

Shark Attacks

Worldwide records through 1960 show when and where
predaceous sharks are likely to attack man.

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In August 1960 an article by us appeared in *Science*, entitled "Shark attacks during 1959: The conditions under which sharks attack man suggest what measures may be taken to reduce risk" (1). We have continued our studies on this subject, and the "Shark Attack File" for the world, sponsored by the Biology Branch of the Office of Naval Research, the Smithsonian Institution, and Cornell University, has been maintained and expanded.

When members of the Shark Research Panel of the American Institute of Biological Sciences receive word of a shark attack anywhere in the world, an attempt is made to obtain documentation from reliable witnesses, doctors, hospitals, police departments, scientists, and others. A two-page form requesting information concerning the details of the attack is sent to those who are willing to collaborate in supplying documentation. The "Shark Attack File" is under the direction of Leonard P. Schultz in the Division of Fishes, Smithsonian Institution, Washington, D.C. A duplicate current working file is maintained by the chairman of the Shark Research Panel, Dr. Perry W. Gilbert at Cornell University, Ithaca, New York.

In our article (1) we summarized recommendations and other pertinent advice to those who enter the domain of dangerous sharks. We have little to add to our advice to bathers, swimmers, SCUBA divers, skin divers, and survivors of air and sea disasters.

Kinds of Attack

We have continued to record shark attacks in the file at the Smithsonian Institution, under "unprovoked" attacks (2) and attacks in four other categories. There were 30 unprovoked

attacks during 1960, many involving severe injuries. Some of the victims were skin diving or spearfishing at the time of attack; others were swimming and bathing, some inshore, one 150 feet offshore, one in the open sea. There were four fatalities.

Attacks were recorded in other categories as follows.

1) "Provoked" shark attacks (3). There were 11 instances in 1960 in which a shark was "provoked" and subsequently attacked a man. Three anglers were severely bitten while hauling sharks into a boat; six commercial fishermen, in their attempt to untangle sharks from nets or traps, were attacked. One skin diver was attacked by a shark he had speared, and a life-guard was knocked off a surf ski. There were no fatalities in this category.

2) Air and sea disasters. There were two instances during 1960 in which "unprovoked" sharks mutilated victims of such disasters. Often there is no way of knowing whether the victims died before the sharks attacked or died as a result of the attacks. Seven persons were involved. There were no survivors.

3) Boat attacks. There were 12 instances during 1960 in which "unprovoked or provoked" sharks made deliberate physical contact with a boat, life raft, water ski, or accessory equipment. There was no fatality among individuals in the boats.

4) Doubtful shark attacks. This category includes five instances in 1960 in which unprovoked sharks approached swimmers but failed to make physical contact with them; it also includes reported shark attacks which subsequent investigation tends to discredit or place in some doubt. Victims from drowning, other than those involved in air and sea disasters, whose bodies were mutilated by sharks are placed in this category.

Analysis

Since reporting on shark attacks for 1959 we have started to tabulate and analyze some of the factors related to shark attacks, as recorded in our files. An analysis of the 790 attacks recorded from the year 1580 to 31 December 1960 indicates that 599 were unprovoked, 42 were provoked, 30 resulted from air and sea disasters, 53 were doubtful, and 76 were boat attacks. We believe a summary based on the data in our files will be of general interest.

In the following analysis we were reasonably careful to exclude unreliable data, because we are well aware that documentation grades from excellent to poor. The latter type of information usually includes only locality, date, and sometimes name of victim, obtained through newspaper accounts. Therefore, although we studied 599 instances of "unprovoked" attack, we may have reliable information about certain facts and circumstances, for example, on only 68 individuals. In the paragraphs below we give the number of instances for which the information appears reliable.

Time of Day

The peak period for bathing is during the daylight hours, from 8:00 A.M. to 7:00 P.M., and this corresponds with the period of the day when most shark attacks occurred. Our records show that most attacks occur between 11 o'clock in the forenoon and 6 o'clock in the afternoon—findings based on 159 instances in which the time of attack was carefully recorded. When our data are expressed in percentages we find that 3.1 percent of the attacks occurred between midnight and 6:00 A.M.; 22 percent between 6:00 A.M. and noon; 66.7 percent between noon and 6:00 P.M.; and 8.2 percent between 6:00 P.M. and midnight.

We pointed out above that most of the shark attacks occurred between 11:00 A.M. and 6:00 P.M., presumably the peak period for swimming. Actually, our figures indicate that 94.3 percent of all attacks occurred during

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daylight hours (from 5:00 A.M. to 7:00 P.M. in tropical regions), whereas only 5.7 percent occurred during darkness.

The question arises, How does the number of swimmers and bathers after dark compare with the number during daylight hours? Although we have no data on that point, we believe that the number of people in the water after dark is significantly less than 5 percent of the number in the water during daylight hours. If that is true, then it is more dangerous to swim at night than in the daytime. Since we need counts of the number of bathers in the water for each hour of the day and night, lifeguards are urged to cooperate in supplying this information.

Time of Year

The time of the year when most attacks occur correlates closely with the swimming season. Around Australia and Africa, 75.4 percent of all attacks have occurred during the summer (from mid-November to mid-April), whereas in North America, 73 percent of the attacks have occurred from mid-May to late September. Northern Australia, the equatorial regions of the Indian and Pacific Oceans, and southern North America are tropical all the year, and in such warm waters, where presumably bathing is not seasonal, shark attacks occur in nearly equal numbers for each month.

Area of Attack

The greater frequency of shark attacks in water warmer than about 65°F was first noted by Stewart Springer in 1943. Two factors at least contribute to this greater frequency. First, the more dangerous kinds of sharks, such as the great white, tiger, and gray sharks (*Carcharhinus*), typically are in greatest abundance in warm waters, and when the seas and river waters become warm during the summer in temperate zones, the "tropical" sharks enter these waters. Second, relatively few swimmers enter water colder than about 65°F. Thus, the warming up of temperate waters is accompanied by an increase in the number of dangerous sharks and an increase in the number of bathers.

However, divers with swim suits do enter colder waters, and three attacks have occurred in water at 55°F along

the California coast. We believe that the area of shark attacks will expand as more and more divers enter the domain of predaceous sharks in the temperate and subtemperate latitudes.

The largest number of shark attacks occur in the areas where bathers are most thickly congregated, usually close to shore. Relatively few bathers venture beyond a few hundred feet from the beach. We have 217 reliable records of the distance from shore at which sharks attacked, and we find that 38.2 percent were within 100 feet of the shore; 16.6 percent were from 101 to 200 feet from shore; 7.4 percent from 201 to 300 feet; 8.3 percent, from 301 feet to a quarter of a mile; 10.6 percent, from a quarter of a mile to 2 miles; and 18.9 percent, in the open sea. In summary, 62.2 percent of the attacks occurred within 300 feet of the shore. This is the area where swimmers are concentrated.

The depth at which sharks most commonly attack coincides with the depth at which there is the greatest concentration of bathers. Of 302 individuals attacked, 212, or 70.2 percent, were in the upper 5 feet of the surface waters, and 75, or 24.9 percent, were in water more than knee-deep and no more than shoulder-deep at the time of attack. Only 15, or 4.9 percent, were between 5 and 80 feet below the surface.

A review of the activities of 360 individuals just before being attacked by sharks indicates that 75, or 20.8 percent, were wading or standing in water knee-deep to chin-deep; 37, or 10.3 percent, were swimming or standing close to where fish were swimming or being caught; 19, or 5.3 percent, were spearfishing or diving and carrying fish; 23, or 6.4 percent, were resting, floating, or clinging to a float at the surface; and 206, or 57.2 percent, were swimming at the surface. Our data reveal that it is dangerous to dive off piers, boats, and ships at anchor in shark-infested bays and lagoons, for we have several records of divers who were attacked under such circumstances the moment they entered the water.

Our files include information on the location of companions and other swimmers in relation to the position of the victim of shark attack. Of 165 individuals, 63, or 38.2 percent, were alone in the water when attacked; an additional 18, or 15.8 percent, were 10 or more feet away from companions; 35 (21.2 percent) were within a

few feet of one other person when attacked; and 41, or 24.8 percent, had companions 4 to 10 feet away.

How dangerous is it to try to rescue someone being attacked by a shark? Our records indicate that of 68 individuals who have gone to the aid of a victim of shark attack, 12, or 17.7 percent, have been attacked. Hence, anyone going to the aid of a person being attacked is definitely placing himself in a dangerous situation.

Weather and Physical Factors

Weather and other physical factors do not appear to be especially significant in triggering shark attacks. For example, the number of attacks when the sky is clear and the number when the sky is cloudy are about equal. We have no evidence that a particular color of clothes or shade of skin is an important factor in stimulating sharks to attack. Bright shiny objects, or contrasting light and dark objects, do attract the attention of sharks. However, our data are too scanty and unreliable at present to suggest significant conclusions about physical factors.

The condition of the water—whether clear or murky—may be of importance because in murky water, as at night, the swimmer is unable to see the approaching shark and avoid it. Many swimmers have pointed out that they were able to ward off an attacking shark in clear oceanic waters.

At the time this article was prepared, our records revealed the following figures on recovery after unprovoked attacks: 390 individuals recovered, 408 died. High mortality occurred in regions where medical care was not immediately available.

In closing we want to say again that it is well established that fresh blood, even diluted and in small quantities, attracts and excites sharks (4).

References and Notes

1. P. W. Gilbert, L. P. Schultz, S. Springer, *Science* **132**, 323 (1960).
2. "Unprovoked" attacks include all cases in which unprovoked sharks made physical contact with the victim or with gear he is wearing.
3. "Provoked" attacks include all cases in which a shark was caught, trapped, speared, injured, or in some way provoked before attacking the victim or the gear he was wearing. Although the use of the terms *unprovoked* and *provoked* may raise questions regarding separation of attacks into two such categories, we believe it is desirable to make this distinction because it emphasizes what sharks may do when annoyed or injured.
4. Marilyn Malin assisted with the documentation of the "Shark Attack File," as well as in other ways. We gratefully acknowledge her able services.