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WHALE SHARK POPULATION STUDY

PRELIMINARY REPORT ON WHALE SHARK RESEARCH UNDERTAKEN IN 1995

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INTRODUCTION:

The field work undertaken in 1995 endeavoured to continue the building up of an extensive database on the individual whale sharks visiting Ningaloo in the March/April season. The photographic and tagging work undertaken in 1992-3 has already established that the same sharks are resighted at Ningaloo in successive seasons suggesting that this is a discrete population. The study has a long term objective of assessing growth and age of whale sharks at Ningaloo. This is expected to take at least ten years.

The resighting of tagged sharks from the 1992 season has allowed estimates of the population, and this year further data was obtained.

OBJECTIVES:

1. To continue the photographic database on individual sharks, so that these animals may be recognised in future seasons, recording scars, sex, and in the males, maturity.

2. To record resightings of sharks from previous seasons, identifying them by tags and photographic data and use this for population analysis.

3. LONG TERM - To obtain measurements of as many of the whale sharks as possible in the database, to allow future estimates of growth and maturity.

METHODS:

Over the period 2-15 April, for each animal encountered that was successfully photographed, a reporting form was completed noting Date, Time, Location (GPS), approximate size, sex, maturity (males only). The presence of any identifying scars was recorded. The presence of tags from the 1992 season was recorded. Each shark was photographed, with a left and right flank photograph, and where possible, shots of scars, and tags. In most sharks the genitals were also photographed.

Where possible, the dorsal fin of each shark was measured, with a metre rule, from the anterior end of the posterior "slit" at the base of the fin to the top of the fin. In many cooperative animals the dorsal fin was measured repeatedly. Attempts were then made to take lateral shots of the whole shark with a diver holding the metre rule horizontal over the midline of the shark, behind the dorsal fin. Projection of these photographs has allowed estimation of the total length of the sharks (head to tip of tail) and the standard length (head to tail peduncle).

A new reporting form was generated for each shark encountered, where identification photos were taken, unless it was immediately evident that the shark was a resighting from earlier in the same day, or of an animal recently encountered that season.

RESULTS:

1995 was a relatively poor shark season with low numbers of whale sharks. Weather conditions were unusual for the April season with a coastal depression causing overcast calm conditions for much of the first week of the month. There was no evidence of the northerly reef front current that is usually present at this time of year, and this may relate to the low numbers of sharks encountered.

22 shark encounter forms were completed. Matching of the animals on the basis of scars and photographic markings, has currently given a total of 17 individual animals encountered.

SEX: Of the 16 sharks in which sex was determined, 12 were male and 4 female (25%). This was a similar proportion of female sharks as the 1994 season, a higher proportion than in previous seasons. In 1992, only 2 female sharks were seen out of a total of 32 sharks that were sexed, and in 1993 only one female in 22 sharks. One of the male sharks encountered in 1995 had large mature claspers, the rest were sexually immature.

SCARS: Three sharks had major scars enabling immediate identification. Of these, two had scarred pectoral fins, and one a scarred dorsal fin with additional body scars. Two of these sharks were resightings, and one a new addition to the database.

TAGGED SHARKS: Of the 25 sharks tagged in 1992, 1 individual (92 A-12-4) was resighted on 6 April this season. This shark had been resighted in 1994 on three occasions (31-3-94, 12-4-94 & 13-4-94). Dorsal fin measurements had been taken on several encounters.

POPULATION:- An estimate of population can be made on the basis of the resighting of this tagged shark.

The number of sharks that have shed their tags is an unknown, but population estimates can be made on the basis of different shedding percentages.

% tag drop-out	estimated population
20	340
40	255
50	212

Estimates of population from previous seasons have put the population between 200 and 300 individuals.

DORSAL FIN HEIGHT: 13 sharks were successfuly measured. Three of these sharks had been measured in previous seasons.

Shark 94 A-2-3 is a female shark with damaged Right Pectoral fin that was first measured in 1994 with two measurements of 47 and 48 cm. Three measurements in 1995 were 48, 49, 49 cm. Shark 92-A-12-4 is the tagged male shark. Measurements in 1994 gave figures of 57, 58, 59, 59, 58 cm. One measurement in 1995 gave a figure of 57 cm.

Shark 86 A-15-1 is a male shark with damaged left pectoral fin. It was first filmed and observed extensively in 1986. Repeated measurements (approx 10) in 1993 gave a dorsal fin height of 62.5cm. The shark was measured 7 times in 1995 giving a height of 64 cm. This is in keeping with the estimates of dorsal fin height of 56 cm in 1986.

The estimated lengths of the sharks - Total length and standard length have been plotted against measured dorsal fin heights in the attached figures both for 1995 and for combined data 1994 and 1995. The ratio of length to dorsal fin height has also been plotted. There is a curvi-linear relationship between dorsal fin height and length with a tendency for smaller sharks to have a greater ratio - i.e. relatively smaller fins

DISCUSSION:

1995 was a relatively quiet whale shark season at Ningaloo. Weather conditions were unusual for April with an early onset of winter weather patterns. There was no evidence of the northerly reef-front current that usually prevails in early April.

While the numbers of sharks encountered were low, the resighting and remeasuring of sharks from previous years has yielded valuable results. The population estimate based on the figures is once again of the same order as in previous years.

There are currently 132 records in the shark database. While matching of tagged and scarred sharks is relatively easy, the matching of animals bearing none of these features is a huge task. There is little doubt that some of these animals will be matched in the future, reducing the total number in the database. Population estimates have generally given a figure of approximately 200 animals. This assumes that the animals presenting on the reef front at the surface each year are drawn from a constant population living off-shore. The situation is obviously more dynamic than this in reality. However, with the number of sharks now in the database, this order of population is not unrealistic.

The use of tags for population analysis has limitations because of tag shedding. Photography of the sharks has allowed identification of a cohort of sharks with "anatomical scars". Re-sighting of this cohort of sharks can be used for population analysis in the same way as the tagged sharks.

Whale sharks have enormous healing potential, and some wounds on them heal with little scarring. The scars chosen for an animal to enter the cohort must be of a permanent nature. These scars consist of shark bites and propellor injuries that have left scars that are permanent, and allow rapid identification in the field.

Some scars, such as truncated dorsal caudal fins, are relatively common. With these animals, careful observation must be made of other markings and size. Two animals now have slits in their dorsal fins; both were tagged in 1992 on the same day 12 April, at which time only one was noted to

have a damaged dorsal fin. Hence this injury has been acquired in the intervening two years. Damaged pectoral fins are also relatively common, but show considerable variation and the individual animals can easily be identified.

Publication of a small photolibrary of these animals will greatly enhance the tourist experience, and allow the collection of re-sighting records from numerous tourist boats. Photos of 23 sharks, and their details are included in the attached appendix.

The long term objective of the present study is to determine the age and growth rate of whale sharks. While absolute measurements of the length of the sharks are of interest because of their massive size, they are not necessary to generate growth curves from measured parameters. The repeated measurement of dorsal fin height should allow an estimate of the growth velocity of the sharks.

Conclusions from the dorsal fin figures must be viewed as preliminary. It is evident that repeated measurements are necessary to produce reliable results. Notwithstanding the difficulties of the technique, they suggest that whale shark growth is very slow. These sharks in the 6-8 metre range are still sexually immature, and should be in a phase of steady growth. We know that fully grown whale sharks attain a total length of greater than 12 metres. Data collected in 1995 suggested that dorsal fin height averages 8% of total body length, and this is confirmed by further measurements this year. Hence, these preliminary figures suggest a growth rate of the order of 12.5 cm per year for 6-8 metre sharks.

The attached figures show a curvi-linear relationship between length and dorsal fin height, with a tendency for small sharks to have a relatively small dorsal fin, and therefore a higher length/Dorsal fin ratio. There is far more scatter in the total length measurements which are considered less reliable than standard length measurements. This is explained by the difficulty of measuring a moving animal whose tail is moving side to side.

Under normal growth circumstances, the growth velocity of the fin should be relate to the age and size of the shark. Remeasurement of animals over a ten year period should allow the generation of growth velocity curves, and for the first time allow estimates of the age of the sharks, and of the age they reach sexual maturity. This will greatly add to our understanding of the species.

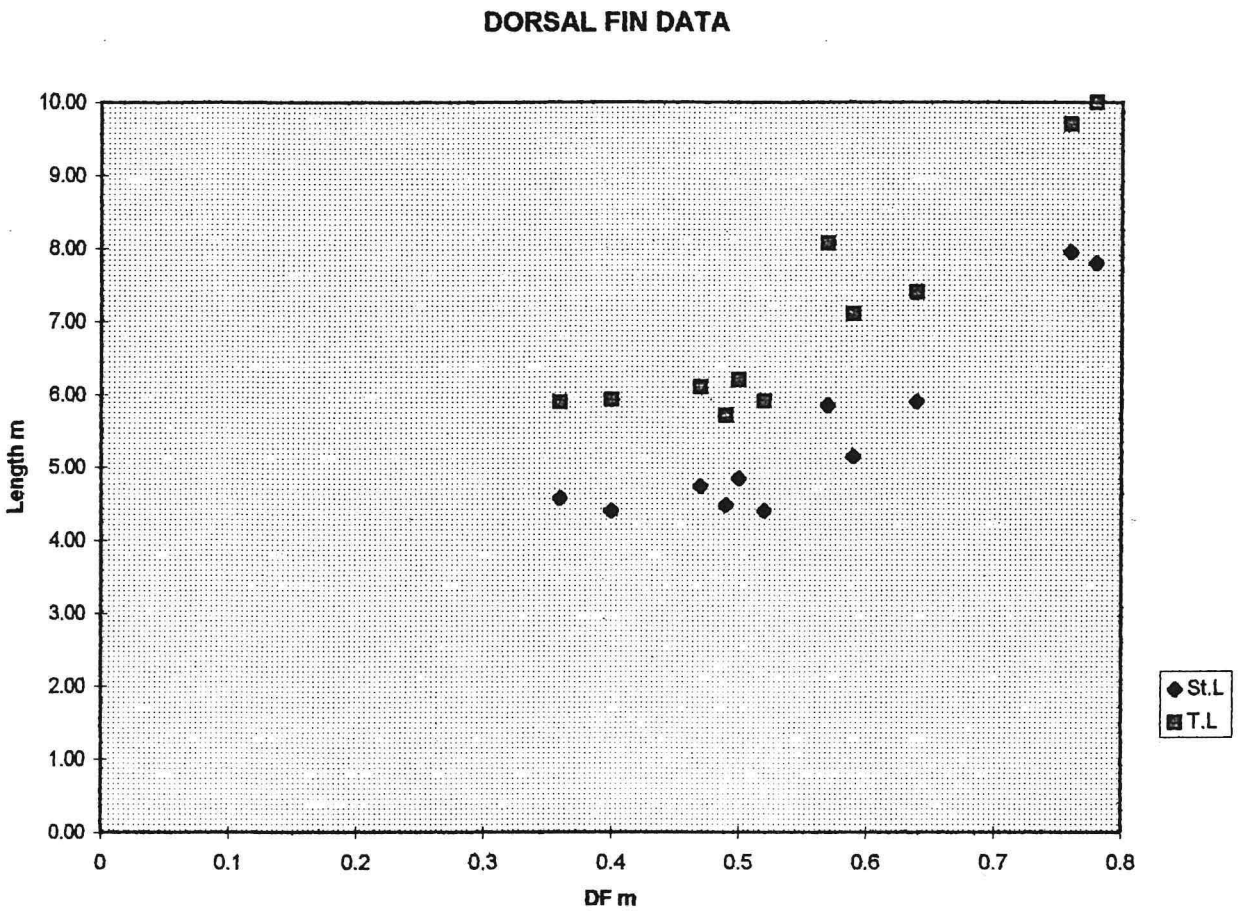

Fig 1. Estimated length of sharks related to measured dorsal fin height for 1995 data. St. L denotes standard length from head to tail peduncle; T.L denotes total length.

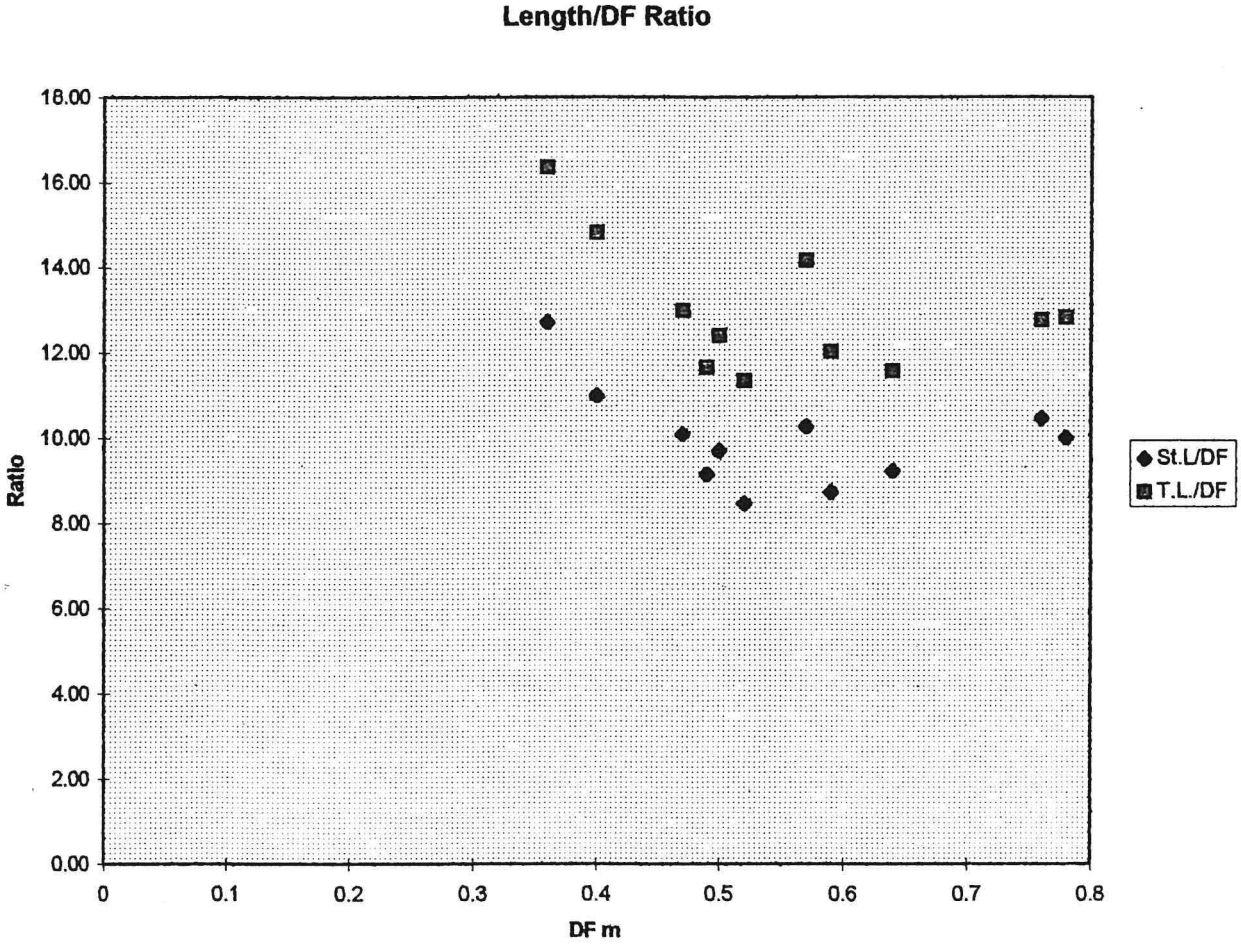

Fig 2. Ratio of length of sharks (metres) to dorsal fin height related to dorsal fin height for 1995 data. St. L denotes standard length from head to tail peduncle; T.L denotes total length. DF denotes Dorsal fin height.

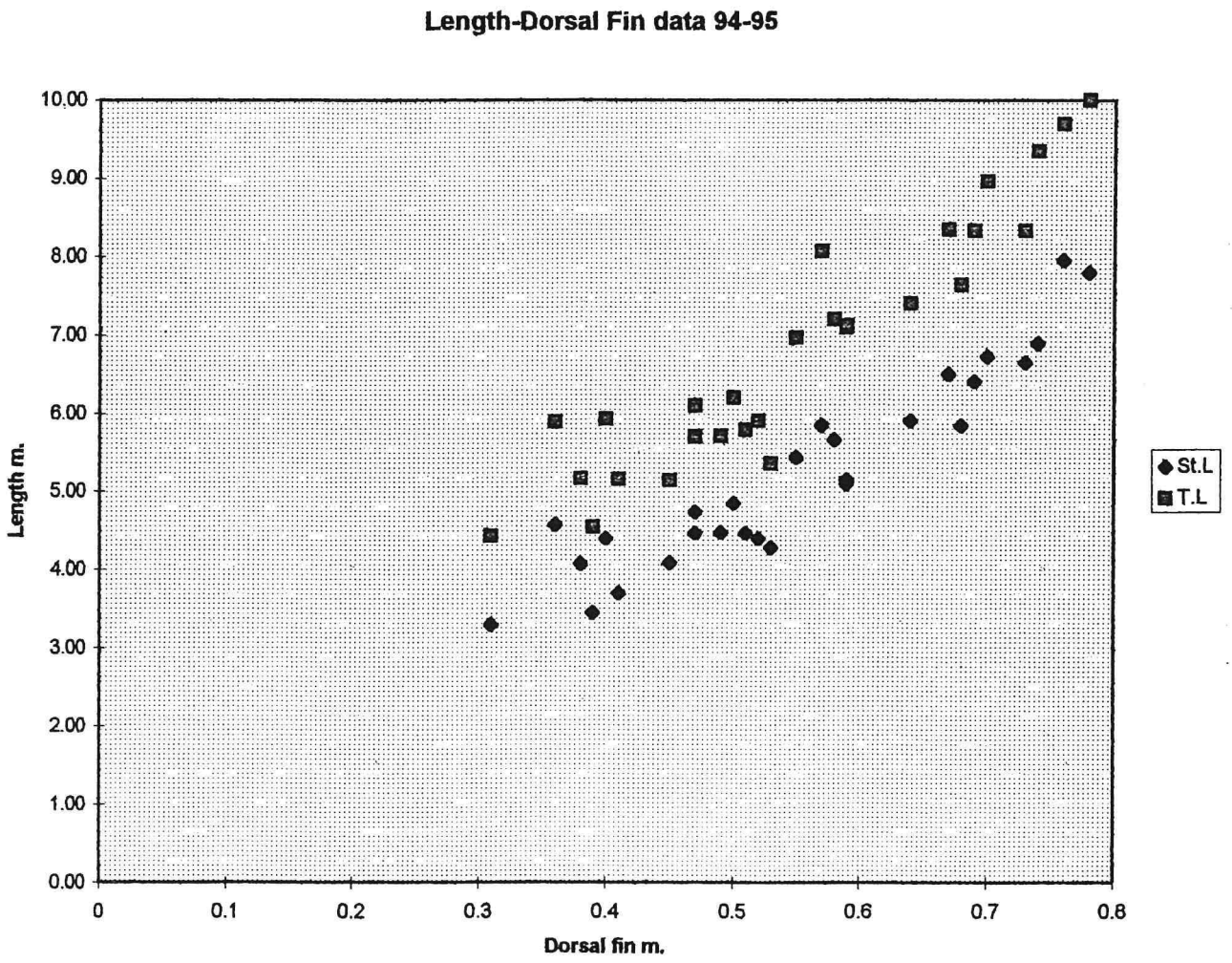

Fig 3. Estimated length of sharks (metres) related to measured dorsal fin height for 1994 and 1995 data. St. L denotes standard length from head to tail peduncle; T.L denotes total length.

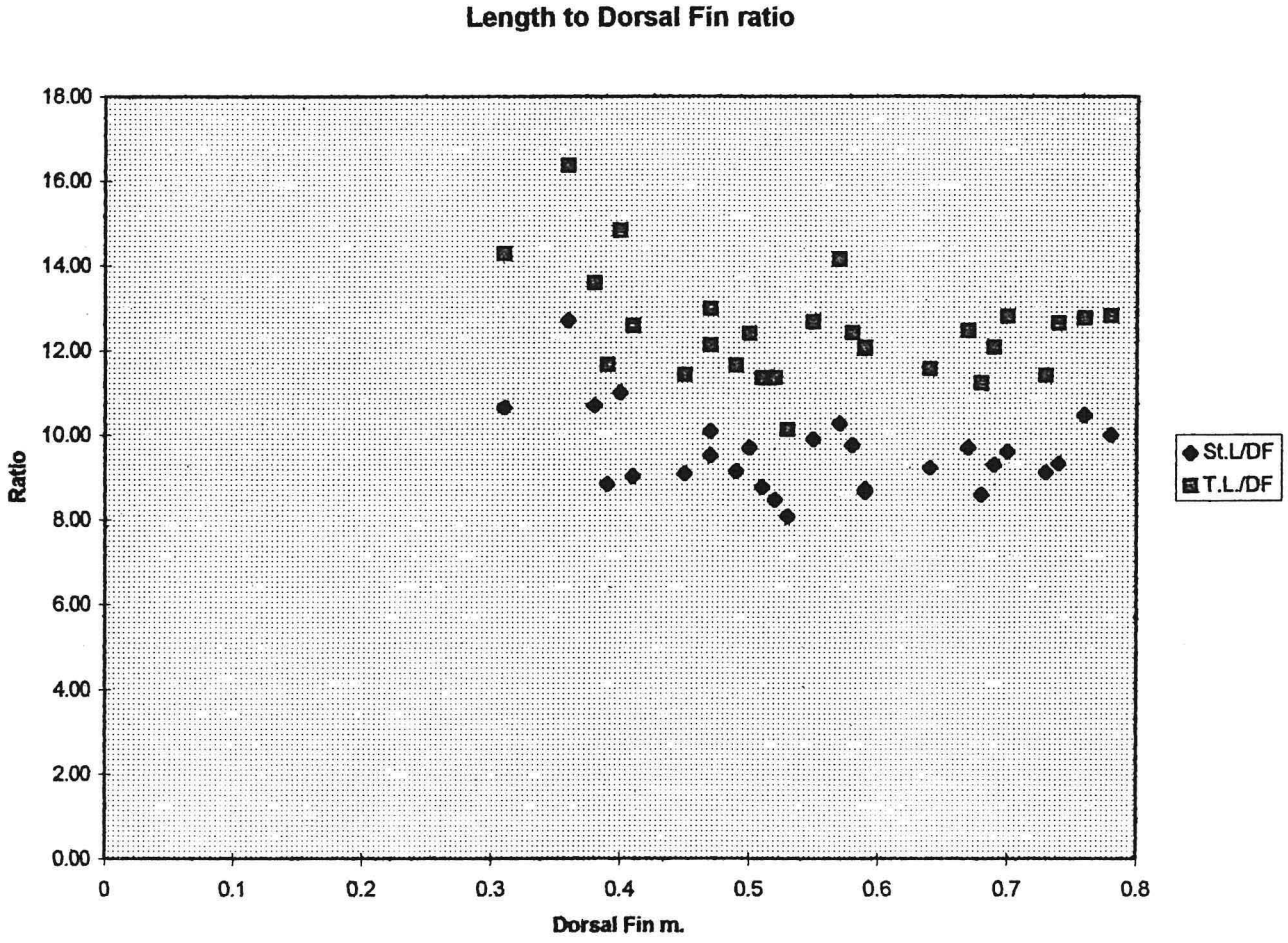

Fig 4. Ratio of length of sharks (metres) to dorsal fin height related to dorsal fin height for 1994 and 1995 data. St. L denotes standard length from head to tail peduncle; T.L denotes total length. DF denotes Dorsal fin height.

INTRODUCTION

The plan for a whale shark data base was initiated by Gordon Anderson of ANCA in 1991. Extensive photography of the sharks was undertaken by the author in that season to establish an area of the body that might represent an individual "fingerprint" identifying each animal.

In that year it was established that, while the markings were very similar over much of the body, the "lateral markings" in the area behind the gills showed variation in each animal which was easily interpreted. It was also shown that these markings were asymmetrical from one side of the body to the other. The head markings are also a "fingerprint", but the complexity of these markings make individual identification difficult.

The main library was therefore started in 1992, and at the same time a tagging programme was initiated. The presence of tags has allowed cross-referencing of ID data. Resightings of tagged animals has allowed estimation of the shark population.

1992 was an extremely successful year with 25 sharks tagged and 43 photographed in all. A number of sharks were noted to have wounds and scars on their body and fins. Where possible these were also photographed.

In 1993, 25 sharks were logged, 22 of which were photographed. Six of the 22 photographed were confirmed to be resightings from 1992. Two of the six were identified by the presence of tags. The other four sharks were identified by their scars; in two of these, tags had been shed. A further shark was identified, that had originally been filmed in 1986. This shark is easily recognised by the presence of the large scar on the left pectoral fin, and is known as "Sharkbite". Measurements of the dorsal fin of sharks was also added to the data collection.

In 1994, from a total of over 80 encounters, 64 sharks were photographed, all in a two week period. Five tagged sharks were resighted. Two resightings from previous years were established on the basis of markings. One of these known as "Stumpy" is easily recognisable by the almost complete absence of the dorsal fin of the tail.

1995 was a relatively quiet year, with only 17 separate sharks encountered, some of them several times. One shark was a tagged animal from 1992. Two sharks were resights of sharks with prominent scars. Remeasurement of these animals is giving the first clues about whale shark growth.

THE COHORT, WHAT IS IT AND WHY?

Included in the library there are now a large number of sharks with wounds and scars that have been photographed. Some of these animals have been seen repeatedly, both in the same, and in different seasons. Some scars consist of "scratches" or loss of pigment on the body of the shark, while others are more major, and consist of amputations of fins, or "sharkbites" from fins.

A group of animals with major scars that are easily identifiable has been selected to include in a "cohort" of animals that can be used for research purposes. The searching out and recognition of these animals will also give more purpose to the diving experience of recreational divers visiting Exmouth as they will be

contributing to the ongoing research of the whale sharks.

The cohort of scarred animals can be used in the same way as tagged sharks to estimate population. Over a period of time, tagged sharks lose their tags. Sharks have been selected for the cohort that have scars that are unlikely to heal. Many of them have been seen to retain these scars over several seasons. Some of these sharks have been given names. Participating divers may enjoy naming some of the as yet un-named sharks in the group. It should be noted that all healthy undamaged whale sharks have a small V in the tip of the tail. This is not a scar.

Each shark has a code number which denotes the first year that it was filmed or photographed. (With two of the sharks this was in 1986 and 1991). The code represents: the year, the month, and the day that they were sighted and the number allocated that day.

Where known, the height of the dorsal fin of each shark has been given, which gives a guide to the overall size of each shark. The total length is approximately 12x the dorsal fin height. Hence a shark with dorsal fin of 60cm would have a total length of approximately 7.2 metres.

THE COHORT

1. 86-A-15-1 Male shark known as "Sharkbite" was first filmed extensively in 1986. It has been resighted in 1993 and 1995. As well as the scar on the fin, this shark has distinctive white mottling behind the fifth gill slit. There is a slight curve to the upper dorsal fin.

2. 92-M-15-1 Male shark, approximately 5.5m in 1992, with obvious left pectoral amputation. This shark was tagged on the right side in front of the dorsal fin in 1992. It is one of several sharks with amputation of the last 1/3 of the tail, similar to sharks 9 and 10. It also has a "serrated" edge to the right pectoral fin. It has not been resighted. Nickname - Nelson

3. 94-A-2-3 Female shark approx. 6m seen four times in 1994. Alongside the scarred right pectoral is some linear scarring on the body.

4. 94-A-16-8 Female shark, approx 6.2m with a scalloped left pectoral fin.

5. 94-A-6-4 A shark Approx. 7m with similar scalloped scarring as 4. this time on the right pectoral. The body has 2 indentations along the right flank giving a dumbell appearance.

6. 94-A-14-1 Small 3.6m female shark with two slits in the right pectoral fin.

7. 94-A-2-1 A 5.5m female shark with a distinctive slit in the lateral end of the left pectoral fin.

8. 94-A-17-4 A small 4m male shark with a single notch in the right pectoral fin. It also has two white marks on the back close to the midline, in front of the dorsal. (These may not persist).

9. 94-A-14-6 A small male shark 4.6m with a similar tail amputation as 10, (which is much larger). The four prominent spots on the tail peduncle should confirm its identity.

10. 92-A-14-4 A large male shark approx. 8.5 m with amputated tail, tagged in 1992. The diamond of white spots at the base of the tail, and the triangle on the tail peduncle should help confirm ite identity. When resighted on 7-4-93 the tag had been shed.

11. 94-M-29-3 A large, approx 10m, male shark with a handsize bite removed from the upper dorsal fin of the tail: possibly a bite from a cookie-cutter shark. It was resighted twice in 1994 on the 3rd and 5th of April. Despite its huge size, it still has small immature claspers.

12. 94-M-29-1 A 5.3m male shark with a truncated lower tail fin, and prominent white scarring on the left tail peduncle. It was encountered and measured repeatedly in 1994.

13. 91-A-3-1 A 6.5 metre male shark known fondly as "Stumpy". He was first photographed in 1991, and then resighted in 1994. A popular shark with divers, as without a proper tail, he swims slowly. "Stumpy" was tagged by CSIRO scientists in 1994, and the tag retrieved after 24 hours giving interesting data on the vertical movement in that period.

14. 92-A-13-1 This male shark of approx. 5-6m size has a large bite defect in the tail. It was tagged in 1992 on the left side,

level with the back of the dorsal fin. The left flank markings are unusual with only a few spots, and lines that are almost continuous.

15. 92-A-14-1 A male shark of approx 7-8m with an unusual curvature of the lower tail fin. Nickname - Curley-tail.

16. 94-A-14-2 A 6.0m male shark with an amputated tail dorsal fin, and two bite scars below. The dorsal fin has a serrated posterior edge. Nickname - Scraggy-tail.

17. 92-A-14-2 A male shark approx 5-6m with an unusual curved tail. It was tagged in 1992 on the left side , in the second depression behind the dorsal fin. Nicknamed Scabre-tail, this shark was seen 10 minutes after shark 15 - Curley-tail - at the same location. Neither of these sharks have been resighted since by the author (1996).

18. 92-A-23-3 A male shark approx 5-6m with a very distinctive dorsal fin. He also has a large bite from the tail, and a large slit in the upper trailing edge. Nickname - Folded-fin.

19. 92-A-12-8 A male shark, approx. 7-8m with a notch in the top of the dorsal fin. He was tagged in 1992 on the right side, but this tag had been shed when he was resighted on 15 April 1993. Twin "hockey-stick" markings on the left flank confirmed the identity. Nickname - Macdonald or Mac 1.

20. 92-A-12-6 A male shark, approx 8.4m which now bears an almost identical scar as No 19. Both these sharks were tagged the same day in 1992. The tag is on the right side, on the second ridge, and was still present when he was resighted twice in 1994. The trailing edge of the dorsal is scalloped in Mac 2.

21. 94-A-13-4 A female shark approx 7m with a prominent notch in the dorsal fin. There is also damage to the right pelvic fin.

22. 92-A-13-8 A male shark, approx. 7m with very distinctive damage to the left second gill. This shark was twice resighted again in 1993. Nick-name - Arthur Scargill.

23. 95-A-7-2 A female shark with two distinctive scars. The dorsal fin is amputated so smoothly that it looks like a shark without a fin. The right fourth gill is damaged. The third and fourth gills give the shape of the greek letter "Delta". Nickname - Delta-gill.

SUMMARY

No	Code	Tagged	Nickname	sex	DF
1	86-A-15-1		Sharkbite	M	64
2	92-M-15-1	*	Nelson		
3	94-A-2-3			F	47
4	94-A-16-8			F	52
5	94-A-6-4				
6	94-A-14-1			F	31
7	94-A-2-1				
8	94-A-17-4			M	35
9	94-A-14-6			M	39
10	92-A-14-4	(*)		M	70
11	94-M-29-3			M	80
12	94-M-29-1			M	43
13	91-A-3-1			M	63
14	92-A-13-1	*		M	
15	92-A-14-1		curley-tail	M	
16	94-A-14-2		scraggy-tail	M	48
17	92-A-14-2	*	scabre-tail	M	
18	92-A-23-3	*	folded fin	M	
19	92-A-12-8	(*)	Mac 1	M	
20	92-A-12-6	*	Mac 2	M	70
21	94-A-13-4		Notch-Fin	F	58
22	92-A-13-8		Arthur Scargill	M	57
23	95-A-7-2		Delta-Gill	F	

Summary of the sharks in the cohort group. The code denotes year, month (M = March, A = April,) and day of first sighting. The final number is the number allocated that day. Sharks tagged in 1992 are marked with a *; those that have since shed tags are in (). DF is Dorsal fin height in cm.

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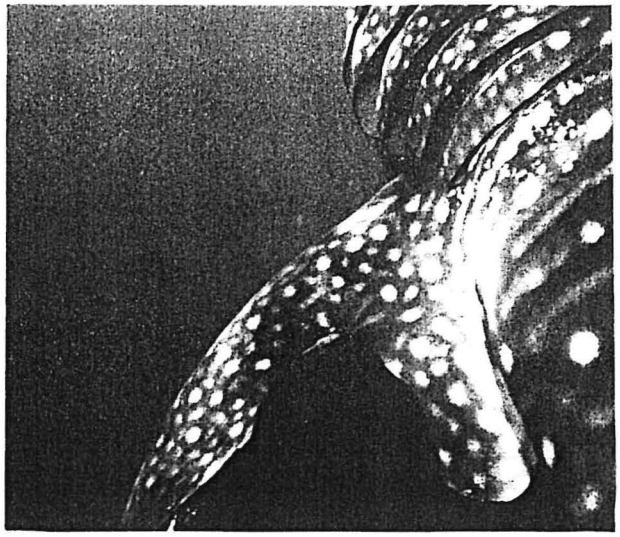

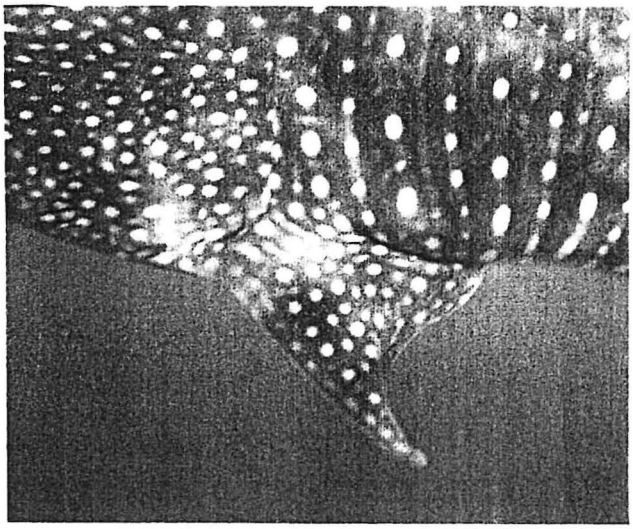

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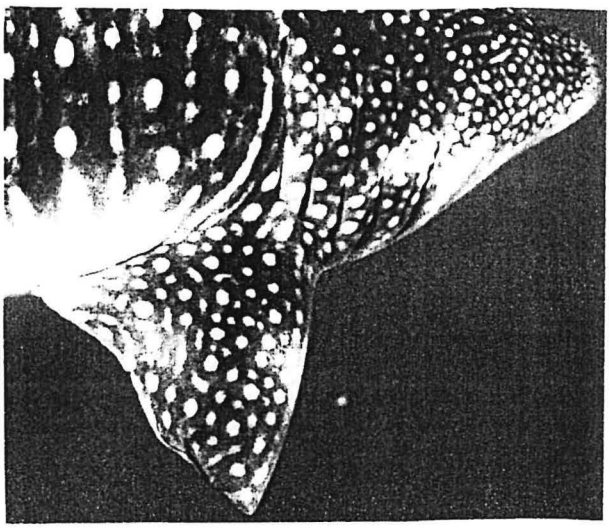

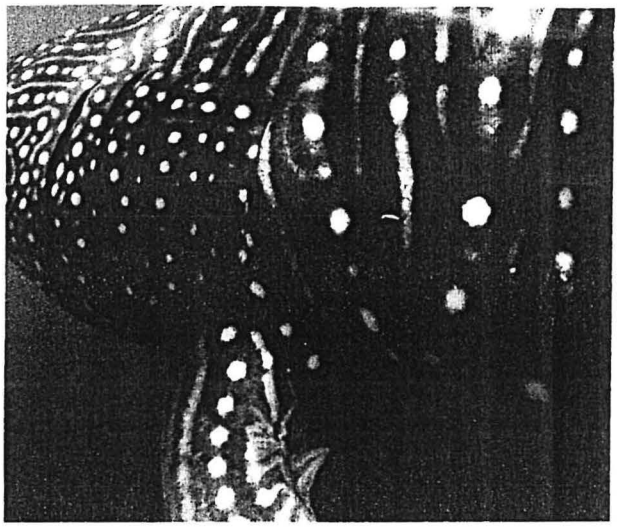

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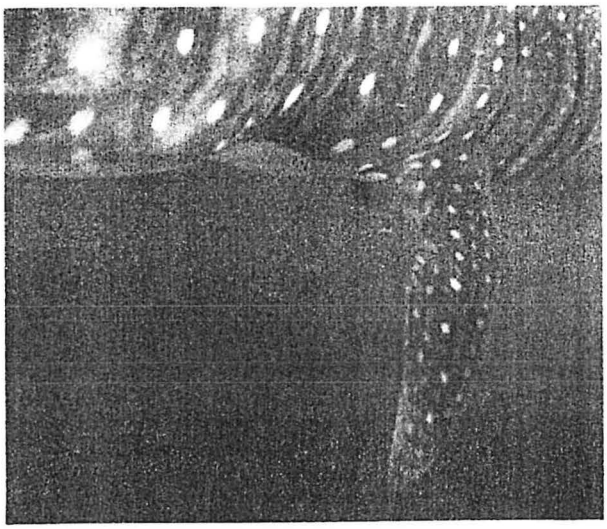

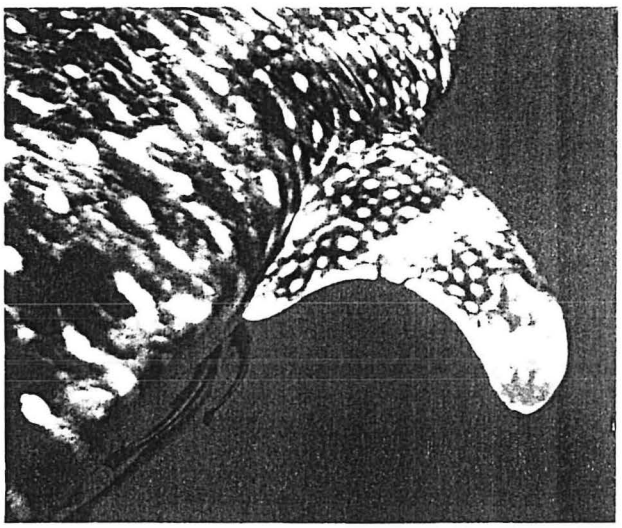

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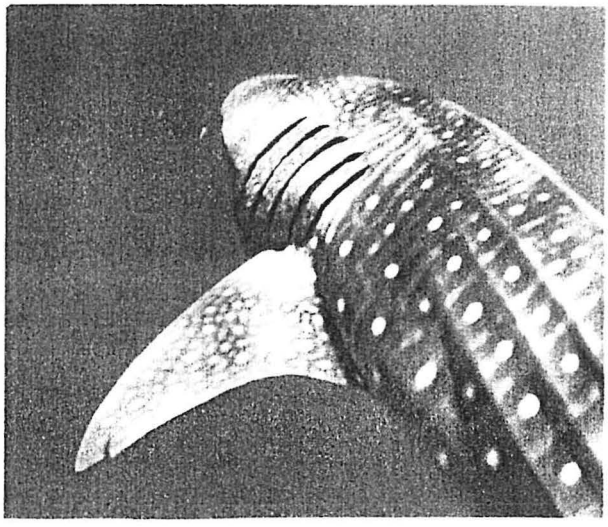

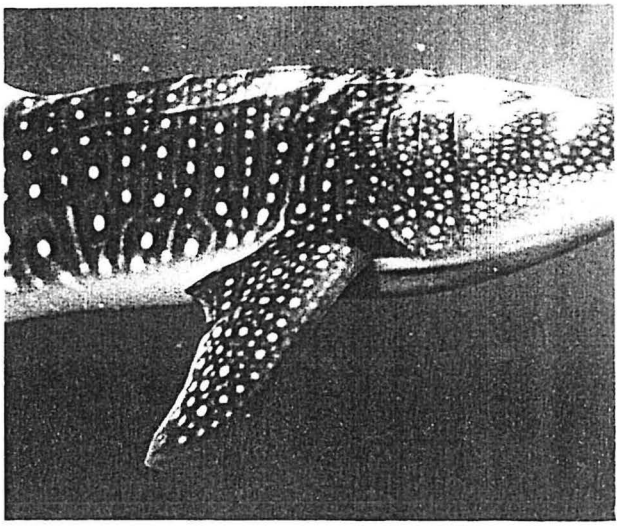

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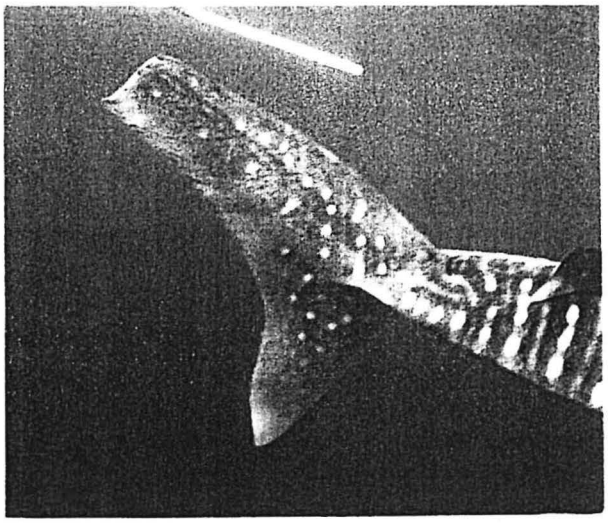

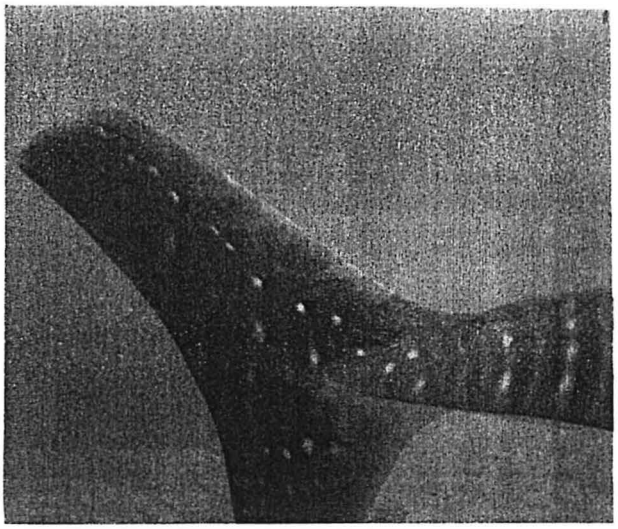

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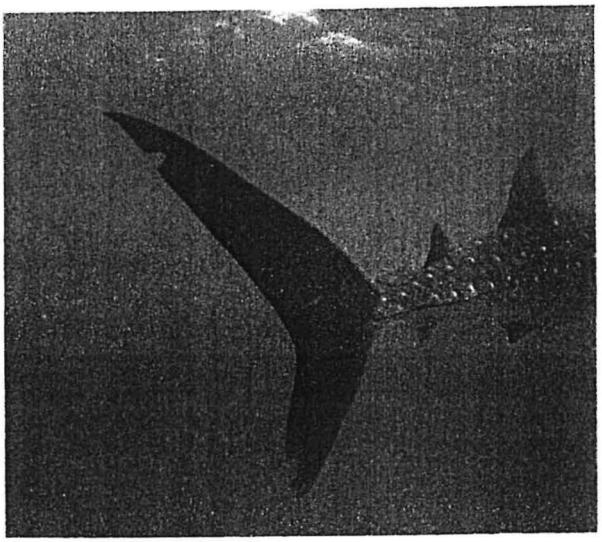

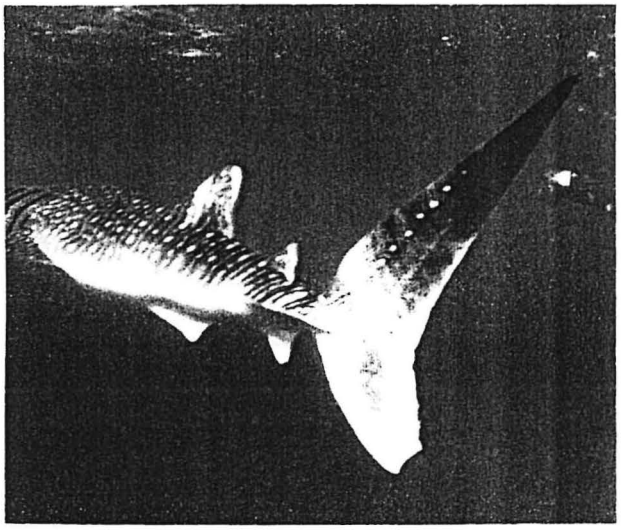

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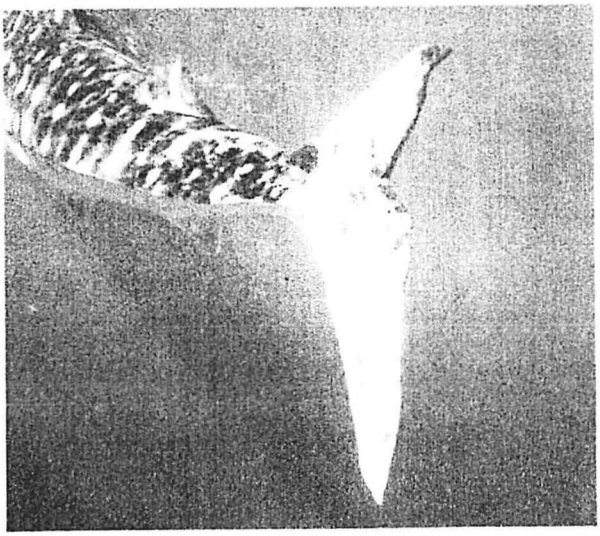

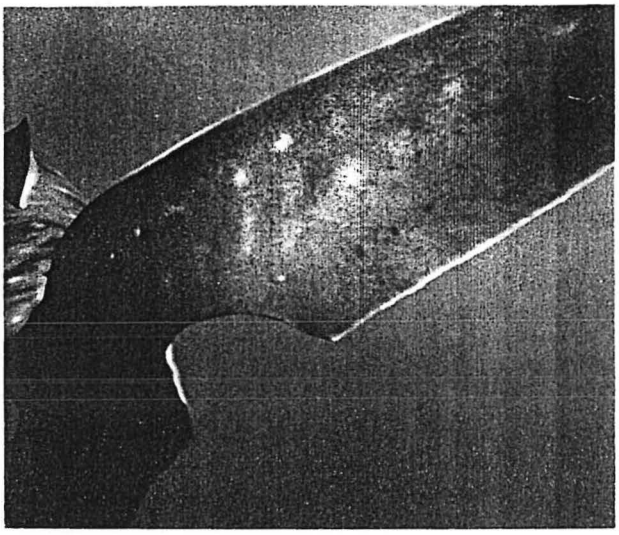

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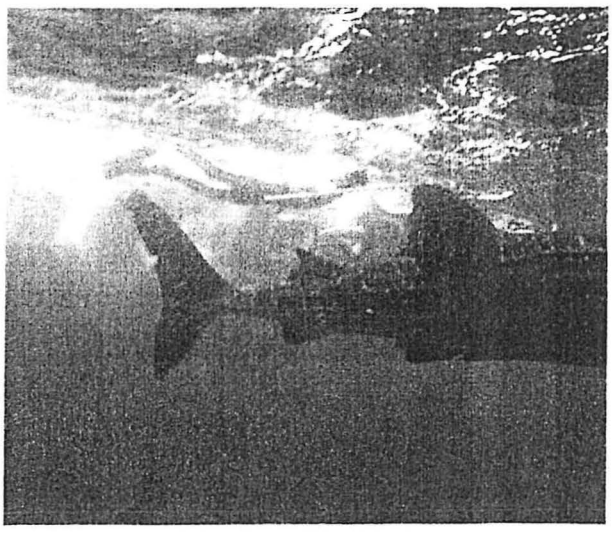

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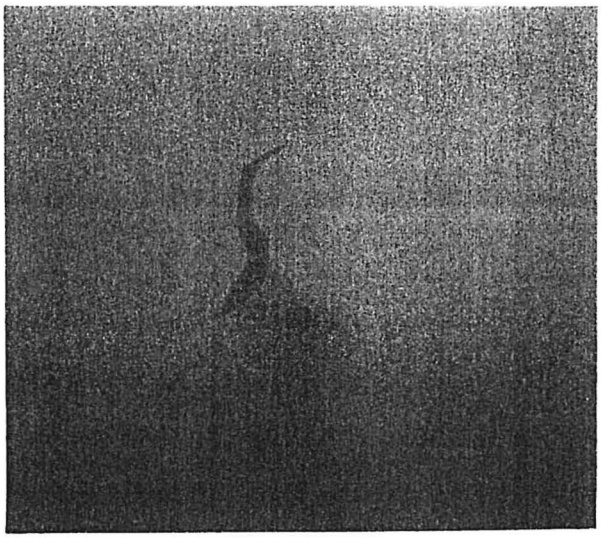

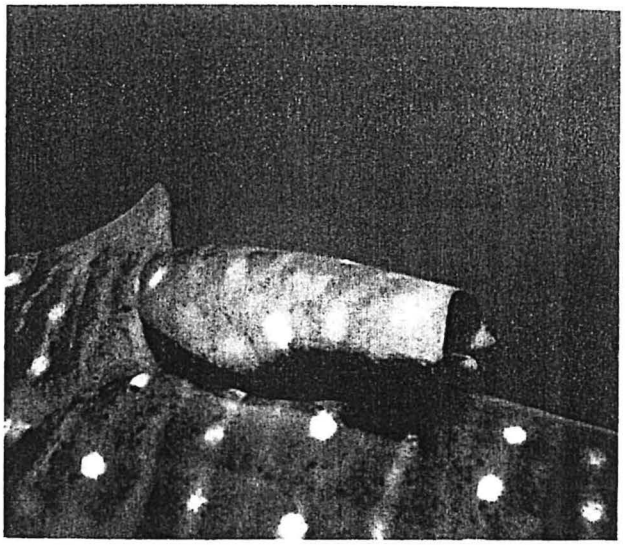

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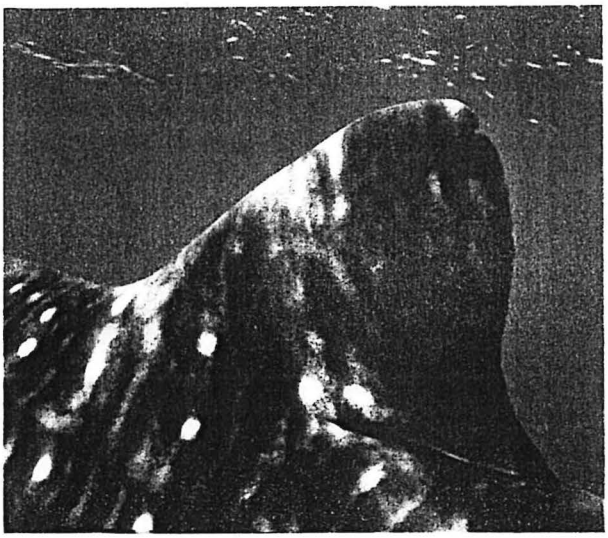

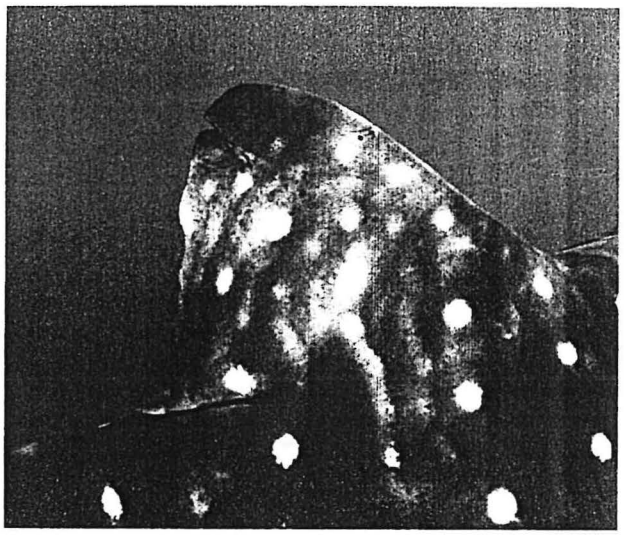

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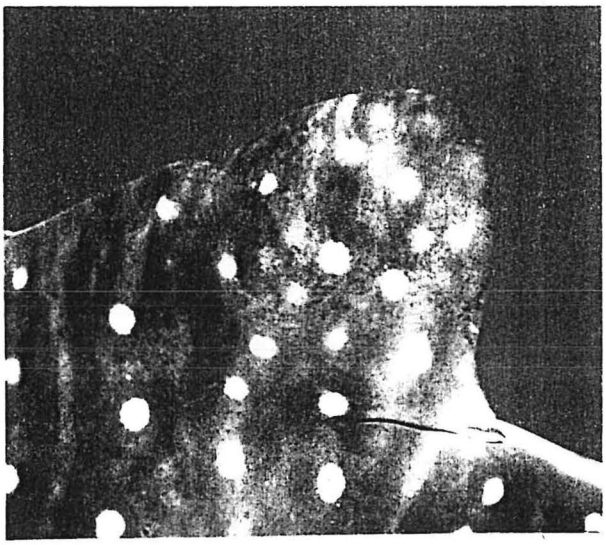

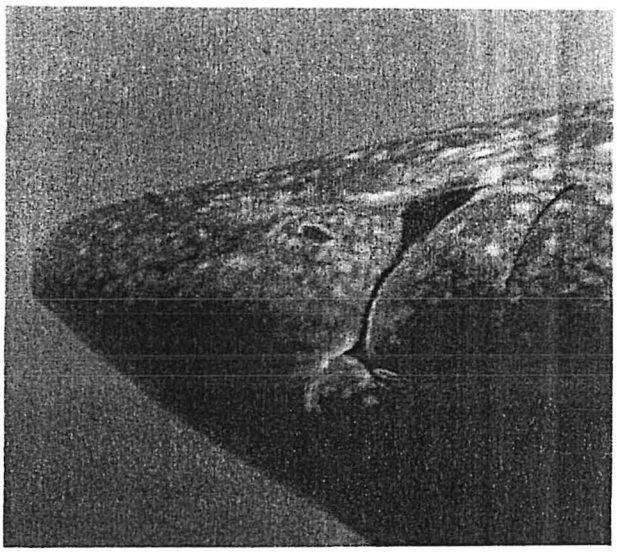

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