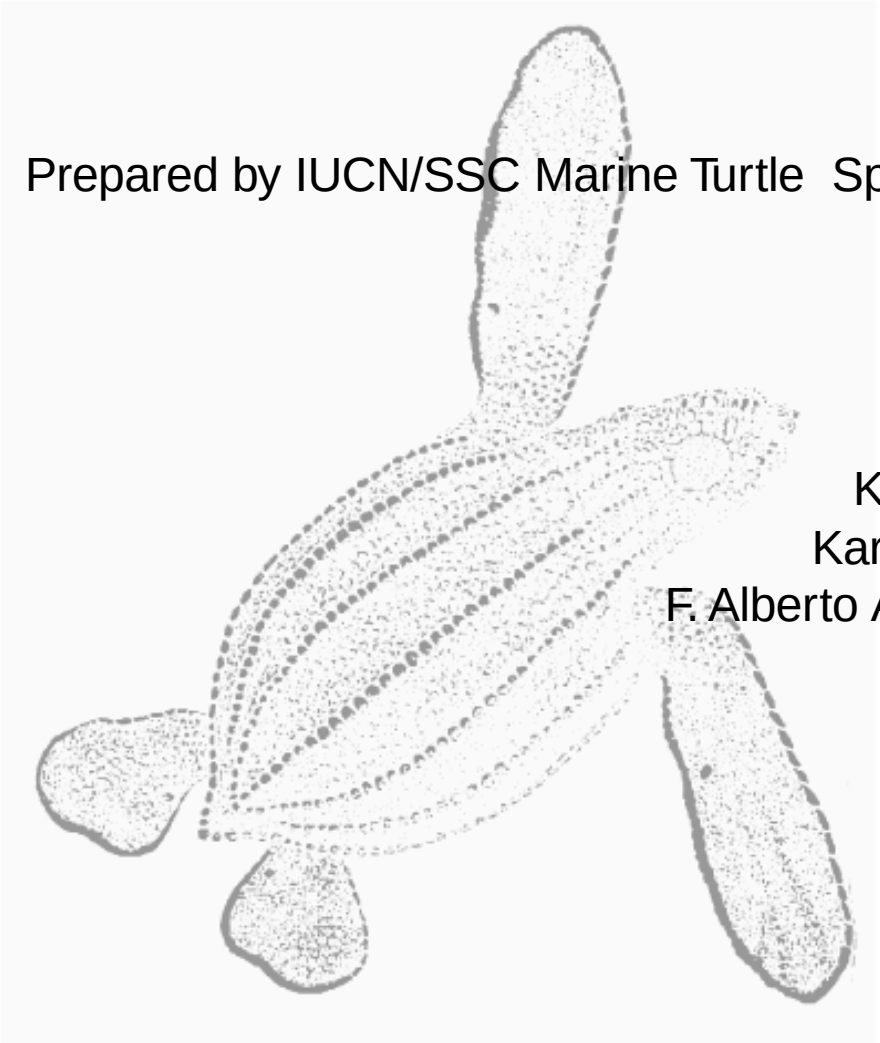
Research and Management Techniques for the Conservation of Sea Turtles

Prepared by IUCN/SSC Marine Turtle Specialist Group



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Preface

In 1995 the IUCN/SSC Marine Turtle Specialist Group (MTSG) published *A Global Strategy for the Conservation of Marine Turtles* to provide a blueprint for efforts to conserve and recover declining and depleted sea turtle populations around the world. As unique components of complex ecosystems, sea turtles serve important roles in coastal and marine habitats by contributing to the health and maintenance of coral reefs, seagrass meadows, estuaries, and sandy beaches. The *Strategy* supports integrated and focused programs to prevent the extinction of these species and promotes the restoration and survival of healthy sea turtle populations that fulfill their ecological roles.

Sea turtles and humans have been linked for as long as people have settled the coasts and plied the oceans. Coastal communities have depended upon sea turtles and their eggs for protein and other products for countless generations and, in many areas, continue to do so today. However, increased commercialization of sea turtle products over the course of the 20th century has decimated many populations. Because sea turtles have complex life cycles during which individuals move among many habitats and travel across ocean basins, conservation requires a cooperative, international approach to management planning that recognizes inter-connections among habitats, sea turtle populations, and human populations, while applying the best available scientific knowledge.

To date our success in achieving both of these tasks has been minimal. Sea turtle species are recognized as "Critically Endangered," "Endangered" or "Vulnerable" by the World Conservation Union (IUCN). Most populations are depleted as a result of unsustainable harvest for meat, shell, oil, skins, and eggs. Tens of thousands of turtles die every year after being accidentally captured in active or abandoned fishing gear. Oil spills, chemical waste, persistent plastic and other debris, high density coastal development, and an increase in ocean-based tourism have damaged or eliminated important nesting beaches and feeding areas.

To ensure the survival of sea turtles, it is important that standard and appropriate guidelines and criteria be employed by field workers in all range states. Standardized conservation and management techniques encourage the collection of comparable data and enable the sharing of results among nations and regions. This manual seeks to address the need for standard guidelines and criteria, while at the same time acknowledging a growing constituency of field workers and policy-makers seeking guidance with regard to when and why to invoke one management option over another, how to effectively implement the chosen option, and how to evaluate success.

The IUCN Marine Turtle Specialist Group believes that proper management cannot occur in the absence of supporting and high quality research, and that scientific research should focus, whenever possible, on critical conservation issues. We intend for this manual to serve a global audience involved in the protection and management of sea turtle resources. Recognizing that the most successful sea turtle protection and management programs combine traditional census techniques with computerized databases, genetic analyses and satellite-based telemetry techniques that practitioners a generation ago could only dream about, we dedicate this manual to the resource managers of the 21st century who will be facing increasingly complex resource management challenges, and for whom we hope this manual will provide both training and counsel.

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Rehabilitation of Sea Turtles

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Transport to Facility

Once rescued, ill or injured sea turtles should be transported to a primary care facility as soon as possible. Turtles should not be flipper tagged prior to evaluation because tagging can cause blood loss in severely anemic animals. Other procedures, such as gastric lavage (see Forbes, this volume), should also be avoided. Transport personnel are an integral part of the rescue effort and should always have essential information about the specifics of rescue and the condition and behavior of the turtle. If the medical facility is distant, individuals responsible for pickup and delivery should be educated in basic problems and complications of inappropriate care. Transport facilities should have containers of varying sizes that can comfortably hold different turtles. Fiberglass or plastic boxes are easily cleaned and can be reused. Containers with rounded corners and walls that slope slightly outward prevent a weakened turtle from crawling into a corner (or a straight wall) and obstructing breathing.

Historically turtles have often been transported on their backs to decrease movement, but this position can be very compromising to many individuals, and so all turtles should be moved in a plastron-down position. Because weak individuals can drown, turtles should not be transported in water, especially cool water during times of cold stress. The bottom of the carrier can be canvas-covered foam kept slightly moist. Moist towels can be placed over the carapace but must avoid obstructing breathing. The carapace and skin can be coated with lanolin or petroleum jelly (such as Vaseline) to avoid drying. Do not transport in open vehicles during excessive heat or cold; the best range of temperature for transport is 20-25° C. Turtles should not be picked up by their flippers. The turtle may be lifted by grasping both sides of the carapace (which can better support its weight) or by using a stretcher that provides adequate support and attachments for carry straps or poles.

Initial Presentation and Evaluation

A delay in therapeutic onset can be fatal to some individuals. At presentation the turtle is first visually evaluated. Visual inspection should categorize overall gross body condition as normal, underweight, or emaciated. While these are subjective categories, anatomic changes become obvious with experience. Turtles with severe weight loss have decreased muscle and fat tissue. In the neck area, the back of the skull has a prominent occipital process that becomes very obvious in thin turtles. In addition, bilateral dorsal and lateral neck muscle groups, which are often hidden among other tissues, become more obvious with weight loss. The soft tissue of the foreflipper and the shoulder area is decreased in thin animals. In very thin animals, the plastron may be sunken or appear indented centrally. Ulcerations of the skin of the plastron are also more common in chronically debilitated animals, and bony spicules of the plastron may perforate the skin and become evident. The eyes may appear sunken, especially when the head is elevated. Chronically ill turtles may be covered with barnacles, worms, and crabs. Leeches on the skin, eyes, mouth, and cloaca are sure signs of chronic illness.

Initial treatment will depend on the turtle's behavior. Turtles out of water may appear more inactive and non-responsive than they actually are. The clinical responses of a normal turtle when dry should be differentiated from sicker animals. While dry, observe respirations. A stronger animal usually picks up its head during breathing. It may also try to move away

from activity. When placed into a pool of water, flipper movement is coordinated, and the head is raised to a 45° angle with each breath. A short, monitored swim test, if the turtle is strong enough, will help in the evaluation if the clinician is not sure of the behavior. Individuals who are thin, do not pick up their head in water to breathe, are uncoordinated, and/or float with their flippers dangling in the water, should be maintained out of water initially. When out of water, it is best if they are kept in a walled container which is padded with foam and covered with canvas as described above. Wet towels may be used over the shell except when temperatures are below 20°C and there are no heating blankets. A light coating of lanolin, vitamin A and D ointment, or petroleum jelly can be used to avoid drying of the shell and skin.

Diagnostic Techniques

After initial evaluation, a blood sample is taken (see Owens, this volume) for a complete blood count and serum chemistries. Until these values are available, a rapid glucose determination is made with a glucose strip, Chemstrip bG (Boehringer Mannheim Corp., 9115 Hague Road, Indianapolis, Indiana 46256 USA). Additionally, a packed red cell volume and total protein can be important indices with which to begin treatment. Complete blood counts (CBC) and serum chemistries, although expensive, should be done on each ill animal because they lead to more efficient diagnosis and treatment. Anemia is common in sick turtles and hampers therapy. Local hospitals may donate some of their services although they will not have the background for initially interpreting the CBC. Radiographs (X-rays) are also essential. Bacterial cultures of wounds and feces may provide some insight into the types of organisms present. Feces should be examined for the presence of parasitic organisms. Cytologic evaluation of the colon may also be helpful in determining the presence of infection and inflammation.

Treatment Techniques

Hypoglycemia

A weak turtle may be hypoglycemic which may be determined by Chemstrips and verified by serum chemistry. Normal serum glucose levels range between 70-120 mg/dl, but can vary in healthy individuals (such as females that are laying and are thin - Brenda Lee Philips, pers. comm., 1996). Individuals that are thin or emaciated and have glucose levels <60 mg/dl should be considered candidates for treatment with glucose supplements by one of the following methods:

1. Oral supplementation depends partially on the ability of the turtle to transfer glucose-containing material (liquid or gruel) to the intestinal tract for absorption. The patient must be somewhat stable, allowing time for complications, such as regurgitation or constipation, to become evident. If the intestinal tract is functional, the turtle may be given up to 1 ml of 50% dextrose per kilogram of body weight 3-6 times per day. This solution should be diluted with ringers, saline or gruel to make the solution less hypertonic. Unfortunately this volume may be difficult to administer in recently hospitalized turtles, and care must be taken to balance the oral approach with serum glucose levels. Esophageal tubing can result in upper intestinal food buildup, regurgitation and aspiration of food, especially in turtles kept out of water. Personnel involved in these procedures should be experienced because of the potential for treatment related complications. During the procedure, the turtle is placed in a vertical heads up position either in a support or held by personnel as discussed in a later section. If possible, the turtle should first be tubed with plain water marked with food coloring to see if it can hold down fluids. If it must be placed dry, it should be maintained at a 45 degree angle to avoid aspiration.
2. Intravenous glucose administration is often the method of choice for severe hypoglycemia in other animal species . Though it can be used, this procedure has numerous disadvantages, including loss of the catheter, difficulty in placement and maintaining integrity when the animal becomes active, and the need for increased manpower and trained personnel. Interosseous administration is another possible method, but requires experienced medical personnel and constant monitoring (Howard Krum, pers. comm., 1996). If not carefully monitored, parenteral fluids can result in dilution of the blood in severely anemic patients.
3. Intracoelomic cavity glucose has been used to treat moderate to severe hypoglycemia. The turtle is placed on its back with its caudal shell elevated to allow the intestinal tract to slide forward. A 20 gauge needle, angled at 30 degrees anterior dorsal, is inserted slowly in the

anterior inguinal region. A 5% glucose solution has been administered to approximately 40 individuals at 11-17 ml/kg body weight depending on the level of serum glucose. This method is used to buy time to allow oral supplementation to be effective. As in every fluid supplementation procedure, veterinary supervision is needed to prevent overhydration and electrolyte problems. Blood samples for glucose determination should be taken at least every 12-24 hr to ascertain treatment response. This is our preferred method for initial stabilization. If the individual does not initially absorb the glucose as evidenced by no response and a continued low serum glucose, then a bolus should be given intravenously. This has been seen most commonly (about 10%) in young emaciated greens. As soon as possible, oral supplementation should piggyback and then replace injectable methods.

Nutritional Supplementation

Tube feeding is a common treatment in nutritionally debilitated individuals, but it has limitations. The basic technique involves placement of a flexible tube into the distal esophagus which connects via a left turn with the stomach. As a result of the turtle's anatomy, the material is delivered to the esophagus in a smaller volume than expected. The turtle is placed at a 45-90 angle with its head up and extended, which straightens the esophagus allowing easier passage. The tube is lubricated, and the mouth is maintained in an open position with a bite block which is covered with rubber to avoid damaging the beak and oral area. Care must be taken not to hyperextend the temporal mandibular joint. The amount of liquid or gruel given will depend on the turtle's size and coordination. As a guide, a 3-4 kg turtle may only be able to keep down 10 ml of gruel initially. If weak, the turtle should be maintained at a 45 angle for 5 min to facilitate movement of the material.

To avoid regurgitation and aspiration, the turtle should be placed back in the water as soon as possible; avoid tipping the head lower than the body. Very weak animals may fare better with thicker materials which are less likely to reflux over the glottis. Turtles that are too weak to stay in the water continually can sometimes be placed in water 1-5 min after eating to allow them to safely reflux any excess materials. Some material may be expelled in the water through the nose which does not indicate aspiration. Individuals that are too weak to place in water can be maintained with the head and body slightly elevated.

While initial feedings may seem discouraging, generally the amount can be increased over a few days. The number of feedings per day are determined by the condition and blood glucose status of the animal. A low residue elemental diet called Vital (Vital HN, Ross Products Division, Abbott Laboratories, Columbus, Ohio 43215-1724 USA) is often substituted for glucose solutions. This diet provides energy with carbohydrates and protein which can be absorbed without having to be processed by the liver. Turtles that are not thin and have normal glucose levels may be fed 3 times per day and should be weighed twice a week until stable or gaining weight. Others may require 3-4 feedings per day, and turtles with low glucose may need up to 6 low volume feedings per day when requiring chronic glucose supplementation. These animals should be weighed every day or at least every two days to keep therapy on a responsive time schedule.

Treatment Considerations

Treatment of ill or injured turtles may require additional therapy beyond food, shelter and antibiotics. A debilitated individual is not only deficient in protein and fat but may have inadequate tissue stores of minerals and vitamins. Young green turtles *(Chelonia mydas)* commonly have extremely low calcium levels coinciding with soft shells. These individuals respond well to calcium supplementation, initially by giving calcium gluconate subcutaneously until the animal can be supplemented orally. The need for this supplement may also be suggested by high levels of muscle enzymes on the serum panel. These animals often have a severe myositis that may be related to a number of factors that may include nutritional debilitation and secondary muscle fatigue. In addition, vitamin E is supplemented orally at 20-30 I.U.'s of dl-alpha tocopheryl acetate per kilogram of body weight once a day for one week and then every other day for one to two weeks. Additional research is being conducted to further clarify the levels needed.

If the turtle is maintained on a predominately fish diet, a multi-vitamin (Mazuri Vitamins, Purina Mills, Box 66812, St. Louis, Missouri 63166-6812 USA) is given per instructions, based on the amount of fish being ingested. A B-complex injection is also given which includes thiamine at a dose of 0.6-1.0 ml per 22 kilograms of body weight once. This is also fol-

lowed up with oral multi-vitamin supplements as mentioned above.

Severely anemic animals may benefit from vitamin K supplementation. Initially 0.5mg/kg body weight may be administered usually once. These individuals may also be iron deficient when compared to other normal individuals. A safe dose of iron has not yet been determined but 0.5 mg/kg of elemental iron per day split for 10 to 14 days has not resulted in excessive serum levels. Iron should be used with caution and under veterinary supervision.

Constipation has been found as a common sequelae to emaciation, dehydration, and debilitation in young green turtles. Loggerhead turtles *(Caretta caretta)*, usually adults, often have large amounts of shell debris in the lower intestinal tract. Initially loggerheads were treated with surgery, but survival was poor since they tended to have severe anemia and emaciation. They were found to be poor surgical candidates unless they were also given blood transfusions.

An alternative medical solution (for constipation) is intestinal stimulants such as metachlopromide (Danbury Pharmaceutical Inc., Danbury, Connecticut 06810 USA) at 0.5 mg/kg orally every 48 hr, or, if the animal cannot feed, by injection at 0.3 mg/kg once per day. This schedule works best when combined with mineral oil on alternate days. The oil can be used at a rate of 2.2 to3 ml/kg body weight in small individuals. Oil should be used only after it is shown that the turtle will be able to keep it down by first giving the turtle water orally. It can also be administered in gelatin capsules. Turtles should be placed in water after being given oil to avoid aspiration. Larger turtles may not need as much oil on a per kilo of body weight basis. A 45 kg turtle may only require 1.0 ml/kg. Caretakers should note on a daily basis if the animals are defecating. The life support systems for sea turtles are heavily impacted by oil, and a foam fractionator can help to mitigate the problems. When feces are not observed and therapeutic success is in doubt for re-establishing normal gut motility, barium can be administered orally at a dose ranging from 5 to 15 ml / kg of a 30 % solution to evaluate intestinal movement. Individuals that can not handle this volume may require several smaller doses.

Many turtles tend to have noticeable parasite loads, such as young green turtles with tissue trematode infestation and loggerheads with trematode and nematode involvement. Ill turtles may not be able to deal with the addition of large numbers of parasites so all individuals should be treated for trematodes and nematodes. We currently use fenbendazole for nematodes at dose of 50-100 mg/kg once and repeated in 2 weeks, and praziquantel at 16 mg/kg once then repeated in two weeks for trematodes.

Basic Facilities

The main focus for most rehabilitation programs is to return animals to the environment where they originated. In general the more successful rehabilitation facilities combine basic husbandry methods, hardworking employees and experienced veterinary personnel. Most facilities can easily be compromised if there are too many animals being retained longer than necessary. Turtles should be returned after attaining adequate health that will maximize survival or when traumatic problems have been successfully treated.

Facilities should include pools, with filter systems if not oceanside, and systems to cool or heat the water. Pools should be low maintenance and easy to clean, adapt and repair. Most facilities use above ground fiberglass pools because of lower expense. With age, seam areas may begin to peel, and turtles can ingest pieces of fiberglass, so caretakers must regularly inspect pools. Filtration systems may be sand and/or cartridge based when required. While flow through systems near shore have many advantages, they are prone to complications from the source including temperature, surrounding water quality, and biohazards such as red tide or pollution. Water temperatures should range between 22 and 26 C. Temperatures above 28 C may lead to lethargy and loss of appetite. Roofing or shade-screening over pools can minimize excessive heat and sunlight and protect from temperature extremes. Young turtles may also benefit from having 50% of their pool covered to allow them to hide. This seems to decrease stress levels, especially in young greens.

Salinity levels are usually maintained at 32-36 ppt. Lower salinity levels can be used to influence hydration and removal of leeches and barnacles, but this is usually recommended where serum sodium levels are elevated above normal. This may indicate a hydration imbalance or intake of saltwater. Excessive salt intake is normally handled physiologically by excretion in healthy turtles, but their capability may be compromised during illness. Lower salinity may be used to aid turtles with excessive buoyancy but can force others to work harder to stay at the surface. Changing salinity levels for short periods may also help control bacteria that are used to high salinity. Turtles should not be left in fresh or brackish water for extended peri-

ods of time without checking serum electrolyte levels.

Chlorine has been used in closed systems (those not constantly adding new water) for short periods to aid in control of severe skin and shell infection. Levels of chlorine up to 1 ppm appear to be beneficial.

Trauma

Watercraft Injuries

Propeller injuries may range from mild to severe and include head lacerations, eye injury, injury to limbs, and carapace lacerations and fractures. The wounds are initially examined for depth and extent of damage. Debris is often present, so the wounds may need to be flushed with sterile saline. Chronic, partially healed propeller wounds may be associated with secondary problems such as emaciation and increased buoyancy. These wounds may have retained dead bone and pockets of debris trapped deep in the tissue connected to the surface by fistulous tracts. Externally the wounds may appear healed, but any small openings should be examined for possible connection to debris channels.

Rapidly moving boats may strike the head or carapace resulting in fractures. Injury to the carapace can also involve fractures to the spinal column which is often complicated with buoyancy problems. Clinically these turtles may do well for extended periods or may have recurrent problems with granulomatous disease of deep tissues. If the spinal cord is damaged, there can be an increased incidence of constipation and colitis. Shell injuries historically have been treated by a variety of methods. The use of acrylic, fiberglass or other hard patch techniques for shell repair has decreased. While these methods may stabilize the wound, a sealed shell defect may also trap debris and inhibit healing. Most shell fractures require 2-6 weeks for damage tissue to be delineated. Hard patch material must be removed to maximize healing and promote normal shell calcification and repair. If a method of shell stabilization is required it should allow regular debridement of the wound.

Most traumatic wounds of the carapace respond well to the Tegaderm® technique. The wound is cleaned, debrided if necessary, and flushed with 5% betadyne solution (if not penetrating the lungs). The shell surrounding the wound is cleaned and dried. The exposed soft tissues are covered with a Vaseline-based triple antibiotic ointment avoiding the wound edges. A sheet of Tegaderm® (3M Health Care, St. Paul, Minnesota 55144 USA) is applied over the wound with 1.5 cm overlap onto dry shell. Multiple pieces of Tegaderm® can be used by overlapping portions on the wound center. All edges of the Tegaderm® that are exposed are then glued to each other and to the shell with cyanoacrylate glue *(e.g.,* Superglue - Loctite Corp., Cleveland, Ohio 44128 USA). The glue is allowed to dry for a few minutes, and then the turtle can be returned to the water. The bandage can be removed at regular intervals, usually once a week, for cleaning and then reapplied.

Wounds will not heal if the turtle's body condition is not adequate to support tissue replacement or, if it is continually losing weight. Proper shell repair may require many weeks of therapy, and turtles should not be turned loose with hard patches such as fiberglass.

Cold-stunning

Increased numbers of turtles may be brought in for rehabilitation when water temperatures fall below seasonal norms for extended periods. These individuals may range from thin to visually in good flesh, are often lethargic, hypothermic, in some cases hypoglycemic, and may have other problems such as septicemia. Initial evaluation should include body temperature. The goal is to elevate the body temperature to a preferred physiologic level. For turtles with short-term exposure that are still coordinated and able to pick up their heads in water, being placed in warmer salt water is often adequate. Water at 26 C is often adequate and can be slowly increased if needed. Animals that are chronically affected, thin, and nonresponsive may require heat supplementation with water heating pads. Treatment techniques used in other species include warm water enemas (difficult in turtles) and IV fluids (also difficult). Another technique that can be used is warm intracoelomic fluid, although this should be combined with an exogenous source of heat and continued body temperature evaluation. Cold stunning effects seen in one area may differ from those seen in another.

Blood samples should be taken from nonresponsive turtles for complete blood count, chemistries, and a rapid determination of glucose level. Care must be taken not to overheat the turtle by providing a cloth barrier between the patient and heating pad. Water based pads are preferred. Regularly check the pad and body temperature. Protect the carapace and skin from drying out by using lanolin or vaseline. Avoid water

soaked cloth material unless it can be kept warm. Antibiotics may not be needed for acutely affected animals although use in nonresponsive turtles should be addressed with the veterinarian involved.

Fishing Hooks and Debris Ingestion

Fishing hooks may cause severe injury with the most damage done in the upper intestinal track, especially the esophagus. This may include retained hooks, perforation, and laceration. Diagnostic techniques may include visual inspection radiology (X-rays) and endoscopy. Removal may be accomplished by hand, endoscope, or surgery. Esophageal surgery is often difficult because of post-surgical complications, but it may be required. Every turtle that is rescued should be considered a possible victim of debris ingestion, including plastic material and monofilament line. Plastic bags and debris may cause intestinal blockage, and monofilament line or rope may result in blockage or perforation. Radiography may be a useful diagnostic technique although plastic material may not show on X-rays.

Exposure to Oil

Turtles exposed to oil-based compounds may suffer from external contamination and/or ingestion. External oils and tar can be removed by washing with dish detergent *(e.g.,* "Dawn") or with vegetable oils. Oral residue can be broken down by the use of organic fats such as mayonnaise. If ingestion is suspected, charcoal-containing compounds may decrease absorption of hydrocarbons which can cause organ damage. Additional supportive therapy such as fluids may also be helpful. Serial blood samples can help to direct therapy.

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