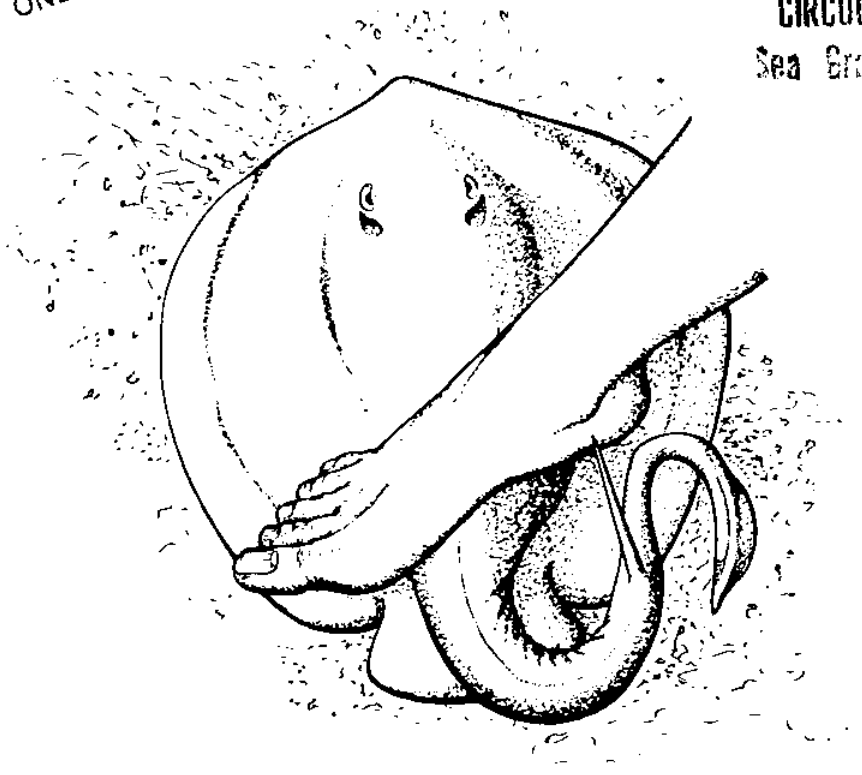
VENOMOUS MARINE FISHES of CALIFORNIA



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THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

VENOMOUS MARINE FISHES OF CALIFORNIA

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INTRODUCTION

Many fishes are capable of producing wounds of varying severity by means of sharp spines located at different places on their bodies. The great majority of such wounds are simple punctures and usually are not complicated by introduction of poisonous or venomous substances produced by the fish. They may, however, become secondarily infected with bacteria.

Well over 200 species of marine fishes in families of the stingrays, scorpionfishes, zebrafishes, stonefishes, weevers, stargazers, scats, toadfishes, rabbitfishes, sharks, ratfishes, catfishes and surgeonfishes have been proven to be venomous or thought to be so. Every year, more species join the ranks of known venomous fishes.

Most venomous fishes are found in shallow water, most frequently in the tropics, and the great majority of these species are non-migratory, slow swimming, and live in protected habitats such as rocks and coral reefs, or spend much of their lives buried in the sand.

Most species seem to use their venom apparatus purely as a defensive weapon, primarily against other fishes. In rare instances, true aggressive behavior toward humans has been recorded (Halstead, 1970).

A number of fishes either proven to be venomous or strongly suspected of being so inhabit California coastal waters (Table 1).

ROUND STINGRAY-----*Urolophus halleri*

Four species of stingrays are found in California coastal waters. While all these rays are capable of producing envenomations, the round stingray is the most common California species and consequently the most likely to be encountered by swimmers and fishermen. Round stingrays (Figure 1) may reach a maximum length of about 20 inches, but most specimens are considerably smaller. They are variable in color and may have a mottled or spotted dorsal surface. Babel (1967) illustrates eight distinct patterns of dorsal markings found on this ray.

The round stingray's sting is located far enough away from the body to provide the ray with a powerful and highly developed striking organ (Figure 2). The spine is a calcified structure serrated on both sides with sharp curved teeth for at least half its length. These lateral teeth are responsible for lacerating the tissues of the victim when the spine is withdrawn from the wound. The intact spine has a sheath of skin which normally covers all but the extreme tip (Figure 3). A stingray spine has two grooves on the ventral side which contain venom glands. The spine, venom glands, and skin are known collectively as the sting.

TABLE 1
CALIFORNIA VENOMOUS FISHES

Cartilaginous fishes-----Class Chondrichthyes

Round stingray family----------Urolophidae
Round stingray----------*Urolophus halleri*

Stingray family----------Dasyatidae
Diamond stingray----------*Dasyatis dipterurus*

Butterfly ray family----------Gymnuridae
Butterfly stingray--------*Gymnura marmorata*

Eagle ray family----------Myliobatidae
Bat stingray----------*Myliobatis californicus*

Chimaera family----------Chimaeridae
Ratfish----------*Hydrolagus collei*

Bony fishes----------Class Osteichthyes

Scorpionfish family----------Scorpaenidae
Sculpin----------*Scorpaena guttata*
Brown rockfish----------*Sebastes auriculatus*
Quillback rockfish--------*Sebastes maliger*
Bocaccio----------*Sebastes paucispinis*
Greenstriped rockfish-----*Sebastes elongatus*
Vermilion rockfish--------*Sebastes miniatus*
Pink rockfish----------*Sebastes eos*
Halfbanded rockfish-------*Sebastes semicinctus*
China rockfish----------*Sebastes nebulosus*
Starry rockfish----------*Sebastes constellatus*
Treefish----------*Sebastes serriceps*
Chilipepper----------*Sebastes goodei*
Calico rockfish----------*Sebastes dalli*
Rosethorn rockfish--------*Sebastes helvomaculatus*
Cow rockfish----------*Sebastes levis*

Stingray injuries usually result from stepping on the animal while wading in the surf or in the mud flats of a bay or estuary (Figure 4). As the spine enters the flesh, the skin sheath surrounding it is ruptured and the pressure exerted causes venom to be expressed from the venom cells. As the spine is withdrawn, portions of the sheath and venom glands may be left in the wound.

Stingrays commonly lie almost completely buried in the upper layers of a sandy or muddy bottom, and waders in these areas should take care to avoid stepping on one which is buried. The act of planting a foot on a ray not only provokes the stinging reflex, but anchors the ray solidly so that it can strike with maximum force. The danger from this type of sting can be largely eliminated by shuffling ones feet along the bottom while wading. Incidentally, many fishermen have discovered to their sorrow that a rubber boot does not always provide adequate protection against a determined stingray.

Many authors have discussed the nature and treatment of stingray wounds. The most complete reviews of the subject are found in the works of Russell (1953, 1965), Russell and Lewis (1956), and Halstead (1970, 1971). All authors report the principal complaint from victims is immediate and severe localized pain out of proportion to that which might be produced from a similar nonvenomous injury. The pain spreads rapidly, usually reaching its greatest intensity within 90 minutes following the injury, and may persist up to 48 hours in untreated cases. Most symptoms are localized, but fainting, nausea, weakness, and anxiety are commonly reported and may be attributed to effects of venom on the circulatory system as well as to severe pain.

FIGURE 1. The round stingray, *Urolophus halleri* (From Halstead, 1970).

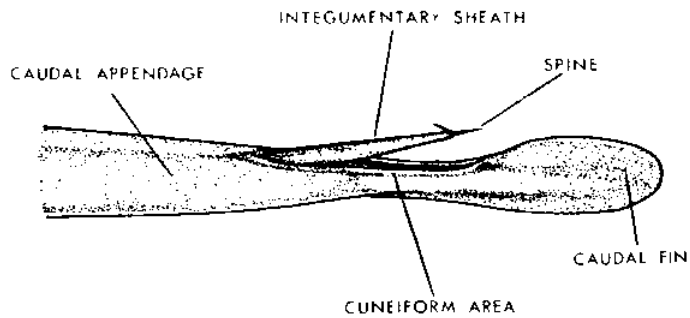

FIGURE 2. Caudal appendage of a stingray (R. Kreuzinger, from Halstead, 1970).

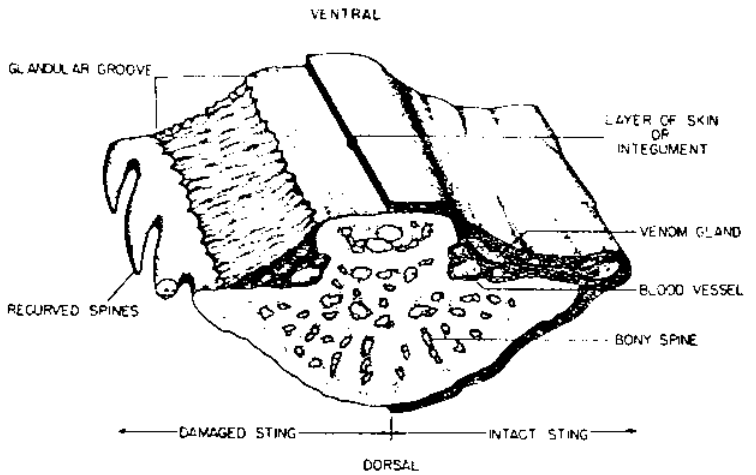

FIGURE 3. Cross section of a typical stingray sting (M. Shirao, from Halstead, 1971).

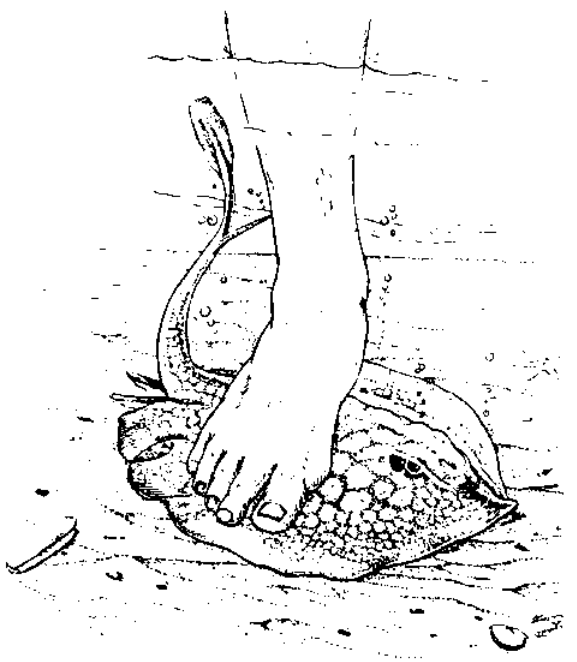

FIGURE 4. Stinging action of the round stingray (From Russell and Lewis, 1956).

Vomiting, diarrhea, sweating, cramps, and difficult breathing are less frequently reported, and true paralysis and death from round stingray envenomations are extremely rare.

Because of its serrated edges and the great force with which the spine may be driven into the flesh, wounds produced by even small stingray spines may be large and severely lacerated, requiring removal of damaged tissue and surgical closure.

Occasionally, a typical wound may be produced by a stingray without appearance of symptoms usually produced by venom. Russell (1953) described being stung on the finger by a round stingray which had just been captured. When the typical effects of the venom failed to materialize, the animal was examined and found to have lost most of the skin sheath and venom gland covering the spine.

Russell (1955) and others have reported as high as 48% of round stingrays captured along the southern California coast have more than one sting and therefore are capable of producing a more serious wound than those with only one sting.

RATFISH-----*Hydrolagus collei*

The ratfish has a strong, sharp spine which precedes the first dorsal fin, and is capable of inflicting a serious wound (Figure 5). Halstead and Bunker (1952) described the ratfish venom apparatus. They reported finding numerous cells which appear to show secretory activity associated with the dorsal spine skin. Extracts of skin containing this glandular tissue killed mice in 24 to 54 hours, while extracts of body skin close to the dorsal fin had no effect. These authors felt ratfish venom probably is not very potent, and it is doubtful that this fish is capable of inflicting injuries fatal to man although severe pain may result from ratfish spine wounds.

Regardless of any possible venom, the spine itself can cause a painful wound and the animal also is capable of delivering a vicious bite with its sharp jaws. Ratfish flesh may be eaten but the reproductive organs seem to be poisonous, and should not be consumed nor be permitted to remain in the body during cooking.

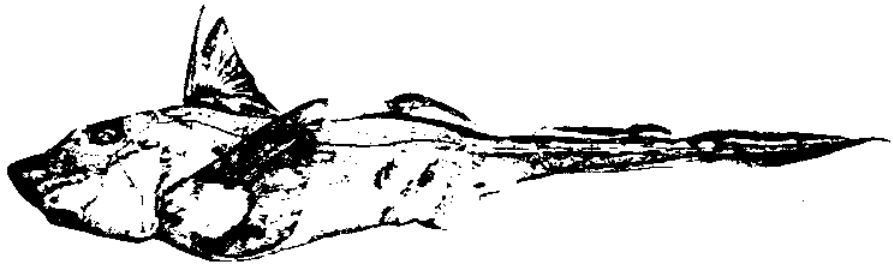

FIGURE 5. The ratfish, *Hydrolagus collei*.

SCULPIN-----*Scorpaena guttata*

The sculpin (Figure 6) is the most venomous member of the scorpionfish family found in California waters. It possesses a formidable array of sharp spines, with 12 in the dorsal fin, 2 in the pelvic fins, and 3 in the anal fin. In addition, numerous sharp knifelike spines are found on the head and gill covers. Halstead, Chitwood, and Modglin (1955) described the sculpin's venom apparatus and reported the association of large venom glands with all spines except those on the head and gill covers.

FIGURE 6. The sculpin, *Scorpaena guttata*.

A typical dorsal spine of the sculpin is covered by a sheath of skin and has two anterolateral-glandular grooves (Figure 7) which contain venom producing cells. The venom flows out between the venom cells and the sheath which is pushed back as the spine penetrates the victim's flesh. The resulting pressure on the glandular tissue aids in expressing the venom.

Sculpin are commonly caught with hook and line by sportfishermen and sometimes taken in nets or on set lines by commercial fishermen. The skindiver will almost surely encounter them at some time during his exploration of rocky reefs and ledges. The sculpin, like many other scorpionfishes, is a bottom dweller and quite sluggish in its habits. Most stingings occur when fishermen handle sculpin while removing them from the hook or fishing bag, or while cleaning them. Skindivers may be stung while hunting among rocks and ledges or when removing sculpin from a spear. A sculpin will usually erect the dorsal spines when approached by a diver, but may remain in place until actually touched. A potentially serious situation developed during the U. S. Navy Sealab II project in 1965 when several aquanauts were stung by sculpin which gathered by the hundreds in the entryway of the Sealab, apparently attracted by the lights.

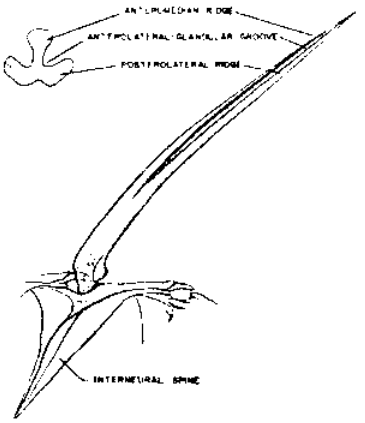

FIGURE 7. A typical dorsal spine of the sculpin, *Scorpaena guttata* (R. Kreuzinger, from Halstead, 1970).

Entrance of a sting into any part of the body is followed almost immediately by intense, sometimes throbbing pain in the area of the wound. The pain spreads so that within 3 to 10 minutes it may involve the entire hand if the wound is on a finger (the most common site of injury). The area of the wound becomes red and swollen, and pain from a finger wound may spread up the forearm and into the armpit within 15 minutes of the sting. Many generalized symptoms described for stingray wounds, such as nausea, weakness, etc., also have been described from sculpin envenomations.

Bear in mind that all the symptoms described may be produced by a wound from one sculpin sting, while the average sculpin possesses 17 venomous stings. Occasionally, by sitting on a sculpin or falling against a sack containing a number of sculpin, a victim may receive venom from several stings simultaneously. This multiple type of envenomation may be quite serious and produce primary shock, respiratory distress, and abnormal heart action, and may require hospitalization of the victim. Russell (1965) and Halstead (1951, 1970, 1971) have discussed the symptoms of sculpin stings thoroughly, including a number of case histories.

ROCKFISHES-----*Sebastes* spp.

Approximately 50 species of *Sebastes* are found off the California coast (Phillips, 1957) and many of these species contribute significantly to sport and commercial fisheries. Roche and Halstead (1972) examined the venom organs of 14 California rockfish, and found venom tissue associated with the fin spines of all species. These 14 species were picked at random, and it seems quite likely that all species of American *Sebastes* may possess a venom apparatus.

Rockfishes of the genus *Sebastes* usually have 13 dorsal spines, 2 pelvic spines, and 3 anal spines. The brown rockfish, *Sebastes auriculatus* (Figure 8), is typical of the species examined. A typical dorsal spine (Figure 9) is very similar to that found in the sculpin although the glandular grooves are somewhat shorter and considerably shallower. This is consistent with smaller venom glands found in the glandular grooves of rockfishes. In most important details, the rockfish venom apparatus resembles closely that of the sculpin. This similarity in structure indicates the method of introducing venom into a spine wound is probably similar.

Most information concerning the symptoms of rockfish stings has been gathered by talking to victims since this subject has not been discussed in the literature. Most victims (usually fishermen) report moderate to severe local pain as the major symptom, although some instances of nausea, weakness, and vomiting have been reported. Russell (personal communication) has treated at least 50 cases of rockfish stings, but symptoms bringing the patient to the hospital were those resulting from infection of the spine wound. Some of these patients reported local pain and swelling immediately following the injury. No data exist on the nature or mode of action of rockfish venom. Until such data are available, rockfishes must be considered only potentially venomous, though it is highly likely that they do introduce venom into wounds caused by their dorsal, pelvic, and anal spines. A sting from a rockfish, while often painful, should not be considered particularly dangerous and apparently causes considerably less pain and fewer complications than a sculpin sting.

FIGURE 8. Brown rockfish, *Sebastes auriculatus*.

TREATMENT

Russell (1953) stated that during the 7 month period between April and November 1952, lifeguard stations between Santa Monica and San Diego, California, a distance of some 130 miles, reported approximately 390 cases of stingray

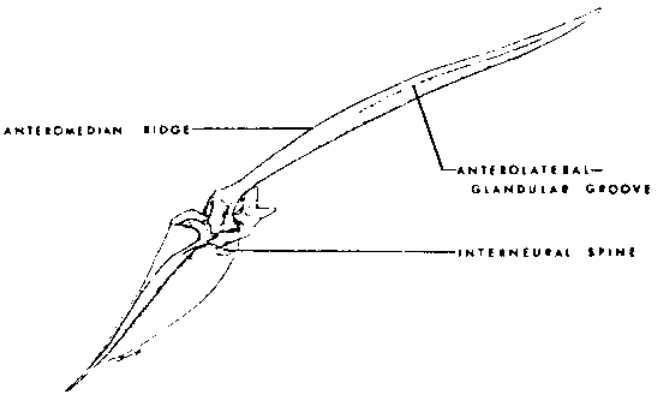

FIGURE 9. A typical dorsal spine of the brown rockfish (S. Callaway, from Roche and Halstead, 1972).

injuries. Another 84 victims were reported treated by physicians in areas unattended by beach services. It is reasonable to assume that an additional 50 victims received no medical attention and recovered from their wounds without particular incident.

Approximately 200 stings by stingrays and 150 by sculpins were reported to Russell (University of Southern California, pers. comm.) during 1970. The majority of stingray injuries were to the foot, while most sculpin stings occurred on the hand. The most severe poisoning occurred in a woman who sat on the dorsal spines of a sculpin and received seven puncture wounds.

It is not the intent of this section to deal with the type of treatment normally afforded by a physician, but rather to present first aid measures which, if instituted promptly and performed correctly, may obviate the need for a physician's services. The symptoms of envenomation by stingrays, ratfish, sculpins, and rockfish are quite similar, so the treatment is quite similar for all of them.

Russell (1965) lists a bewildering array of substances which have been used in the treatment of stingray injuries, including such surprising things as cactus, mashed cockroaches, fish liver, and urine.

Treatments which have been used commonly and recommended highly by some authorities have included the use of hot water, ammonia, formaldehyde, and potassium permanganate solution. A study of numerous case histories indicated the use of either ammonia or formaldehyde may greatly increase the seriousness of a stingray injury and *their use is strongly discouraged.* Potassium permanganate is still used by some to irrigate stingray wounds in strengths of 0.01 to 5%, in the belief that it destroys the venom. *This contention is not supported by experimental evidence.*

The following is the consensus regarding stingray injuries, based on hundreds of case histories.

The wound should be irrigated promptly and thoroughly with the cold salt water at hand. It is especially important to remove any bits of spine sheath or venom tissue that remain in the wound. This material may appear like shreds of grayish mucus. Much of the venom may be washed out by this operation, and cold water serves as a mild anesthetic.

When the wound has been irrigated thoroughly and no further evidence of foreign material can be seen, the extremity should be submerged in hot water for 30 to 60 minutes at as high a temperature as the patient can tolerate without injury. Epsom salt may be added to this hot soak if desired. After the soaking, the wound should be examined for the presence of any foreign tissue which may have been overlooked. An antiseptic and a sterile dressing should be applied.

Due to the peculiar construction of the sting, stingray wounds may be large enough to require suturing. This and other treatment, such as injection of antibiotics, is the province of the physician. Many physicians routinely recommend antibiotics and anti-tetanus therapy after stingray injuries.

Wounds from the spines of ratfish, sculpin, and rockfish are of the puncture variety and are not complicated by laceration and tissue damage produced by stingrays. Actually, this fact may affect the treatment since irrigation which is so valuable in lacerated stingray wounds is not nearly as effective with a puncture wound. Sucking the wound vigorously may remove some of the venom, but is not as effective as suction applied to a snake bite.

Soaking in hot water, as described for stingray wounds, seems to be the most effective first aid treatment. The addition of Epsom salt to the water is optional. The effectiveness of this treatment for all venomous fish stings is apparently due in part to inactivation of the venom by heat.

If the pain and swelling from any fish sting fail to decrease in a reasonable length of time after first aid treatment, the victim should visit a physician promptly, since these wounds are extremely prone to secondary infections which may prove quite serious if left untreated.

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