tourists and others who have contributed to the knowledge of Whale Sharks.

THANK YOU

RIC KARNIEWICZ.