

Unprovoked Fatal Shark Attack in Lifou Island (Loyalty Islands, New Caledonia, South Pacific) by a Great White Shark, *Carcharodon carcharias*

Eric Clua, PhD,*† and Bernard Séret, PhD‡

Abstract: The case of a fatal, unprovoked shark attack is reported and analyzed. The incident took place on the 30th of September 2007, in the lagoon of Luengoni Bay, Lifou Island (Loyalty Islands, New Caledonia). A young French woman who was snorkeling was severely bitten on the right thigh and died of hemorrhage. An analysis based in particular on the size and color of the shark, the characteristics of the wounds, and the behavior of the shark before and after the bite suggests that the aggressor was a great white shark, *Carcharodon carcharias*.

Key Words: sharks, lethal wound, shark bites, exploratory bite, New Caledonia

(*Am J Forensic Med Pathol* 2010;31: 281–286)

According to the International Shark Attack File (cf. ISAF web site: <http://www.flmnh.ufl.edu/fish/Sharks/ISAF/ISAF.htm>), the number of negative interactions between humans and sharks in the world totaled 112 in 2007, composed of 71 unprovoked attacks and 41 incidents (provoked attacks, air-sea disasters, boat bites, etc). For Oceania and Pacific Islands, the records since the 1950s are respectively 125 cases with 51 being fatal, among which New Caledonia accounted for 10 attacks with 4 fatal cases. Major problems in the investigation of shark attack cases are often the identification of the shark species involved and the determination of the motivation of the attack. Both questions have long been investigated by many authors.^{1–10} We report and analyze the only fatal attack in 2007, referred under the N 4299 in the ISAF database, which was an unprovoked shark attack on the 30th of September 2007 on a young French woman who was snorkeling in the lagoon of Luengoni Bay, Lifou Island (Loyalty Islands, New Caledonia).

METHODS

This report is based on the analysis of the following documents: (i) the police notes (gendarmerie nationale) made on the September 30, 2007, including the interrogation of the witness (L.L.), a friend of the victim who was snorkeling with her; (ii) the medical death certificate prepared by Dr. Antoine Roth from We (Lifou) issued on the same day; (iii) a series of photographs of the wounds included in the police report; and (iv) the report made on the October 8, 2007, by the author (E.C.) for the local authorities of the Loyalty Islands. Also, the coauthor (B.S.)

interviewed the friend of the victim, Miss L.L., a few weeks after the attack, when she was back in France.

To identify the shark species involved in the attack, we compared (from photographs) the wounds made by the bite to previous cases reported in the literature.^{11–23} Several studies concerning bites on marine mammals were also used.^{24–27} Also, prints with dried jaws of tiger sharks and great white sharks (from collections) were done on a soft material (a green foam), to compare the puncture marks made by the teeth of both species.

RESULTS

Report of the Case

On the morning of the 30th of September 2007, a 23-year-old nurse (S.B.) started snorkeling in the lagoon of Luengoni Bay, located on the South-East of Lifou island (Loyalty Islands, New Caledonia) (Fig. 1). She was accompanied by a female friend (L.L.). They were alone on the beach in the early morning (around 8:30 AM). S.B. entered the water first, her friend L.L. stayed on the beach to adjust her contact lenses and then entered in the water to follow S.B. who was heading toward the islet of Conforama, about 100 m from the shore (Fig. 2). They were swimming one in front of each other, separated by approximately 10 m. S.B. was about 30 m from the islet when a large dark “shark” (described as a large dark shadow with a dorsal fin) came between them. According to L.L., they both saw the shark at the same time, before it jumped out of the water to turn and target S.B. and bit her on the right thigh. L.L. heard her friend shouting and saw her flapping the water with her fins. She panicked and rushed out of the water to get help from people of the local village. A fisherman used his small boat to get the body of the victim, which was floating at a short distance in northwest of Conforama (Fig. 2). It took about 20 minutes for the body of the victim to be retrieved after the attack. When the fisherman beached his boat, the police were already on the beach and took charge of the victim. The local medical doctor, Dr. Antoine Roth, made a basic examination of the victim after transporting the body to the medical center and issued the death certificate. Because the cause of the death was obvious (a shark attack), no autopsy was required by the police.

The Luengoni Bay is a lagoon about 2-km long and 800-m wide, with half of the lagoon made of a white sandy bottom (average depth of 2 m) and the other half composed of slab and sand (average depth of 6 m). The southern part is bounded by a sandy beach flanked by mangrove trees; the northern part is a barrier reef of 50- to 100-m width, interrupted by 2 small passes; the third and largest being the north-western one, about 100-m wide and 12-m deep. The other 2 passes have around 8 m depth (Fig. 1).

The tide was high at 8:41 AM with a coefficient of 1.3 m. The attack took place in about 2.5-m depth, in unusually (for a tropical lagoon) turbid water (less than 4-m visibility) due to organic material and sand suspended by strong Southeast winds (15–20 knots). The victim was wearing a 2-piece swimsuit decorated by purple flowers on a white background.

Manuscript received April 10, 2008; accepted September 25, 2008.

From the *Secretariat of the Pacific Community (SPC), BP D5, 98848 Noumea, New Caledonia, France; †Ministère de l'Agriculture et de la Pêche, 251 rue de Vaugirard, 75 732 PARIS CEDEX 15, France; and ‡IRD/Muséum National d'Histoire Naturelle, Département Systématique et Evolution, Paris cedex 5, France.

Correspondence: Eric Clua, PhD, Secretariat of the Pacific Community, BP D5, 95 Promenade Roger Laroque, 98848 Noumea, New Caledonia, France. E-mail: EricC@spc.int.

Copyright © 2010 by Lippincott Williams & Wilkins

ISSN: 0195-7910/10/3103-0281

DOI: 10.1097/PAF.0b013e3181ec7cb8

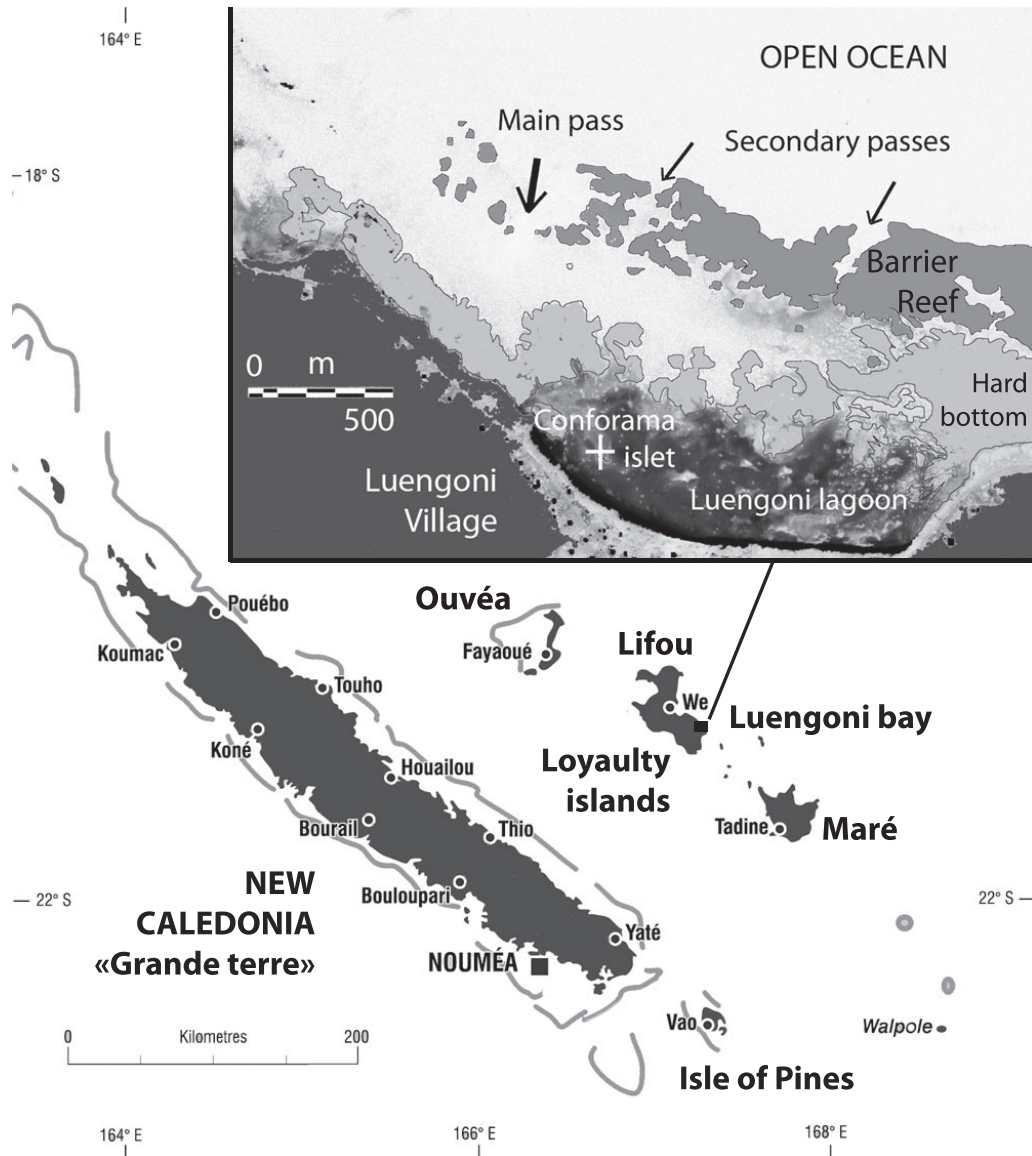


FIGURE 1. Location of Lifou island in the archipelago of the Loyalty Islands with the details of the geomorphological structure of the Luengoni bay, showing a lagoon widely open to high sea through 3 passes in the reef barrier (designed from an aerial image, courtesy of Lifou city hall). The bottom of the lagoon is constituted by immersed slab and sand. The location of the attack close to the Conforama islet is shown by +.

Description of the Wound

A single large bite was made to the right thigh, from the hip to the knee, with a maximum length of about 40 cm (Fig. 3). The thigh was cut deeply, with the femur bone broken at the level of the hip. The muscular mass was sectioned but was still attached to the femur bone whose distal part was still articulated to the knee. Despite the large bite, almost no tissue was removed as shown by the repositioning of the scalloped muscular mass on the leg (Fig. 4); the inner and outer margins on the wound on the inner part of the thigh fit together well although they are somewhat swollen.

The margin of the wound on the inner thigh is broadly curved and presents clear cut sections (made by large flat teeth) separated by small ragged pieces of skin/flesh (indicating that the teeth did not form a continuous cutting edge but instead were separated by more or less wide spaces). The margin of the wound

on the outer part of the thigh is also broadly curved and shows similar aligned flat sections separated by small rags of skin/flesh, but somewhat shredded.

The blood vessels were divided and according to the medical certificate, the victim died of exsanguination and hypovolemic shock. Apart from this large bite on the right thigh, no other wounds were identified on the body.

Analysis

Identification of the Shark

Potential shark species likely to make such large bites are very few in the area; potential candidates are the tiger shark and the great white shark. Examination of the wound made by the bite, on the series of available photographs, shows:

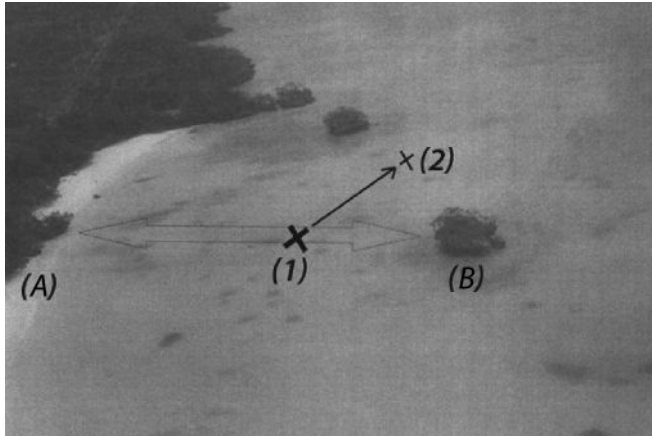


FIGURE 2. Location of the attack in the Luengoni lagoon. (A) Luengoni beach; (B) Conforama islet; (A) to (B) about 100 m; (1) location of the attack; (2) location of retrieval of the body of the victim; (1) to (2) drifting of the body.



FIGURE 3. The shark bite on the right thigh of the victim. The bite is not total, the thigh was not removed but is still attached to the knee; the femur is broken at level of hip.

A large bite of about 40-cm width obviously made by a large shark; Clean cut sections of a few centimeter aligned in a board curve on both sides of the bite indicating a series of flat teeth in both jaws;

Small tatters of skin and flesh between clear-cut punctures indicating the presence of spaces between the teeth of the shark; The femur broken at the level of the hips indicating the powerful pressure of the bite, strong enough to break this thick bone; The thigh was largely scalloped, but still attached at the level of the knee, indicating that the shark did not intend to swallow it and released its bite; no flesh was removed as shown by the repositioning of the thigh (Fig. 4).

Interview of the witness indicates the following:

A large dark shark coming from the lagoon and passing between the victim and the witness; and
A shark jumping out of the water to reach the victim.



FIGURE 4. The repositioning of the thigh scalloped by the bite shows that there was no significant loss of soft tissues.

These anatomic and behavioral elements suggest to us that a great white shark was responsible for this attack. The teeth of the tiger shark form a continuous cutting edge, whereas those of the great white are spaced and make a series of more or less spaced punctures. Also, a tiger shark would not have released its mouth contents but would have swallowed it instead; great whites are known to bite and spit out either as a strategy of attack to weaken the prey or just as a “tasting bite.” Viewed from above, a great white shark appears darker than a tiger shark, fitting with the description of the witness. Great white sharks are also known to jump out of the water, to target prey from the surface; instead, no tiger shark were ever observed with such behavior.

Considering the shape and arrangement of functional teeth on great white shark jaws,^{28,29} we can conclude that the sections of the wound on the inner thigh of the victim correspond to the bite of the upper jaw teeth, and those on the outer part of the thigh to the impact of the lower jaw teeth. Thus we infer that the victim faced the shark before the attack; this hypothesis is consistent with her friend’s statement that she and the victim saw the shark at the same time and that the victim struck the water with her fins, probably as an instinctive self-protection movement. Thus the shark was coming from the northwest, ie, where the main pass is through the barrier reef. The outer slope of the barrier is steep, and the open ocean is relatively close from the shore (Fig. 1). Great white sharks are mainly present in deep cooler waters around New Caledonia but regularly some individuals show up in shallow warmer waters of the lagoons (cf. Discussion).

Size of the Shark

Table 1 provides regressions for the great white shark and the tiger shark between the total length (TL) of the shark and the width of the mouth/jaw or that of the bite, from the published data.^{25,30–32} Considering the approximate size of the bite (about 40 cm), the TL of the shark would range between 372 and 430 cm TL for a great white shark (for a similar bite width, a tiger shark would have between 267 and 399 cm TL). The sex of the shark is unknown; if it was a male, it would be an adult animal as males of great white sharks mature between 350 and 410 cm TL³²; if it was a female, it would be a late adolescent or a very young adult because females of great whites mature between 400 and 500 cm TL.³³

TABLE 1. Estimated Total Length (TL) From Mouth Width or Bite Width for the Great White Shark and the Tiger Shark Using Regressions From Literature

Great White Shark <i>Carcharodon carcharias</i>		Tiger Shark <i>Galeocerdo cuvier</i>		
Long and Jones ³⁰	Bass et al ³¹	Bass et al ³²	Heithaus ²⁵	
TL = (Bite width + 2.4642)/0.0986 n = 6 from 163 to 510 cm TL	Mouth width = 10.4% ± 1.3% TL 14 M + 19 F from 170 to 391 cm TL	Mouth width = 11.7% ± 1.7% TL 10 M + 20 F from 104 to 410 cm TL	Jaws width = 0.12 ± 7.99 TL n = 93	
Bite Width (cm)	Calculated TL (cm)	Calculated TL (cm)	Calculated TL (cm)	Calculated TL (cm)
35	380.0	324.0–349.0	284.6–313.7	225.1–358.3
36	390.1	333.7–358.7	293.2–322.2	233.4–366.6
37	400.2	343.3–368.3	301.7–330.8	241.8–374.9
38	410.4	352.9–377.9	310.3–339.3	250.1–383.3
39	420.5	362.5–387.5	318.8–347.9	258.4–391.6
40	430.7	372.1–397.1	327.4–356.4	266.8–399.0

DISCUSSION

Occurrence of the Great White Shark in New Caledonia

Although the great white shark is most commonly found under temperate latitudes, it has been previously recorded from New Caledonia.³⁴ Records of large sharks are often published in the local newspaper “Les Nouvelles calédoniennes.” Table 2 compiles the records of large great white sharks and tiger shark observed or caught in New Caledonian waters. Since 1971, 12 articles report on observations or capture of several great white sharks, ranging from 2.6 m to above 6 m TL and found between 18 and 420 m depth. The number of articles reporting on the capture of tiger sharks is greater (20 articles), specimens ranging from 2- to above 5-m TL and most were caught near passes of the reef or around islets. In November 1996, a group of 8 scuba divers encountered a 3.5-m great white shark at 14-m depth in the pass of Boulari (SE coast of New Caledonia). A similar encounter happened on the September 8, 2007, between a group of 5 scuba divers and a 5-m great white shark at 18-m depth in the pass of Dumbea (SE coast of New Caledonia). In both cases, the shark just came to investigate the divers and went by. Also in 2007, 2 great white sharks were observed feeding on the carcass of a pygmy sperm whale southern New Caledonia (E.C., unpublished data).

Great white sharks have also been observed off Lifou. In 1996, the coauthor (B.S.) interviewed a fisherman of Luengoni village who reported observations of great white sharks outside the barrier reef when he was free-diving for lobsters. During the exploratory cruise “Chondrial” in January 2002, a large cat shark (*Pseudotriakis microdon*) was caught on a long-line set in the North of Lifou by about 600-m depth, it had a large bite that was attributed to a 3.5-m great white shark (B.S. unpublished data). In 1999, a male spearfisher from Ouvéa (Loyalties Islands) was bitten on the back, the wound had 30-cm width; it was presumed a great white shark had made this attack (B.S. unpublished data).

On the 28th of September 2007, ie, 2 days before the attack in Luengoni Bay, the crew of the ferry “Bético” observed several large sharks feeding on the floating carcass of a whale a few miles off islet Vauvillier (southeast off Lifou), ie, about 20 km from Luengoni Bay. This aggregation may have played a role in the presence of the great white in the Luengoni lagoon.

Shark Attacks in New Caledonia

An historical review of shark/human interactions in New Caledonia was made by B.S. (unpublished data). It includes 37 cases between 1950 and May 2008, of which 6 happened in the Loyalties

Islands (Ouvéa, Lifou, and Maré). In 1983, a teenager had his calf bitten at We (Lifou island). In 1999, a spearfisher from Ouvéa was severely bitten on the back, and a great white shark was suspected. In 2002, a spearfisher disappeared off the east coast of Lifou; only parts of the equipment were subsequently found. In 2005, a spearfisher from Maré was bitten on the arm. In 2007, a spearfisher from Ouvéa was apparently bitten by a shark. If the number of records is greater around the main island of New Caledonia (Grande Terre), a few cases are also reported from the Loyalties Islands with 3 from Lifou. In 2 cases, the great white was presumed to be the aggressor.

Motivation of the Attack

This attack enters in the category of the unprovoked attacks as defined by ISAF, ie, “incidents where an attack on a live human by a shark occurs in its natural habitat without human provocation of the shark.” In the present case, the victim who was snorkeling did not display any evident stimulus likely to have provoked the attack.

Great white sharks feed mainly on fishes, and marine mammals; the young having a more piscivorous diet and the adults preferring marine mammals,^{33,35} and they have a full set of sensory organs to detect their prey. Great white sharks are good swimmers; however, they have developed various tactics to catch prey able to swim faster and longer than themselves. The bite and spit hypothesis^{36,37} has been proposed to explain cases of predation on marine mammals in which the shark inflicts a powerful bite to the prey to immobilize it or to kill it. Also it could be a tactic to avoid injury from large prey. In the same way, the exsanguination predation has been proposed³ in which the prey is killed by bleeding it to death.

In interactions with humans, similar bites are often observed by great white sharks.^{7,38} The shark made a more or less strong bite without completing it. These inhibited bites on humans may have several motivations.²² When the shark comes back after the first strike to feed on the victim, this could be interpreted as a true feeding predation. When the shark does not come back after the first strike, this could be interpreted as a tasting bite: the prey is bitten to taste its edibility. This kind of bite has also been interpreted as “mistaken identity” predation, but great white sharks are highly selective visual predators, so such mistakes can be evoked only when the water is turbid.

In this case, there was a single incomplete bite, with no tissue removed. During the 20 minutes that the victim stayed in the water before being retrieved by the fisherman, the shark had sufficient time to return and bite the victim again; this did not happen. This suggests that the shark was investigating, and we can conclude that it was most probably an exploratory bite, for the shark to taste a potential

TABLE 2. Records of Large Specimens of Tiger Sharks and Great White Sharks in New Caledonia

Date	Location	Size in m (Gender)	Weight (kg)	Depth (m)	Observations	Les Nouvelles Calédonniennes
<i>Carcharodon carcharias</i>						
1971	Pass on eastern coast					4 September 1979
1st September 1979	Pass of St Vincent	3.8	500	420	Longliner Yamin II	4 September 1979
February 1990	Grand Coude, southern lagoon	4.5	1500		Longliner Thalassa	2 February 1990
22 March 1992	50 miles off île des Pins	>6	2000	400	Longliner Yamin II	25 March 1992
September 1992	Ua islet, southern lagoon	4		#6	Reporters of BBC	2 October 1992
November 1994	Canal Woodin				From a recreational boat	18 November 1994
January 1997	Near Walpole	4.5	1000		Longliner Kanjar	6 January 1997
July 1997	Southern New Caledonia	2.6			Longliner Thalassa	2 July 1997
January 1998	La Sarcelle	5 + a small one			On a carcass of a whale	3 January 1998
November 1998	Southern New Caledonia	4.5 & 4.1		150–300	Longliner Thalassa	15 November 1998
8 September 2006	Ugo islet, southern lagoon	3.5 (M) 4.2 (F)			Divers in a cage	11 September 2006
8 August 2007	Pass of Dumbèa	4		18	Group of 5 scuba-divers	11 September 2007
11 November 2007	Mba Islet	4		Surface	From a recreational boat	13 November 2007
<i>Galecerdo cuvier</i>						
October 1979	Poya	>5				31 October 1979
August 1983	Île aux Cocos (southern lagoon)	5				27 August 1883
April 1984	Pass of Dumbèa	4				1st April 1984
October 1985	Grand Récif - île aux Golat	2.5				17 October 1985
February 1992	Bay of La Moselle	2				27 February 1992
March 1992	Canal Woodin	3.3	300			1st March 1992
September 1992	Southern New Caledonia	>3			Longliner Yasmine II	12 September 1992
April 1994	Redika islet	4				10 April 1994
November 1994	Bay of St Anne (Prony)	5–4.5–3			With a bullshark	18 November 1994
March 1995	Touho	4.8				18 March 1995
May 1995	Touho	5	650			12 May 1995
February 1996	Touho	4.7	600			20 February 1996
October 1996	Poiembout	3.5				10 October 1996
December 1996	Gouaro reef (Bourail)	>3				13 December 1996
November 1998	La Sarcelle	Several large			On a carcass of whale	29 November 1998
December 1998	Îlot Uarè & Serpent	4.14	450			1st December 1998
November 1999	Poya	3.2				19 November 1999
March 2000	Bay of St Vincent	4				23 March 2000
January 2002	Bay of Prony	Several large			On a carcass of whale	25–30 January 2002
June 2006	Isle of Pines	Several large			On a carcass of a whale	06 June 2006
25 January 2007	Kone	~4		15	Attack on a spearfisherman	29 January 2007

Source: The local newspaper Les Nouvelles calédonniennes.
TL indicates total length.

prey. As in many other reported cases, the shark did not feed on the victim, as humans are not a usual prey of great white sharks.

ACKNOWLEDGMENTS

The authors thank M. Neko Hnepeune, Mayor of Lifou Island, M. Dominique Mole, General Secretary of Lifou Island, M. Afif Lazrak, General Secretary of the administrative subdivision of the Loyalties Islands, M. H. Ansquer, the vice-coroner of the French Republic in Noumea for trusting us in investigating the case. The authors also thank the parents of the victim for their understanding and her friend (L.L.) for her collaboration. The Director of the International Shark Attack File, Dr. George Burgess, kindly shared his expertise.

REFERENCES

1. Coppleson VM. *Shark Attack*. Sydney, Australia: Halstead Press; 1962:269.
2. Baldrige HD, Williams J. Shark attack: feeding or fighting? *Mil Med*. 1969;134:130–133.
3. Klimley AP. The predatory behaviour of the white shark. *Am Sci*. 1994;52:122–133.
4. Klimley AP, Ainley DG, eds. *Great White Sharks. The Biology of Carcharodon Carcharias*. San Diego, CA: Academic Press; 1996:517.
5. Lea RN, Miller DJ. Sharks attacks off the California and Oregon coasts: an update, 1980–84. Symposium on great white shark. *Mem South Cal Acad Sci*. 1985;9:144–150.
6. Martin AR. *Field Guide to the Great White Shark*. Vancouver, BC: Reef Quest Center for Shark Research; 2003:195.
7. Martin AR. A review of shark agonistic displays: comparison display features and implication for shark-human interactions. *Mar Freshw Behav Physiol*. 2007;40:3–34.

8. Martin AR. White shark bite forensics—a photo essay. Available at: http://www.elasmo-research.org/education/white_shark/forensics.htm. Accessed June 2008.
9. Nelson DR. Aggression in sharks: is the gray reef shark different? *Oceanus*. 1981;24:45–56.
10. Woolgar JD, Cliff G, Hafez H, et al. Shark attack: review of 86 consecutive cases. *J Trauma*. 2001;50:887–891.
11. Byard RW. An autopsy approach to shark attack victims. *Scan J Forensic Sci*. 2004;10:67–69.
12. Byard RW, Gilbert JD, Brown K. Pathologic features of fatal shark attacks. *Am J Forensic Med Pathol*. 2000;21:225–229.
13. Byard RW, Ross AJ, Riches KJ. Recovery of humans remains after shark attack. *Am J Forensic Med Pathol*. 2006;27:256–259.
14. Caldicott DGE, Mahajani R, Kuhn M. The anatomy of a shark attack: a case report and review of the literature. *Injury*. 2001;32:445–453.
15. Collier RS. Recurring attacks by white sharks on divers at two Pacific sites off Mexico and California. *Environ Biol Fish*. 1992;33:319–325.
16. Cirillo G, James H. Pattern association—a key to recognition of shark attacks. *J Forensic Odontostomatol*. 2004;22:47–48.
17. Davies DH, Campbell GD. The aetiology, clinical pathology and treatment of shark attack. *J R Nav Med Serv*. 1962;3:110–136.
18. Guildera KJ, Ogden JA, Highhouse K, et al. A case study of the injury and treatment: shark attack. *J Orthop Trauma*. 1991;5:204–208.
19. Iscan MY, McCabe BQ. Analysis of human remains recovered from a shark. *Forensic Sci Int*. 1995;72:15–23.
20. Manire CA, Gruber SH. Anatomy of a shark attack. *J Wilderness Med*. 1992;3:4–8.
21. Ritter EK, Levine M. Use of forensic analysis to better understand shark attack behaviour. *J Forensic Odontostomatol*. 2004;22:40–46.
22. Ritter EK, Levine M. Bite motivation of sharks reflected by the wound structure on humans. *Am J Forensic Med Pathol*. 2005;26:136–140.
23. Roach K. Body and mind. Anatomy of a shark bite. Available at: www.channel4.com/science/microsites/S/science/body/bodyshock_shark.html. Accessed June, 2008.
24. Cockcroft VG, Cliff G, Ross GJB. Shark predation on Indian Ocean bottlenose dolphins *Tursiops truncatus* off Natal, South Africa. *S Afr J Zool*. 1989;24:305–309.
25. Heithaus M. Shark attacks on bottlenose dolphins (*Tursiops aduncus*) in Shark Bay, Western Australia: attack rate, bite scar frequencies, and attack seasonality. *Mar Mamm Sci*. 2001;17:526–539.
26. Heithaus MR, Wirsing AJ, Dill ML, et al. Long-term movements of tiger sharks satellite-tagged in Shark Bay, Western Australia. *Mar Biol*. 2007;151:1455–1461.
27. Hoff van den J, Morrice MG. Sleeper shark (*Somniosus antarcticus*) and other bite wounds observed on southern elephant seals (*Mirounga leonina*) at Macquarie Island. *Mar Mamm Sci*. 2008;24:239–247.
28. Nambiar P, Bridges TE, Brown KA. Allometric relationships of the dentition of the great white shark, *Carcharodon carcharias*, in forensic investigations of shark attacks. *J Forensic Odontostomatol*. 1991;9:1–16.
29. Nambiar P, Brown KA, Bridges TE. Forensic implications of the variation in morphology of marginal serrations on the teeth of the great white shark. *J Forensic Odontostomatol*. 1996;14:2–8.
30. Long DJ, Jones RE. White shark predation and scavenging on cetaceans in the eastern North Pacific Ocean. In: Klimley AP, Ainley DG, eds. *Great White Sharks. The Biology of Carcharodon carcharias*. New York, NY: Academic Press; 1996:293–308.
31. Bass AJ, D'Aubrey JD, Kistnasamy N. Sharks of the east coast of southern Africa. 3. The families Carcharhinidae and Sphyrnidae. *Invest Rep Oceanogr Res Inst Durban*. 1975;38:1–100.
32. Bass AJ, D'Aubrey JD, Kistnasamy N. Sharks of the east coast of southern Africa. 4. The families Odontaspidae, Isuridae, Cetorhinidae, Alopiidae, Orectolobidae and Rhiniodontidae. *Invest Rep Oceanogr Res Inst Durban*. 1975;39:1–102.
33. Compagno LJ. *Sharks of the World. An Annotated and Illustrated Catalogue of Shark Species Known to Date*. Vol. 2: Bullhead, Mackerel and Carpet Sharks (Heterodontiformes, Lamniformes, and Orectolobiformes). FAO Species Catalogue for Fisheries Purposes. No 1. Rome, Italy: Food and agriculture organization of the United Nations; 2001:1–269.
34. Séret B. Chondrichthyan fishes of New Caledonia. *Chondros*. 1994;5:6–9.
35. Tricas TC. Feeding ethology of the white shark *Carcharodon carcharias*. *South Cal Acad Sci Mem*. 1985;9:81–91.
36. Tricas TC, McCosker JE. Predatory behaviour of the white shark (*Carcharodon carcharias*), with notes on its biology. *Proc Cal Acad Sci*. 1984;43:221–238.
37. McCosker JE. White shark attack behaviour: observations of and speculations about predator and prey strategies. *South Cal Acad Sci Mem*. 1985;9:123–135.
38. Ellis R, McCosker JE. *Great White Shark. The Definitive Look at the Most Terrifying Creature of the Ocean*. New York, NY: Harper Collins Pub and Stanford University Press; 1991:270.