

Spines!

Though these beasties are mostly products of vivid imaginations, the sea is filled with amazing creatures. Some are so large as to inspire terror but are actually quite docile towards humans. Sharks are the most well-known of marine perils, despite the fact that they rarely harm people. Far more common are the animals that may appear small and harmless but possess potent weapons: say, a spine through which they can deliver a venom.

The underwater photographer who has backed into a cluster of sea urchins or the diver who places a hand on the perfectly camouflaged scorpionfish is not likely to die from his injuries, but he's certainly going to be uncomfortable for a while.

In this article, we'll consider similar encounters and limit our discussion to injuries produced by creatures with spines.

Spines

Spines are adapted by animals for various purposes: they're generally used for protection, although propulsion and gathering prey are frequently the tasks of specialized spines. Spines may be concealed or highlighted; slashing or penetrating; and venomous or nonvenomous. Some are fragile, needlelike in size and sharpness, while others are large and strong with recurved teeth.

Animals in several phyla possess spines that are alike in the principle of operation, but differ in location, size, potency of venom and degree of hazard to the diver. We will start with some of the invertebrate animals and examine the characteristics and functions of spines found in this group.

Spiny Invertebrates

The echinoderms are radially symmetrical animals with (usually) five arms, or radii, and have a more or less rigid skeleton embedded in the body wall. The starfish and sea urchins belong to this phylum, with a few species of interest to divers.

Starfishes

There are two known venomous starfishes: the *Acanthaster planci* (crown of thorns) and *Acanthaster ellisi* of the Indo-Pacific and eastern Pacific regions respectively. Their outer surfaces are covered by large, sharp spines: they're soft calcareous structures that break off on penetration and are difficult to remove.

Glands in the animal's skin produce a venom that causes a severe inflammatory response in humans. This consists of redness and swelling, and causes vomiting and numbness. In some rare cases, these starfish injuries can even cause paralysis.

Sea Urchins

Sea urchins are equipped with spines that vary greatly among species. The spines in some species are long, hollow, slender and needle-sharp. The sharpness permits them to penetrate easily and then break because of their brittleness. In some species a venom accompanies the spines and penetration may immediately result in a burning sensation followed quickly by redness, swelling and aching. More serious symptoms of numbness and paralysis have been reported. Infection is common.

There are quite a few hazardous sea urchin species, and they all produce similar symptoms. A few typical species are these: *Toxopneustes pileolus* is the felt cap sea urchin found in the Indo-Pacific region; two closely related species are *Toxopneustes elegans* of Japan and *T. roseus* of the eastern Pacific.

The common long-spined, or hairy, sea urchin *Diadema setosum* is found throughout the Indo-Pacific and West Indies. This species often takes pieces of seaweed, shell or pebbles with its tube feet to cover itself. This may work as camouflage and protect it from predators and the sun, but it also attracts divers and accounts for many injuries.

Sea urchin spines may not cause as much initial damage as the spines from stingrays, but they can be painful and have potential long-term effects if not treated properly. If you decide to try to remove them, be careful that you get the entire spine: sea urchin spines are very brittle and break easily. Even after the foreign body has been removed, the skin around the puncture site(s) can be stained by the color from the spines causing a "tattooing" affect.

In general, if intense pain and swelling are still present after 48 hours, it is likely that remnants of spines remain in the wound. You'll need professional care to remove them. Plus, if the spines are in or near any joints, especially in the hand or foot, you may want to consider seeking professional care at the time of injury. Often the body will push the spine fragments out, but there are also cases where the spines remained and become calcified (hardened), causing complications near the joints.

At one time some authorities recommended crushing the remaining spines under the skin. DO NOT attempt this. This action can have some serious complications. You may only succeed in driving the pieces deeper and potentially injuring other structures or tissues such as: veins, nerves and tendons (not to mention the fact that this can really hurt). If the wounds are not serious enough to require professional care then the recommended cleaning process should be used.

Stingrays & Dogfish

Stingrays are found in tropical to warm temperature seas. Their favorite habitat is a sandy area, a shoal or river mouth in shallow water. They lie on top of the sand or partially burrowed with only the eyes, gill slits and tails visible. The stinging spine is part of the tail and situated near the base. The spine is made of a hard material and has sharp, recurved teeth along either side. There are deep grooves on the underside of the spine where the venom glands are located. The spine is covered by an integumentary sheath, which protects the stinging organ.

Most injuries occur by accident, not design. Often a victim steps on an unsuspecting stingray lying in the sand; the resulting defensive move by the stingray causes the injury. The injury begins as a puncture wound when the spine penetrates the skin and then becomes a jagged laceration as the spine is withdrawn and the recurved teeth, or barbs, inflict further injury.

While this in-and-out process occurs with the barbed spine, venom is injected into the wound. The sheath remains behind in fragments in the wound so that the wound contains a foreign body (the sheath), a venom, seriously damaged tissue and inevitably bacterial contamination. The result is a complicated injury that requires extensive treatment and a prolonged healing time. A few deaths have occurred when the spine penetrated either the chest or abdomen of a child falling on the animal.

A relative of the stingray, the dogfish is also equipped with some formidable defenses. The spiny dogfish *Squalus acanthias* is known to have injured humans. In fact, there is a reference dating from 200 A.D. in a Grecian fishing poem: "Dogfish, from their prickly mail, well-named the spinous; These in punctures sharp, a fatal poison from their spines inject."

This animal inhabits the North Atlantic and North Pacific oceans. Dogfish have a single spine at the anterior margin of each of the two dorsal fins. When the spine enters the skin, venom enters from the venom gland located on the upper portion of each spine.

Ratfish, Catfish & Weeverfishes

The ratfishes (*Chimaera*) are a group of cartilaginous fishes. They have two dorsal fins, the first of which has a sharp spine at the anterior edge; this first fin delivers a venom. The *Chimaera* prefer cold water and are found from the surface down to 9,900 feet (3,000 meters) deep. These animals inflict a very painful sting with immediate pain. The pain increases in intensity before gradually decreasing but persisting for days. The area around the wound becomes numb and blue with the appearance of a severe inflammatory reaction.

Catfish are a large group of species, most of which are freshwater fish with a few marine species. Catfish have a single, strong, needle-sharp spine located in front of the dorsal and pectoral fins. The spine is covered by an integumentary sheath, which contains the venom glands. In a few species there are recurved teeth (barbs) along the spine which can lacerate a wound; this enhances venom absorption and increases the likelihood of infection.

Two common freshwater species in the United States are the "catfish" (*Galeichthys felis*) and the Carolina madtom (*Noturus furiosus*). The sea catfish (*Bagre marinus*) inhabits the east coast of the Americas from New England to Brazil.

The weeverfishes are small, attractive but aggressive marine fish with a well-developed venom apparatus.

They may be a real danger to a diver. The weevers bury themselves in soft sand until they dart out rapidly to strike. They have a series of dorsal spines with venom glands producing a venom with neurotoxin and hemotoxin features.

The pain from a weeverfish sting is instant and rapidly becomes increasingly worse to reach excruciating levels. If not treated, the pain will subside in about 24 hours, although full recovery may take several days to months. There have been very severe reactions reported, including death.

Stingrays

In 1608 New World explorer Capt. John Smith grounded his ship in the Rappahanock River in eastern Virginia while exploring the Chesapeake Bay. While waiting for the tide to refloat his ship, he went flounder giggering, using his sword for a gig (a pronged spear). Seeing a large flattish shape, Smith giggered a stingray, but did not know what type of animal he had encountered once he drew it out of the water.

As he removed the stingray from his sword, he received a sting on the wrist from the spine at the base of the ray's tail. The venom made Smith very sick, and in fact he was certain that he would not recover. Preparations were made for his death, even to the extent of a grave being prepared. However, treatment with a hot oil relieved his symptoms, and he eventually enjoyed the stingray for supper. The island still bears the name Stingray Isle because of that incident.

Capt. Smith was not the first person – nor will he be the last – in North America to be stung by a ray. There are estimates of more than 1,500 injuries per year in the United States from this animal.

The numerous species of toadfishes (*Batrachoididae*) are small bottom fishes that inhabit most of the warm-water coastal areas of the world. They are ugly (except, possibly, to other toadfish) with broad, depressed heads and a large mouth. They have two dorsal fin spines with venom glands and another spine located in the gill cover.

There are other fish with venomous spines capable of producing wounds in divers. These include the flying gunard (*Dactylopterus volitans*); sea robin (*Trigla lyra*); dragonet (*Callionomus lyra*); rabbitfish (*Siganus doliatus*); scats (*Scatophagidae* sp.); stargazers (*Uranoscopus* sp.) and leatherbacks (*Carangidae* sp.).

Scorpionfishes

The scorpionfishes (Scorpaenidae) are found worldwide in tropical and temperate areas. They can be divided into three main groups:

- zebrafish (Pterois);
- scorpionfish (Scorpaena);
- stonefish (Synanceja).

The zebrafish, also known as turkeyfish or lionfish, are beautiful, ornate coral reef fishes usually found in shallow water hovering over a crevice or resting on a fixed object. They are fearless, and with a likewise fearless diver, grabbing one of these fish can result in an extremely painful experience.

The scorpionfish (Scorpaena) and stonefish (Synanceja) are shallow-water dwellers and may be found on sandy bottoms, rocks or coral reefs. Their protective camouflage coloring makes them extremely difficult to see, and accidental encounters are common.

The spines of the three groups differ somewhat, but all deliver a venom. The stonefish is perhaps the most dangerous, as its spines are very strong and capable of penetrating a boot while delivering a potent venom. Fatalities have occurred from the sting of stonefish.

With the exception of the stonefish, the symptoms of a sting are pretty much the same for all species of scorpionfishes. Identification of the responsible fish may not be possible, but there is no great variety in symptomatology regardless of the species responsible: there is immediate pain with increasing intensity and a cyanotic wound that remains the same for several hours and then begins to improve.

The sting of the stonefish, however, produces excruciating pain sometimes with paralysis of the limb. There may be life-threatening symptoms of heart failure, delirium, seizures and respiratory distress. In some rare instances death has occurred after a sting from a stonefish.

Stonefish sting

The clinical features of stonefish envenomation include:

1. Local pain increasing in intensity over a few minutes and lessening after a few hours;
2. One or more puncture wounds;
3. Puncture site anesthetized;
4. Site inflamed and sometimes cyanotic;
5. Surrounding area hypersensitive, pale, swollen;
6. Regional lymph nodes tender and painful;
7. Generalized symptoms are sometimes severe with distress disproportionate to the clinical signs;
8. There is frequently malaise, nausea and vomiting, sweating, delirium;
9. Temperature elevation;
10. Cardiovascular shock;
11. Respiratory distress;
12. Death may occur.

Recovery may require many months.

There is an antivenin available for stonefish stings from Commonwealth Serum Laboratories in Melbourne, Australia CSL Limited: www.CSL.com.au.

Treatments for Injuries

The wounds produced by the various species of animals with a venomous spine have common features. The wounds are frequently lacerated puncture wounds that contain foreign material, a venom and bacterial contamination.

After initial evaluation and stabilization of the injured person, the basic principles of wound care apply to these injuries:

- It is important to relieve pain as promptly as possible; and
- Cleanse the wound of all foreign material, using a sterile technique if available.

If any foreign material remains, healing will be delayed or just not occur. Irrigation of the wound may remove venom as well as portions of the integumentary sheath, slime and sand. Many of these venoms are heat-labile (destroyed or altered by heat), so try a hot soak (45C) – at as high a temperature as can be tolerated – for 30-90 minutes. If hot water is not available, use “instant” hot packs.

The care of these wounds can be summarized as follows:

1. Rest the affected area in elevated position;
2. Immerse wound in 45C water for 30-90 minutes or until pain is relieved and does not recur;
3. Do not use epinephrine for pain relief;
4. Systemic analgesics or narcotics are rarely needed;
5. Resuscitation as needed;
6. General wound care including antibiotics if indicated;
7. Removal of foreign bodies in and around affected area.

Some of these wounds will be severe either due to the size of the animal (stingray) or the potency of the venom (stonefish). The stingray wound may require surgical exploration and debridement to remove foreign material and damaged tissue. The stonefish injury may require the administration of an antivenin, which itself may be hazardous.

Victims of these injuries should be treated at a local medical facility, the sophistication of which will depend on the location of the diving area. Divers Alert Network can assist in advice concerning immediate care of these injuries and referral to appropriate medical centers. (DAN Members, of course, can be evacuated at no cost to them if that is indicated medically.)

Prevention

Preventing these types of injuries is best accomplished by avoiding contact with the animal. This sounds simple, but it may not be in conditions of poor visibility, currents, confined areas or other environmental limitations.

Divers should not attempt to handle, tease, feed or annoy any marine animal: exploring a crevice with your hand is a good way to receive an injury from a concealed animal defending itself.

Do not allow a current to force you against a fixed object that may be covered with critters. Protective clothing is very important. Make an effort to find out which animals you may encounter in your dive, and learn about their characteristics and habitats before you begin the dive.