

Dangerous Marine Animals

5C-1 INTRODUCTION

5C-1.1 Purpose. This appendix provides general information on dangerous marine life that may be encountered in diving operations.

5C-1.2 Scope. It is beyond the scope of this manual to catalog all types of marine encounters and potential injury. Planners should consult the recommended references listed at the end of this appendix for more definite information. Medical personnel are also a good source of information and should be consulted prior to operating in unfamiliar waters. A good working knowledge of the marine environment should preclude lost time and severe injury.

5C-2 PREDATORY MARINE ANIMALS

5C-2.1 Sharks. Shark attacks on humans are infrequent. Since 1965, the annual recorded number of shark attacks is only 40 to 100 worldwide. These attacks are unpredictable and injuries may result not only from bites, but also by coming in contact with the shark's skin. Shark skin is covered with very sharp dentine appendages, called denticles, which are reinforced with tooth-like centers. Contact with shark skin can lead to wide abrasions and heavy bleeding.

5C-2.1.1 Shark Pre-Attack Behavior. Pre-attack behavior by most sharks is somewhat predictable. A shark preparing to attack swims with an exaggerated motion, its pectoral fins pointing down in contrast to the usual flared out position, and it swims in circles of decreasing radius around the prey. An attack may be heralded by unexpected acceleration or other marked change in behavior, posture, or swim patterns. Should surrounding schools of fish become unexplainably agitated, sharks may be in the area. Sharks are much faster and more powerful than any swimmer. All sharks must be treated with extreme respect and caution (see Figure 5C-1).

5C-2.1.2 First Aid and Treatment.

1. Bites may result in a large amount of bleeding and tissue loss. Take immediate action to control bleeding using large gauze pressure bandages. Cover wounds with layers of compressive dressings preferably made with gauze, but easily made from shirts or towels, and held in place by wrapping the wound tightly with gauze, torn clothing, towels, or sheets. Direct pressure with elevation or extreme compression on pressure points will control all but the most serious bleeding. The major pressure points are: the radial artery pulse point for the hand; above the elbow under the biceps muscle for the forearm (brachial artery); and the groin area with deep finger-tip or heel-of-the-hand pressure for bleeding from the leg (femoral artery). When bleeding cannot be controlled by direct pressure and elevation or pressure points, a tourniquet or ligature may

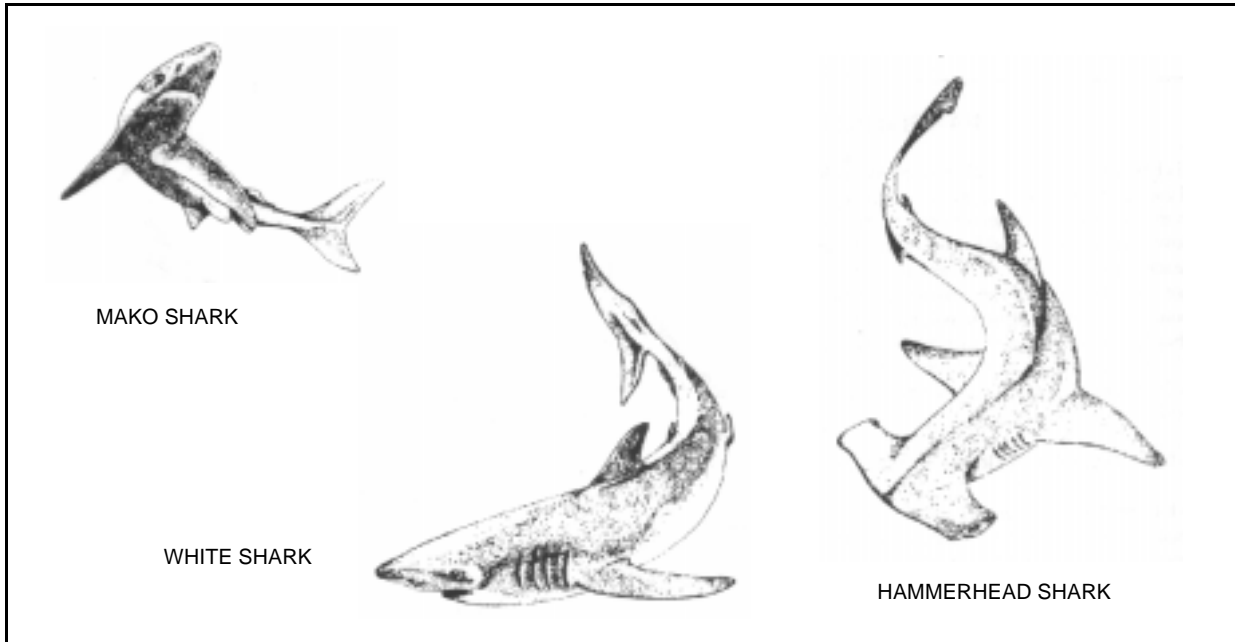


Figure 5C-1. Types of Sharks.

be needed to save the victim's life even though there is the possibility of loss of the limb. Tourniquets are applied only as a last resort and with only enough pressure to control bleeding. Do not remove the tourniquet. The tourniquet should be removed only by a physician in a hospital setting. Loosening of a tourniquet may cause further shock by releasing toxins into the circulatory system from the injured limb as well as continued blood loss.

2. Treat for shock by laying the patient down and elevating his feet.
3. If medical personnel are available, begin intravenous (IV) Ringer's lactate or normal saline with a large-bore cannula (16 or 18 ga). If blood loss has been extensive, several liters should be infused rapidly. The patient's color, pulse, and blood pressure should be used as a guide to the volume of fluid required. Maintain an airway and administer oxygen. Do not give fluids by mouth. If the patient's cardiovascular state is stable, narcotics may be administered in small doses for pain relief. Observe closely for evidence of depressed respirations due to the use of narcotics.
4. Initial stabilization procedures should include attention to the airway, breathing, and circulation, followed by a complete evaluation for multiple trauma.
5. Transport the victim to a medical facility as soon as possible. Reassure the patient.
6. Should a severed limb be retrieved, wrap it in bandages, moisten with saline, place in a plastic bag and chill, but not in direct contact with ice. Transport the severed limb with the patient.

7. Clean and debride wounds as soon as possible in a hospital or controlled environment. Since shark teeth are cartilage, not bone, and may not appear on an X-ray, operative exploration should be performed to remove dislodged teeth.
8. Consider X-ray evaluation for potential bone damage due to crush injury. Severe crush injury may result in acute renal failure due to myoglobin released from injured muscle, causing the urine to be a smoky brown color. Monitor closely for kidney function and adjust IV fluid therapy appropriately.
9. Administer tetanus prophylaxis: Tetanus toxoid, 0.5 ml intramuscular (IM) and tetanus immune globulin, 250 to 400 units IM.
10. Culture infected wounds for both aerobes and anaerobes before instituting broad spectrum antibiotic coverage; secondary infections with *Clostridium* and *Vibrio* species have been reported frequently.
11. Acute surgical repair, reconstructive surgery, and hyperbaric oxygen (HBO) adjuvant therapy improving tissue oxygenation may all be needed.
12. In cases of unexplained decrease in mental status or other neurological signs and symptoms following shark attack while diving, consider arterial gas embolism or decompression sickness as a possible cause.

5C-2.2

Killer Whales. Killer whales live in all oceans, both tropical and polar. This whale is a large mammal with a blunt, rounded snout and high black dorsal fin (Figure 5C-2). The jet black head and back contrast sharply with the snowy-white underbelly. Usually, a white patch can be seen behind and above the eye. The killer whale is usually observed in packs of 3 to 40 whales. It has powerful jaws, great weight, speed, and interlocking teeth. Because of its speed and carnivorous habits, this animal should be treated with great respect. There have been no recorded attacks on humans.

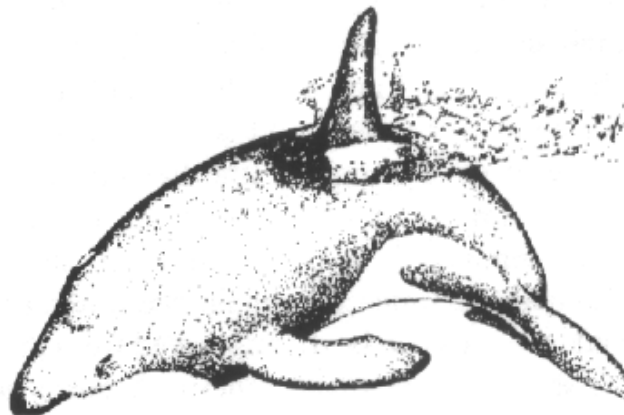


Figure 5C-2. Killer Whale.

5C-2.2.1 **Prevention.** When killer whales are spotted, all personnel should immediately leave the water. Extreme care should be taken on shore areas, piers, barges, ice floes, etc., when killer whales are in the area.

5C-2.2.2 **First Aid and Treatment.** First aid and treatment would follow the same general principles as those used for a shark bite (paragraph 5C-2.1.2).

5C-2.3 Barracuda. Approximately 20 species of barracuda inhabit the oceans of the West Indies, the tropical waters from Brazil to Florida and the Indo-Pacific oceans from the Red Sea to the Hawaiian Islands. The barracuda is a long, thin fish with prominent jaws and teeth, silver to blue in color, with a large head and a V-shaped tail (Figure 5C-3). It may grow up to 10 feet long and is a fast swimmer, capable of striking rapidly and fiercely. It will follow swimmers but seldom attacks an underwater swimmer. It is known to attack surface swimmers and limbs dangling in the water. Barracuda wounds can be distinguished from those of a shark by the tooth pattern. A barracuda leaves straight or V-shaped wounds while those of a shark are curved like the shape of its jaws. Life threatening attacks by barracuda are rare.

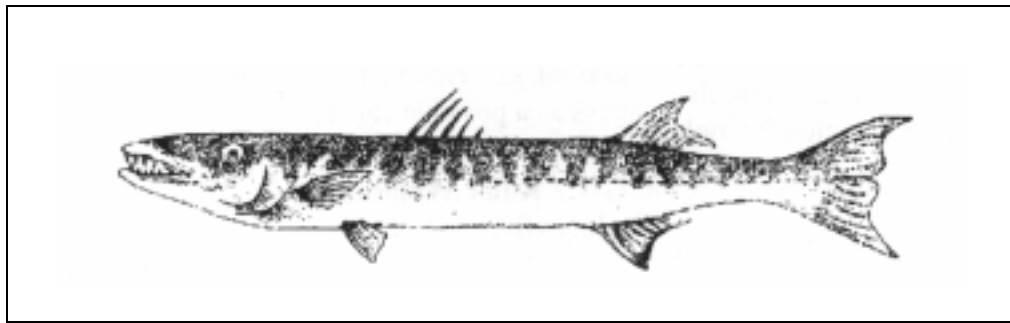


Figure 5C-3. Barracuda.

5C-2.3.1 **Prevention.** Barracuda are attracted by any bright object. Avoid wearing shiny equipment or jewelry in waters when barracudas are likely to be present. Avoid carrying speared fish, as barracuda will strike them. Avoid splashing or dangling limbs in barracuda-infested waters.

5C-2.3.2 **First Aid and Treatment.** First aid and treatment follow the same general principles as those used for shark bites (paragraph 5C-2.1.2). Injuries are likely to be less severe than shark bite injuries.

5C-2.4 Moray Eels. While some temperate zone species of the moray eel are known, it primarily inhabits tropical and subtropical waters. It is a bottom dweller and is commonly found in holes and crevices or under rocks and coral. It is snake-like in both appearance and movement and has tough, leathery skin (Figure 5C-4). It can grow to a length of 10 feet and has prominent teeth. A moray eel is extremely territorial and attacks frequently result from reaching into a crevice or hole occupied by the eel. It is a powerful and vicious biter and may be difficult to dislodge after a bite is initiated. Bites from moray eels may vary from multiple small punc-

ture wounds to the tearing, jagged type with profuse bleeding if there has been a struggle. Injuries are usually inflicted on hands or forearms.

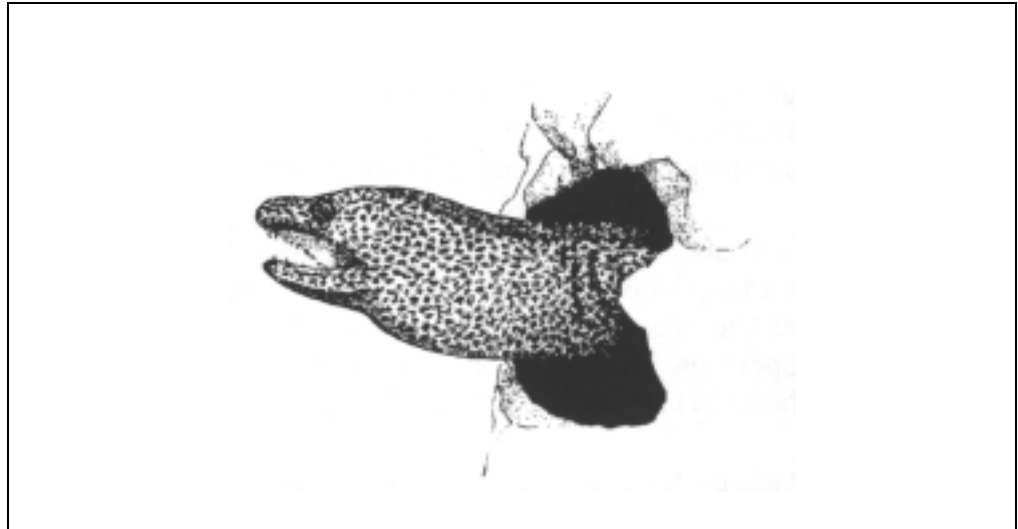


Figure 5C-4. Moray Eel.

5C-2.4.1 **Prevention.** Extreme care should be used when reaching into holes or crevices. Avoid provoking or attempting to dislodge an eel from its hole.

5C-2.4.2 **First Aid and Treatment.** Primary first aid must stop the bleeding. Direct pressure and raising the injured extremity almost always controls bleeding. Arrange for medical follow-up. Severe hand injuries should be evaluated immediately by a physician. Mild envenomation may occur from a toxin that is released from the palatine mucosa in the mouth of certain moray eels. The nature of this toxin is not known. Treatment is supportive. Follow principles of wound management and tetanus prophylaxis as in caring for shark bites. Antibiotic therapy should be instituted early. Immediate specialized care by a hand surgeon may be necessary for tendon and nerve repair of the hand to prevent permanent damage and loss of function of the hand.

5C-2.5 **Sea Lions.** The sea lion inhabits the Pacific Ocean and is numerous on the West Coast of the United States. It resembles a large seal. Sea lions are normally harmless; however, during the breeding season (October through December) large bull sea lions can become irritated and will nip at divers. Attempts by divers to handle these animals may result in bites. These bites appear similar to dog bites and are rarely severe.

5C-2.5.1 **Prevention.** Divers should avoid these mammals when in the water.

5C-2.5.2 **First Aid and Treatment.**

1. Control local bleeding.
2. Clean and debride wound.

3. Administer tetanus prophylaxis as appropriate.
4. Wound infections are common and prophylactic antibiotic therapy is advised.

5C-3 VENOMOUS MARINE ANIMALS

5C-3.1 Venomous Fish (Excluding Stonefish, Zebrafish, Scorpionfish). Identification of a fish following a sting is not always possible; however, symptoms and effects of venom do not vary greatly. Venomous fish are rarely aggressive and usually contact is made by accidentally stepping on or handling the fish. Dead fish spines remain toxic (see Figure 5C-5). Venom is generally heat-labile and may be decomposed by hot water. Local symptoms following a sting may first include severe pain later combined with numbness or even hypersensitivity around the wound. The wound site may become cyanotic with surrounding tissue becoming pale and swollen. General symptoms may include nausea, vomiting, sweating, mild fever, respiratory distress and collapse. The pain induced may seem disproportionately high to apparent severity of the injury. Medical personnel should be prepared for serious anaphylactic reactions from apparently minor stings or envenomation.

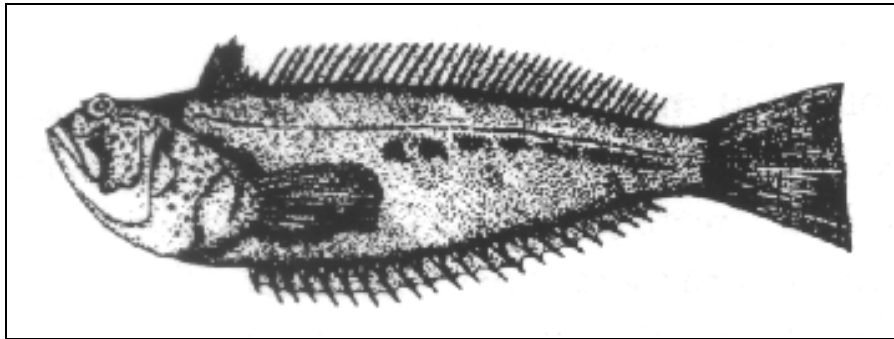


Figure 5C-5. Venomous Fish. Shown is the weeverfish.

5C-3.1.1 Prevention. Avoid handling suspected venomous fish. Venomous fish are often found in holes or crevices or lying well camouflaged on rocky bottoms. Divers should be alert for their presence and should take care to avoid them.

5C-3.1.2 First Aid and Treatment.

1. Get victim out of water; watch for fainting.
2. Lay patient down and reassure.
3. Observe for signs of shock.

4. Wash wound with cold, salt water or sterile saline solution. Surgery may be required to open up the puncture wound. Suction is not effective to remove this toxin.
5. Soak wound in hot water for 30 to 90 minutes. Heat may break down the venom. The water should be as hot as the victim can tolerate but not hotter than 122°F (50°C). Immersion in water above 122°F (50°C) for longer than a brief period may lead to scalding. Immersion in water up to 122°F (50°C) should therefore be brief and repeated as necessary. Use hot compresses if the wound is on the face. Adding magnesium sulfate (epsom salts) to the water offers no benefit.
6. Calcium gluconate injections, diazepam, or methocarbamol may help to reduce muscle spasms. Infiltration of the wound with 0.5 percent to 2.0 percent xylocaine with no epinephrine is helpful in reducing pain. If xylocaine with epinephrine is mistakenly used, local necrosis may result from both the toxin and epinephrine present in the wound. Narcotics may also be needed to manage severe pain.
7. Clean and debride wound. Spines and sheath frequently remain. Be sure to remove all of the sheath as it may continue to release venom.
8. Tourniquets or ligatures are no longer advised. Use an antiseptic or antibiotic ointment and sterile dressing. Restrict movement of the extremity with immobilizing splints and cravats.
9. Administer tetanus prophylaxis as appropriate.
10. Treat prophylactically with topical antibiotic ointment. If delay in treatment has occurred, it is recommended that the wound be cultured prior to administering systemic antibiotics.

5C-3.2 Highly Toxic Fish (Stonefish, Zebra-fish, Scorpionfish). Stings by stonefish, zebrafish, and scorpionfish have been known to cause fatalities. While many similarities exist between these fish and the venomous fish of the previous section, a separate section has been included because of the greater toxicity of their venom and the availability of an antivenin. The antivenin is specific for the stonefish but may have some beneficial effects against the scorpionfish and zebrafish. Local symptoms are similar to other fish envenomation except that pain is more severe and may persist for many days. Generalized symptoms are often present and may include respiratory failure and cardiovascular collapse. These fish are widely distributed in temperate and tropical seas and in some arctic waters. They are shallow-water bottom dwellers. Stonefish and scorpionfish are flattened vertically, dark and mottled. Zebrafish are ornate and feathery in appearance with alternating patches of dark and light color (see Figure 5C-6).

5C-3.2.1 **Prevention.** Prevention is the same as for venomous fish (paragraph 5C-3.1.1).

5C-3.2.2 **First Aid and Treatment.**

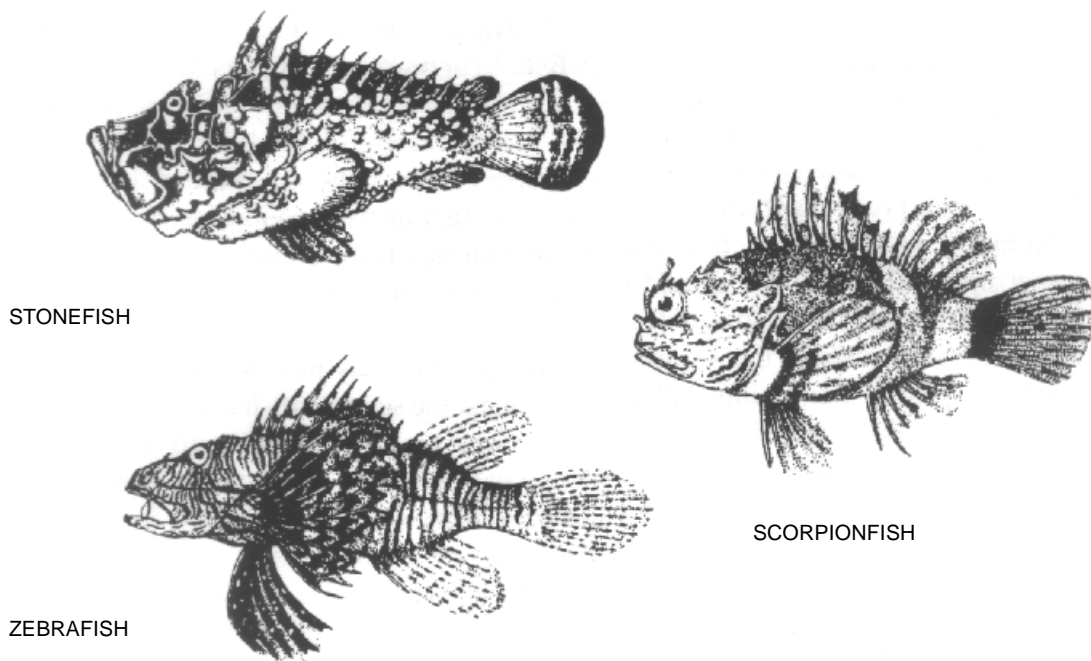


Figure 5C-6. Highly Toxic Fish.

1. Give the same first aid as that given for venomous fish (paragraph 5C-3.1.2).
2. Observe the patient carefully for the possible development of life-threatening complications. The venom is an unstable protein which acts as a myotoxin on skeletal, involuntary, and cardiac muscle. This may result in muscular paralysis, respiratory depression, peripheral vasodilation, shock, cardiac dysrhythmias, or cardiac arrest.
3. Clean and debride wound.
4. Antivenin is available from Commonwealth Serum Lab, Melbourne, Australia (see Reference 4 at end of this appendix for address and phone number). If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylactic shock (severe allergic reaction). In brief, one or two punctures require 2,000 units (one ampule); three to four punctures, 4,000 units (two ampules); and five to six punctures, 6,000 units (three ampules). Antivenin must be delivered by slow IV injection and the victim closely monitored for anaphylactic shock.
5. Institute tetanus prophylaxis, analgesic therapy and antibiotics as described for other fish stings.

5C-3.3 Stingrays. The stingray is common in all tropical, subtropical, warm, and temperate regions. It usually favors sheltered water and will burrow into sand with only eyes and tail exposed. It has a bat-like shape and a long tail (Figure 5C-7). Approximately 1,800 stingray attacks are reported annually in the U.S. Most attacks occur when waders inadvertently step on a ray, causing it to lash out defensively with its tail. The spine is located near the base of the tail. Wounds are either of the laceration or puncture type and are extremely painful. The wound appears swollen and pale with a blue rim. Secondary wound infections are common. Systemic symptoms may be present and can include fainting, nausea, vomiting, sweating, respiratory difficulty, and cardiovascular collapse.



Figure 5C-7. Stingray.

5C-3.3.1 Prevention. In shallow waters which favor stingray habitation, shuffle feet on the bottom and probe with a stick to alert the rays and chase them away.

5C-3.3.2 First Aid and Treatment.

1. Give the same first aid as that given for venomous fish (paragraph 5C-3.1.2). No antivenom is available.
2. Institute hot water therapy as described under fish envenomation.
3. Clean and debride wound. Removal of the spine may additionally lacerate tissues due to retropointed barbs. Be sure to remove integumental sheath as it will continue to release toxin.
4. Observe patient carefully for the possible development of life-threatening complications. Symptoms can include cardiac dysrhythmias, hypotension, vomiting, diarrhea, sweating, muscle paralysis, respiratory depression, and cardiac arrest. Fatalities have been reported occasionally.
5. Institute tetanus prophylaxis, analgesic therapy, and broad-spectrum antibiotics as described for fish envenomation.

5C-3.4 Coelenterates. Hazardous types of coelenterates include: Portuguese man-of-war, sea wasp or box jellyfish, sea nettle, sea blubber, sea anemone, and rosy anemone (Figure 5C-8). Jellyfish vary widely in color (blue, green, pink, red, brown) or may be transparent. They appear to be balloon-like floats with tentacles dangling down into the water. The most common stinging injury is the jellyfish sting. Jellyfish can come into direct contact with a diver in virtually any oceanic region, worldwide. When this happens, the diver is exposed to literally thousands of

minute stinging organs in the tentacles called nematocysts. Most jellyfish stings result only in painful local skin irritation.

The sea wasp or box jellyfish and Portuguese man-of-war are the most dangerous types. The sea wasp or box jellyfish (found in the Indo-Pacific) can induce death within 10 minutes by cardiovascular collapse, respiratory failure, and muscular paralysis. Deaths from Portuguese man-of-war stings have also been reported. Even though intoxication from ingesting poisonous sea anemones is rare, sea anemones must not be eaten.

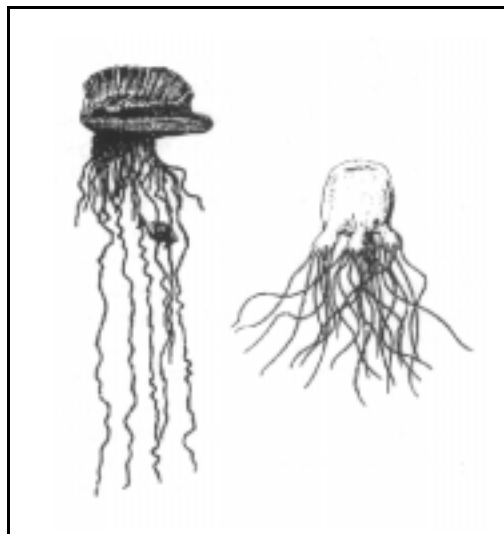


Figure 5C-8. Coelenterates. Hazardous coelenterates include the Portuguese Man-of-War (left) and the sea wasp (right).

- 5C-3.4.1 **Prevention.** Do not handle jellyfish. Beached or apparently dead specimens may still be able to sting. Even towels or clothing contaminated with the stinging nematocysts may cause stinging months later.
- 5C-3.4.2 **Avoidance of Tentacles.** In some species of jellyfish, tentacles may trail for great distances horizontally or vertically in the water and are not easily seen by the diver. Swimmers and divers should avoid close proximity to jellyfish to avoid contacting their tentacles, especially when near the surface.
- 5C-3.4.3 **Protection Against Jellyfish.** Wet suits, body shells, or protective clothing should be worn when diving in waters where jellyfish are abundant. Petroleum jelly applied to exposed skin (e.g., around the mouth) helps to prevent stinging, but caution should be used since petroleum jelly can deteriorate rubber products.
- 5C-3.4.4 **First Aid and Treatment.** Without rubbing, gently remove any remaining tentacles using a towel or clothing. For preventing any further discharge of the stinging nematocysts, use vinegar (dilute acetic acid) or a 3- to 10-percent solution of acetic acid. An aqueous solution of 20 percent aluminum sulfate and 11 percent surfactant (detergent) is moderately effective but vinegar works better. Do not use alcohol or preparations containing alcohol. Methylated spirits or methanol, 100 percent alcohol and alcohol plus seawater mixtures have all been demonstrated to cause a massive discharge of the nematocysts. In addition, these compounds may also worsen the skin inflammatory reaction. Picric acid, human urine, and fresh water also have been found to either be ineffective or even to discharge nematocysts and should not be used. Rubbing sand or applying papain-containing meat tenderizer is ineffective and may lead to further nematocysts discharge and should not be used. It has been suggested that isopropyl (rubbing) alcohol may be effective. It should only be tried if vinegar or dilute acetic acid is not available.

- 5C-3.4.5 **Symptomatic Treatment.** Symptomatic treatment can include topical steroid therapy, anesthetic ointment (xylocaine, 2 percent) antihistamine lotion, systemic antihistamines or analgesics. Benzocaine topical anesthetic preparations should not be used as they may cause sensitization and later skin reactions.
- 5C-3.4.6 **Anaphylaxis.** Anaphylaxis (severe allergic reaction) may result from jellyfish stings.
- 5C-3.4.7 **Antivenin.** Antivenin is available to neutralize the effects of the sea wasp or box jellyfish (*Chironex fleckeri*). The antivenin should be administered slowly through an IV, with an infusion technique if possible. IM injection should be administered only if the IV method is not feasible. One container (vial) of sea wasp antivenin should be used by the IV route and three containers if injected by the IM route. Each container of sea wasp antivenin is 20,000 units and is to be kept refrigerated, not frozen, at 36-50°F (2-10°C). Sensitivity reaction to the antivenin should be treated with a subcutaneous injection of epinephrine (0.3cc of 1:1,000 dilution), corticosteroids, and antihistamines. Treat any hypotension (severely low blood pressure) with IV volume expanders and pressor medication as necessary. The antivenin may be obtained from the Commonwealth Serum Laboratories, Melbourne, Australia (see Reference 4 for address and phone number).
- 5C-3.5 Coral.** Coral, a porous, rock-like formation, is found in tropical and subtropical waters. Coral is extremely sharp and the most delicate coral is often the most dangerous because of their razor-sharp edges. Coral cuts, while usually fairly superficial, take a long time to heal and can cause temporary disability. The smallest cut, if left untreated, can develop into a skin ulcer. Secondary infections often occur and may be recognized by the presence of a red and tender area surrounding the wound. All coral cuts should receive medical attention. Some varieties of coral can actually sting a diver since coral is a coelenterate like jellyfish. Some of the soft coral of the genus *Palythoa* have been found recently to contain the deadliest poison known to man. This poison is found within the body of the organism and not in the stinging nematocysts. The slime of this coral may cause a serious skin reaction (dermatitis) or even be fatal if exposed to an open wound. No antidote is known.
- 5C-3.5.1 **Prevention.** Extreme care should be used when working near coral. Often coral is located in a reef formation subjected to heavy surface water action, surface current, and bottom current. Surge also develops in reef areas. For this reason, it is easy for the unknowing diver to be swept or tumbled across coral with serious consequences. Be prepared.
- 5C-3.5.2 **Protection Against Coral.** Coral should not be handled with bare hands. Feet should be protected with booties, coral shoes or tennis shoes. Wet suits and protective clothing, especially gloves (neoprene or heavy work gloves), should be worn when near coral.
- 5C-3.5.3 **First Aid and Treatment.**
1. Control local bleeding.

2. Promptly clean with hydrogen peroxide or 10-percent povidone-iodine solution and debride the wound, removing all foreign particles.
3. Cover with a clean dressing.
4. Administer tetanus prophylaxis as appropriate.
5. Topical antibiotic ointment has been proven very effective in preventing secondary infection. Stinging coral wounds may require symptomatic management such as topical steroid therapy, systemic antihistamines, and analgesics. In severe cases, restrict the patient to bed rest with elevation of the extremity, wet-to-dry dressings, and systemic antibiotics. Systemic steroids may be needed to manage the inflammatory reaction resulting from a combination of trauma and dermatitis.

5C-3.6

Octopuses. The octopus inhabits tropical and temperate oceans. Species vary depending on region. It has a large sac surrounded by 8 to 10 tentacles (Figure 5C-9). The head sac is large with well-developed eyes and horny jaws on the mouth. Movement is made by jet action produced by expelling water from the mantle cavity through the siphon. The octopus will hide in caves, crevices and shells. It possesses a well-developed venom apparatus in its salivary glands and stings by biting. Most species of octopus found in the U.S. are harmless. The blue-ringed octopus common in Australian and Indo-Pacific waters may inflict fatal bites. The venom of the blue-ringed octopus is a neuromuscular blocker called tetrodotoxin and is also found in Puffer (Fugu) fish. Envenomation from the bite of a blue-ringed octopus may lead to muscular paralysis, vomiting, respiratory difficulty, visual disturbances, and cardiovascular collapse. Octopus bites consist of two small punctures. A burning or tingling sensation results and may soon spread. Swelling, redness, and inflammation are common. Bleeding may be severe and the clotting ability of the blood is often retarded by the action of an anticoagulant in the venom.

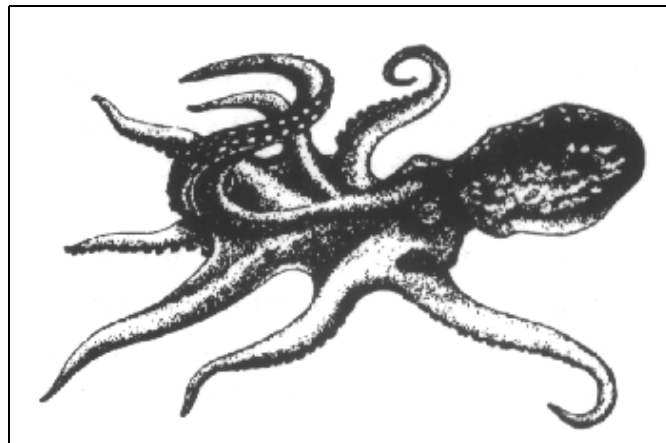


Figure 5C-9. Octopus.

5C-3.6.1 **Prevention.** Extreme care should be used when reaching into caves and crevices. Regardless of size, an octopus should be handled carefully with gloves. One should not spear an octopus, especially the large ones found off the coast of the Northwestern United States, because of the risk of being entangled by its tentacles. If killing an octopus becomes necessary, stabbing it between the eyes is recommended.

5C-3.6.2 **First Aid and Treatment.**

1. Control local bleeding.
2. Clean and debride the wound and cover with a clean dressing.
3. For suspected blue-ringed octopus bites, do not apply a loose constrictive band. Apply direct pressure with a pressure bandage and immobilize the extremity in a position that is lower than the heart using splints and elastic bandages.
4. Be prepared to administer mouth-to-mouth resuscitation and cardiopulmonary resuscitation if necessary.
5. Blue-ringed octopus venom is heat stable and acts as a neurotoxin and neuromuscular blocking agent. Venom is not affected by hot water therapy. No antivenin is available.
6. Medical therapy for blue-ringed octopus bites is directed toward management of paralytic, cardiovascular, and respiratory complications. Respiratory arrest is common and intubation with mechanical ventilation may be required. Duration of paralysis is between 4 and 12 hours. Reassure the patient.
7. Administer tetanus prophylaxis as appropriate.

5C-3.7 **Segmented Worms (Annelida) (Examples: Bloodworm, Bristleworm).** This invertebrate type varies according to region and is found in warm, tropical or temperate zones. It is usually found under rocks or coral and is especially common in the tropical Pacific, Bahamas, Florida Keys, and Gulf of Mexico. Annelida have long, segmented bodies with stinging bristle-like structures on each segment. Some species have jaws and will also inflict a very painful bite. Venom causes swelling and pain.

5C-3.7.1 **Prevention.** Wear lightweight, cotton gloves to protect against bloodworms, but wear rubber or heavy leather gloves for protection against bristleworms.

5C-3.7.2 **First Aid and Treatment.**

1. Remove bristles with a very sticky tape such as adhesive tape or duct tape. Topical application of vinegar will lessen pain.

2. Treatment is directed toward relief of symptoms and may include topical steroid therapy, systemic antihistamines, and analgesics.
3. Wound infection can occur but can be easily prevented by cleaning the skin using an antiseptic solution of 10 percent povidone-iodine and topical antibiotic ointment. Systemic antibiotics may be needed for established secondary infections that first need culturing, aerobically and anaerobically.

5C-3.8 Sea Urchins. There are various species of sea urchins with widespread distribution. Each species has a radial shape and long spines. Penetration of the sea urchin spine can cause intense local pain due to a venom in the spine or from another type of stinging organ called the globiferous pedicellariae. Numbness, generalized weakness, paresthesias, nausea, vomiting, and cardiac dysrhythmias have been reported.

5C-3.8.1 Prevention. Avoid contact with sea urchins. Even the short-spined sea urchin can inflict its venom via the pedicellariae stinging organs. Protective footwear and gloves are recommended. Spines can penetrate wet suits, booties, and tennis shoes.

5C-3.8.2 First Aid and Treatment.

1. Remove large spine fragments gently, being very careful not to break them into small fragments that remain in the wound.
2. Bathe the wound in vinegar or isopropyl alcohol. Soaking the injured extremity in hot water up to 122°F (50°C) may help. Caution should be used to prevent scalding the skin which can easily occur after a brief period in water above 122°F (50°C).
3. Clean and debride the wound. Topical antibiotic ointment should be used to prevent infection. Culture both aerobically and anaerobically before administering systemic antibiotics for established secondary infections.
4. Remove as much of the spine as possible. Some small fragments may be absorbed by the body. Surgical removal, preferably with a dissecting microscope, may be required when spines are near nerves and joints. X-rays may be required to locate these spines. Spines can form granulomas months later and may even migrate to other sites.
5. Allergic reaction and bronchospasm can be controlled with subcutaneous epinephrine (0.3 cc of 1:1,000 dilution) and by using systemic antihistamines. There are no specific antivenins available.
6. Administer tetanus prophylaxis as appropriate.
7. Get medical attention for deep wounds.

5C-3.9 Cone Shells. The cone shell is widely distributed in all regions and is usually found under rocks and coral or crawling along sand. The shell is most often symmetrical in a spiral coil, colorful, with a distinct head, one to two pairs of tentacles, two eyes, and a large flattened foot on the body (Figure 5C-10). A cone shell sting should be considered as severe as a poisonous snake bite. It has a highly developed venom apparatus: venom is contained in darts inside the proboscis which extrudes from the narrow end but is able to reach most of the shell. Cone shell stings are followed by a stinging or burning sensation at the site of the wound. Numbness and tingling begin at the site of the wound and may spread to the rest of the body; involvement of the mouth and lips is severe. Other symptoms may include muscular paralysis, difficulty with swallowing and speech, visual disturbances, and respiratory distress.

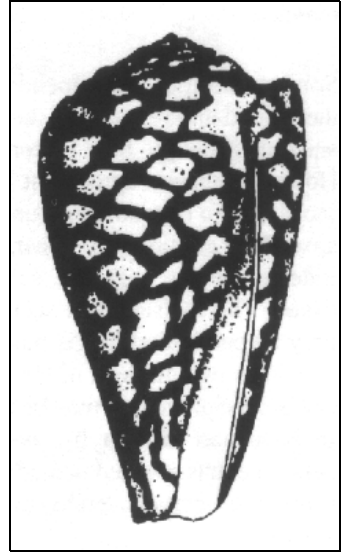


Figure 5C-10. Cone Shell.

5C-3.9.1 Prevention. Avoid handling cone shells. Venom can be injected through clothing and gloves.

5C-3.9.2 First Aid and Treatment.

1. Lay the patient down.
2. Do not apply a loose constricting band or ligature. Direct pressure with a pressure bandage and immobilization in a position lower than the level of the heart using splints and elastic bandages is recommended.
3. Some authorities recommend incision of the wound and removal of the venom by suction, although this is controversial. However, general agreement is that if an incision is to be made, the cuts should be small (one centimeter), linear and penetrate no deeper than the subcutaneous tissue. The incision and suction should only be performed if it is possible to do so within two minutes of the sting. Otherwise, the procedure may be ineffective. Incision and suction by inexperienced personnel has resulted in inadvertent disruption of nerves, tendons, and blood vessels.
4. Transport the patient to a medical facility while ensuring that the patient is breathing adequately. Be prepared to administer mouth-to-mouth resuscitation if necessary.
5. Cone shell venom results in paralysis or paresis of skeletal muscle, with or without myalgia. Symptoms develop within minutes of the sting and effects can last up to 24 hours.

6. No antivenin is available.
7. Respiratory distress may occur due to neuromuscular block. Patient should be admitted to a medical facility and monitored closely for respiratory or cardiovascular complications. Treat as symptoms develop.
8. Local anesthetic with no epinephrine may be injected into the site of the wound if pain is severe. Analgesics which produce respiratory depression should be used with caution.
9. Management of severe stings is supportive. Respiration may need to be supported with intubation and mechanical ventilation.
10. Administer tetanus prophylaxis as appropriate.

5C-3.10 Sea Snakes. The sea snake is an air-breathing reptile which has adapted to its aquatic environment by developing a paddle tail. Sea snakes inhabit the Indo-Pacific area and the Red Sea and have been seen 150 miles from land. The most dangerous areas in which to swim are river mouths, where sea snakes are more numerous and the water more turbid. The sea snake is a true snake, usually 3 to 4 feet in length, but it may reach 9 feet. It is generally banded (Figure 5C-11). The sea snake is curious and is often attracted by divers and usually is not aggressive except during its mating season.

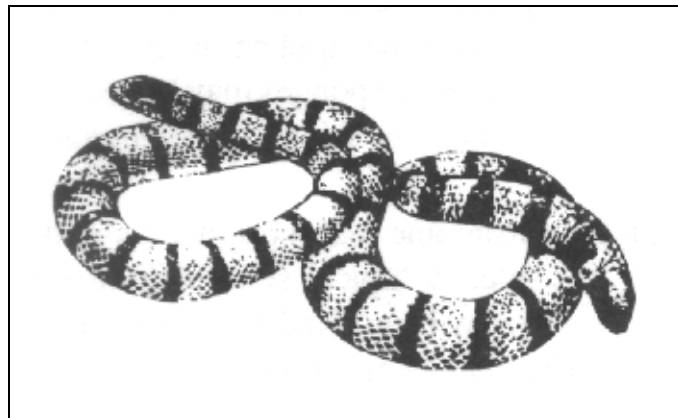


Figure 5C-11. Sea Snake.

5C-3.10.1 Sea Snake Bite Effects. The sea snake injects a poison that has 2 to 10 times the toxicity of cobra venom. The bites usually appear as four puncture marks but may range from one to 20 punctures. Teeth may remain in the wound. The neurotoxin poison is a heat-stable nonenzymatic protein; hence, sea snake bites should not be immersed in hot water as with venomous fish stings. Due to its small jaws, bites often do not result in envenomation. Sea snake bites characteristically produce little pain and there is usually a latent period of 10 minutes to as long as several hours before the development of generalized symptoms: muscle aching and stiffness, thick tongue sensation, progressive paralysis, nausea, vomiting, difficulty

with speech and swallowing, respiratory distress and failure, plus smoky-colored urine from myoglobinuria, which may go on to kidney failure.

5C-3.10.2 **Prevention.** Wet suits or protective clothing, especially gloves, may provide substantial protection against bites and should be worn when diving in waters where sea snakes are abundant. Also, shoes should be worn when walking where sea snakes are known to exist, including in the vicinity of fishing operations. Do not handle sea snakes. Bites often occur on the hands of fishermen attempting to remove snakes from nets.

5C-3.10.3 **First Aid and Treatment.**

1. Keep victim still.
2. Do not apply a loose constricting band or tourniquet. Apply direct pressure using a compression bandage and immobilize the extremity in the dependent position with splints and elastic bandages. This prevents spreading of the neurotoxin through the lymphatic circulation.
3. Incise and apply suction (see cone shell stings, paragraph 5C-3.9).
4. Transport all sea snake-bite victims to a medical facility as soon as possible, regardless of their current symptoms.
5. Watch to ensure that the patient is breathing adequately. Be prepared to administer mouth-to-mouth resuscitation or cardiopulmonary resuscitation if required.
6. The venom is a heat-stable protein which blocks neuromuscular transmission. Myonecrosis with resultant myoglobinuria and renal damage are often seen. Hypotension may develop.
7. Respiratory arrest may result from generalized muscular paralysis; intubation and mechanical ventilation may be required.
8. Renal function should be closely monitored and peritoneal or hemodialysis may be needed. Alkalinization of urine with sufficient IV fluids will promote myoglobin excretion. Monitor renal function and fluid balance anticipating acute renal failure.
9. Vital signs should be monitored closely. Cardiovascular support plus oxygen and IV fluids may be required.
10. Because of the possibility of delayed symptoms, all sea snake-bite victims should be observed for at least 12 hours.
11. If symptoms of envenomation occur within one hour, antivenin should be administered as soon as possible. In a seriously envenomated patient, antivenin therapy may be helpful even after a significant delay. Antivenin is

available from the Commonwealth Serum Lab in Melbourne, Australia (see Reference D of this appendix for address and phone number). If specific antivenin is not available, polyvalent land snake antivenin (with a tiger snake or krait Elapidae component) may be substituted. If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylaxis (severe allergic reaction). Infusion by the IV method or closely monitored drip over a period of one hour, is recommended.

12. Administer tetanus prophylaxis as appropriate.

5C-3.11 Sponges. Sponges are composed of minute multicellular animals with spicules of silica or calcium carbonate embedded in a fibrous skeleton. Exposure of skin to the chemical irritants on the surface of certain sponges or exposure to the minute sharp spicules can cause a painful skin condition called dermatitis.

5C-3.11.1 **Prevention.** Avoid contact with sponges and wear gloves when handling live sponges.

5C-3.11.2 **First Aid and Treatment.**

1. Adhesive or duct tape can effectively remove the sponge spicules.
2. Vinegar or 3- to 10-percent acetic acid should be applied with saturated compresses as sponges may be secondarily inhabited by stinging coelenterates.
3. Antihistamine lotion (diphenhydramine) and later a topical steroid (hydrocortisone), may be applied to reduce the early inflammatory reaction.
4. Antibiotic ointment is effective in reducing the chance of a secondary infection.

5C-4 POISONOUS MARINE ANIMALS

5C-4.1 Ciguatera Fish Poisoning. Ciguatera poisoning is fish poisoning caused by eating the flesh of a fish that has eaten a toxin-producing microorganism, the dinoflagellate, *Gambierdiscus toxicus*. The poisoning is common in reef fish between latitudes 35°N and 35°S around tropical islands or tropical and semitropical shorelines in Southern Florida, the Caribbean, the West Indies, and the Pacific and Indian Oceans. Fish and marine animals affected include barracuda, red snapper, grouper, sea bass, amberjack, parrot fish, and the moray eel. Incidence is unpredictable and dependent on environmental changes that affect the level of dinoflagellates. The toxin is heat-stable, tasteless, and odorless, and is not destroyed by cooking or gastric acid. Symptoms may begin immediately or within several hours of ingestion and may include nausea, vomiting, diarrhea, itching and muscle weakness, aches and spasms. Neurological symptoms may include pain, ataxia (stumbling gait), paresthesias (tingling), and circumoral parasthesias (numbness around the mouth). Sensory reversal of hot and cold sensation when touching or eating objects of extreme temperatures may occur. In severe cases,

respiratory failure and cardiovascular collapse may occur. Pruritus (itching) is characteristically made worse by alcohol ingestion. Gastrointestinal symptoms usually disappear within 24 to 72 hours. Although complete recovery will occur in the majority of cases, neurological symptoms may persist for months or years. Signs and symptoms of ciguatera fish poisoning may be misdiagnosed as decompression sickness or contact dermatitis from unseen fire coral or jellyfish. Because of rapid modern travel and refrigeration, ciguatera poisoning may occur far from endemic areas with international travelers or unsuspecting restaurant patrons.

5C-4.1.1 **Prevention.** Never eat the liver, viscera, or roe (eggs) of tropical fish. Unusually large fish of a species should be suspected. When traveling, consult natives concerning fish poisoning from local fish, although such information may not always be reliable. A radioimmunoassay has been developed to test fish flesh for the presence of the toxin and soon may be generally available.

5C-4.1.2 **First Aid and Treatment.**

1. Treatment is largely supportive and symptomatic. If the time since suspected ingestion of the fish is brief and the victim is fully conscious, induce vomiting (syrup of Ipecac) and administer purgatives (cathartics, laxatives) to speed the elimination of undigested fish.
2. In addition to the symptoms described above, other complications which may require treatment include hypotension and cardiac dysrhythmias.
3. Antiemetics and antidiarrheal agents may be required if gastrointestinal symptoms are severe. Atropine may be needed to control bradycardia. IV fluids may be needed to control hypotension. Calcium gluconate, diazepam, and methocarbamol can be given for muscle spasm.
4. Amytriptyline has been used successfully to resolve neurological symptoms such as depression.
5. Cool showers may induce pruritus (itching).

5C-4.2 **Scombroid Fish Poisoning.** Unlike ciguatera fish poisoning (see paragraph 5C-4.1), where actual toxin is already concentrated in the flesh of the fish, scombroid fish poisoning occurs from different types of fish that have not been promptly cooled or prepared for immediate consumption. Typical fish causing scombroid poisoning include tuna, skipjack, mackerel, bonito, dolphin fish, mahi mahi (Pacific dolphin), and bluefish. Fish that cause scombroid poisoning are found in both tropical and temperate waters. A rapid bacterial production of histamine and saurine (a histamine-like compound) produce the symptoms of a histamine reaction: nausea, abdominal pain, vomiting, facial flushing, urticaria (hives), headache, pruritus (itching), bronchospasm, and a burning or itching sensation in the mouth. Symptoms may begin one hour after ingestion and last 8 to 12 hours. Death is rare.

5C-4.2.1 **Prevention.** Immediately clean the fish and preserve by rapid chilling. Do not eat any fish that has been left in the sun or in the heat longer than two hours.

5C-4.2.2 **First Aid and Treatment.** Oral antihistamine, (e.g., diphenhydramine, cimetidine), epinephrine (given subcutaneously), and steroids are to be given as needed.

5C-4.3 Puffer (Fugu) Fish Poisoning. An extremely potent neurotoxin called tetrodotoxin is found in the viscera, gonads, liver, and skin of a variety of fish, including the puffer fish, porcupine fish, and ocean sunfish. Puffer fish—also called blow fish, toad fish, and balloon fish, and called Fugu in Japanese—are found primarily in the tropics but also in temperate waters of the coastal U.S., Africa, South America, Asia, and the Mediterranean. Puffer fish is considered a delicacy in Japan, where it is thinly sliced and eaten as sashimi. Licensed chefs are trained to select those puffer fish least likely to be poisonous and also to avoid contact with the visceral organs known to concentrate the poison. The first sign of poisoning is usually tingling around the mouth, which spreads to the extremities and may lead to a bodywide numbness. Neurological findings may progress to stumbling gait (ataxia), generalized weakness, and paralysis. The victim, though paralyzed, remains conscious until death occurs by respiratory arrest.

5C-4.3.1 **Prevention.** Avoid eating puffer fish. Cooking the poisonous flesh will not destroy the toxin.

5C-4.3.2 **First Aid and Treatment.**

1. Provide supportive care with airway management and monitor breathing and circulation.
2. Monitor anal function.
3. Monitor and treat cardiac dysrhythmias.

5C-4.4 Paralytic Shellfish Poisoning (PSP) (Red Tide). Paralytic shellfish poisoning (PSP) is due to mollusks (bivalves) such as clams, oysters, and mussels ingesting dinoflagellates that produce a neurotoxin which then affects man. Proliferation of these dinoflagellates during the warmest months of the year produce a characteristic red tide. However, some dinoflagellate blooms are colorless, so that poisonous mollusks may be unknowingly consumed. Local public health authorities must monitor both seawater and shellfish samples to detect the toxin. Poisonous shellfish cannot be detected by appearance, smell, or discoloration of either a silver object or a garlic placed in the cooking water. Also, poisonous shellfish can be found in either low or high tidal zones. The toxic varieties of dinoflagellates are common in the following areas: Northwestern U.S. and Canada, Alaska, part of western South America, Northeastern U.S., the North Sea European countries, and in the Gulf Coast area of the U.S. One other type of dinoflagellate, though not toxic if ingested, may lead to eye and respiratory tract irritation from shoreline exposure to a dinoflagellate bloom that becomes aerosolized by wave action and wind.

- 5C-4.4.1 **Symptoms.** Symptoms of bodywide PSP include circumoral paresthesias (tingling around the mouth) which spreads to the extremities and may progress to muscle weakness, ataxia, salivation, intense thirst, and difficulty in swallowing. Gastrointestinal symptoms are not common. Death, although uncommon, can result from respiratory arrest. Symptoms begin 30 minutes after ingestion and may last for many weeks. Gastrointestinal illness occurring several hours after ingestion is most likely due to a bacterial contamination of the shellfish (see paragraph 5C-4.5). Allergic reactions such as urticaria (hives), pruritus (itching), dryness or scratching sensation in the throat, swollen tongue and bronchospasm may also be an individual hypersensitivity to a specific shellfish and not PSP.
- 5C-4.4.2 **Prevention.** Since this dinoflagellate is heat stable, cooking does not prevent poisoning. The broth or bouillon in which the shellfish is boiled is especially dangerous since the poison is water-soluble and will be found concentrated in the broth.
- 5C-4.4.3 **First Aid and Treatment.**
1. No antidote is known. If the victim is fully conscious, induce vomiting with 30cc (two tablespoons) of syrup of Ipecac. Lavaging the stomach with alkaline fluids (solution of baking soda) may be helpful since the poison is acid-stable.
 2. Provide supportive treatment with close observation and advanced life support if needed until the illness resolves. The poisoning is also related to the quantity of poisonous shellfish consumed and the concentration of the dinoflagellate contamination.
- 5C-4.5 **Bacterial and Viral Diseases from Shellfish.** Large outbreaks of typhoid fever and other diarrheal diseases caused by the genus *Vibrio* have been traced to consuming contaminated raw oysters and inadequately cooked crabs and shrimp. Diarrheal stool samples from patients suspected of having bacterial and viral diseases from shellfish should be placed on a special growth medium (thiosulfate-citrate-bile salts-sucrose agar) to specifically grow *Vibrio* species, with isolates being sent to reference laboratories for confirmation.
- 5C-4.5.1 **Prevention.** To avoid bacterial or viral disease (e.g., Hepatitis A or Norwalk viral gastroenteritis) associated with oysters, clams, and other shellfish, an individual should eat only thoroughly cooked shellfish. It has been proven that eating raw shellfish (mollusks) presents a definite risk of contracting disease.
- 5C-4.5.2 **First Aid and Treatment.**
1. Provide supportive care with attention to maintaining fluid intake by mouth or IV if necessary.
 2. Consult medical personnel for treatment of the various *Vibrio* species that may be suspected.

- 5C-4.6 Sea Cucumbers.** The sea cucumber is frequently eaten in some parts of the world where it is sold as Trepang or Beche-de-mer. It is boiled and then dried in the sun or smoked. Contact with the liquid ejected from the visceral cavity of some sea cucumber species may result in a severe skin reaction (dermatitis) or even blindness. Intoxication from sea cucumber ingestion is rare.
- 5C-4.6.1 **Prevention.** Local inhabitants can advise about the edibility of sea cucumbers in that region. However, this information may not be reliable. Avoid contact with visceral juices.
- 5C-4.6.2 **First Aid and Treatment.** Because no antidote is known, treatment is only symptomatic. Skin irritation may be treated like jellyfish stings (paragraph 5C-3.4.4).
- 5C-4.7 Parasitic Infestation.** Parasitic infestations can be of two types: superficial and flesh. Superficial parasites burrow in the flesh of the fish and are easily seen and removed. These may include fish lice, anchor worms, and leeches. Flesh parasites can be either encysted or free in the muscle, entrails, and gills of the fish. These parasites may include roundworms, tapeworms, and flukes. If the fish is inadequately cooked, these parasites can be passed on to humans.
- 5C-4.7.1 **Prevention.** Avoid eating raw fish. Prepare all fish by thorough cooking or hot-smoking. When cleaning fish, look for mealy or encysted areas in the flesh; cut out and discard any cyst or suspicious areas. Remove all superficial parasites. Never eat the entrails or viscera of any fish.

5C-5 REFERENCES FOR ADDITIONAL INFORMATION

1. *Prevention and Treatment of Dangerous Marine Animal Injuries*, a publication by International Bio-toxicological Centre, World Life Research Institute, Colton, CA; November 1982; P.S. Auerbach and B.W. Halstead.
2. *Management of Wilderness and Environmental Emergencies*, Macmillan Publishing Co., New York, N. Y., 1983. Eds. P.S. Auerbach and E.C. Greehr.
3. *The Life of Sharks*, Columbia University Press, New York 1971. P. Budkur.
4. Commonwealth Serum Laboratories, 45 Poplar Road, Parkville, Melbourne, Victoria, Australia; Telephone Number: 011-61-3-389-1911, Telex AA-32789.
5. *Sharks*. Doubleday, Garden City, N.Y., 1970. J. Y. Cousteau.
6. *Fish and Shellfish Acquired Diseases*. American Family Physician. Vol 24: pp. 103-108, 1981. M. L. Dembert, K. Strosahl and R. L. Bumgarner.
7. *Consumption of Raw Shellfish - Is the Risk Now Unacceptable?* New England Journal of Medicine. Vol 314: pp.707-708, 1986. H. L. DuPont.

8. *Diving and Subaquatic Medicine*, Diving Medical Centre, Masman N.S.W., Australia; 1981, Second edition; C. Edmonds, C. Lowry and C. Pennefather.
9. *Poisonous and Venomous Marine Animals of the World*, Darwin Press Inc., Princeton, NJ; 1978; B. W. Halstead.
10. *Principles and Practice of Emergency Medicine*, W. B. Saunders Co., Philadelphia, PA; 1978, pp. 812-815; G. Schwartz, P. Sofar, J. Stone, P. Starey and D. Wagner.
11. *Dangerous Marine Creatures*, Reed Book Ptg., Ltd., 2 Aquatic Drive, French's Forest, NSW 20806 Australia. C. Edmonds.
12. *A Medical Guide to Hazardous Marine Life*, Second Edition, Mosby Yearbook, 1991, P.S. Auerbach.

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