Training Manual

GOI-UNDP-GEF Sponsored Training Programme

Dealing with Marine Mammals Stranding In India

CENTRAL MARINE FISHERIES RESEATRCH INSTITUTE

(*INDIAN COUNCIL OF AGRICULTURAL RESEARCH*)

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DEALING WITH MARINE MAMMALS STRANDING IN INDIA

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Dealing with Marine Mammals Stranding in India

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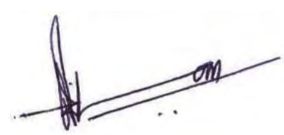
Foreword

Whenever a Marine mammal gets stranded, the local people, who often are the first witnesses, may not be aware of how to handle these marine mammals or know of the proper authorities to contact. Different protocols have to be followed depending on whether the animal is healthy and needs to be returned to the sea, or if it is injured or weak and requires treatment or euthanasia. If a dead animal is washed ashore then proper necropsy studies should be undertaken to determine the cause of death. The Central Marine Fisheries Research Institute has therefore compiled this field manual on "Dealing with Marine Mammals Stranding in India" to address the lack of protocols in India for handling a stranded marine mammal or for necropsy studies of a dead animal.

Building a network of volunteers who can assist in marine mammal strandings and ensuring proper coordination among them will improve the scenario at the stranding site with better documentation of data and samples collected. This stranding manual gives a clear picture about how to tackle a marine mammal stranding situation. Minor descriptions about the biology and sample collection techniques are also provided, which will aid in improving our understanding of these animals. There are lots of interesting facts yet to be unearthed, and I hope this manual will enhance our understanding of the biology of these species.

I wholeheartedly complement Dr. M. Sakthivel, Dr. G. Gopakumar, Sh. S. Ramkumar, Sh. Vaibhav Mhatre and Sh. Sachin T Jose for their studious efforts in bringing out this field manual.



July, 2014

A. Gopalakrishnan
Director

Acknowledgement

The main source of technical information for preparing this manual on Dealing with Marine Mammal Strandings in India were obtained from the published works of Joseph R. Geraci and Valerie J. Lounsbury entitled Marine Mammals Ashore – A field Guide for Strandings published by Baltimore Aquarium., Not much study was carried out in preparing this manuscript, most of the information has been either partially or completely sourced from the aforesaid book, with extensive use of Technical Reports published by U.S. Department of Commerce NOAA NMFS. Some of the Anatomical and Physiological aspects of marine mammals were sourced from Functional Anatomy of Marine Mammals written by R. J. Harrison, published in three volumes and The biology of Marine Mammals edited by Herald T. Anaderson – these two books were helpful in understanding the physiological changes that a marine mammal undergoes when it is stranded and how to deal with it, these two books explained in detail also most all of anatomical aspects of the marine mammals which was helpful in preparing the sample collection manual and euthanasia section. Some of the text and images were taken as it is from the books of Joseph R. Geraci and Valerie J. Lounsbury, as no replacement could be found for these images, every images used in this manual has been duly acknowledged.

Since this manual preparation is exclusively for capacity building and training purpose and lack of proper information regarding marine mammal strandings in India, there was no other go but to partially or completely follow a certain reputed book. Hence, this manual is a compilation of existing works carried out by reputed authors in the field of Marine Mammal Strandings. The resources obtained from the above mentioned sources are duly acknowledged at every stage with due credits given to the authors and their work. Moreover, this manual is purely for educational purpose, especially prepared for GOI-UNDP-GEF pilot project on Capacity Building of local officials of Sindhudurg district in Maharashtra on Stranded and Beached Cetaceans. This manual is purely for training and capacity building purpose and supplied free of cost. It is not an authentic work by the authors in the field of Marine Mammals.

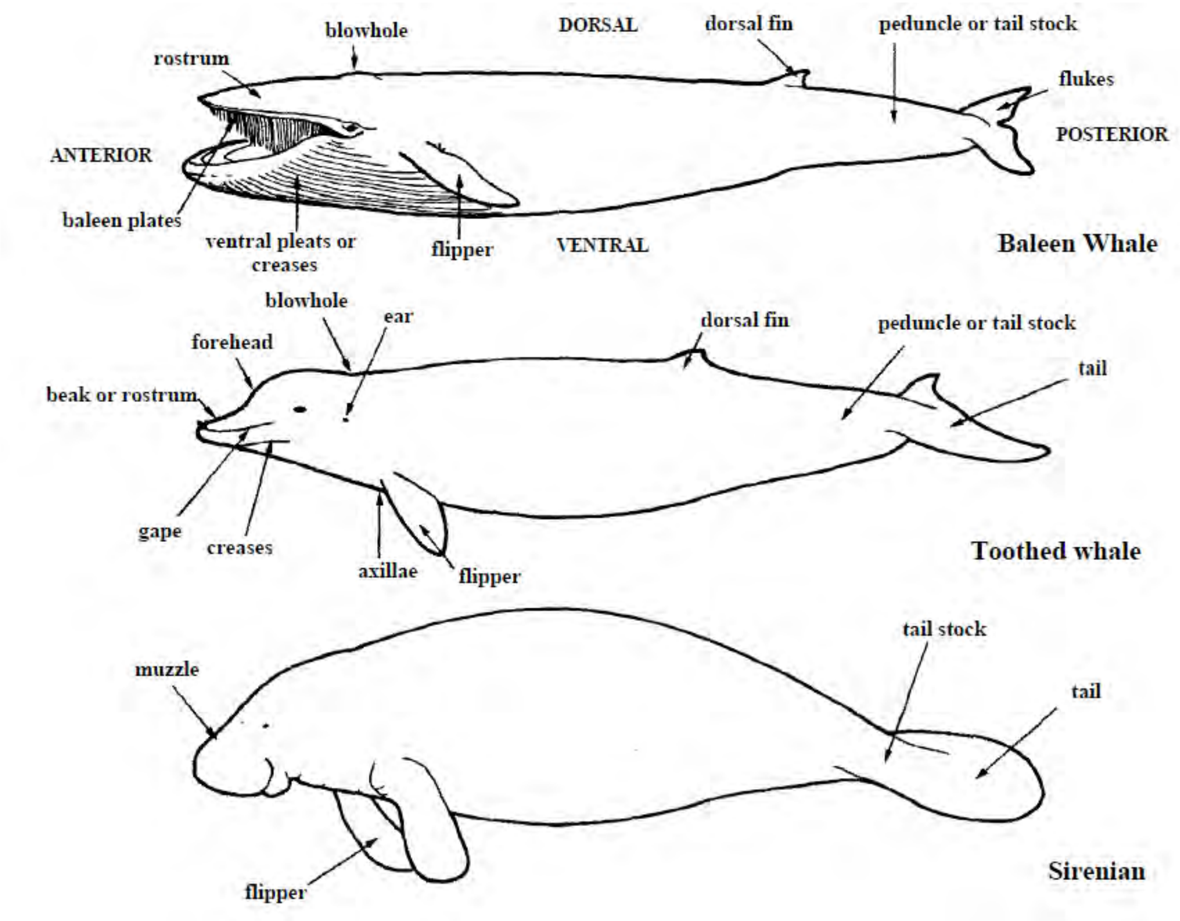
Contents

Introduction

Marine mammals – such as whales, dolphins, porpoises and sea cows have long been considered to be some of the most spectacular and majestic mega fauna on earth. For generations, they have captured the attention and imagination of people and cultures all over the world. Despite their beauty and the awe they inspire, virtually every species of marine mammal is listed as threatened or endangered, largely due to the direct and indirect impacts of human activities. Hundreds of years of aggressive hunting, combined with habitat destruction, marine noise, chemical pollution and increased shipping traffic have reduced populations to just a fraction of their original numbers. Several species are facing imminent extinction. In recent years, there is increasing awareness of the integral importance of marine mammals to healthy aquatic ecosystems, and of the growing threats that a variety of human activities pose to these animals and their environments.

All marine mammals have undergone major adaptations, which permit them to live in the water. The cetaceans (whales, dolphins and porpoises) and sirenians (dugongs – sea cow) spend their entire lives in the water, while other marine mammals come ashore for various reasons, at particular times in their life cycle. Every year, thousands of cetaceans and sirenians are found stranded, either alive or dead, on beaches all over the world. They may be alone or in groups, and while some animals are old or sick, many of them are young and appear to be perfectly healthy. This is a natural phenomenon and has been happening since time immemorial, but all such stranded cetaceans and sirenians face the grave danger of an inability to breathe. Whales and dolphins are often very social mammals, some exhibiting high levels of cognition. Many live in complex and little-known communities, are capable of experiencing a range of emotions and have been demonstrated to be sentient and sapient beings. They will suffer physically as a result of being out of the water for prolonged periods of time, an experience which is undoubtedly psychologically stressful for these marine mammals.

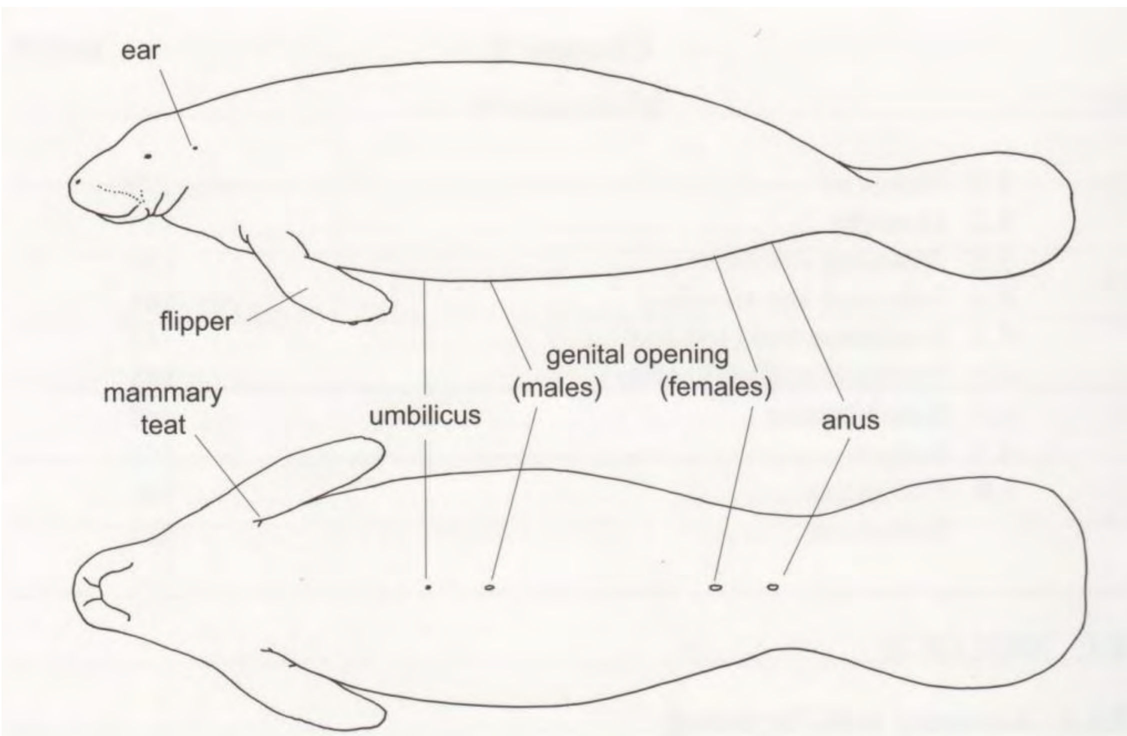
Certain stranding of cetaceans is easy to explain: the animals simply die at sea and are washed ashore ('cast ashore') with the tides and currents. But live stranding is more mysterious, and many theories have been put forward to explain their possible cause. One theory is that changes in the earth's magnetic field cause an animal to lose its sense of direction. Cetaceans may have an extra sense called bio-magnetism, which enables them to detect variations in the earth's magnetic field. They may use the magnetic field, like a map, to navigate. The field is always changing, so, occasionally, they could become confused and swim towards the shore. Alternatively, an earthquake or storm could cause it to panic; a brain infection may cause disorientation; its sonar system may fail; or it may simply get lost or feel sick and need to rest. In mass stranding, the whole group may be in trouble in some way, or they may be following one individual that is ill or disoriented.



External features of Cetaceans and Sirenians

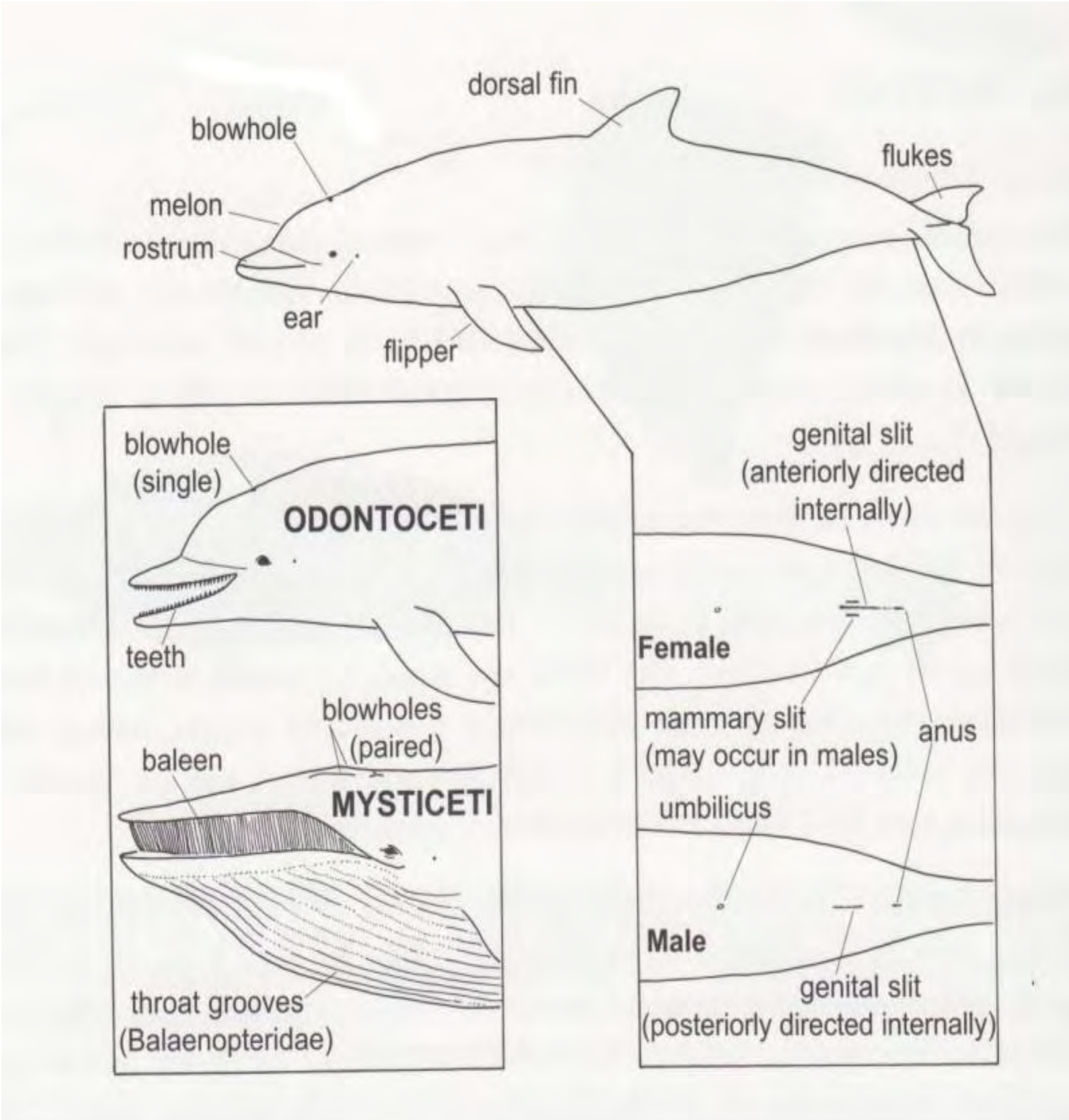
In most cases, the animals are still alive when they first become stranded, usually on gently shelving beaches. Post mortem operations often reveal an injury, infection or debility which must have caused discomfort and made it difficult for the whale to behave normally in deep water. Under these circumstances, faced with the risk of drowning, it would be natural for the cetacean to seek a place where it could continue to breathe while marshalling its strength to deal with other problems. Swimming about above a level, shallow bottom may lead to disorientation and to an inability to find the way back out to deeper waters. Large societies require elaborate systems of social cohesion and communication, and it is these which lead to mass stranding. The initial cause of a single stranding may be illness (perhaps caused by parasites), injury, the birth of a calf too close to shore, evasive action under the threat of predation or a simple accident. Some whales are more susceptible to stranding than others, for example, pilot whales seem to strand more often than most.

In India most of the marine mammal records come from stranding and accidental catch in trawls and purse seine. There are two main habitats of marine mammals in India, *viz.,* Arabian Sea on the western coast with a wide continental shelf and constant salinity and Bay of Bengal with narrow continental shelf and fluctuating salinity. Both the habitats provide optimum living condition for tropical marine mammals as there are few Islands which offer less hindrance in their movement. Arabian Sea is rich in bio-resource and offers enormous food (most important are squid and shrimp) to hungry whales and dolphins. The Gulf of Mannar, the Gulf of Kutch and the Andaman and Nicobar group of Islands have lush growth of sea-grass where the sea cows show their dominance.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

External morphology of Sirenians



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

External morphology of toothed (odontocete) and baleen (mysticete) whales. The genders can be distinguished by the difference in the configuration of the genital fold; the male usually has two openings, one behind the other, separated by a bridge of tissue. The female has a longer, more prominent slit which encompasses the closer-spaced genital and anal openings and is flanked by a small slit on each side containing the nipples. An object inserted into the genital opening of a female will be directed toward the head, and in a male, toward the flukes

In this training manual, the various options have been dealt with for dealing with stranded cetaceans from the first approach on the beach, to immediate release, to euthanasia for those beyond hope, and to disposal of carcasses.

Stranding/Beaching - Perspectives

Defining a Stranded Animal

A "strand" is a beach, or land bordering a body of water, and stranded is defined as having run aground. The latter term also describes any creature having been left in a helpless position, such as a marine mammal that falters ashore ill, weak, or simply lost. The expression mass-stranded, while not so enshrined in convention, generally refers to a simultaneous stranding of two or more cetaceans other than a female and her calf.

Mass die-off refers to mortality on a large scale. The term does not describe the cause of death, the number of species involved, nor whether any animals came ashore, but merely the outcome. Mass die offs have resulted from rapidly spreading viruses such as influenza and phocine distemper, parasitic infection, and long-term ingestion of algal toxins. Each of these events has brought hundreds or thousands of animals ashore, but none in the manner that could be called a "mass stranding".

Since shore is not the only place where a marine mammal is helpless, a stranding is routinely defined as an animal that cannot cope in its present situation or borrowing from aviation vocabulary - one that is outside its survival envelope. That includes orphaned dependent offspring, a dolphin swimming aimlessly. This enlarged concept of stranding calls for help as a preventive measure and highlights the quandary of deciding when to act. Some writers distinguish between stranding and beaching, the latter referring to animals cast ashore already dead. For scientific purposes it is useful to adopt that distinction when it can be made, that is, when the animal's condition on arrival is known. Otherwise, the common tendency is to use "stranded" for any live or dead specimen.

Why do marine mammals strand?

In most stranding cases, the cause of stranding is unknown, but some identified causes include:

- Disease
- Parasite infestation
- Harmful algal blooms
- Injuries due to ship strikes
- Fishery entanglements

- Pollution exposure
- Trauma
- Starvation

In addition, stranding often occur after unusual weather or oceanographic events. In the past few years, increased efforts in examining carcasses and live stranded animals has increased our knowledge of mortality rates and causes, allowing us to better understand population threats and pressures.

What information is gained from necropsies of stranded marine mammals?

If a stranded marine mammal has recently died, then a significant amount of valuable information can be gained from it. For instance:

- Complete pathology to investigate diseases and parasites
- Reproductive biology data
- Life history (what does the animal eat, how long do they live, how many calves do they have, how old are they when they first reproduce)
- Pollution
- Normal biology and physiology parameters

These types of sampling opportunities also help validate and increase understanding and interpretation of data collected from wild populations.

Physiological perspectives on stranded animals:

Adjusting to the marine environment required the modification of numerous body systems. The proficient divers – cetaceans and sirenians – demonstrate a host of anatomic and physiologic adaptations for efficiently acquiring, storing and utilizing oxygen. Some of the more apparent features are:

- Lungs made firm and “springy” by small coils of cartilage that encircle the airways throughout, permitting the lungs to virtually snap open after a dive
- A large volume of blood that is quite dark owing to its rich supply of oxygen-carrying haemoglobin
- An expansive circulatory system with intriguing reservoirs (thoracic rete in cetaceans) for storing blood until it is needed, or for re-routing it elsewhere
- Muscles that are dark, often nearly black with myoglobin, a pigment that can store extra oxygen for release during long dives

Cetaceans rely on blubber, a tissue that is mostly fat. By regulating blood circulation, a marine mammal is able to deal with extreme variations in temperature when swimming from the surface to the bottom or from one region to another. Blubber has other important roles besides providing insulation. The tissue is buoyant and enables the animal to remain at the surface to breathe and rest there without effort. Marine mammals drink little sea water and draw most of their fresh water from food. During fasting, or when prey is scarce, fat from the blubber is released for energy, and, like that in a camel's hump, produces crucial fresh water as a by-product.

The skin of all marine mammals is impervious to sea water. To achieve this impenetrable state, the epidermis of cetaceans employs extraordinary cells tightly woven into an architecture that is unique among mammals. The adrenal gland's response to stress in cetaceans also serves to protect the animals from surrounding sea water. Aldosterone released from the adrenal cortex causes the animal to retain its own salt and water, freeing it from the need to drink any quantity of sea water. By this mechanism, an animal in stress becomes physiologically isolated from the external environment.

These adaptations enable a baleen whale to migrate thousands of kilometres over several months while fasting, a sperm whale to breath-hold for hour-long dives to 2,000 meters or more. On the other hand, failure of a system can jeopardize the tenuous shield protecting the animal from its environment. An animal that cannot eat for whatever reason becomes thin. With less blubber, it must work harder simply to stay afloat and keep warm, thereby burning more energy that depletes more fat - it's only remaining source of nourishment and water. The life-draining spiral tightens rapidly, and its effect can be seen in animals that come ashore to strand. Many are emaciated, dehydrated, and exhausted.

Of what interest is a stranded animal?

As the shore developed into a fashionable dwelling place, the occurrence of a whale on a beach must have been a curiosity at best, and at worst a nuisance. But they had value, too. Stranding furnished some of the first cetaceans for live displays and were a source of specimens for museum exhibits and curios for coastal dwellers. The existence of some marine mammal species is known only from stranding. Details accumulated over the years have furnished pictures of growth rates, age at maturity, gestation period, birth intervals, reproductive season, and longevity of numerous species.

How this scientific information relates to conservation measures and policy depends on the species. The animals that strand most commonly are generally those that are most abundant. In fact, releasing one carrying infectious organisms is apt to be harmful. The rescue of an endangered Cetacean is another matter; every addition will have a measurable effect on the very small population. Still, only time may tell whether reintroducing any creature that was "weeded out" in the first place is, in the long term, beneficial to the wild population.

The average person today would not respond to a stranding merely because the animal has some scientific value. More often, we are moved by the humane need to help an animal in distress. Beyond that, marine mammals have taken on a new role that is reflected in the way we view them and how we react when any one of them comes ashore. Dugongs crippled by boats are a steady reminder of how we indulge our recreational activities at the expense of wildlife. Any mass stranding of whales is certain to rekindle arguments over the possible role of pollutants, of which the ocean has plenty. Marine mammals, it seems, have become a totem of our battle for a fresh, clean environment. We search the beaches for evidence of casualties and find stranded animals. We can only speculate on how many are victims of our excesses, but each and every one of them help us keep the vigil.

Development of Stranding Response Networks:

The vast body of literature on stranding consists mostly of reports of single animals. To be truly valuable, data have to be collected in a consistent way, on the greatest possible number of specimens, and over a long period of time. Only then can the information contribute to an understanding of the size, shifts or movements in a population, and factors underlying natural mortality. It is unlikely that any new stranding plan can be developed without borrowing extensively from previous thought and experience. Hence, developing the 'Stranding Response Networks' will provide optimum solutions to deal with these situations.

Dealing with stranded animals on the beach

In many cases a stranded cetacean will be unable to return to the sea without help. If you find a stranded animal, inform the local police or Forest Department officer first. All marine mammals are protected under Indian law. If the stranded animal is alive, get expert help before trying to make it more comfortable. If it is dead, do not touch the carcass.

When to Intervene?

Not every animal on the beach needs help. Recognizing normal behaviours will avert any unnecessary action. Certain conditions demand attention such as; Dugong with crippling propeller wounds is by any measure disabled and cannot recover without help. The same may be true for an animal in impending danger, for example: finless porpoise trapped in a fishing weir. Their peril is not as immediate as that of a dolphin on a hot beach, but they are nonetheless in difficulty and have a better chance of surviving if given some attention.

In time, every would-be rescuer faces an animal in circumstances that are ambiguous, in which the risk to health is debatable, and any action taken is certain to be questioned. What should be done for a lone young bottlenose dolphin marooned or a humpback whale that may (or may not) be too far upriver to find its way back. Deciding what action to take in these situations requires an understanding of the animal's natural history, what typically happens when such animals are left alone, and intuition that comes only with experience (and mistakes). In making any decision, we should keep in mind that a rescue effort is notice to the public and authorities that the animal needs help, whether it really does or not. These kind of uncertain situations, beyond all others, require firm planning with the help of experienced colleagues.

What Are the Options?

Once the decision is made to intervene, three options for immediate action are to return the animal to sea, transport it to a care facility, or euthanize it. The decision is simple when dealing with a healthy stray that needs only to be returned to a suitable habitat, or, at the other extreme (euthanasia), an animal that is clearly beyond help.

Most situations are more complex, and managing them must take into account, among other things, the likelihood of success and the safety of the operation. The "Decision" begins with the broadest question common to all situations – is there enough help available? From there, a series of criteria will guide the approach one might use in most circumstances. As the options are weighed, the most important maxims are to protect human health and safety and to take no action that will only prolong suffering.

CRITERIA FOR MAKING DECISIONS:

Logistic Support:

Almost anything is possible with adequate resources; little or nothing can be done without them. An experienced, organized, and well-equipped response team is of paramount importance. Involvement of volunteers with little or no training must necessarily be limited to non-hazardous activities. Good planning will ensure that the required level of support and expertise is available, and help to guarantee the success of the operation. Attempting too much with too little, causes needless risk to both the workers as well as animals. Dragging a pilot whale across a rocky beach for lack of a decent carrier, or holding a Dolphin in an unventilated box are harmful actions, and unnecessary if help is only an hour away.

How Many Animals?

A small animal on an accessible beach usually requires simple straightforward action-few persons and little equipment-whereas a sperm whale or mass stranding is certain to stretch resources and demand an organized response.

Environmental Conditions:

The action plan must take into account the time of day, beach topography, sea state and weather conditions. The terrain may be too rocky, muddy, or littered with sharp debris to drag animals safely or use vehicles. Remote locations are naturally more difficult to manage. Harsh terrain, rough seas, darkness, or simply a rising tide can increase the risk to animals and the team, and impede the rescue effort. Severe weather may force a change in plans, limiting one's options to observing the animal, offering minimum protection, and euthanizing it when conditions are appropriate.

Cetaceans are prone to hyperthermia. Their dark colours absorb heat, and blubber retains it. Circulatory adaptations for cooling are not efficient on land and break down completely with the onset of shock. For many reasons, the larger the animal, the greater the problem. Adding to hyperthermia are dehydration from hot winds and the destructive effects of sunburn. A cetacean on a hot beach requires immediate attention.

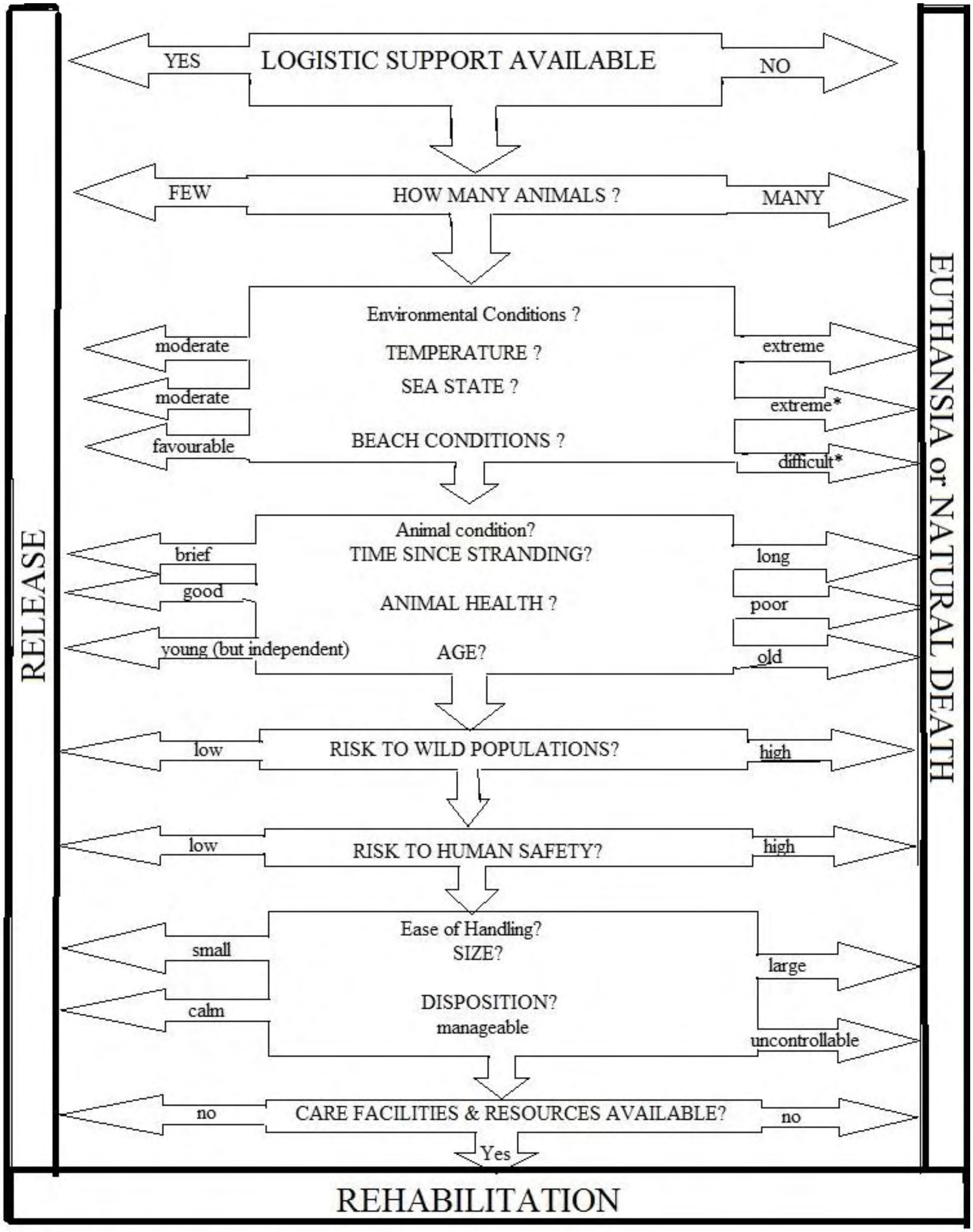
Cold temperatures can affect those with insufficient blubber-a characteristic of many of the dolphins that come ashore. Small animals are more vulnerable to cold stress because their surface area is large compared to their mass. Sand is irritating to the eyes and mouth, and can be blown with enough force to etch glass, scour paint, and injure tissues of the animals and their attendants.

Animal Condition:

A healthy animal is resilient, whereas one that is ailing may not survive the ordeal associated with the rescue. However, it is not always possible to distinguish between the two from their outward appearance. In fact it may be difficult to determine at a distance whether a whale is living, much less in good health. Marine mammals seldom display expressions or postures suggestive of pain or discomfort, or abnormal behaviour unless seriously ill. The body contour of cetaceans is formed largely by blubber, which retains its basic shape even when the animal has lost weight. For the most part, the health of an animal can be determined only after rigorous clinical examination.

Singly stranded odontocetes are usually ill as well, or may be separated from a vital social group. The fate of these animals after release is uncertain. Larger, older animals generally decline in health more rapidly than smaller ones. Large size is detrimental to beached cetaceans because of the proportionally damaging effects of mass and gravity.

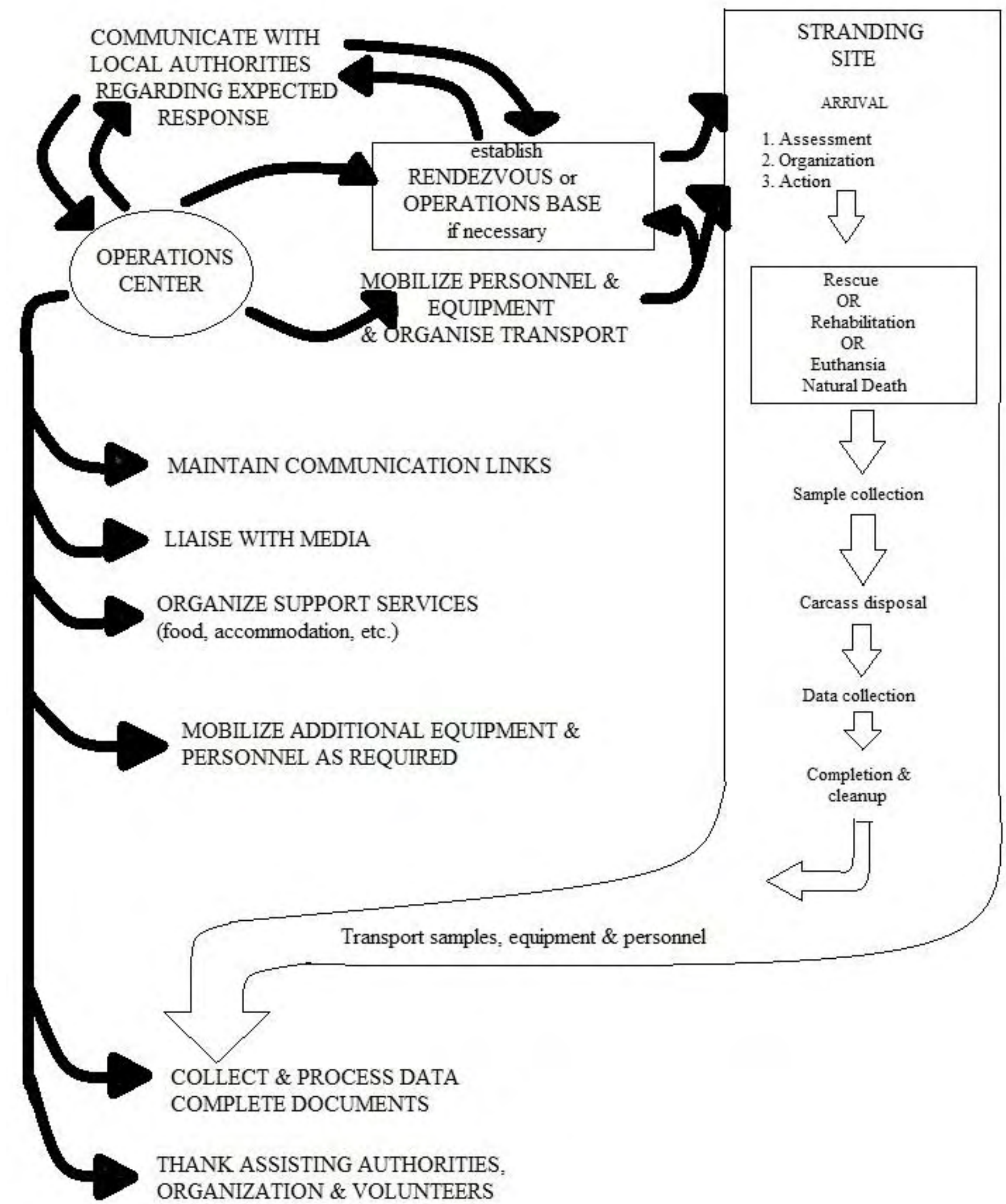
Prompt action can slow but not entirely arrest the deterioration of an animal's health on the beach. Before returning any animal to sea, consider that the process of recovery may take longer than environmental conditions will allow.



(* or wait for improved conditions)

Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammals Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Decision Guide for Live Animals

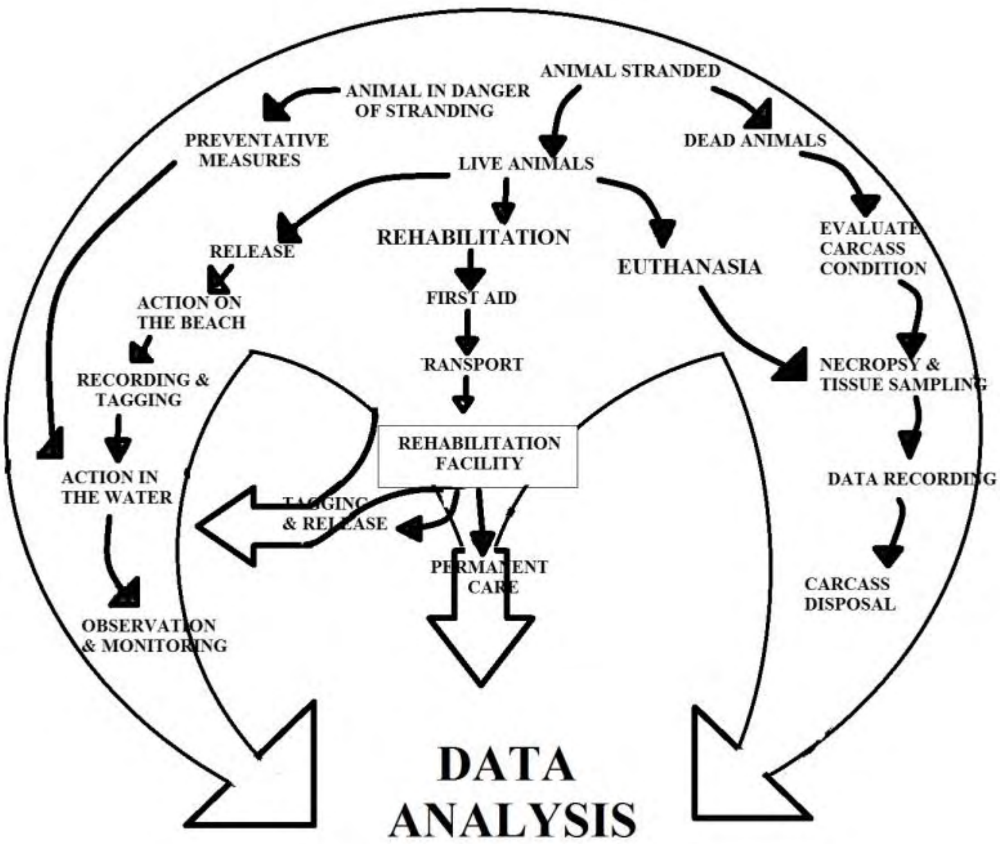


Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammals Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Stranding Response

Ease of Handling:

The ability to approach, handle and move an animal depends on its size and demeanour. Some are small enough to be picked up by hand, have the disposition of the family dog. At the other extreme are animals that are too cumbersome to move without unacceptable risk. Little can be done for a large whale cast high and half buried on a silted beach. Most circumstances lie somewhere in between. When in doubt, consider first the interest of the animal and the safety of the attendants.



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Options for responding to stranded cetaceans

Immediate Release as an Option:

Return to sea is an option when:

- The animal is manageable and logistic support adequate
- Beach and environmental conditions are favourable

- The animal is healthy and able to function normally
- Social requirements can be met (e.g., maternal care for young)
- The area of release is within the natural range, suitable (out of harm's way) and navigable

Singly stranded odontocetes are usually poor candidates for immediate release. Whether or not to release a large whale or smaller mass stranded cetaceans will be determined almost entirely by the available logistic support. When dealing with the latter, attention should be given first to younger animals, those in good health, and those on the beach for the shortest time. Before returning animals to sea, a plan should be in place for visual or electronic monitoring.

Rehabilitation as an Option:

Rehabilitation is an option when:

- There is a good chance the animal can be restored to health.
- Facilities are available and equipped for the species and number of animals involved
- Arrangements can be made for safe and expeditious transport
- The animal is manageable and poses no major risk to others or to facility staff
- There are sufficient funds and staff to provide care for a reasonable period.

Euthanasia as an Option:

Euthanasia is an option when:

- It is necessary to end suffering of an animal in irreversibly poor condition
- The decision can be made and the action directed by an experienced, qualified person
- Essential materials and equipment are available
- The procedure can be carried out humanely
- No rehabilitation facility is available for orphaned dependent young
- Rescue is impossible and no care facility is available
- Animals persistently re-strand
- A distressed cetacean ashore is likely to attract others milling nearby to mass strand.

Euthanasia for marine mammals is a contentious issue, much more so than the accepted practice of terminating the life of a pet or other domestic animal. Anyone facing this option should be prepared for opposition from both the public and other team members. The Animal Welfare Act defines euthanasia as the humane destruction of an animal, using a method that produces near instantaneous unconsciousness and rapid death without evident pain or distress, or using anaesthesia to produce painless loss of consciousness.

Intravenously administered anaesthetic agents and euthanasia preparations that have been used successfully in small cetaceans satisfy this definition; other approaches (e.g. firearms, suffocation) may not, particularly on large whales. A clumsy attempt to euthanize an animal without adequate equipment or expertise can cause more suffering than a natural death, and promotes greater reluctance to accept euthanasia as a humane alternative.

In practice, public response influences the method of euthanasia, not necessarily because of humane considerations, but for aesthetic reasons. Consider the reaction to shooting a whale or draining a whale of its blood on a public beach. These considerations aside, there is often philosophical opposition to euthanasia. Some find the practice unacceptable under any circumstance. Others, including team members, may be unwilling or unprepared to accept this action after having struggled earlier to save the animal's life.

At the stranding site, the topic of euthanasia must be broached with tact and consideration. Members of the response team, the general public and the media should be informed of the procedure in all its dimensions: the reasons, the approach, and possible complications. Euthanasia must be carried out or supervised by experienced, qualified personnel with a detailed plan and adequate resources.

Single Stranding

BIOLOGICAL FEATURES:

Anatomy:

The Cetacea are the oldest and most diverse group of marine mammals, with fossil evidence dating back at least 40 to 50 million years. All living families of baleen (suborder: Mysticeti) and toothed (suborder: Odontoceti) whales recognized today had evolved by 5-25 million years ago. The Artiodactyla, or even-toed ungulates, are the cetaceans closest terrestrial relatives.

Cetaceans have fusiform, streamlined bodies, with paddle-like flippers used for steering, balancing and stopping, but not for moving forward. That action is powered by both the upward and downward movement of the tail or flukes. Most species have a dorsal fin, which serves as a stabilizer. The flukes and dorsal fin are mostly composed of dense connective tissue but no bone. Streamlining is aided by the smooth, rubbery skin, generally lacking in glands and hairs, and the absence of protruding ears and hind limbs and, in males, of external genitalia.

Odontocete teeth are usually closely spaced, uniform in shape and size, and bear growth rings in cross section that are useful for estimating the age of the animal. Mysticetes have, instead of teeth, a series of baleen plates suspended from each side of the upper jaw. Hair-like bristles on the inner edges of these keratinous plates intertwine, forming a sieve that filters food from the water. The color, number and length of the plates can be used to help identify the species.

The nose, or blowhole, is situated on top of the head, somewhat to the left of the mid-line in odontocetes. The nostrils are paired in mysticetes and single in odontocetes. The nasal passages of the latter contain an interconnected series of air sacs that are involved in sound production. A unique arrangement of the larynx allows odontocetes to swallow and breathe at the same time. The lungs are symmetrical, without external lobulation, and turgidly elastic; the pleura are unusually thick and well-vascularized. There is a well-defined lung-associated lymph node.

The cardiovascular system has a unique adaptation of arteries and veins, known as the periarterial venous rete, which helps the animal regulate body temperature. Each artery at the surface (particularly evident in the flukes, flippers and dorsal fin) is surrounded by a network of veins, all encased in a rigid channel of connective tissue underlying the dermis. When there is a need to retain body heat, arterial blood flows to the surface under low pressure and returns along the surrounding venous rete, which absorb heat from the central artery. To cool, blood flows under high pressure, thereby collapsing the surrounding veins against the rigid tunnel walls, and returns instead by superficial veins that lie closer to the surface of the skin. The vessels in the flukes are the usual sites for blood sampling.

The gastrointestinal tract has some unusual modifications. The esophagus is penetrated dorso-ventrally by the laryngeal tube. In most species, food must pass to either side of this structure to reach the three-chambered stomach; in pygmy sperm whales, the left side is a blind pouch and food must pass to the right of the laryngeal tube. Digestion begins in the first stomach (fore stomach), actually an enlargement of the distal part of the esophagus, aided by enzymes and hydrochloric acid that reflux from the second (fundic) chamber. Undiluted acid in excess can produce ulcers in all chambers (particularly the first), a condition often seen in starving stranding. The third (pyloric) stomach secretes mucus and prepares the food for intestinal digestion. In odontocetes, the first and second chambers often contain nematodes, and it is not unusual for the second and third chambers to have a mucosal surface embedded with grape-like structures, each containing the trematode, *Braunina cordiformis*. The intestinal tract of odontocetes is not visibly organized into small and large intestines and in small animals it can measure 20 to 30 m in length. Mysticetes have a distinguishable colon.

Other notable features include the absence of a gall bladder, a peculiarly small and firm spleen, which may be accompanied by one or more even smaller accessory spleens, and a long chain of large mesenteric lymph nodes. The kidneys are elongated and lobulated, and the urinary bladder small. The testes are intra-abdominal and lie ventral to the kidneys. The testes in Phocoena and certain other species become so enlarged during the mating season that they exceed the kidneys in size and weight. Veins carrying cool blood from the dorsal fin and flukes are juxtaposed to arteries supplying the testes; the resulting cooling action allows the production and storage of viable sperm under otherwise unsuitably high body temperatures.

Natural History:

Life histories vary widely among species and even among geographic stocks. Some factors, including age at sexual maturity, lactation period and calving interval, are also influenced by external conditions such as population density and food availability, and are therefore subject to change.

The smaller odontocetes have shorter life spans and accelerated reproductive cycles compared with the larger species. The Porpoises, with a life span of only 7 to 15 years, becomes sexually mature at age 4 to 6 and has a gestation period of 10 to 12 months, followed by 6 to 8 months of nursing. Sperm, killer and pilot whales, at the other end of the range, possibly live to 60 years or more; they reach sexual maturity at 8 to 10 years. The pregnancy lasts 14 to 16 months, and calves may nurse for 2 years or more; the females of such species may have a long post reproductive life.

Baleen whales evolved reproductive cycles that are synchronized with annual migrations between low latitude winter calving grounds and high latitude summer feeding areas. Quite in contrast with the large odontocetes, these massive animals mature relatively young (4 to 10 years), carry the fetus for only about 10 to 12 months, nurse for a brief 4 to 10 months, and reach ages of 50 to 80 years or more.

The social structure of odontocetes is diverse. Some species, such as Porpoises, are usually seen singly or in pairs. Others, spinner dolphins for example, form highly organized schools that provide for them the benefits of cooperative foraging, protection from predators, and a safe neighbourhood for rearing their young. Not all highly social species mass strand, but mass stranding always involve social species, such as pilot, sperm and false killer whales. Baleen whales have a different social organization and, except for mother-calf pairs, appear to lack the binding dependence evident in odontocete schools. They occur alone or in loose aggregations, with behaviourally interacting units consisting of about 2 to 6 animals. Circumstances may force small groups of mysticetes to founder ashore, but in the true sense, these animals do not mass strand.

Although most odontocete species feed primarily on schooling fish and squid, many also include shrimp, crabs, and bottom-dwelling fish and invertebrates in their diets. Animals of the same species may have definite food preferences. For example, some pods of killer whales feed exclusively on fish, while others prefer marine mammals. Mysticetes are adapted to foraging on prey that can be engulfed and strained from the water - dense patches of krill (euphausiid and copepod crustaceans) and small schooling fishes such as capelin and menhaden.

Distribution:

More than 30 species of cetaceans and one species of sirenian occur in Indian waters. Fin and sperm whales and Risso's dolphin, among others, are wide-ranging and have far different stranding patterns than animals with a more restricted distribution. Pelagic species such as beaked whales may be seen at sea so rarely that their description relies entirely on stranding records.

MORTALITY:

Natural Mortality:

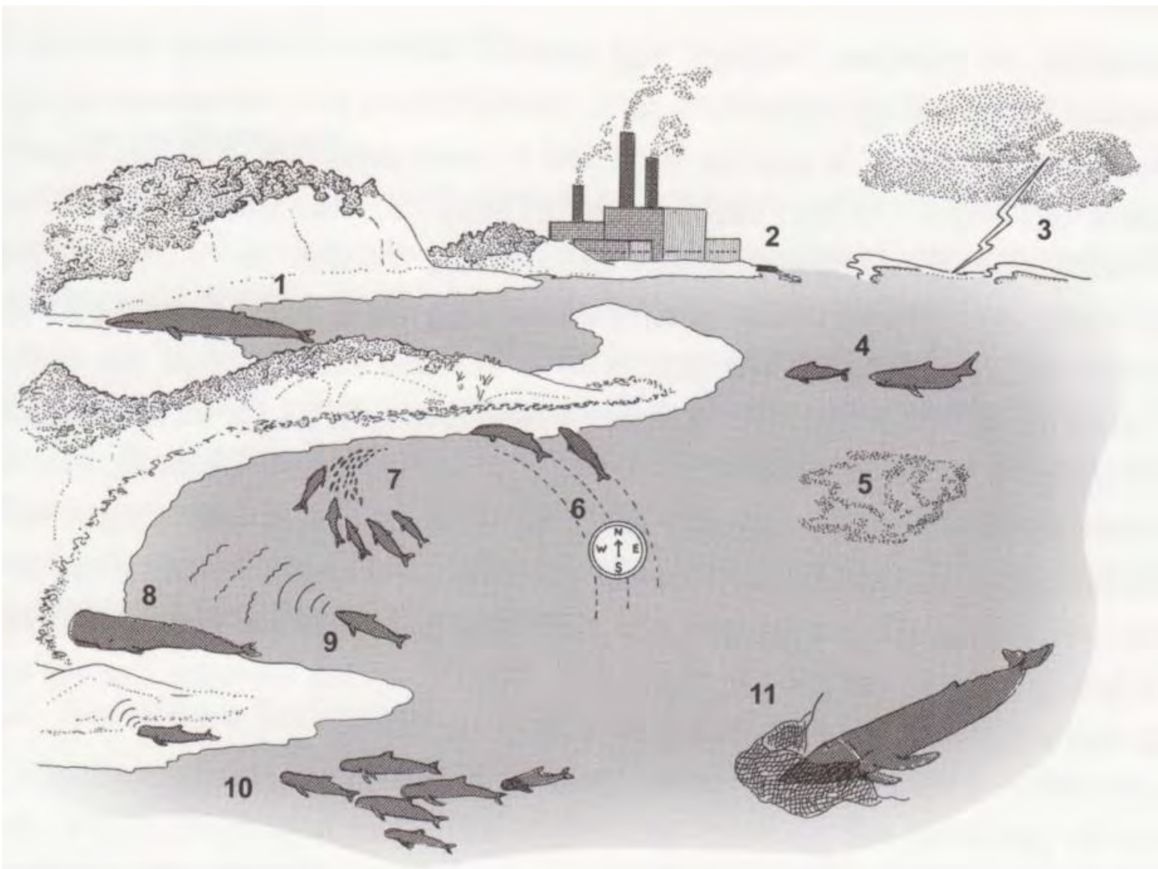
Little is known about natural mortality in cetaceans, because it is difficult to garner such basic information as population size, calf production and survival data, and accurate age estimates. Following the general mammalian pattern, mortality is high in the very young, decreases sharply with maturity, and increases again in advanced age. Species that provide longer maternal care have greater juvenile survival. Mortality rates seem higher in males than females in species presumed to be polygynous (*i.e.*, dominant males mate with a number of females), including pilot and sperm whales.

Nearly every cetacean beyond the age of a new-born has parasites; some may even be acquired *in-utero*. Some parasites play an arguable role in disease and mortality. Nematodes that reside seemingly innocuously in lungs and stomach can overwhelm a host facing other stressful conditions. Aberrant migrations of trematodes through the brain have been linked to stranding of common dolphins. Damage to the bones of the head, caused by nematodes of the genus *Crassicauda*, has been linked to mortality of young pan-tropical spotted dolphins. Other species of *Crassicaud*a injure renal blood vessels and mammary tissue, perhaps with serious effects. Small respiratory tract nematodes of the genus *Stenurus* are commonly found in the auditory or eustachian tubes, middle ears and cranial sinuses, but there is no firm evidence for the popular notion that they precipitate stranding.

Cetaceans have been found with cardiovascular problems, lung diseases not associated with parasites, nutritional disorders, and infections caused by a range of opportunistic pathogens. These conditions simply reflect the broad range of illnesses facing any species, and none is regarded as having population-wide effects.

However, certain large-scale threats are becoming identified. The recent outbreak of morbillivirus infection that killed at least 750 striped dolphins, *Stenella coeruleoalba*, in the

Mediterranean suggests that viruses may have long been overlooked as possible causes of mass mortality. Fourteen humpback whales died near Cape Cod after eating fish that contained saxitoxin produced by the marine dinoflagellate, *Gonyaulax tamarensis* (responsible for paralytic shellfish poisoning in humans). Brevetoxin produced by *Gymnodinium breve* was implicated in the mass mortality of bottlenose dolphins along the Atlantic coast during 1987-1988. If these events are linked to human-induced changes in the environment, they may foreshadow an emerging trend in cetacean mortality.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Possible causes of cetacean stranding. 1. Complex topographic and oceanographic conditions. 2. Pollution. 3. Weather conditions. 4. Predators. 5. Natural toxins. 6. Geomagnetic disturbances and errors in navigation while following geomagnetic contours. 7. Following prey inshore. 8. Disease. 9. Disturbance of echolocation in shallow water. 10. Social cohesion. 11. Human-related injuries

Human-Related Mortality:

Cetaceans too often become trapped in fishing nets. Entanglement associated with coastal fisheries is a serious threat to the finless porpoises and dugongs throughout much of its range. It is also a significant cause of injury and death to humpback whales. Pelagic fisheries are harmful to offshore species. Large numbers of spotted and spinner dolphins, among others, are taken in purse seines and drift-nets.

Oil spills, like other forms of pollution, contribute to overall degradation of habitat, can influence prey abundance and diversity, and may increase stress and susceptibility to infections. Some cetacean populations have accumulated high levels of contaminants that are tentatively linked with disease, including tumors and reproductive disorders.

STRANDING PATTERNS:

Coastal animals that reside in an area or migrate through it seasonally have a stranding pattern that is predictable and more or less consistent. Bottlenose dolphins strand throughout the year. These trends have a long history that is rooted firmly in the biology of the species. More recently, traditional patterns have become complicated by human activities that are less direct and not always predictable - for example, a coastal fisheries operation that, when in full swing, may have a serious impact on local cetaceans.

Stranding patterns are not quite as evident for pelagic species although correlations with locations, tides, storms, geomagnetic disturbances and other factors have been proposed. Some species follow the inshore migration of prey. Animals that strand in a cluster over a period of a few days may be victims of poisoning, infectious disease, intensive local fisheries operations, or unusual environmental events. These episodes can be of such short duration that the ultimate cause may no longer be evident by the time the investigating team takes action.

The mother/calf bond is strong and may remain so long after the end of lactation. Consequently, if both come ashore, it may be impossible to determine what led the way. Young males of some social species may appear alone at predictable times of the year. For example, juvenile dolphins, suggesting they may have been lost or displaced from a bachelor group. There is evidence that yearling *Tursiops* come ashore alone after being displaced from the herd during the breeding season.

Animals that wander beyond their normal range make unusual appearances in bays or far up river, always generate public interest. Public sentiment may override any consideration as to whether intervention in these cases is necessary, justifiable or even possible.

STRANDING RESPONSE:

Evaluating the Event:

A cetacean may be observed swimming dangerously close to shore. If there is no obvious injury or disability and intervention is deemed necessary, attempts can be made to direct the animal back to sea. This has been done by using boats and chains of people (under calm conditions) as a means of herding, and by creating disturbance and underwater noise (slapping the water's surface or striking objects together below it, using boat engines). Under the best of conditions, it is difficult to sustain the effort needed to herd an animal a long distance, and there is a good chance it will come ashore somewhere else, probably close to the original site. If the animal is seriously debilitated, no amount of effort is likely to avert the eventual stranding.

The response team's appropriate course of action for a stranded cetacean will depend on the animal's size, age and health, the available support, environmental conditions, and the time on the beach. The options are to tag and release the animal if it is healthy, transport it to a facility for medical attention, euthanize it, or let it die naturally. Decisions should be timely and the action swift to relieve the animal of progressive injury and discomfort.

Except for obvious abnormalities, it is not always possible to judge the health of a cetacean by its outward appearance. Even sophisticated tests may not reveal the nature of the illness, and such analyses take more time than the beached victim can spare. When circumstances do not permit an exhaustive examination, certain broad assumptions can be made to anticipate the animal's health. These assumptions are based on an understanding of life history and historical stranding patterns.

Coastal animals such as *Tursiops*, expected to be familiar with the nearshore environment, usually strand singly only when ill, although they may be occasional victims of an outgoing tide. Unless it's a simple case of re-floating, their only reasonable chance of survival is in a care facility. Some offshore animals have characteristic illnesses. *Delphinus* frequently strand because of terminal brain damage caused by the trematode *Nasitrema*; even with the best medical care, there is little chance they will recover.

Many pelagic specimens come ashore in apparent good health, or at least free of recognizable disease. Smaller ones on the beach for only a short period of time have a reasonable chance of withstanding the rigors of being returned to sea although their long-term survival is undocumented. The larger the animal and the longer it lies on the beach, the less likely it is to survive after release. Nothing can be done to save a whale too large to handle with the available resources, or one that has suffered prolonged exposure. The animal should either be euthanized or left to die naturally; the latter is becoming more unacceptable to the general public.

Specific Equipment:

Much of the equipment required for cetacean stranding is geared to moving or supporting the animals. Any specimen beyond the size of a small pilot whale will require heavy equipment. Many devices specifically designed for moving cetaceans have been cumbersome and impractical to use.

Basic equipment will generally prove to be the most useful. These items include:

Foam pads or mattresses	Tarpaulins sheets
Towels or blankets	Zinc oxide
Shovels	Ropes
Buckets	Slings
Water sprayers	Stretchers and poles
Inflatable rafts	Heavy machinery (cranes, front-end loaders)

Approach:

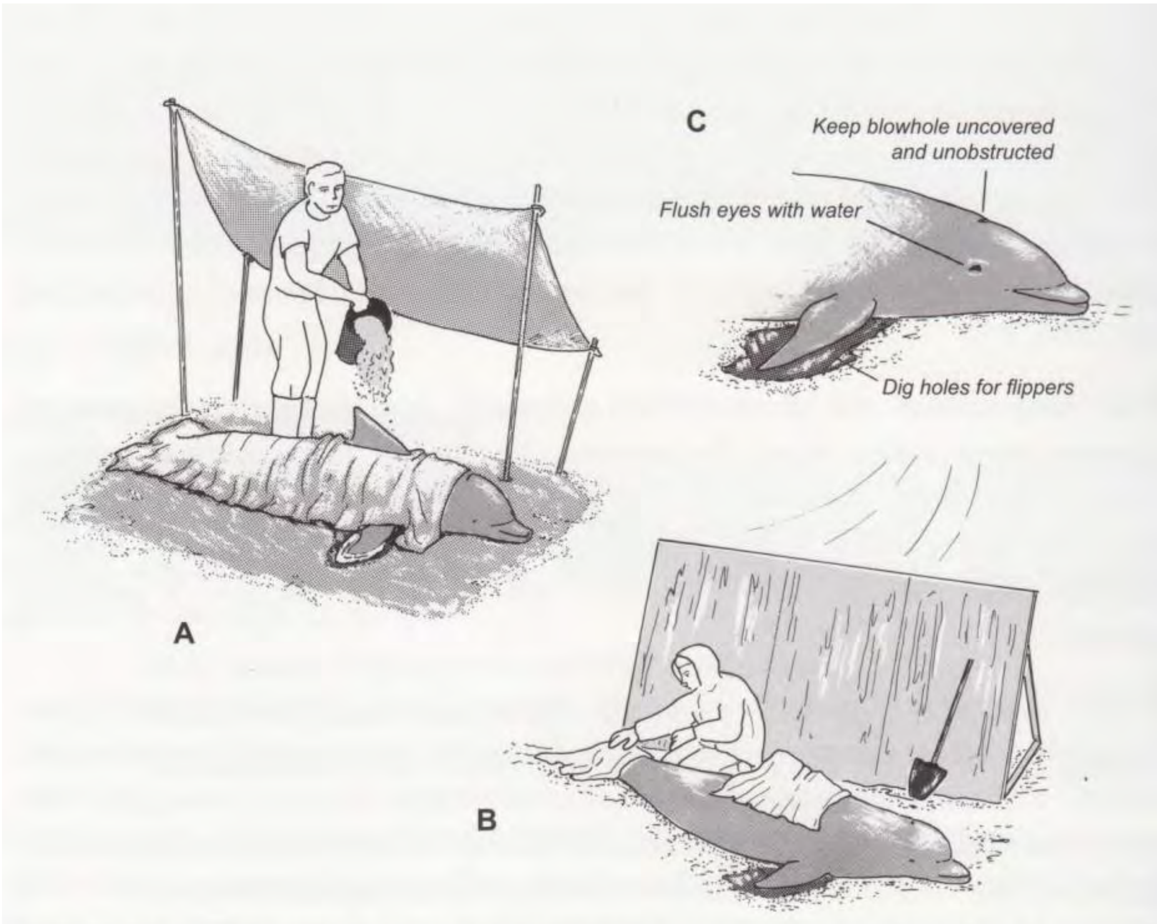
Observe the animal's behaviour and prepare a safe plan before making the approach. Advance slowly, calmly and cautiously, avoiding loud or startling sounds, abrupt movements, or bright lights. This will allow the stranding to become gradually accustomed to your presence. The animal is not likely to be aggressive, but people have been bitten accidentally, and the thrashing flukes of a confused whale have wrecked more than one knee joint. Only persons with experience should approach the animal, keeping well clear of the flukes and mouth. Animals may panic in certain situations. A mother separated from her calf or attempting to protect it may become aggressive. A lone member of a social species may become frightened when separated from the pod. Consider the animal's possible response to your intended actions.

FIRST AID:

Determining Condition:

Countless procedures are used to evaluate the health of an animal, ranging from distant observation to blood and tissue analyses. Behavioural observations are quick, non-invasive, and can be done by persons with minimum training. Behavioural criteria can be used to assign animals to one of three categories:

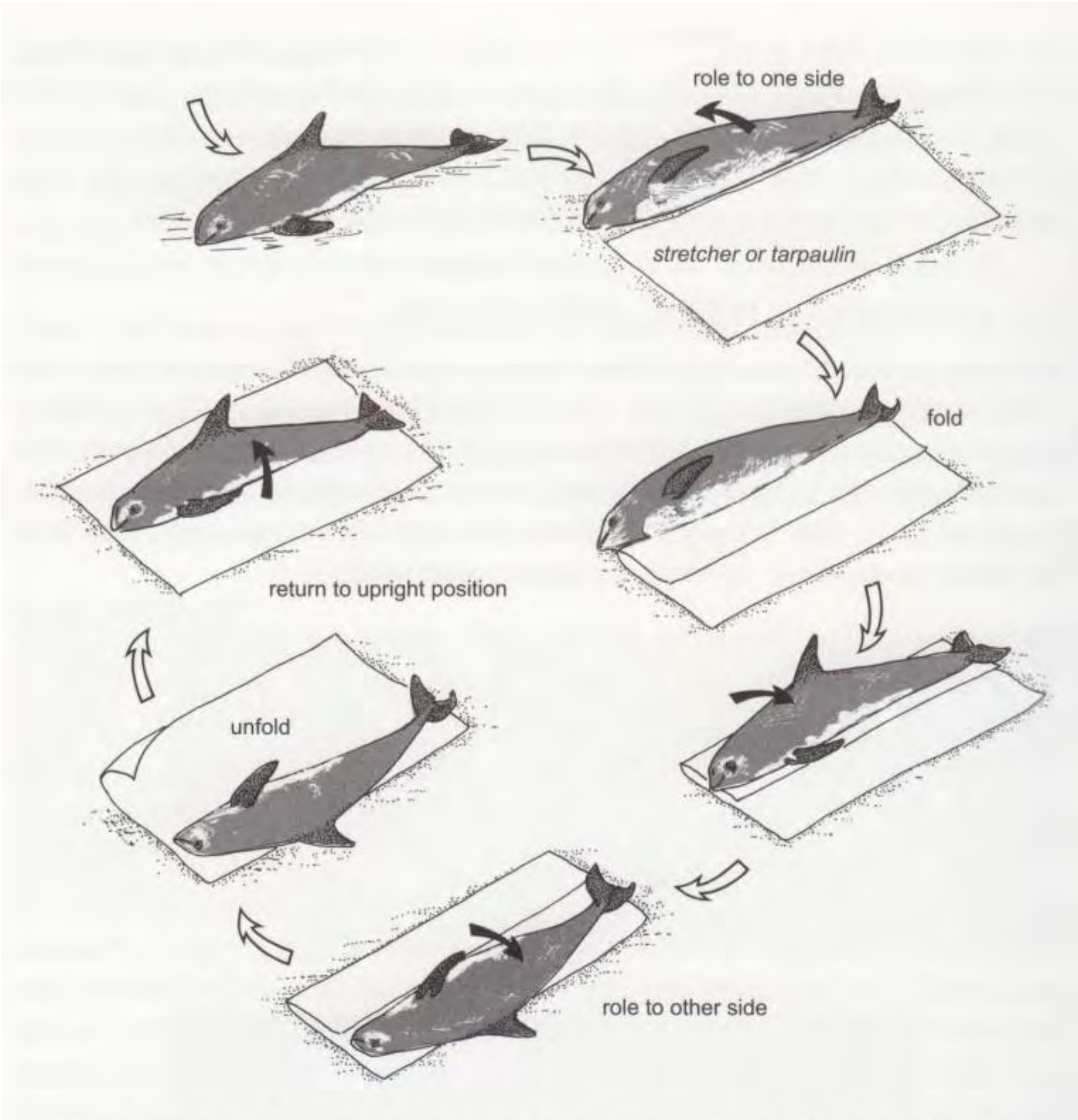
1. Alert (aware, responsive to environmental stimuli)
2. Weakly responsive (responsive only after much stimulation)
3. Non-responsive (not responding to noise or touch)



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

First aid measures on the beach. A. Summer: provide shade, drape leaving dorsal fin exposed, and keep moist; dig holes for flippers and fill with water. B. Winter: provide protection from wind, cover dorsal fin and flukes with cloths soaked in vegetable or mineral oil; dig holes for flippers. C. Always: keep blowhole unobstructed and eyes free of sand; allow flippers to assume a natural position.

A stranded cetacean inevitably develops respiratory fatigue and distress. This occurs sooner in larger animals whose chest cavity will be increased respiratory rate (up to 6 to 8 breaths/minute may be normal for an excited *Tursiops*; a fin or pilot whale may respire as little as once every minute or so) and audible gurgling sounds as the animal breathes in and out. If respirations are slower than expected, flushing water over the blowhole may stimulate breathing. Extensive bleeding, frothy or foul-smelling fluids from the blowhole are signs of critically poor health.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore,

Technique for positioning a cetacean onto a tarpaulin or stretcher without lifting

Without using invasive procedures, it is possible to make a rough evaluation of cardiovascular function. Heart rate, for what it is worth, can be determined using a stethoscope in a small animal, and perhaps by placing a hand firmly under the axillary region of a larger one. Even under normal conditions, however, the rate varies considerably (*eg*., from 30 to 100 beats/minute in *Tursiops*) during the breathing cycle. One result of deteriorating cardiovascular function is poor circulation, making it difficult to obtain blood samples from the usual peripheral sites. Body temperature control is also reduced when blood fails to reach the extremities where excess heat is normally dumped.

The next level of assessment requires handling the animal. Gentle tapping near the eye should elicit a blink. Attempts to pry open the jaw; pull the tongue or tug the flipper forward should be met with firm resistance. Once the jaw is open, a finger pressed firmly on the gums over the teeth causes blanching followed by immediate return of normal pink colour; a slow return or bluish discoloration is a sign of poor circulation.

Body temperature can be determined accurately enough for early assessment purposes using a deep rectal thermometer. In small to medium-sized animals, normal temperatures are about 36.5° to 37°C. In cold weather, temperature may drop rapidly below 35.6°C, signalling the onset of hypothermia or cardiovascular shock. Temperatures above 40° C are critical and above 42° C probably terminal. If time permits and a clinical laboratory is accessible, a blood sample may be collected for hematologic and plasma chemical analyses. These may reveal conditions that are not readily apparent and can help establish a long-term prognosis.

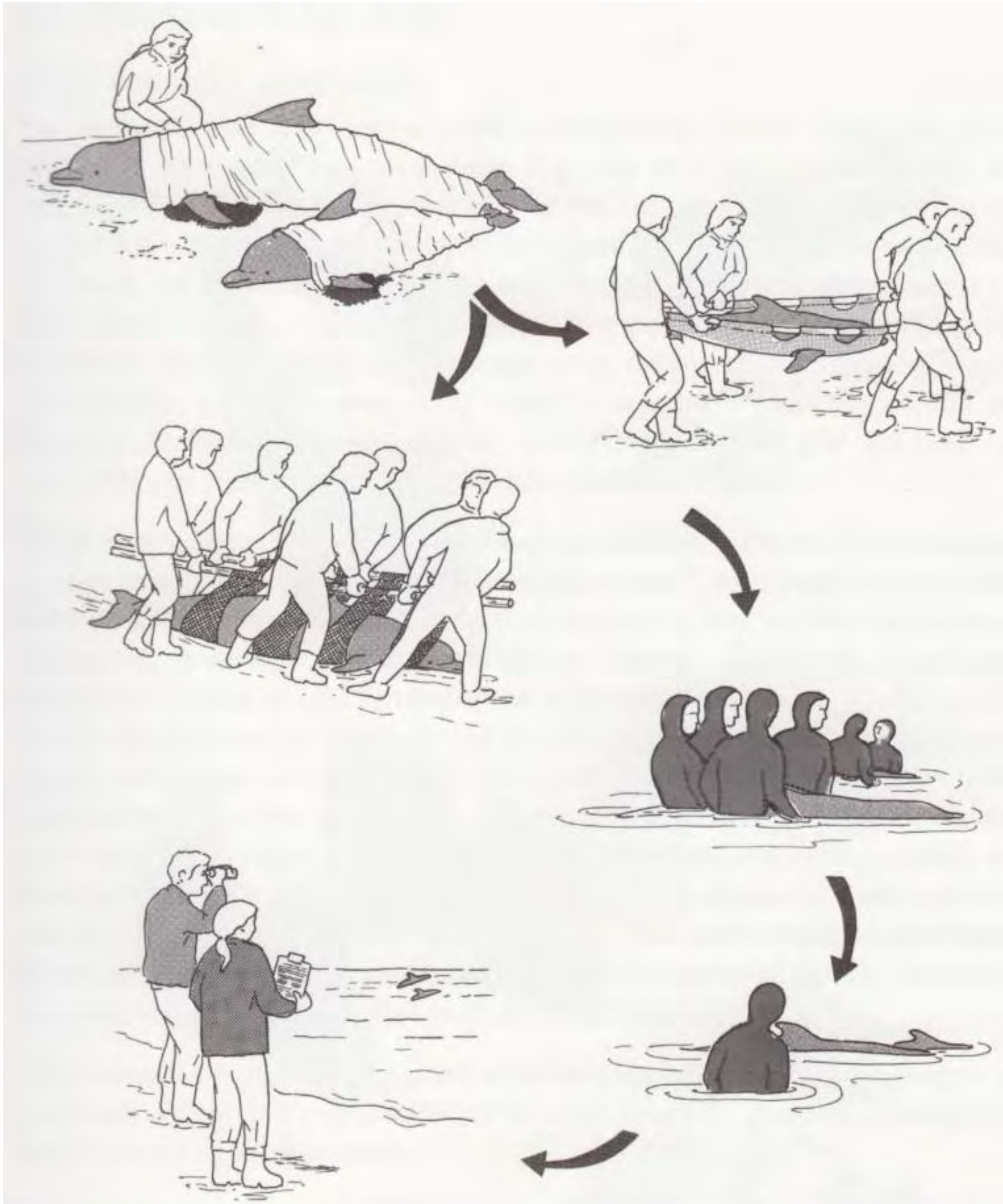
Supportive Care:

General — The time between stranding and the arrival of the rescue team can be gainfully used by volunteers to relieve distress and improve the animal's chance of recovery. The key is to prevent further injury and keeps the animal comfortable while minimizing handling and disturbance.

The eyes and blowhole must be protected from blowing sand and kept moist with clean fresh or salt water. Flushing the area around the blowhole can be done only when the blowhole is closed; the best time is immediately after the animal breathes. Inexperienced persons should observe the breathing sequence before attempting to do this. No matter where water is applied to clean or cool the animal, the source (hose, bucket, sponge) should be held close to the skin to minimize the startle reflex. It is easier to keep the blowhole free of water and sand, and presents less risk to the lungs, when the stranding is placed on its belly. This can be done easily with a small animal, but in larger ones, only with some risk to the rescuers. Using a spade to burrow beneath the animal, dig holes in the sand to allow the flippers and flukes to lie in a natural position. Banking sand or placing other (non-injurious) material alongside the body will reduce the tendency to roll.

Exposure to Warm Temperatures - For their comfort and wellbeing, animals on the beach must be protected from the elements. Prolonged exposure to wind and sun can result in excessive drying and damage to the skin, overheating at warm temperatures (hyperthermia), and hypothermia at cold temperatures. A cetacean on the beach faces the risk of hyperthermia, even on cloudy temperate days. The risk increases dramatically as the temperature rises. Dark skin absorbs heat, blubber retains it, and the circulatory system that normally helps to dissipate heat may be sluggish and not up to the task. A whale out of water has no other mechanism to cool itself.

The danger of hyperthermia can be minimized by draping exposed surfaces except the blowhole with towels or sheets kept moist by periodic wetting. Lighter colored materials are preferable because they reflect light and heat, but in a pinch, items of clothing, newspapers, or even wet seaweed or mud will do. If the situation permits, a small shelter constructed over the animal will provide valuable protection. Heat loss occurs principally from the extremities, which should therefore be kept wet or cooled with ice. A trench dug in the sand around the animal can be kept filled with water through a channel connection to the sea. An application of zinc oxide will protect skin from sun and windburn and help prevent dehydration. Oil-based compounds, including those used in sun tanning products, retard heat loss and may do more harm than good. Skin already damaged should be kept moist, shaded and protected with zinc oxide or antibiotic ointment.



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General rescue sequence involving first aid and supportive measures; moving the animal to the water by lifting in a stretcher or dragging with slings; support in the water with gradual acclimatization; and observation and monitoring of released animals

Exposure to Cold Temperatures - A good layer of blubber insulates an animal against cold. Emaciated specimens, calves and small species are at greater risk of becoming hypothermic. The diagnosis requires some expertise. On a frigid beach, provide shelter from wind and precipitation, and cover the extremities with a mineral or vegetable oil-dampened cloth.

Protection from Surf - A cetacean in the surf zone may be battered by waves, trapped among rocks, rolled onto its side or become mired. If the animal is too large to be moved into deeper water or to higher ground, shift it so it is perpendicular to the water's edge, with the head facing land. In this position, the body offers the least resistance to the surf, and the blowhole is as far from water as it can be under the circumstances. Heavy, struggling animals can become bogged down and trapped in sand or mud that eventually fixes them into place. They are then victims of the rising tide and nearly impossible to rescue because of the difficulties and hazards of working in soft sediments.

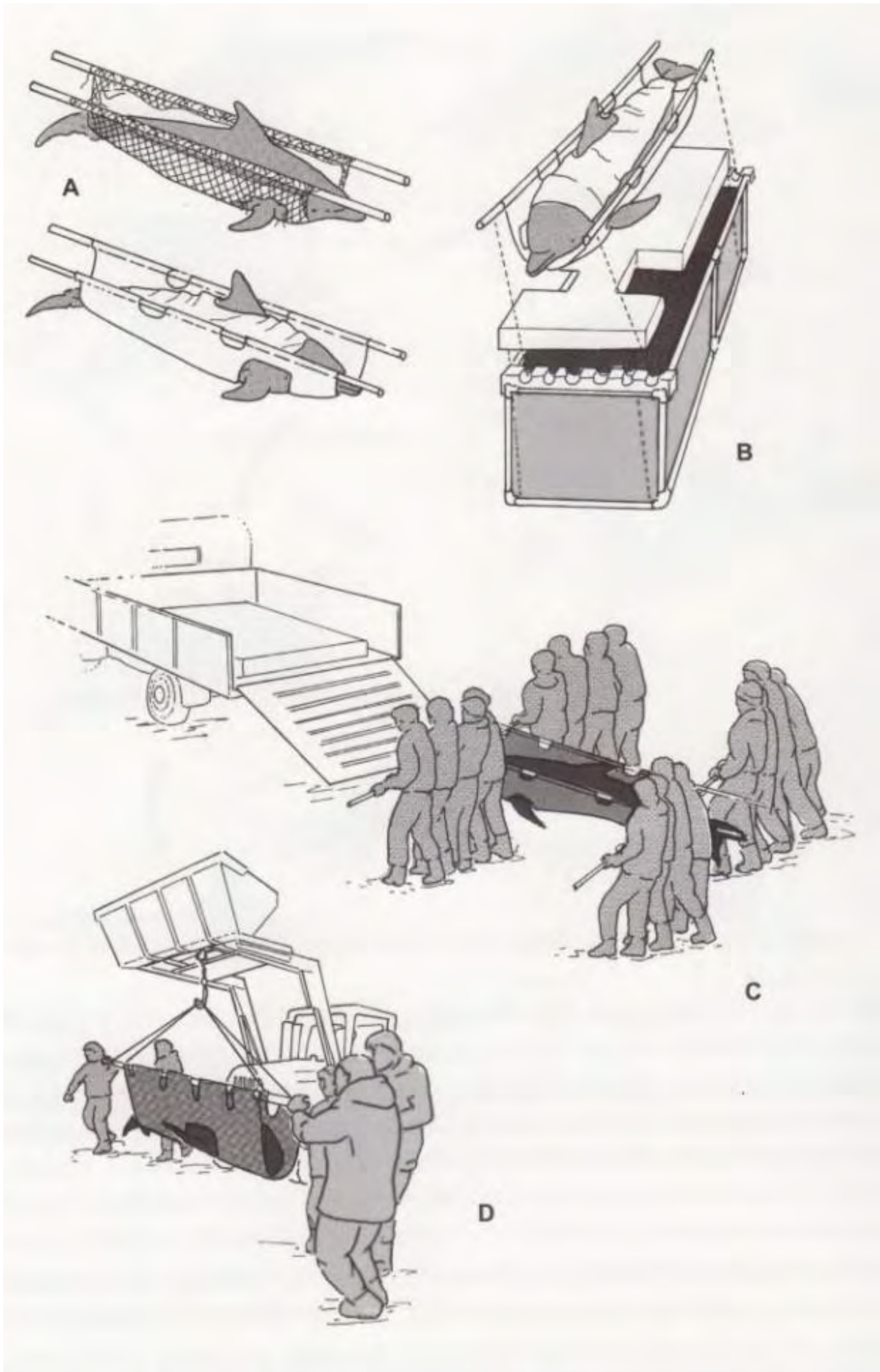
Lacerations and Injuries - Sharp rocks and sea shell fragments can have the same effect on cetacean skin as a keen-edged knife, causing serious injury to a struggling animal. The risk of lacerations can be reduced by removing or covering hazardous objects, placing padding around the body, or moving the victim to a safer place. Efforts to calm or restrain whales under these circumstances are unrealistic. Tranquilizers and sedatives should never be used on animals that are to be immediately released. There is no proven benefit to medicating an animal that has just stranded and is about to be released. Without opportunity for continued care, a single application of ointment, a bolus of antibiotics, or a feeding of fish has little value. However, an animal that faces a longer period out of water before it is released or transported will benefit from prompt medical care to wounds, fluid therapy to maintain hydration, and even a long-acting antibiotic.

Stress and Shock - A cetacean on the beach is almost certainly stressed. Stimulated by the pituitary gland, hormones (cortisol and aldosterone) from the adrenal cortex are released into the circulation. Prolonged high aldosterone causes excessive sodium retention, thereby increasing the animal's thirst for water. Within a few hours after stranding, some cetaceans begin to show evidence of shock or vascular collapse. The onset of shock impairs the mammal's chance of survival.

Rescuers have attempted to reduce circulatory problems and muscle cramps by periodically shifting the animal's body position and rolling it onto each side for 20 minutes or so. If a stretcher is available, floating the animal in shallow water may be of some value. Some advocate massaging the muscles of the back; this procedure may benefit a small animal, but it is not likely to be effective on a larger one with thick blubber. Corticosteroids and other medications may help minimize muscle damage and delay the onset of shock

HANDLING, LIFTING AND MOVING:

In any rescue operation, moving and handling are critical activities, whether dragging an animal from dangerous surf, manoeuvring it into deeper water for release, or loading it onto a transport vehicle. Most procedures are potentially injurious to both the animals and personnel and should only be attempted when supervised by trained staff and when adequate support is available. Six people might be able to carry a medium-sized bottlenose dolphin on a stretcher, whereas a beluga or pilot whale may require 16 or more strong bodies.



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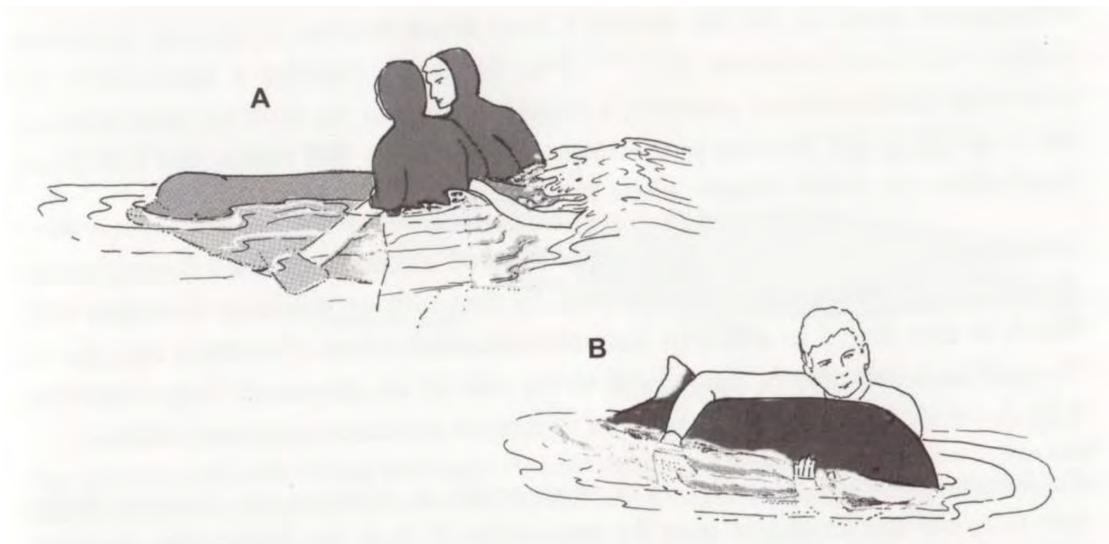
Cetacean transport methods. A. Stretchers with holes for flippers. B. Specially constructed transport box with foam pad and waterproof liner. C. Manual method of moving a small pilot whale onto a foam-padded transport vehicle, using poles positioned cross-wise through stretcher handles to allow necessary support. D. Use of heavy equipment to move whales

Several methods are useful for moving small whales and dolphins. An animal can be placed or rolled onto a tarpaulin or stretcher, then lifted or dragged. Field stretchers should be large and strong enough to bear the weight of any reasonably large animal, which means a small one will be safely enveloped in it. When the whale will remain in the stretcher for more than 15 or 20 minutes, openings must be provided for the flippers (to prevent crushing and overheating) and the genital region (to prevent urine burns). For short rescue procedures, the flippers may be more conveniently kept within the stretcher. Fabrics should be smooth and easy to clean and sterilize; canvas, woven plastic, and netting are commonly used. Lining with towels or sheeting further reduces the chance of skin injury. Once the animal is in the stretcher, care should be taken to ensure no seams or creases press into the skin.



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Supporting cetaceans in the water. A. Use of strap or sling to keep blowhole above surface. B. Supporting a small porpoise

Dragging is an acceptable option only when lifting is impossible. Slings positioned under the body behind the flippers can be used to drag the animal on the beach or to support it in the water; on land, extra support under the head may be necessary. Ensure that such slings are well-padded and wide enough to distribute pressure sufficiently to minimize injury and discomfort when the animal is pulled. Never use naked rope as a sling. Drag only over smooth terrain after all obstacles have been removed.

Although it has been suggested to be an effective means of moving cetaceans, rolling is not recommended. An animal healthy enough for release can be expected to react violently. This procedure will certainly be stressful and may result in damage to the flippers or dorsal fin. If an animal is small enough to roll, it is small enough to manoeuvre onto a stretcher or sling.

Cranes and other heavy lifting equipment are needed for moving large specimens and for loading them onto transport vehicles. Secure the animal in the stretcher with enough rope or straps to prevent thrashing, and attach guide ropes or “tag lines” that will enable handlers to hold the stretcher steady. Make sure that no one stands directly underneath the load.

IMMEDIATE RELEASE:

General Considerations:

Coordinate the animal’s release with an incoming or high tide, and assure that personnel and equipment are adequate for operating in the surf zone and perhaps deeper water. Choose a route that is free of obstacles such as shallow reefs or sandbanks, by first consulting a hydrographic chart or persons familiar with the area. Under some conditions, transport to an alternate site - perhaps miles away - may be necessary. When weather or tide conditions are unsuitable, the animal may be placed in a tidal pond or fabricated pen enclosure and released when circumstances improve. Make every effort to keep a mother and calf together during release. A free-ranging dolphin may remain with her dead offspring for weeks, suggesting that returning even a dead calf to the water with its mother may help to prevent her re-stranding. Orphaned maternally-dependant young should not be released under any circumstances. Calves whose mothers cannot be verified should be considered orphaned. Lone animals of a social species are not good candidates for release, unless there is a good chance they will regain contact with a herd.

Marking and Tagging:

Any animal returned to sea should be marked or tagged and the details of its release carefully documented. Only then can observers determine whether or not the animal survived and if rescue procedures were effective. Dorsal fin tags are easy to apply with the appropriate attachment devices. They can be made in various colours, shapes and sizes. Every team should be equipped with a quantity of colored or numbered plastic cattle ear-tags, and a small boring device for attaching the tag through the dorsal fin. Freeze brands are effective for long-term marking but are not immediately visible and must be combined with some other type of tag.

Radio (satellite or Very-High- Frequency [VHF]) tags provide much more information but are costly and require specialized tracking equipment. Tags can be applied only by trained personnel. Natural marks (*e.g.*, unusual fin or fluke shapes, scars) should be photographed to assist in later identification of re-stranded animals, or as a way to monitor individuals from small, local populations.

Acclimating Animals in the Surf:

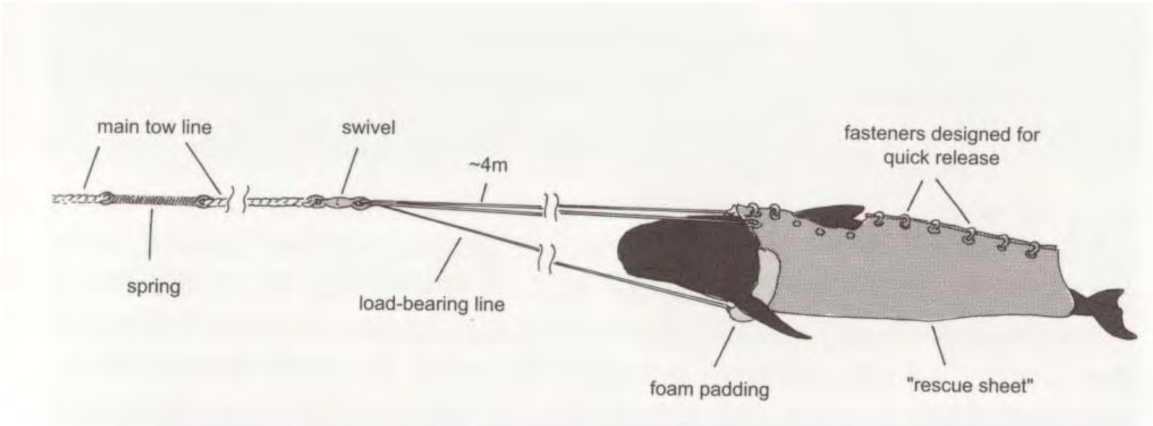
There is more to releasing a stranded whale than hauling it back to sea. Without careful planning, handling and treatment, rescue attempts can end in disaster. In preparation for its release, the animal on the beach should be kept wet and cool to avoid a quick change in temperature that might evoke a startle reaction. Once in water, the body should be kept upright and the blowhole clear of the surface. One person alone may be able to handle a finless porpoise (assuming reserve help is on hand), but certainly more are needed for a larger species. Acclimation is not complete until the animal is able to surface on its own to breathe. The process can take a long time and puts rescuers at risk of hypothermia. Proper gear (*e*.g., wet suits) and a relief team must be available. A mother and calf should be acclimated together.

Gentle side-to-side rocking of an animal that is not fully coordinated when re-floated has the presumed benefit of restoring blood circulation and muscle tone. Some species, such as false killer whales, tolerate this handling well, while others, such as striped dolphins, react violently. Abandon the procedure or use a more gentle approach if the animal resists. After about 30 minutes of rocking, try again to move the animal into deeper water.

Many cetaceans re-strand with frustrating persistence, each time compounding the damaging effects of the last stranding, until their condition is irreversible. The rescue team should know when to quit and pursue another alternative.

Herding and Towing:

The animal, even when acclimated, may need to be directed outward to sea. Doing this by swimming alongside is risky because a cetacean's behaviour is unpredictable. Kayaks and surfboards are light, portable, and work well in shallow waters. "Jet" boats are quiet, manoeuvrable, have no propellers that might cause injury, and are also suited to inshore work. Once the whale is farther offshore, sturdier craft are needed, manned by at least one observer in addition to the pilot. Boats are generally positioned flanking and to the rear of the whale. Keep engine speed low and constant. Where conditions (e.g., estuaries or inland waterways) inhibit effective herding operations, it may be preferable to secure the animal and tow it to sea.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

A method for towing utilizing a "rescue sheet" with quick-release fasteners, a swivel between lines from sling and main tow-line to reduce twisting, and a spring in the main tow-line to dampen speed surges

Towing a cetacean requires skill and experience, as well as a suitable boat. Improperly placed ropes or slings can cut into the skin or prevent the animal from surfacing to breath. A whale that suddenly makes a burst for the open sea may swamp a small boat or escape before it can be properly released from its harness. Accounts of re-stranded animals with rope wounds around necrotic tails are testimony that not all towing attempts are successful. The first rule is to tow head first. Towing backwards by the tail can damage the flukes, dislocate vertebrae, and result in suffocation. Towing head-first and orienting the animal seaward may help prevent this from occurring. With all methods of towing, it is certain that a whale, sensing freedom of movement in the water, may decide on its own course.

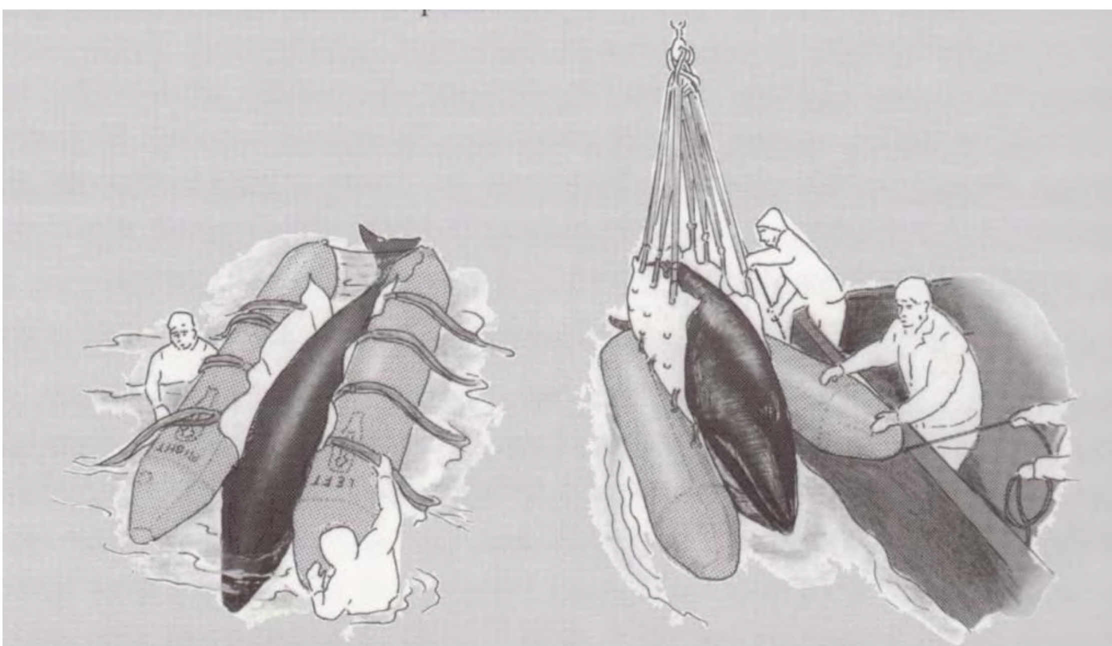
Better than ropes, a harness with wide banding and substantial padding will help to distribute pressure due to the force of towing. For example, a length of cloth or strapping can be draped over the back; the two ends are then passed behind and underneath the flippers (one on each side) and attached to the tow-line. This arrangement tends to lift the animal's head when tension is applied. A similar procedure with more technical detail incorporates a broad sheet for maximum distribution of pressure, a swivel to prevent the tow-line from twisting, and a spring in the tow-line to minimize speed surges inevitable in swells. All ropes and harnesses must allow for rapid release when the need arises.

The tow-line must be sturdy; long enough to keep the whale a safe distance from the engines, but short enough to allow manoeuvrability. A longer line will help keep the animal level and reduce its tendency to rise up and pitch forward into the water. Towing speed should not exceed 1 knot. Stop intermittently (e.g., 20 seconds moving, 10 seconds stop) to allow the whale to breathe. The animal can be placed in a flooded inflatable raft and towed, or into a specially designed stretcher supported by two rafts or pontoons, which is then towed as a unit or fastened alongside a boat. Cetaceans can also be "towed" in a stretcher or sling fixed to the side of an adequately large boat. A net sling has the advantages of minimum resistance and easy release.

How far to drive or tow an animal offshore will depend largely on the topography of the region. A few kilometres will normally be enough if the beach is open, the coast straight and the water deep. Strong coastal currents and complex topography may require that the animal be towed a considerable distance offshore before it is released.

Helicopters and Boats:

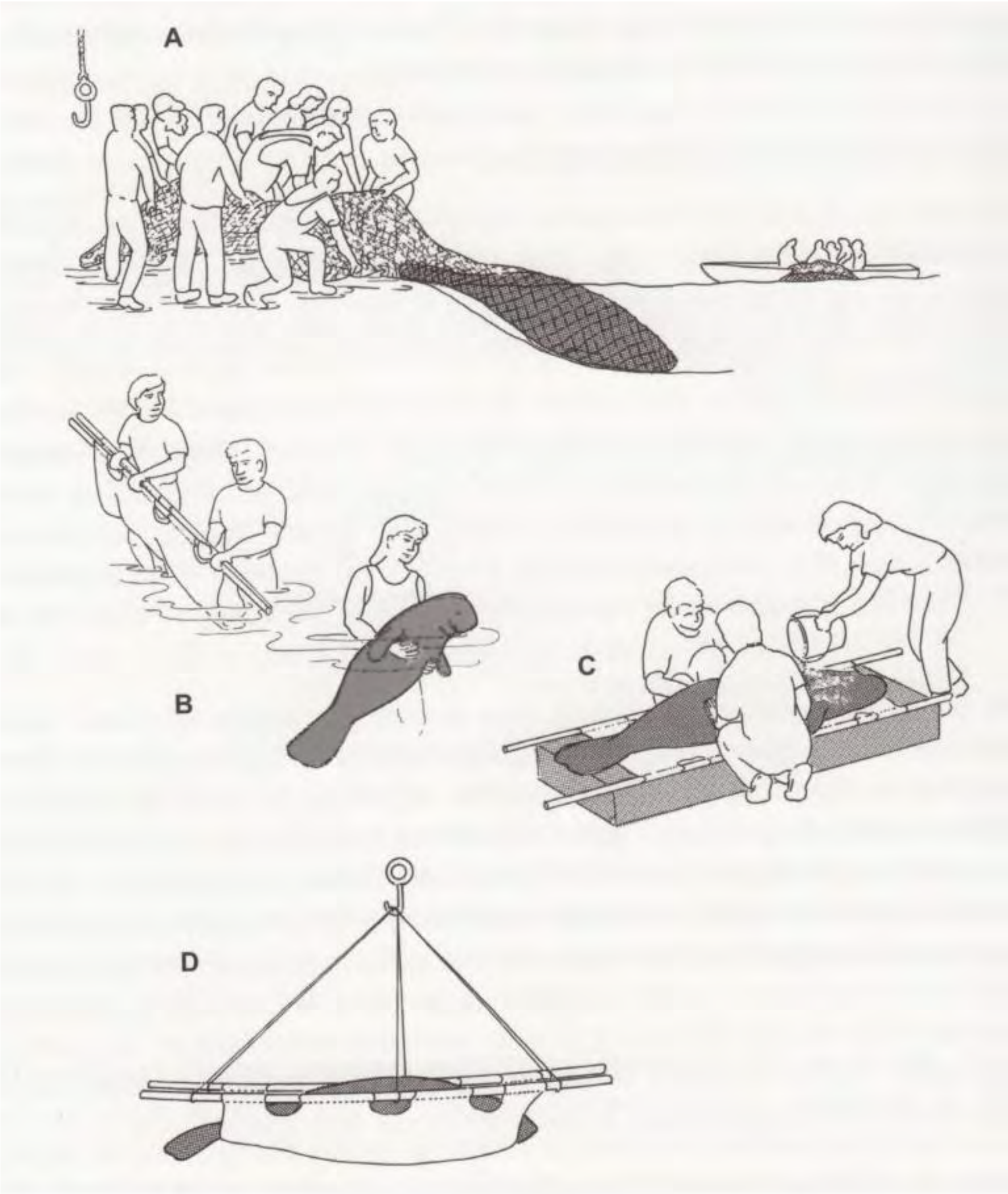
Helicopters have been used to move animals off the beach quickly. In one incident, 22 *Tursiops* were trapped by a receding tide in a bay; the trapped animals were rescued successfully using a helicopter to transport them to safer waters. A cow and calf were placed together in a sling, flown, and tethered near a waiting fishing boat. The rest were shifted in a similar manner, when the shifting process was complete, the cow was released and the entire pod swam calmly into deeper waters.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

A stretcher attached to pontoons can be used to support cetaceans up to the size of a whale and to move them offshore for release

In a similar manner, small cetaceans can be carried on the decks of fishing boats and released at a suitable site. Such methods have the advantage of moving animals directly to a specific location—one far enough offshore to discourage re-stranding. Where the stranding area is inaccessible to land vehicles, helicopters and boats may also be useful for moving animals to alternate holding or release sites.

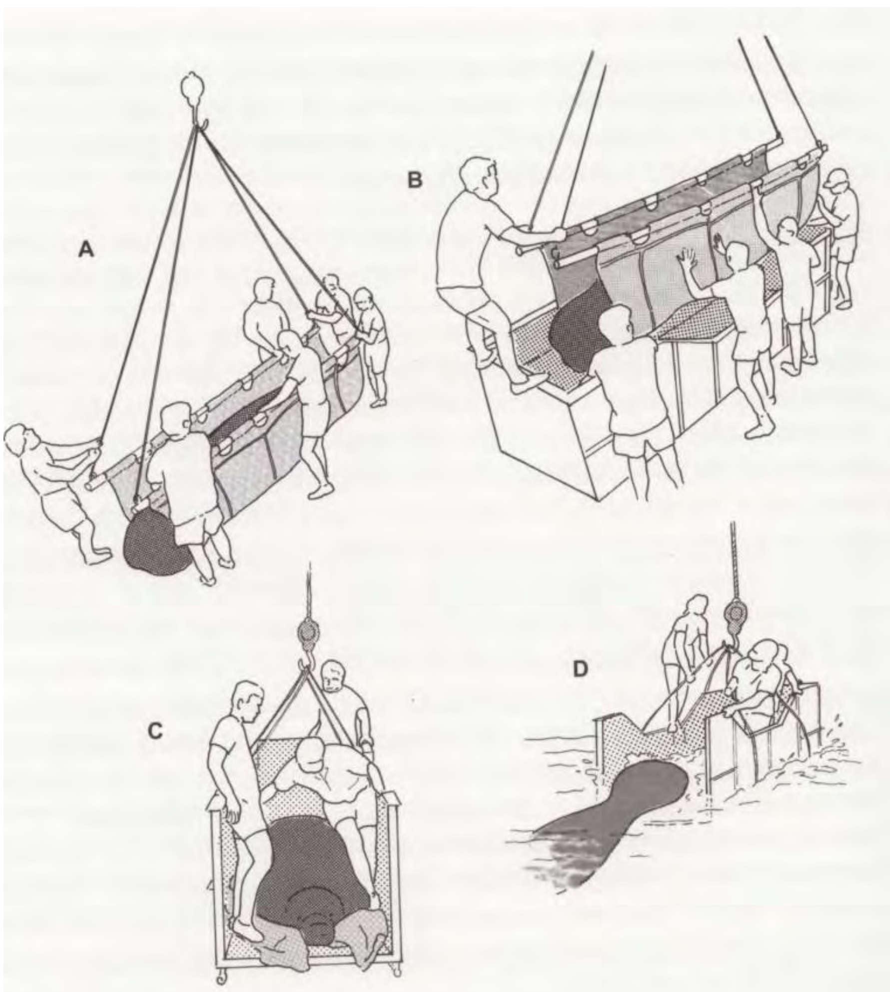


Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Techniques for Sirenian handling and transport. A. Netting a dugong and drawing it into shallow water or into a skiff (keep the nostrils above water). B. Supporting a neonate in the water by grasping it around the pectoral region from behind; secure in a stretcher before lifting it from the water. C. Transport on a foam pad; keep moist. D. Moving adults or large juveniles by means of a crane or block and tackle

Observing and Monitoring:

The success of a release can only be measured by knowing exactly what has happened to the animals. One cannot assume that a whale has survived simply because it has not re-stranded. Maintain visual contact as long as possible. In a few instances, an animal can be observed from shore, but most serious efforts will require sea-going vessels or aerial reconnaissance. Unfortunately, this is expensive and often difficult to arrange. Chemical lights that are visible up to a mile or more away can be used to track released animals at night. The lights come in a variety of colours and can be attached (using biodegradable cotton string) to the dorsal fin tag. Still, though logistically difficult, electronic tagging (satellite, VHF) is the only reliable means of determining whether the animal has fully recovered.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Techniques for transport and release12. A. Lifting a manatee in a stretcher with a crane. B. Lowering a stretcher into a specially designed transport box. C. Lowering of transport box into water at the release site. D. Release. NOTE: Be prepared for sudden thrashing at all stages. Keep a firm hold on stretcher, poles, lines, and box

TRANSPORT TO CARE FACILITY:

The same equipment and approach to moving a whale on the beach is used to load it for transport. The success of the operation will depend on the type of vehicle that can be driven to the scene. Animals may be transported on thick foam pads. Close-cell foam is rigid and, because it does not absorb water, remains light; it is ideal for short-term transport. Open-cell foam, preferred for longer travel, is softer, contours easily to the animal’s form, but will absorb water and become heavy. Some individuals may be more comfortable on their sides. Specially constructed transport boxes are generally used for longer distances. Protect the animal from sun, wind, and exhaust fumes, and keep it cool and wet. One or more representatives from the rehabilitation centre should be involved in the handling and transport since they ultimately share responsibility for the animal’s health.

During transit to the rehabilitation centre, attendants should monitor respiratory rate, record body temperature, and, if possible, collect blood samples and swabs for culture. This will expedite assessment of the animal’s condition upon arrival, allowing therapy to begin with minimal delay.

REHABILITATION:

General Considerations:

Select animals for rehabilitation that have a reasonable chance of recovery, and respect the decision of the accepting facility. Small young specimens lifted from the beach soon after stranding are usually good rehabilitation candidates, because they can easily be transported and handled for diagnostic and therapeutic procedures. A coastal species such as *Tursiops truncatus* has reasonable prospects, whereas stranded *Delphinus delphis*, *Stenella spp*. and other pelagic forms seem to have more difficulty adjusting to captivity.

A pelagic animal that has come ashore in a mass stranding, which as far as we know is a behavioural and not health related phenomenon, may have a better chance than a singly stranded animal which is more likely to be sick and debilitated. Cetaceans often fare better in pairs or groups than alone. Social groupings are seldom possible unless the animal is part of a multiple stranding. The remaining option of placing a newly arrived stranding alongside a colony animal combines the worst elements of poor husbandry and bad medical practices.

A medical examination is performed as soon as the animal arrives at the facility so therapy can begin immediately. To restore salt and water balance caused by dehydration and shock, the animal can be placed for up to a week or so in brackish water of about 10 ppm, roughly equivalent to the salinity of body fluids, or in fresh water for a few hours at a time, in hopes that it will drink. Replacement fluids can also be given by stomach tube.

After a long time on the beach, larger specimens, such as pilot whales, may suffer poor blood circulation to vital organs including liver and muscle, which then malfunction. Rigorous intervention is required to control and reverse this condition - incipient shock. Sometime during the course of rehabilitation, cetaceans are often given medications for stress, as well as antibiotics to control infections and to prevent bacteria from invading what might now be a weakened subject.

Nutrition:

A rigorous nutritional program may be required to restore and maintain the animal's health. First, it is necessary to restore fluid balance by tube-feeding fluids for a few days before giving whole fish or fish gruel. Besides special nutritional needs, dependent calves require a social setting that is difficult and expensive to provide in captivity. Attempts to satisfy this need include companion animals and a steady stream of volunteers. Calves are also best provided with a choice of toys and gadgets, as long as the objects are too large to swallow.

RELEASE FOLLOWING RECOVERY:

Criteria for judging suitability for release include medical evaluation, overall physical fitness including swimming and diving behaviour, and the ability of the animal to feed on its own. A young dependent cetacean has a poor chance of survival and still less of being successfully returned to sea. While rearing a calf to the point of physical independence might be feasible, "social maturity" may be equally vital for survival and perhaps impossible to attain in captivity.

EUTHANASIA:

Saving stranded animals is not always possible. Sooner or later, the response team will find themselves faced with a situation where actions to save the victim are futile and prolong pain and suffering. Euthanasia then becomes the only humane option. Indications of a clear call for euthanasia include:

- Disabling injuries such as a dislocated or broken tailstock, penetrating wounds in the thorax or abdomen
- Significant haemorrhage from the mouth, blowhole, genital opening or anus

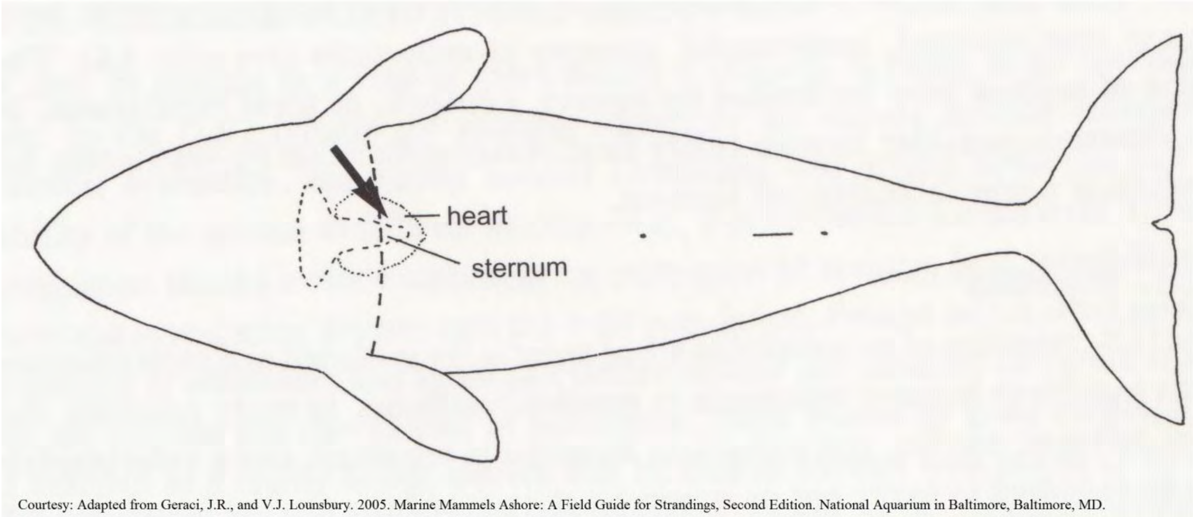
- Rectal temperature of 42°c or above
- Blistering and sloughing of a major portion of the skin surface
- Loss of reflexes (e.g., blowhole, palpebral, corneal, genital, and tongue withdrawal)
- Loss of jaw tone, or protruding penis

Most methods of euthanasia, even when rapidly effective and considered humane, can be visually disturbing and even hazardous to onlookers. Discretion is essential. For the sake of other whales on the beach as well as the public, carry out the procedure behind a visual barrier when methods other than injection are used.

Injection:

In many regions, the use of syringes, needles, and euthanasia solutions is regulated. A veterinarian may be required to carry out the procedure. A cetacean up to the size of a pilot whale can be euthanized by injecting a barbiturate or other lethal agent into a vein of the flippers, dorsal fin, flukes or caudal peduncle, or directly into the heart or abdominal cavity. The dose can be estimated from length measurements. More than the calculated amount may be required if the needle is not seated well enough in the vein, and almost always when an animal is in shock, because circulation to the heart and brain is impaired.

At the point of death or immediately before, the tail may begin to stroke rhythmically in a swimming motion for a few seconds - a behaviour known to the old whalers as “flurrying”. The action in water may be enough to propel the animal forward, even when held by handlers. The period of flurrying may be reduced or eliminated altogether when enough agents is given quickly, and prolonged if too little is injected or if it is released slowly. Flurrying is less apt to occur if the animal is first given a sedative. It is advisable to prepare onlookers for problems that might arise with lethal injections.



The base of the cetacean heart can be reached from either side of the sternum along a line connecting the base of the flippers

An attempt to euthanize a large whale by injection into the tail vein or peripheral vessels is likely to be unsuccessful as well as prohibitively expensive. It is suggested a needle equal in length to about one-half the diameter of the whale, should be inserted through an incision (made following local anaesthesia) penetrating the skin and blubber.

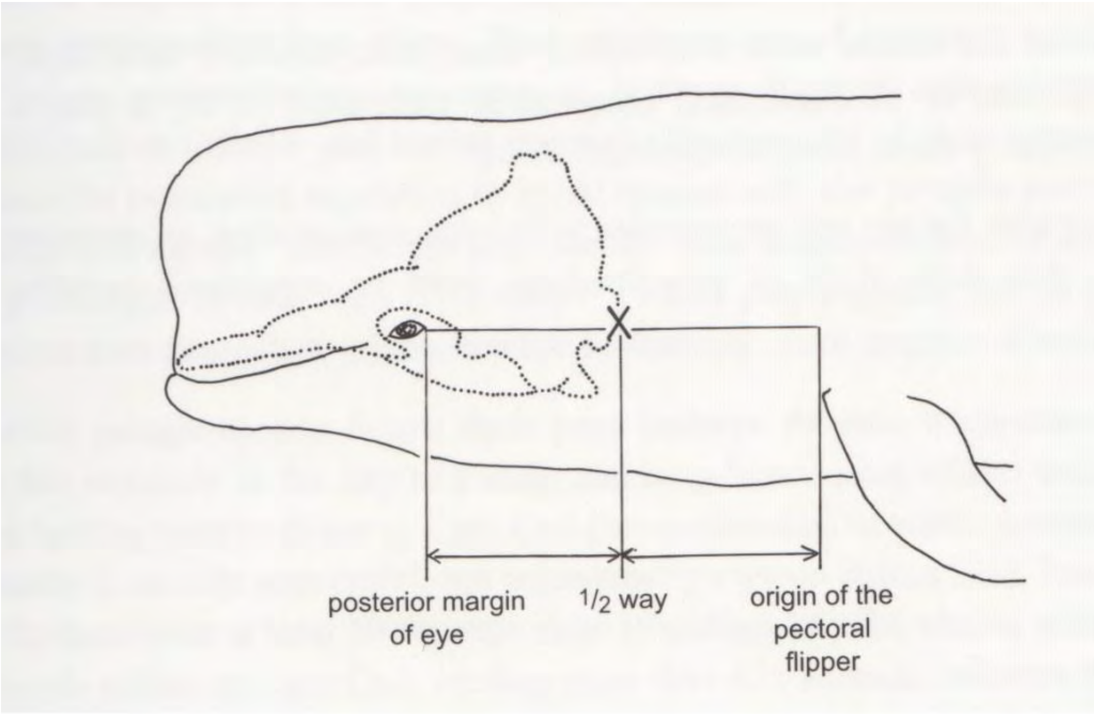
Although the precise entry point for each species has yet to be mapped, as a rule of thumb, the heart can be reached by directing the needle from a point just behind the origin of the flipper to the same point on the opposite side of the body. The heart can also be reached by inserting the needle to either side of the sternum, at a point just posterior to a line joining the base of the flippers. The quantity of solution required will depend on its type and strength and on the condition of the animal, but will be much less than if administered into peripheral vessels.

Explosives:

When euthanasia solutions or persons qualified to use them are unavailable, other methods can be employed, providing implementation is relatively painless and death is rapid. Suffocation by obstructing the blowhole is not effective or humane. Explosives can be used to euthanize large whales humanely, although the procedure must be supervised by an expert and may require special arrangement with local authorities. When placed either deep in the whale’s mouth or on the cranium or nape and covered with sandbags and heavy rubber, explosion can result in immediate death without excessive noise or damage to the carcass. This method, however, is dangerous if not done properly, may be prohibited by local statutes, and is likely to be met with resistance if attempted on a public beach. Strict precautions must be taken to keep observers at a safe distance.

Shooting:

Smaller specimens can be killed quickly by shooting. Use a firearm with a large bore (.303 or greater), high muzzle velocity, and a free, solid or jacketed bullet. The gun should be fired approximately 1 meter from the animal's head; a firearm discharged directly against the animal's skin may explode. Aiming down and backward through the blowhole to an imaginary point joining the flippers is sometimes recommended, but if the shot is aimed too far backwards, the bullet must pass through the thickest part of the skull. Preferably, aim slightly upward through a point midway between the eye and the ear opening, or shoot through the eye, angling the shot backwards and upwards toward a point above the opposite ear. Shooting into the heart of a cetacean with a large girth will probably not result in a quick death. Shooting is generally not an effective way of euthanizing whales over about 8 m in length or a sperm whale of any size (due to their cranial anatomy), and may be inadvisable in areas where rocks increase the danger of ricochet.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Target area for euthanizing odontocetes by shooting. The target area X (occipital condyle) is reached by a shot fired from above or below, or from the side halfway between the eye and the origin of the pectoral flipper.

Exsanguination (Bleeding):

Exsanguination is an option when equipment required for other methods is unavailable, shooting unsafe, or there is no qualified person to administer a lethal injection. The technique is bound to generate adverse public reaction, even if the penetration site is first injected with local anaesthetic.

The cetacean brain draws its principal blood supply not from the internal carotid arteries, as in most other mammals, but from a *rete mirabele* network that enters through the foramen magnum, protected deep in a mass of tissue in the back of the head. The Faroe Islanders, in their pilot whale harvest, have traditionally sought that site for cutting the blood supply to the brain. It is approached by directing a lance downwards from the back of the animal's neck. Inserted deep enough, the lance will sever both the vessels and spinal cord, and death will be quick. Severing the carotids is not the best approach to euthanasia.

A lance can also be inserted deep into the thorax to penetrate the heart and cut major vessels. Proper entry sites for each whale species have not been mapped, but they generally lie on either side of the ventral midline, behind the origin of the flippers. In some specimens, the location is marked by an obvious heartbeat. Observers should be prepared for the disturbing appearance of this procedure.

Confirming Unconsciousness and Death:

For large whales in particular, confirming unconsciousness and death can be difficult. The probable indicators which can reveal the presence of consciousness are motor activity, reflex responses (papillary reflex, palpebral reflex, threat response, and corneal reflex), tonicity of jaws and detectable heart beat.

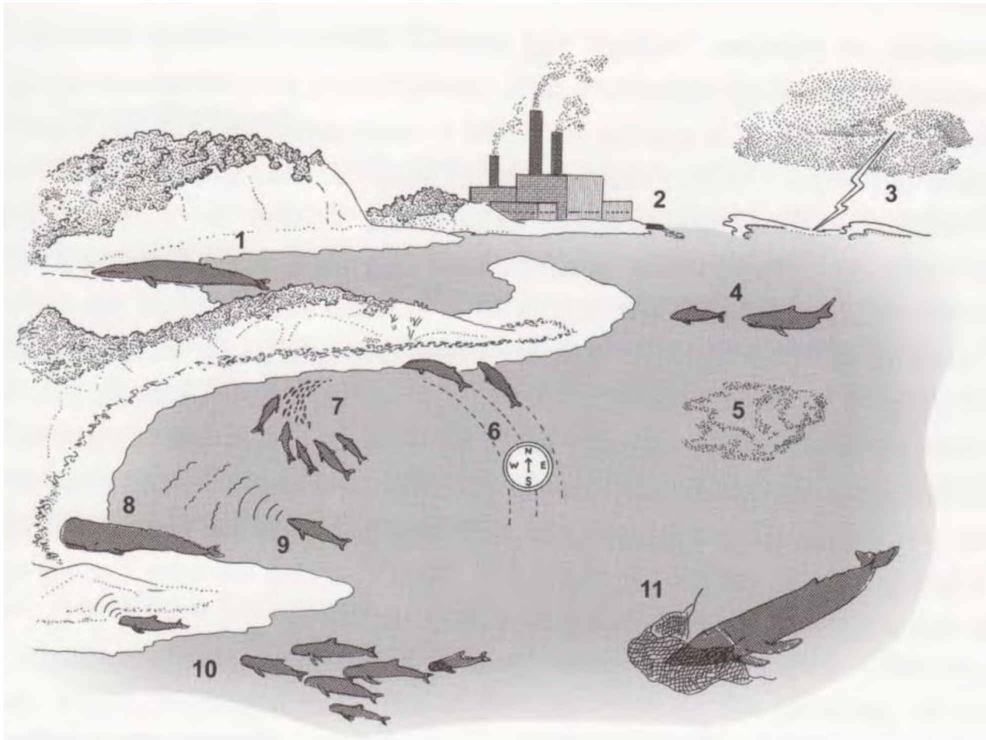
Mass Stranding

A mass stranding can be defined as two or more cetaceans (excluding parent-calf pairs) coming ashore alive at the same time and place. Only a few species of odontocetes typically mass strand in groups of 15 to 100 or more: sperm whales, pilot whales, false killer whales and certain species of dolphins. Several other species occasionally come ashore in smaller numbers (e.g., pygmy killer whales, pygmy sperm whales, common dolphins, rough-toothed dolphins, and spotted and striped dolphins). All are gregarious, more or less pelagic forms, or at least less accustomed to inshore waters than such coastal dwellers as bottlenose dolphins or finless porpoises.

Why does mass stranding occur?

Certain pelagic species follow their prey inshore. The activity is uneventful for the most part, but occasionally a group of animals strikes land. There are too few data to suggest any cyclic activity in stranding patterns. Some investigators have correlated stranding frequency with periods of climatic warming and oceanic current changes that result in lower abundance or a shift in the distribution of prey. Perhaps such shifts bring greater numbers of animals closer to shore; thereby increasing the likelihood that some will run around.

While cetaceans do follow prey inshore, there is often no evidence they were feeding at, or just prior to, the time of stranding. Apart from bringing whales and dolphins into risky territory, it is doubtful inshore foraging behaviour alone plays a major role in these events. Certain theories propose that in times of stress, cetaceans may seek safety on land. This escape behaviour presumably had evolved in amphibious ancestors and was retained in the primitive sub-cortical region of the brain. Why such a maladaptive trait should persist after 50 million years of evolution, and be expressed in only a few species (some distantly related), are questions that defy experimentation or explanation.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Possible causes of cetacean stranding. 1. Complex topographic and oceanographic conditions. 2. Pollution. 3. Weather conditions. 4. Predators. 5. Natural toxins. 6. Geomagnetic disturbances and errors in navigation while following geomagnetic contours. 7. Following prey inshore. 8. Disease. 9. Disturbance of echolocation in shallow water. 10. Social cohesion. 11. Human-related injuries

Other thoughts are as alluring—and just as un-testable. The concept of suicide-implying some advantage, real or imagined, in taking one's own life - does not hold with what we know of animal (other than human) behaviour. Sergeant reasoned that mass stranding may be a means of regulating populations of social species having low juvenile mortality rates and long life spans. High population density can result in lower birth rates and a reduced period of fertility in social cetaceans; such density dependent mechanisms likely play a greater role in population control than stranding, which involve a relatively small number of animals. Klinowska proposed that cetaceans use the earth's magnetic field as both a compass, as some other vertebrates do, and as a map for navigation.

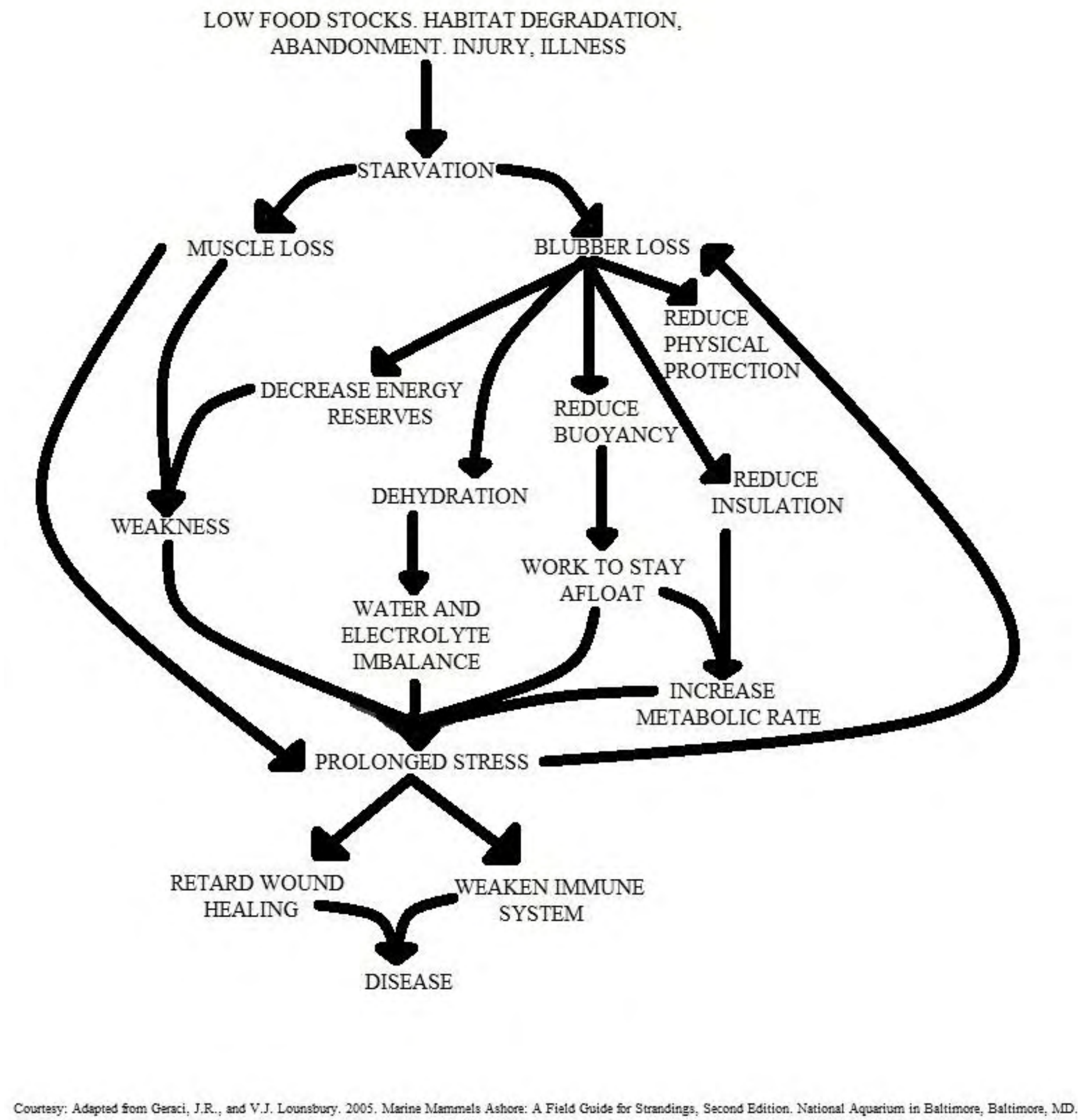
Some cetaceans, for example pygmy sperm whales and common dolphins, apparently have single-domain magnetite crystals in the soft tissue covering the brain, similar to those found in other vertebrates that use the magnetic field for orientation. It remains to be seen whether these simple particles can allow a cetacean to determine north and south, and more importantly, its actual position. The latter, a “magnetic map sense,” has not been proven for any species of animal. The only experimental study with cetaceans, involving two bottlenose dolphins, failed to show any response to changes in a magnetic field or its intensity.

Further study may establish whether cetaceans utilize geomagnetic information, which might bring them inadvertently to certain inshore locations. The results are less likely to explain why they strand.

In the Surf Zone

Many species of cetaceans come close to shore, but few strand. The reason for their presence in shallow water seems less important than the possible factors that occasionally result in large numbers coming ashore. In some cases, animals are trapped and grounded by the outgoing tide. A fortunate few, maybe some with experience, re-float themselves and swim away on the following tide; others become stuck. Such accidents typically occur in areas with long meandering channels, broad tidal flats, strong or unusual currents, or extreme tidal flow or volume, sometimes in conjunction with spring tides near full or new moon.

The way a species behaves in panic might influence its chances of stranding. Humpback and reportedly change direction repeatedly during flight, and whether that is related or not, seldom mass strand. In contrast, a frightened sperm whale may steer a straight course for hours, even ramming objects in its path without changing direction. They do mass strand. Coastal whalers use sharp sounds to drive striped dolphins and pilot whales ashore, banking on their tendency to flee in a straight line from the source of alarm. This type of response might direct pelagic animals away from danger in open water, but when inshore, they strand on any beach that is in the way. To complicate matters, some species prone to panic, including pilot whales and sperm whales, sometimes swim calmly to shore with no apparent sign of alarm.



Pathways from starvation to disease in marine mammals

Shortly after the discovery that some odontocetes use echolocation to perceive their environment, it is proposed that distortion of echolocation signals in shallow water may present an animal with false clues, causing it to beach. The problem would be greatest in areas of gently sloping beaches, a feature common to many (but certainly not all) mass stranding, and during storms when water is churned with air and sand. Sonar failure has since been linked to several other suggested causes of mass stranding, notably environmental factors including thermal gradients, complex topography and turbidity, and illnesses such as parasitic neurologic disease.

This theory presumes the species in question rely almost exclusively on sonar when in near-shore waters and that this faculty becomes seriously unreliable under certain conditions. It also supposes the sonar of pelagic forms is somehow less sophisticated than that of *Tursiops*, a species that rarely mass strand.

Limited studies have shown that many individuals within a mass stranded group bear evidence of illness at the time they are examined. Others show effects of long-standing disease, which in some cases may have debilitating effects. Whether these conditions might have influenced the group to wander beyond its “safe” range, or encouraged the initial stranding is impossible to determine. Confounding the issue is that chronic disease processes are commonly found in outwardly healthy free-ranging cetaceans, both those that mass strand and those that do not.

Common Elements:

Cetaceans that mass strand are pelagic forms with a highly evolved social structure. Certain aspects of behaviour that benefit the school in open water seem sometimes deleterious near shore. Once a critical number of animals heads for shore, the rest of the herd is likely to follow. What is the initial stimulus? Observations suggest there may be many situations, such as simple grounding, illness in an individual, electrical storms and other meteorological events, in which animals are drawn to assist one another or perhaps led to panic.

Social organization alone, however, does not provide all the answers. For example, some stranding are spread over miles of coastline, or occur over a period of days or longer. Only part of a pod may strand while the rest of the animals leave or do not become involved. Many species that form large schools, such as spinner dolphins and seldom, if ever, mass strand. Clearly, other factors contribute to stranding, but social cohesion is a common thread running through other sometimes nebulous and often un-testable theories. At some point certain stranding seem to be ordained and the animals determined to remain ashore, returning each time they are pushed out to sea. Re-floating the majority of the group may be successful, some suggest, when a vocalizing animal is first returned as a decoy to deeper water. However, rescue is not always that simple.

Studies show that the initial stranding can result in physical damage and physiological stress and shock, conditions that can affect survival. When released, stranded animals sometimes return, not necessarily because they are compelled to be there, but because one or more of them are now overcome with illness acquired during the last stranding. In other words, subsequent attempts to strand may have little to do with the reason the animal or group came ashore in the first place. Understanding the debilitating effects of the stranding process, particularly to those animals that re-strand is vital to planning an effective response with realistic goals.

STRANDING RESPONSE:

Information on cetacean biology and natural history, stranding patterns, basic equipment for handling, supportive care, rehabilitation and euthanasia is presented under the section "Single Stranding of Cetaceans". Much of it applies here, but a mass stranding requires a particular approach tailored to the size and number of animals, time ashore, and, of course, the available resources. Small details on the location, weather conditions, orientation of the carcasses - of little value in single stranding - suddenly become important resources for later attempts to determine the cause of the event. The following sections discuss specific needs and actions when responding to a mass stranding.

Organization:

One person must be in charge of on-site activities. This Stranding Coordinator can then delegate the responsibilities for various aspects of the operation to several assistants. These may include:

- Coordinating with local authorities, the public and media
- Procuring supplies and equipment
- Training and supervising on-site volunteers
- Providing personal amenities for all workers
- Looking after the health and safety of the team
- Supervising animal support, handling and transport teams
- Examining carcasses and collecting tissues
- Assembling completed data forms and collected samples
- Disposing of carcasses
- Debriefing of all involved personnel

Individuals must remain focused on their assigned tasks. Volunteers recruited on-site are an essential resource in any mass stranding, and only too willing to help out, particularly during rescue operations. Their work - tasks involving little risk - must be fully supervised.

Early Warnings:

Mass stranding may be foreshadowed by unusual behaviour of animals still in the water. For example, pelagic species appearing uncharacteristically near shore or remaining inshore may be candidates for eventual stranding. The pod may be "milling"- continually circling or moving haphazardly in a tightly packed group - with a member occasionally breaking away and swimming toward the beach. Such behaviour may last for only a few minutes or as long as days before any stranding occurs. Early reporting will allow the Operations Centre to respond promptly, with greater chance of either preventing the stranding or rescuing the animals that come ashore.

Averting a Stranding:

When a stranding appears imminent, measures can be taken to drive or herd the animals from the surf. Take advantage of the same social instincts that formed the group in the first place. Use noise, nets, people, and boats to herd the animals offshore. Align one or more animals in deeper water facing seaward for others to follow, or hold or tether one offshore as a decoy. Choosing a decoy is not easy. The "herd leader" might be the ideal candidate, but only the other members of the group know which one that is, and if they followed it to shore once, they may do so again. The animal chosen should be healthy (a sick one may also bring the pod back), alert, some suggest vocal, and able to withstand towing or other procedures. Although an adult might seem appropriate, a juvenile may, in fact, elicit a greater response from other pod members. Position the decoy animal so it vocalizes toward the herd (hopefully beckoning and not discouraging them), and release the decoy once the group ventures into deeper water. Every animal handled should be identified with a tag, and the details (tag number, time, location) reported to the Operations Centre.

Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Techniques for stranding prevention and returning cetaceans to sea, including use of underwater noise, manual reorientation, herding with small craft, and towing in a sling or stretcher

FIRST AID:

Determining Condition:

At a mass stranding, always deal with the live animals first. Decide quickly whether further stranding can be averted, and determine which animals should be returned to sea, prepared for transportation to a care facility, or euthanized. Besides the health of the animals, other factors - environmental conditions and the time and resources available - will influence how many can be saved. Identify each animal, as well as carcasses, with non-adhesive, highly visible, coloured ribbon or tape to direct the teams responsible for treatment and handling, sampling and disposal.

Handling and Supportive Care:

All live animals should be given supportive care. Organize enough working groups to ensure safe handling of each animal without squandering resources. Keep the team’s safety in mind; allow only those with suitable apparel and equipment (e.g., wet suits) to operate in harsh surf or weather conditions.

Each group should be large enough to tend to an individual animal’s needs. When fewer persons are available, invest in the animals judged to have the greatest prospect of survival, not those near death, and stick to the basics. Protect against sunburn, douse with water, and monitor respiratory rates and behaviour as a head start for the handling team when it arrives. Avoid the urge to do much more. Moving any cetacean requires force. Up to 10 or more people may be needed to carry a young pilot whale; three times that number will be unable to lift an adult.

OPTIONS:

Immediate Release:

The goal should be swift release of the largest manageable number that has the best chance of surviving. Carefully select candidates for release, and resist the pressure to "let them all go." As social animals, the integrity of the group may be as important to survival as the health of the individual. Without information on what constitutes the minimum size or critical composition of a viable pod of whales, an arbitrary decision will have to be made when assembling a group for release. Animals in adequate condition closest to the water-line should be the first returned. Begin by holding them, together with any unbeached animals, in shallow water as a nucleus for rescue. Healthy, strong animals receive priority. Mothers and calves should be moved together. A mother whose calf is dead may be less prone to re-strand if the calf is re-floated with her and kept from shore. Individuals further up the beach will have to wait for sufficient resources to move them to the water, but, meanwhile, must receive supportive care.

A proven approach is to relocate as many animals as possible to a safe place in shallow water where they can rest and become reoriented. There, assigned team members can tag each one, monitor behaviour and vital signs, and obtain blood samples, so that useful correlations can be made for any animal that re-strands. After this preliminary operation, the group is released into a clear path of open water. This strategy permits the team to work as a unit instead of dealing with animals independently and haphazardly. It also allows the entire pod to be freed together when surf and tidal conditions are appropriate.

Transport to Care Facility:

Animals that require a period of medical care may be transported to rehabilitation facilities. Make a point of selecting two or more individuals for each centre.

Euthanasia:

Euthanasia, besides its humane purpose, may be the only recourse to prevent hopelessly stranded animals from drawing others to shore. Thus, the survival of the group may rest on the lives of a few. Rescuers are on trial each time they confront a whale that is healthy, but un-rescuable, and with a condition that will inevitably deteriorate. Take the time, base the decision on careful examination, including blood samples if possible, and logistic considerations; explain your reasoning, and proceed confidently. The time and method of euthanasia should be noted on the data sheet and on the identification tag, to assist other teams that will require this information.

Organizing to collect specimens and data:

Data and specimens collected from fresh carcasses may be among the most valuable thing gathered from the entire event. Yet the stranding investigator who ignores the needs of live animals for the sake of "science" will understandably anger team members and observers alike. One approach is to quickly remove some of the freshest carcasses to a location suitable for dissection, while maintaining efforts on the beach to help those that are still alive.

Valuable time can be lost wandering among carcasses, puzzling over what to do and whether it has already been done. Examining large numbers of cetaceans requires working teams, each performing a specific task on all carcasses.

At least three teams are needed:

1.	Measuring group	2 persons to obtain measurements 1 person to record data
2.	Sample collection	1-2 persons with basic anatomical knowledge to collect specimens 1 person to label and bag samples
3.	Necropsy team	1 skilled "pathologist" 1 assistant 1 to record data

Each group conducts its activity in pre-arranged order, marks the carcass (alphabetic, numeric or color code) to show its work is completed, and moves on to the next. Specimens for contaminant analyses and microbiology can only be taken from fresh carcasses; this requires close cooperation between the sampling and necropsy teams. The disposal group removes only the carcasses that are marked to show all other tasks have been completed. This approach allows the on-site coordinators to assess the progress of the operation at a glance and make adjustments in task assignments to balance activities as necessary.

The teams' progress depends on a steady supply of equipment and data sheets. Pre-packaged measurement, dissection, and sampling kits will save time at the outset and will need to be replenished as materials are misplaced, broken, or depleted. Individuals should be assigned the task of collecting completed data sheets and placing them into a (supervised) central file.

Pay attention to hygiene, and provide personal amenities for the team. Require everyone to wear gloves. Arrange for a steady supply of clean water for washing hands and equipment. Have the necessary materials and equipment to clean and sterilize instruments when collecting specimens for microbiology and toxicology. All collected samples and data must be retrieved, organized, and centrally stored at the end of each day, under the supervision of a designated person. Specimens for shipping must be properly packaged and documented.

Emphasize quality. It is better to obtain good samples and perform thorough examinations with accurate documentation on a small number of animals than to do a hasty job on many.

Monitoring for Re-stranding:

Mass stranded animals returned to sea may re-strand, sometimes immediately, but perhaps days or even weeks later. The success rate of these rescue operations is unknown, and can only be determined by long-term monitoring of animals that are released. The cost of surveillance can be cut and the effectiveness increased if local individuals or groups (*eg*., fishermen, Coast Guard, sailing clubs) are involved in the effort. Combined with the attention of the media (now certain to be involved), this broadened array of observers will increase the likelihood that sightings or stranding will be reported in time to take action.

Protocols for Necropsy and Specimen Collection

The quality of information obtained from stranded animals depends on a number of factors, including

- Condition and location of the specimens
- Size, skills, organization, interests and morale of the team
- Adherence to clear, detailed protocols
- Availability of equipment and supplies
- Number of animals to be examined
- Amount of time available
- Care maintained in packaging and labelling samples
- Care in shipping and storing samples

General Documentation:

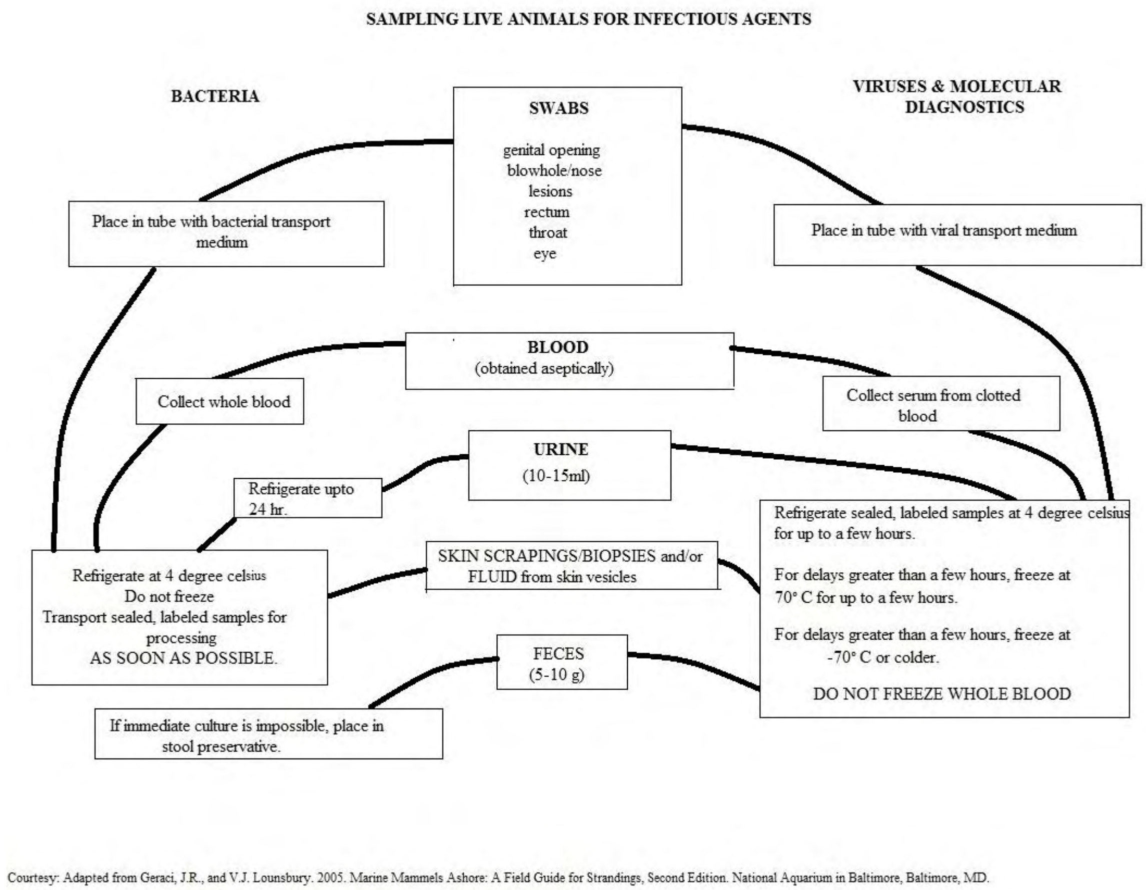
Information has scientific value only when carefully documented. Persons recording data need reasonable language skills, legible writing, and familiarity with appropriate terminology. The use of standardized data sheets or a bound log book made of good quality paper (waterproof is ideal) is recommended. Notes should be taken with waterproof ink or soft pencil. Beyond written observations, photographic and video-taped records may bring to life such details as color pattern, distinctive markings, scars or injuries, and the pattern of a mass stranding that may provide clues only after careful scrutiny. Ideally, include photographs showing dorsal, lateral and ventral views, and the head with mouth open to expose teeth or baleen. At minimum, attempt a full lateral view of cetaceans. Rare specimens are especially valuable and require an extra measure to ensure a complete body of data.

Public Health Concern:

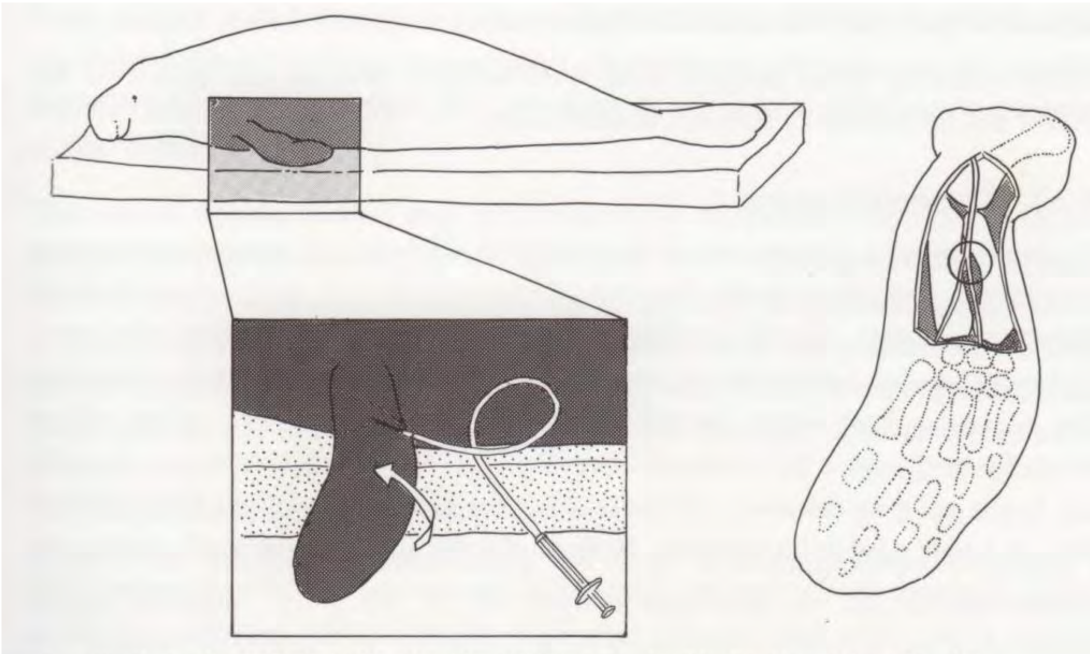
Dead and decaying marine mammal tissues harbor a variety of potentially harmful organisms, some of which can infect humans. Dangerous consequences from exposure can be reduced by wearing appropriate clothing (protective overalls and rubber gloves), eye protection (safety glasses, sun glasses), and by being careful when handling tissues. Persons should protect open wounds with dressings and avoid contact with fluids or airborne droplets. Keep disinfectant solutions at hand.

Sampling from live animals:

Take photographs of anatomical or other distinguishing features that will help identify the species or individual. Photograph all lesions. Skin scrapings, biopsies of skin and blubber, and culture swabs for microbiology are easily obtained from living animals. If possible, and if qualified people are present, a blood sample should be collected, regardless of the animals' condition or probable disposition.

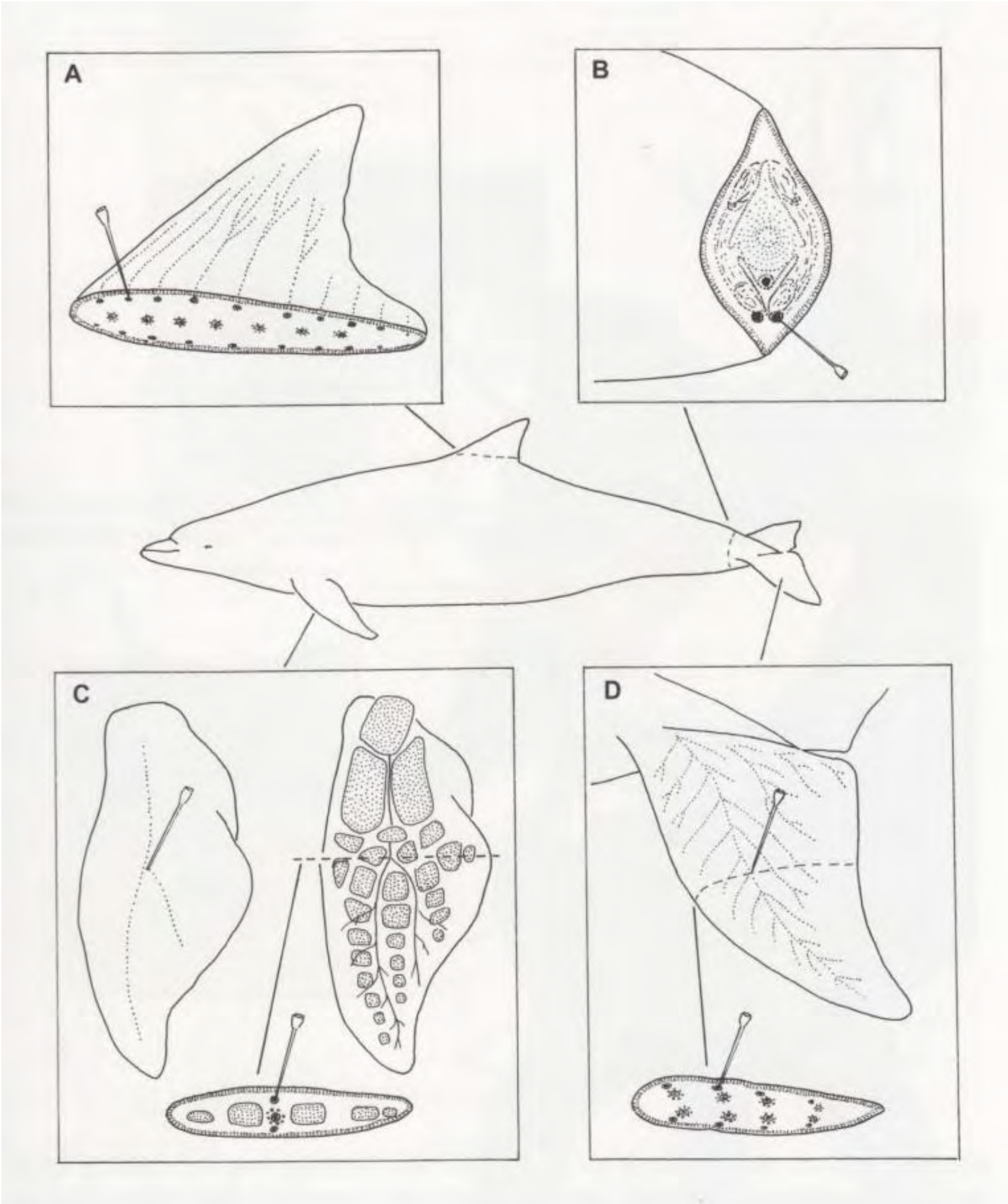


Sampling live animals for infectious agents



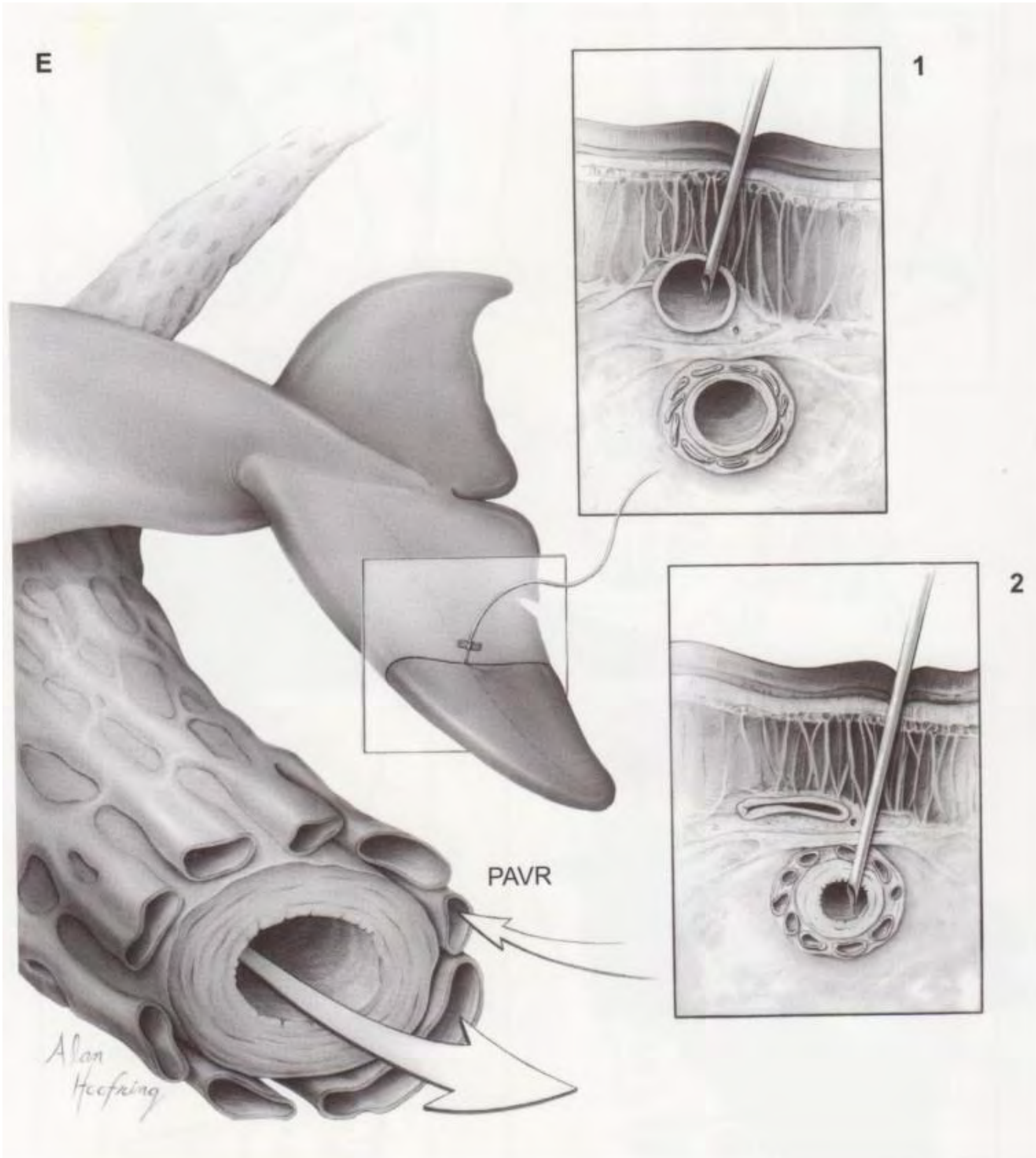
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Manatee blood sampling. Needle (18-20 gauge, 2.5-4 cm) with extension tube is inserted into the palmar side of the forelimb between the radius and ulna



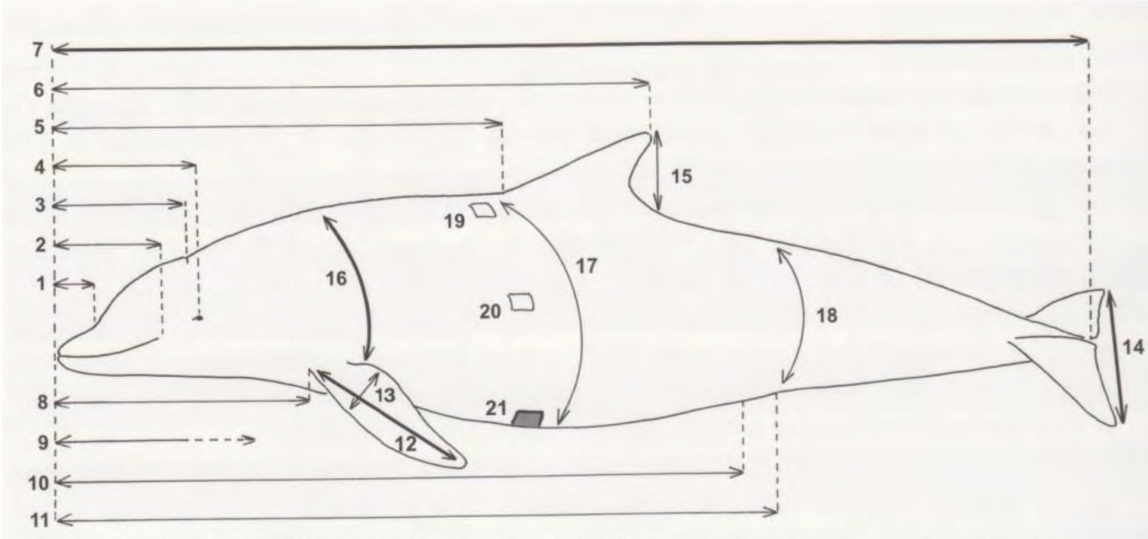
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Cetacean blood sampling. A. Dorsal fin. B. Caudal peduncle. C. Pectoral flipper. D. Flukes. Sampling is carried out at all sites, on small to large cetaceans, using an 18 gauge 4 cm needle.



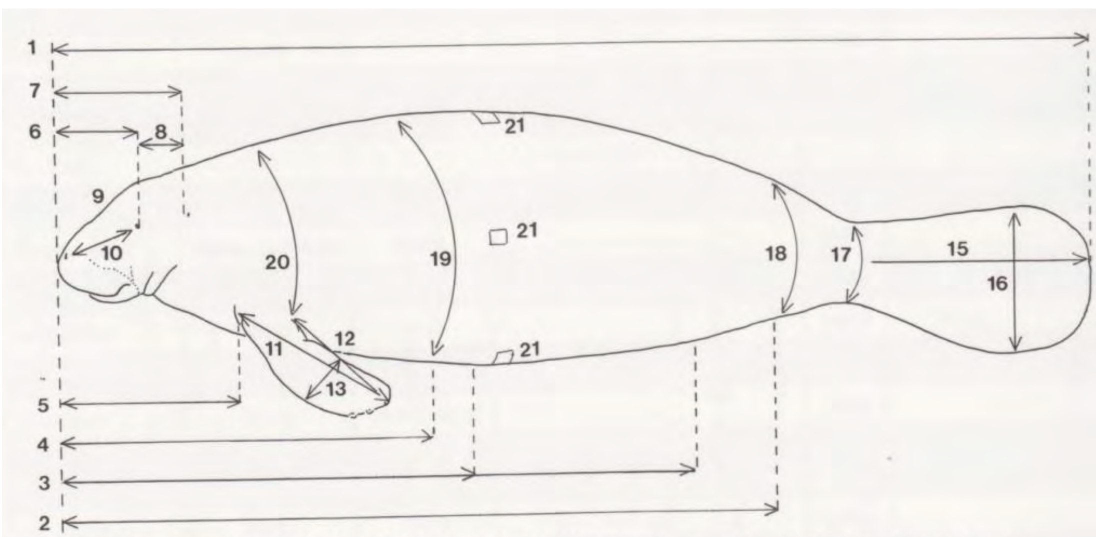
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Cetacean blood sampling (continued). E. Blood sampling from the flukes. 1. When taking blood under warm conditions, insert the needle into a superficial vein, evident as a ridge along the dorsal surface. 2. Under cold conditions, when venous blood is returned through the periarterial venous rete (PAVR), insert the needle deeper to strike the artery or the PAVR. Use of an extension set between the needle hub and vacutainer minimizes injury to animal or handler and insures continues flow if the animal moves.



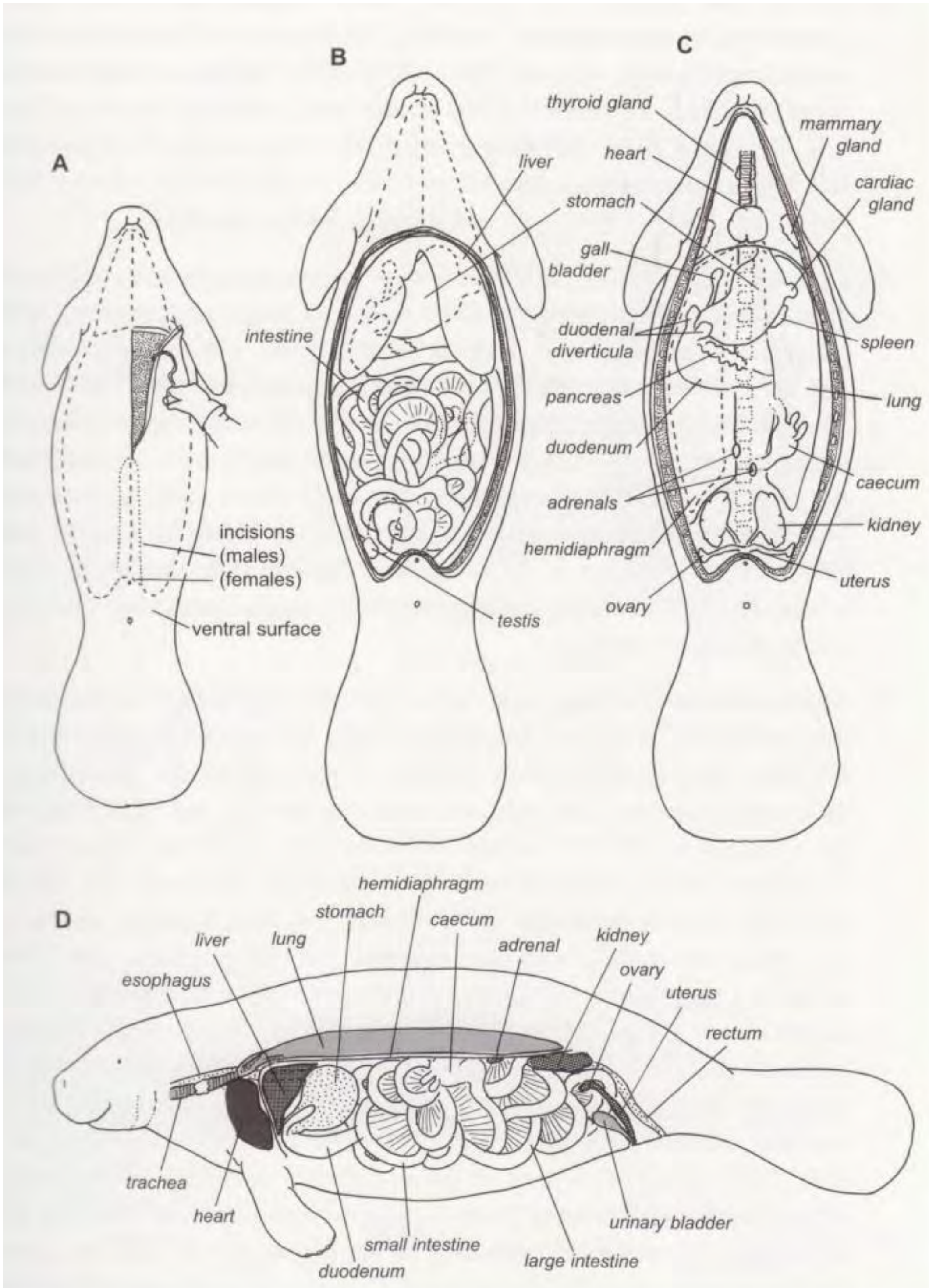
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Measuring cetaceans. 1. Snout to melon. 2. Snout to angle of mouth. 3. Snout to blowhole. 4. Snout to center of eye. 5. Snout to anterior insertion of dorsal fin. 6. Snout to tip of dorsal fin. 7. Snout to fluke notch. 8. Snout to anterior insertion of flipper. 9. Snout to caudal end of ventral grooves (when present). 10. Snout to center of genital aperture. 11. Snout to center of anus. 12. Flipper length. 13. Flipper width (maximum). 14. Fluke width. 15. Dorsal fin height. 16. Girth: axillary. 17. Girth: maximum (specify location). 18. Girth: at level of anus. 19. Blubber thickness: dorsal (anterior and lateral to dorsal fin). 20. Blubber thickness: lateral. 21. Blubber thickness: ventral. As a minimum, measure 7, 12, 14, 17 and 21



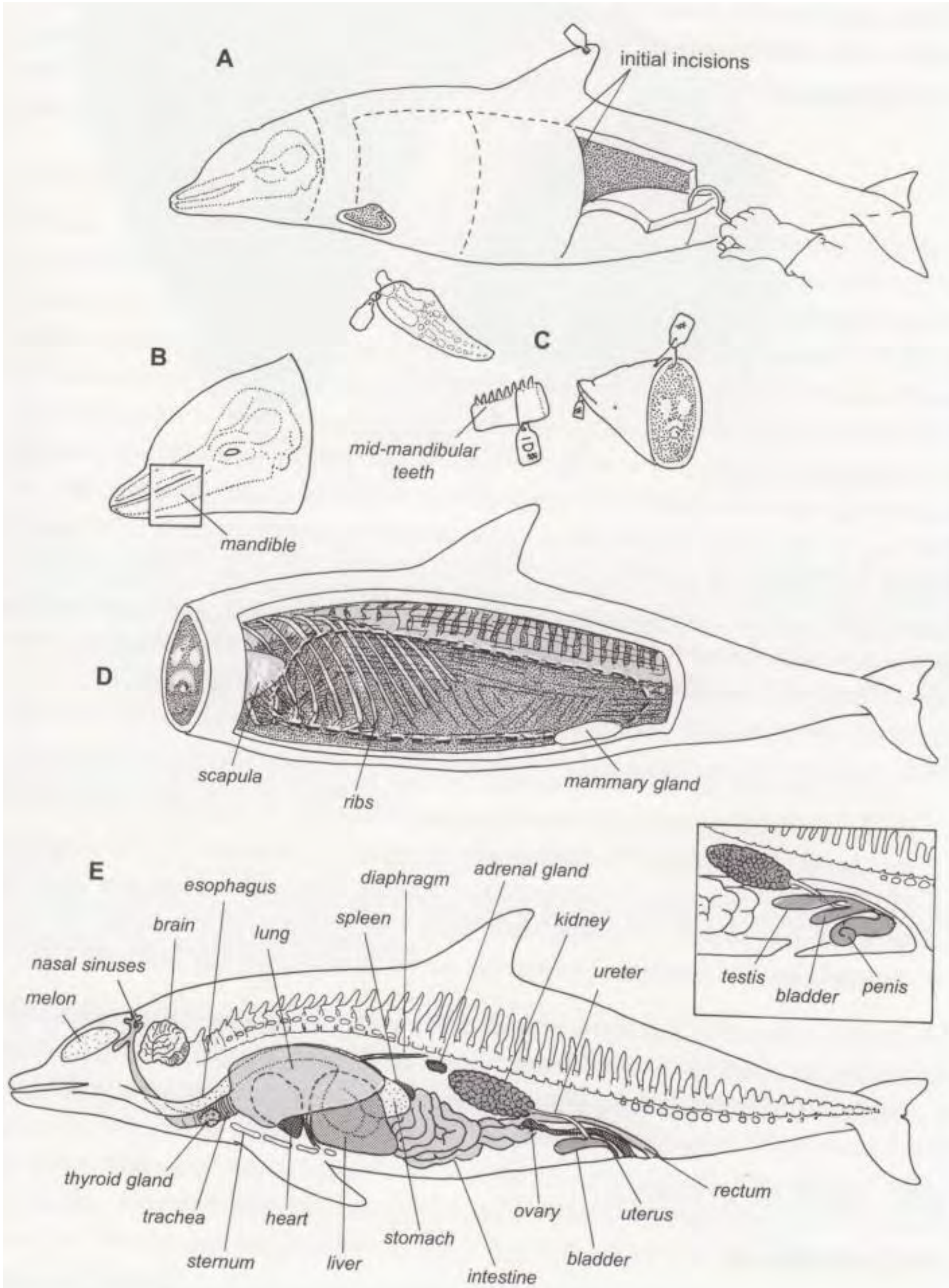
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD

Measuring manatees. 1. Tip of snout to tip of fluke. 2. Tip of snout to center of anus. 3. Tip of snout to center of genital aperture. 4. Tip of snout to center of umbilicus. 5. Tip of snout to anterior insertion of flipper. 6. Tip of snout to center of eye. 7. Tip of snout to external ear. 8. Center of eye to ear. 9. Distance between centers of eyes. 10. Center of eye to center of nostril (same side). 11. Flipper length, anterior insertion to tip. 12. Flipper length, axilla to tip. 13. Maximum width of flipper. 14. Perpendicular length of teat, right and left (see Fig. 8.1 for location). 15. Base of fluke to posterior tip. 16. Maximum width of fluke. 17. Girth at fluke base. 18. Girth at anus. 19. Girth at umbilicus. 20. Girth at axilla. 21. Thickness of skin: dorsal, lateral, ventral. Thickness of blubber-Outer: dorsal, lateral, ventral. Inner: dorsal, lateral, ventral. Girths and flipper lengths recorded on fresh animals (Code 2) only



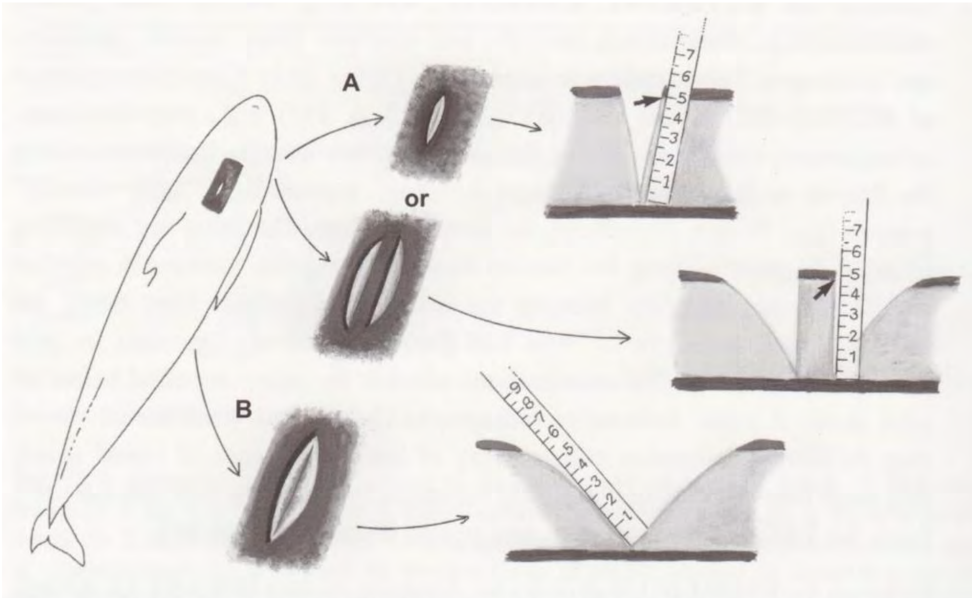
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Manatee dissection and internal anatomy. A. Incisions for manatee dissection. B. Major internal organs before opening of pericardial cavity. C. Major internal organs after removal of liver, intestines, and left hemidiaphragm. D. Lateral view of major internal organs



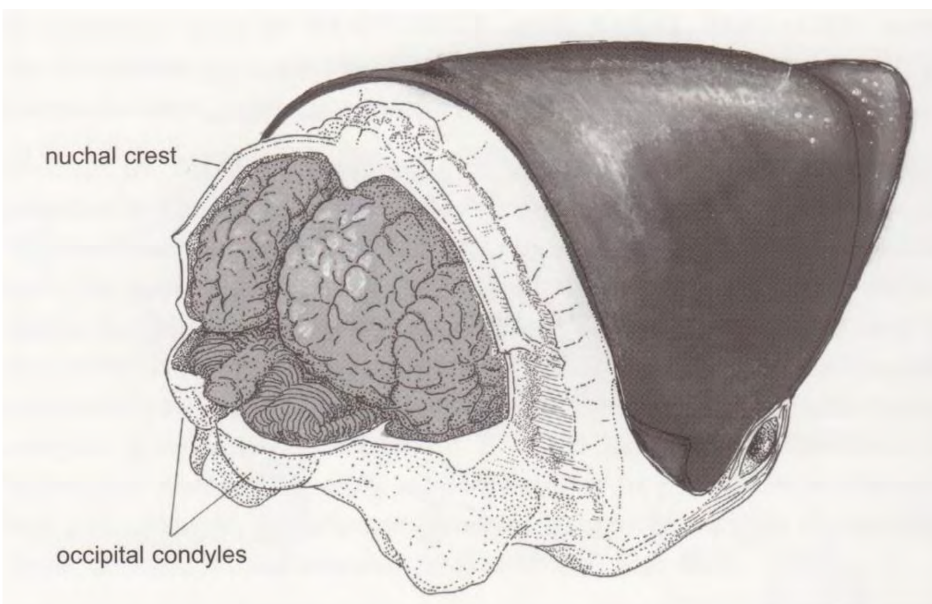
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammals Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Cetacean dissection and internal anatomy. A. Initial incisions for removal of skin and blubber. B. Site of mandibular tooth collection for age determination. C. Labeled voucher specimens and samples for age determination. D. Opening in lateral body wall in relation to skeletal structure. E. Lateral view of major internal organs, female and (inset) male



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Measuring blubber thickness. A. To minimize distortion, measure within a short incision or measure the column of blubber between two longer incisions. B. A long incision results in distortion of the blubber and inaccurate measurements



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Removing the cetacean brain. Make two horizontal cuts, one through the occipital condyles and the other posterior to the nuchal crest. Join these laterally with two vertical cuts. A chisel may be needed to break the bony septum that separates the hemispheres. Remove the bony plate to expose the brain, tilt the skull backwards while sliding a hand over the surface of the hemispheres to sever soft tissue connections to the dura and cranial nerves

Carcass Evaluation:

Before obtaining tissue samples from dead animals, the quality of the carcass must be evaluated to determine its suitability for the intended study.

External Features:

The condition of a marine mammal carcass cannot be evaluated solely by its outward appearance or estimated by knowing the time since death. The rate of decomposition is influenced more by body temperature in a robust (thick blubber layer) animal and by environmental temperature in one that is lean. Larger, rotund carcasses retain heat longer than smaller, thin ones. Cetaceans sink initially at death, then float days or weeks later when buoyed by decomposition gases, and arrive ashore outwardly unchanged but internally decomposed. At the other extreme, seagulls may begin gouging the eyes and penetrating the skin and blubber of the jaw and body openings of a living dolphin, perhaps already mutilated by shells and rocks during stranding. By the time the animal dies, the carcass may already appear to be spoiled. In summer or when ill, leaner carcasses come ashore only after they sink and re-float.

Rigor mortis, defined as stiffening of the body after death, is an indicator of the time of death in many species. The process begins within hours after death, varying with the animal's terminal condition and the ambient temperature. The duration is also variable, but is measured in hours or, under cool conditions, perhaps a day or two. The presence of rigor mortis indicates a carcass in moderately good condition. The skin, eyes, and exposed mucous membranes dry rapidly after death and are not an accurate gauge of quality of a carcass out of water. These tissues retain their vital appearance longer in water or with humidity or precipitation and then, too, may be unreliable indicators.

Bloating is generally a sign that a carcass is not fresh, though some diseases may cause gas production in tissues even in live animals. Tell-tale signs of decomposition include a protruding tongue and penis. At some point the gases escape, and it may not be obvious whether the process has just begun or ended.

Internal Features:

The blubber of a fresh carcass is firm, mostly white, and only moderately oily. With time, it may become tinged with blood (imbibition) from underlying tissues. Eventually, the oil begins to separate (delipidation) and pool, leaving behind a lacework of greasy connective tissue fibers. Fresh muscle is dark (except in fetuses and sea cows) and firm, and the bundles are distinguishable and easily separated. As a carcass decomposes, the muscles become soft, pale, translucent, and pasty; fiber bundles become almost indistinguishable. The rate of decomposition may be increased by the animal's terminal condition, such as a generalized infection with increased body temperature (fever) or wounds that expose the body to rapid bacterial invasion. Because blood tends to promote the process, decomposition is retarded in animals that bleed to death. The rate of decomposition of an internal organ is related to temperature, the amount and arrangement of connective tissue, and proteolytic enzyme content. Peculiar to marine mammals other than the sea cows is the abundance of hemoglobin and myoglobin that, in contact with tissues, accelerates decomposition. Skin, blubber and muscle can remain intact and may even show gross lesions for as long as 7 to 9 days after death. The heart and lungs maintain their integrity for perhaps 2 or 3 days, while adrenal glands, liver, spleen, brain, kidney, and mucosa of the digestive tract decompose with frustrating rapidity.

Protocols – General Considerations:

In our zeal to gather as much information as we can from a carcass, we may spend time, energy and resources collecting specimens of marginal or no value. The effectiveness of the operation will be increased by following clear protocols using only suitable carcasses. In a mass stranding, it is better to concentrate on the freshest specimens, not necessarily the most convenient, and to perform the procedures as soon as possible. Marking carcasses with colored ribbons or tags to indicate the stage of protocol completion will increase efficiency and reduce confusion. The best samples are obtained through careful dissection, avoiding contamination of tissues by contact with dirty instruments, other organs, or body fluids. At the outset, be sure the type and quality of equipment and packaging materials are satisfactory for the task at hand. With thoughtful planning, it will be possible to obtain morphometric data first, followed by external samples for microbiology. Once the carcass is opened, tissue samples for microbiology and toxicology take precedence, followed by sampling for histopathology, parasitology, and life history. This order follows the sequence of general dissection and examination

Carcass Examination:

Procedures for dissecting and examining carcasses vary with the size and species of the subject and personal preference of the investigator. The following outline, condensed from specific protocols and personal experience, is one approach to carrying out a systematic examination of a carcass.

1. **IDENTIFY** the species and determine the sex. **DESCRIBE** and **PHOTOGRAPH** form, color pattern, scars, other distinguishing features (e.g., number and position of teeth or characteristics of baleen), injuries, external lesions, etc.; for populations included in photo catalogues, photograph pertinent characteristics. Tooth counts are taken from one side of the upper and lower jaw.
2. Take **MEASUREMENTS**, including blubber thickness; obtain body **WEIGHT** if possible.
3. Conduct the **EXTERNAL EXAMINATION**. Note general condition (e.g., emaciation); describe and illustrate scars, lesions, parasites and discharges. Take samples as appropriate. Distinguish "crush" wounds from "high velocity" wounds (i.e., bullets, propellers); the latter may show shattering and scattering of bone fragments along the wound tracks. Distinguish between a gunshot wound and any other by locating the bullet; take samples from along the projectile path (preserve in 10 percent neutral buffered formalin) to determine (by histological examination) whether the injury occurred before or after death. Check for evidence of other **HUMAN RELATED INJURY** (e.g., propeller scars, entanglement). Look for **TAGS** or tag scars (i.e., tear in rear flipper or dorsal fin). Examine the **UMBILICUS** of neonates. Examine the **MAMMARY GLANDS**; attempt to express milk, note color and consistency, make smears for examination for parasite ova. In odontocetes, extend the **PENIS** from its sheath; examine the surface and soft tissues at the base for small cauliflower-like lesions.
4. Examine the **MOUTH** and **TEETH/BALEEN**; note abnormalities (i.e., worn or broken teeth, gum and tongue condition, obstructions) or parasites. For cetaceans, note number and position of teeth, or the number, color, and length of the longest baleen plates. Check the **BLOWHOLE/NASAL PASSAGES** for parasites, discharges, or obstructions; make smears for parasitologic examination. Examine the **EYES** for clarity, surface lesions, injuries and discharges. Take external swabs for microbiology before opening the carcass.
5. Open the carcass for **INTERNAL EXAMINATION**, preferably on or abutting a plastic or teflon sheet. (In cetaceans, a section of skin and blubber can serve as a small work surface.) Have all instruments, collecting jars, labels and preservatives on hand before making the first incision. For seacows, position the carcass on its back; make a mid-line

incision through skin, blubber and muscle from jaw to anus, without penetrating the abdominal cavity. Fold back the skin and blubber from each side; remove or deflect the forelimbs, including the scapula. Be prepared to remove a flipper or claws for age determination. Position a cetacean carcass on its side, preferably left side up (for easier removal of rib cage). Remove portions of the lateral body wall and dorsal musculature.

6. At each stage of the examination, sample tissue as soon as it is exposed. First take samples for toxicology and microbiology. Be prepared to describe, photograph and remove tissues for histopathology. Search specific locations for parasites. Package and label samples immediately.
7. Examine the **BLUBBER** or **SUBCUTANEOUS FAT**; note visible parasites (cetaceans); sample for toxicology. Dissect the **MAMMARY GLANDS**. Examine the superficial **FASCIA** (cetaceans) for parasite tracts (white, noodle-like structures). Note **MUSCLE** color, texture, and abnormalities.
8. Cut through the abdominal musculature to expose the **ABDOMINAL CAVITY**, but avoid puncturing the intestines. Examine with organs in place, noting color, consistency, and abnormalities (e.g., fluids, lesions, discolorations, adhesions). Examine the **MESENTERIES** and **MESENTERIC LYMPH NODES**. In neonates, observe the umbilical connections to the liver and bladder. Check for cestode cysts in cetaceans.
    a. Move the stomach and intestines aside and, using the kidneys as landmarks, locate, remove and examine the **ADRENAL GLANDS**. Collect, package separately and label, including “right” or “left”.
    b. Remove and examine the **SPLEEN**; note size, texture and character of a cut surface. Carefully remove the **GASTROINTESTINAL TRACT** and associated organs, first tying off the stomach near the base of the esophagus and at the colon. Examine the peritoneum and abdominal cavity. Spread the GI tract out on a clean surface (away from the carcass) for examination. Remove and examine the **PANCREAS**; note the degree of scarring or fibrosis in cetaceans; dissect open the **HEPATOPANCREATIC DUCT** (in cetaceans) and check for trematodes (flukes). Dissect the gut free from the mesentery. Examine the **STOMACH** surface for perforations. Collect the stomach, with contents, from small animals after first tying it off at the duodenum; freeze for later examination. Alternatively,

open the stomach into a plastic bag or bucket and collect the contents; note any ulcerations, foreign objects or parasites, both free and embedded in the mucosa (grape-like clusters in the first and second chambers of cetaceans). Examine the external surfaces of the **INTESTINES** for nodules, segmented discoloration, or adhesions. Open and examine the gut for hemorrhage, character of the mucosa, parasites, and obstructions; describe the contents. Note the texture of the **OMENTUM** and **MESENTERIES**.

c. Remove and examine the **LIVER**, noting surface texture and color. Cut the lobes in several places in order to examine the internal structure. Open the **GALL BLADDER** (none in cetaceans) and **BILE DUCTS**; examine for trematodes.

d. Examine the **KIDNEYS** for adhesions, abscesses, or hemorrhage; remove by cutting them away from the dorsal musculature. Slice in several places and examine the interior for stones or cysts. Examine the **URETERS** and **BLADDER**. Aspirate urine with a syringe and needle (in males this can be collected from the penis by squeezing the bladder), check the color, and save for later analysis. Open the bladder and check for stones. In great whales and beaked whales, examine the vessels and urinary ducts for nematodes.

e. Remove and examine the **REPRODUCTIVE TRACT**; note presence of a fetus, tumors, abscesses, or unusual amounts of fluids. Record the weight, length and sex of any fetus. Collect the whole fetus for toxicology studies. Examine the ovaries for corpora lutea; if present, take special care to locate the fetus or collect the entire reproductive tract. Examine, weigh and measure the testes. Package the gonads separately and label “left” or “right” (freeze or fix in 10 percent neutral buffered formalin). (Examination for and counting of corpora albicantia and corpora lutea, and checking the epididymis for sperm are best done in the laboratory. In dolphins, urine may also contain microscopic evidence of sperm.)

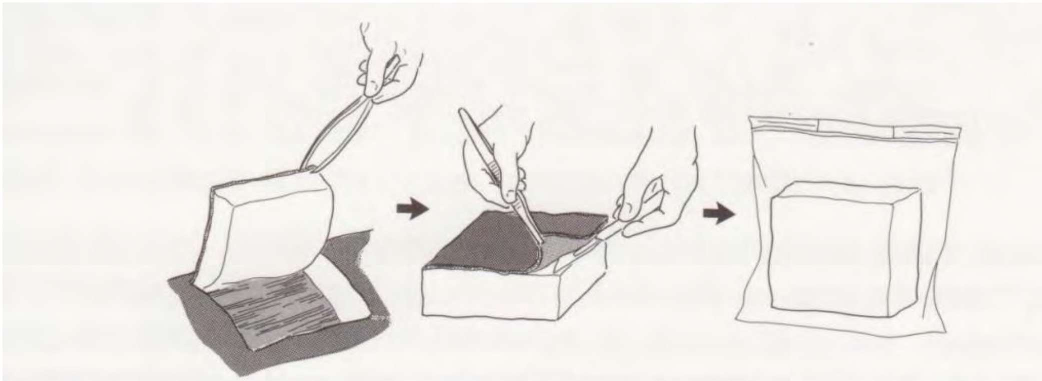
9. Open the **THORACIC CAVITY** (sea cows) by cutting the rib cage along the ides at the junctions of the ribs and costal cartilages; remove the sternum and attached cartilages. In cetaceans, cut the articulations between the ribs and sternum, and the ribs and vertebrae (cranial ribs have double articulations along the back). Attempt to disarticulate rather than cut the ribs; the former may be easier on a large cetacean. (Large baleen whales

often float in on their backs; a ventral midline incision along the small cartilaginous joints of the sternum will separate the thorax, and the whale's weight will help open the carcass.) **Cover the tips of fractured or cut bones to prevent personal injury.** Examine the thoracic cavity with organs in place; note abnormalities (e.g., discolorations, excess fluids, lesions, adhesions). Examine the **PLEURA** and **DIAPHRAGM**. Note size, color and consistency of the **THYMUS**. Sample pericardial fluid with a sterile syringe before opening the pericardium, or introduce a swab through a small incision.

a. In small animals remove the **PLUCK** (heart, lungs, trachea, and esophagus) intact by cutting the tongue from the lower jaw and pulling it backward, severing connective tissue attachments and hyoid bones. Note any congestion or hemorrhages in the muscles of the thoracic inlet. Place the pluck on a clean surface, ventral side up, for dissection.
b. Remove and examine the **THYROID GLAND**. Note size, shape, and consistency.
c. Open and examine the **ESOPHAGUS**; check for ulcers, obstructions and migrant stomach parasites. In cetaceans, the **LARYNGEAL TUBE** is now exposed for examination.
d. Examine the **LUNGS** for color, consistency and texture. Note the condition of the bronchial lymph nodes. In cetaceans, examine a lung-associated lymph node and sample for histopathology. Open the **TRACHEA** and **BRONCHI**, continue dissection through to small airways and into the parenchyma of lungs. Note characteristics of airway fluid (i.e., clear, frothy, hemorrhagic). Collect any parasites present. Describe and sample areas that appear to stand out in marked contrast to the main body of tissue. Aspirate fluid to check for the presence of sea water.
e. Examine the **HEART**. Note color and quantity of pericardial fluid, and amount of coronary fat. Examine for pale areas, hemorrhages or evidence of congenital defects. Sample blood from the right ventricle. Open the heart following the course of the circulation— from right atrium to ventricle into pulmonary artery, and left atrium to ventricle into aorta; note thickness of the walls and irregularities

of valve leaflets. Check for nematodes (left atrium and ventricle). Note presence and nature of clots.

10. To collect or examine the **SKULL**, disarticulate the head between the skull and the first cervical vertebra; secure a tag for identification.
11. Examine the **MIDDLE EAR** and **PTERYGOID SINUSES** of cetaceans for parasites by placing the head upside down and dissecting away the lower jaw. Take time and care to free all tissue attachments at the angle of the jaw; the alternative of prying open the mandible with force will crush the tympanic bones. Cut away soft tissue to expose the entrance to the pterygoid sinus; use a bone cutter to dissect deep into this cavity. Rinsing sinuses with saline or water will help flush out concealed trematode parasites.
12. In fresh carcasses of baleen whales, collect the **WAX PLUG** at the proximal end of the auditory canal; place it in a rigid container with 10 percent neutral buffered formalin for aging studies.
13. To expose the **BRAIN** (useful only on fresh specimens), remove the top of the skull and cut away the soft tissues over the cranial vault. This procedure requires a handsaw, hammer and chisels, and for larger animals, a sturdy meathook or prybar as well. Examine the exposed brain for color, consistency, lesions and parasites. Fix brain for histology by slicing every 1-2 cm, with some cuts extending deep enough into the cortices for the preservative to reach ventricles; place in 10 percent neutral buffered formalin.
14. Sample **TEETH** for **AGE DETERMINATION**. In odontocetes, they may be extracted from the mandible by cutting down into the gum tissue on either side of the tooth row and prying out at least 6-8 midrow teeth. Alternatively, use a saw to take a section of mid-mandible with teeth in place for later extraction. Teeth are not useful for age determination of sea cows.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Correct procedure for collecting blubber samples, showing removal of skin and muscle

BLOOD STUDIES:

Blood samples provide an opportunity to evaluate the functional capacity of organs, as one approach to determining what processes might have been responsible for or associated with the stranding event. A broad spectrum of analyses can be performed, including plasma chemistry, hematology, antibody titers, and toxicology, as a means of investigating a range of pathologic conditions.

Carcass selection: Code 1 ideal; 2 limited; 3, 4, 5 useless.

Blood samples only have value for clinical pathology when taken from live animals, or within minutes after death. Organs deteriorate rapidly, causing progressive changes in concentrations of blood gases, enzymes and electrolytes, among other parameters. Samples collected from animals dead for more than a few minutes are useful only for serological studies.

Sampling:

Freshly dead animals, including those euthanized by lethal injection, can sometimes be sampled in the same way as live ones. When procedures are carried out more than a few minutes after death, **samples can be taken from the right ventricle of the heart with a syringe and needle**. 20-30 mL of whole blood is enough to run a comprehensive set of analyses. Five tubes should be ready to receive the blood: samples are put **1)** in EDTA for hematology, **2)** in heparin for harvesting plasma, **3)** in a chemically clean tube for separating serum, **4)** in EGTA (ethyleneglycol-bis-N4-tetraacetic acid) for catecholamines, and **5)** in sodium citrate for glucose and coagulation studies. **Record times of death and sampling.** Place samples in a cooler or on ice, but do not freeze, and transport to the laboratory as soon as possible for processing. When a delay of more than about 4 hours is anticipated, centrifuge the blood to separate the plasma or serum; these samples, free of red blood cells, can be frozen if delivery to the laboratory within a day is impossible. A blood smear is useful if samples for hematology cannot be analyzed within 24 hours.

Ideal:

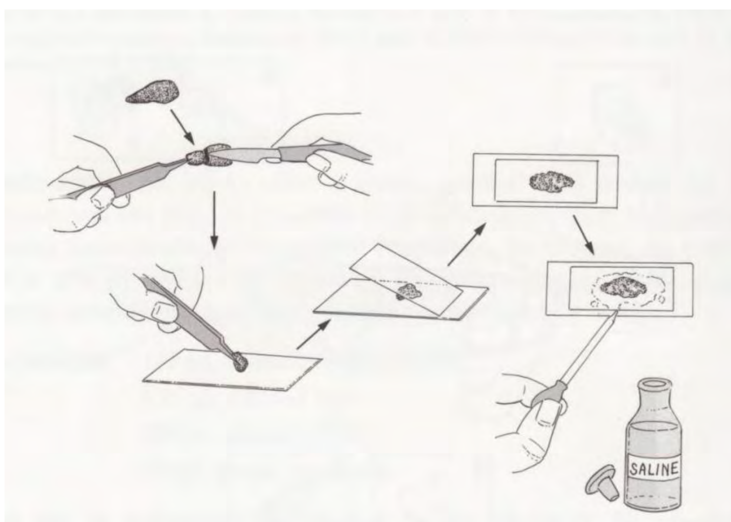
Samples should be obtained before death and analyzed immediately. Serial samples collected several hours apart are particularly informative.

Practical:

Rarely do situations allow for blood to be taken from a carcass in good enough condition to be of much use for clinical diagnostics. However, viral antibodies will persist and can be detected in samples taken many hours or even days after death from **Code 2** animals.

Precautions:

Samples are easily contaminated with body fluids. Blood cells settle out in the heart and vessels giving misleading values for hematology, and the time of death, if not observed, cannot be reliably established. Red cells can rupture if samples are mishandled or frozen, giving erroneous results.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Crush-smears of cetacean brain and mammary tissue may show presence of parasite ova

MORPHOMETRICS:

Morphometric and descriptive data provide basic biological information and have added value when correlated with factors such as age, stage of maturity, reproductive status, parasitic burden and disease processes. The accumulation of such data results in a better understanding of general population health, demographic trends, and identification of discrete stocks. Studies of organ weights help to define specific physiological adaptations and attributes.

Carcass Selection: Code 2, 3 ideal; 1, 4, 5 limited.

Every carcass provides some morphometric data, even skeletal remains. The amount available depends on the state of the carcass.

Measurements:

Measurements are taken according to the appropriate protocol for the animal. The procedure is straightforward, requiring one or two persons with a tape-measure and ideally a third to record. Rare species demand a thorough approach. **Augment measurements with photographic documentation.** All measurements can be valuable, but standard length is consistently useful. Except for girth and other specified dimensions, **measurements are always taken in a straight line from point to point**, never following the contours of the animal. **Standard length** is the straight line distance from the tip of the snout (or the melon, if more anterior) to the tip of the tail or notch of the flukes. Girth measurements are useful only when there is no evidence of bloating. The girth of large whales is recorded as 2 times the measured distance between the mid-ventral and mid-dorsal points on one side of the body. Estimated measurements or weights must be clearly indicated as such on the data sheet, including the basis for the estimate (e.g., partial measurements, visual assessment).

Blubber thickness (does not include skin) is measured from a perfectly perpendicular cut; distorting the tissue distorts the results. Counts of **ventral grooves** and descriptions (length, number and color) of **baleen plates** are useful for identification of mysticetes. A count taken of grooves on one side of the body, from the mid-ventral groove upward, can be doubled to give the total figure. Length is measured from the tip of the lower jaw to the end of the longest groove (excluding the mid-ventral) in a straight line parallel to the body axis. Baleen is counted along the outer edge of the series of plates at gum level, as shown in; optimally, the number is an average of counts obtained for both sides of the jaw.

Ideal:

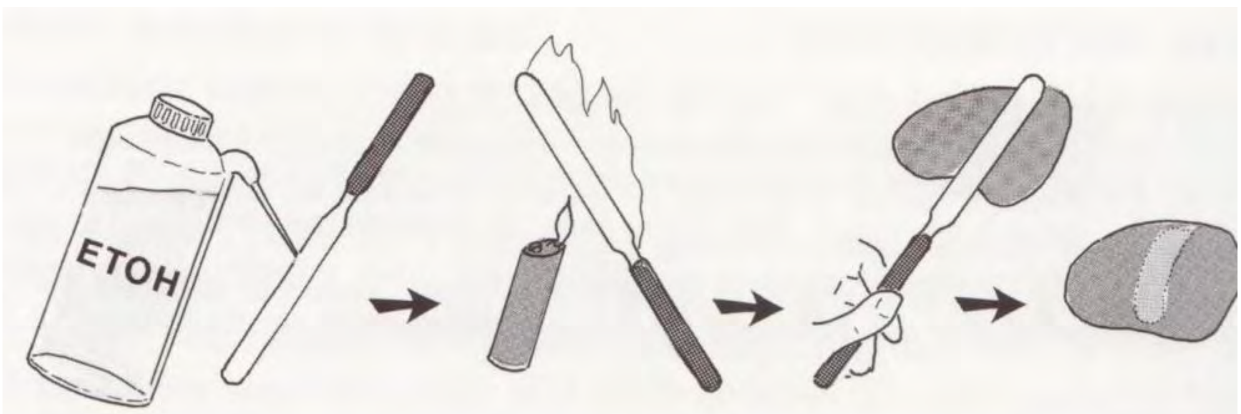
A complete set of data includes measurements of as many external features as possible, whole body weights, and weights of major organs.

Practical:

Rarely are all measurements taken, but even under poor conditions with few resources and no time to spare, it will be possible to obtain standard length, using knots as markers on a rope or string if necessary. Animals or organs too large to weigh intact can be divided and the pieces weighed separately. Metric units are preferred, but any system of measurement can be converted later.

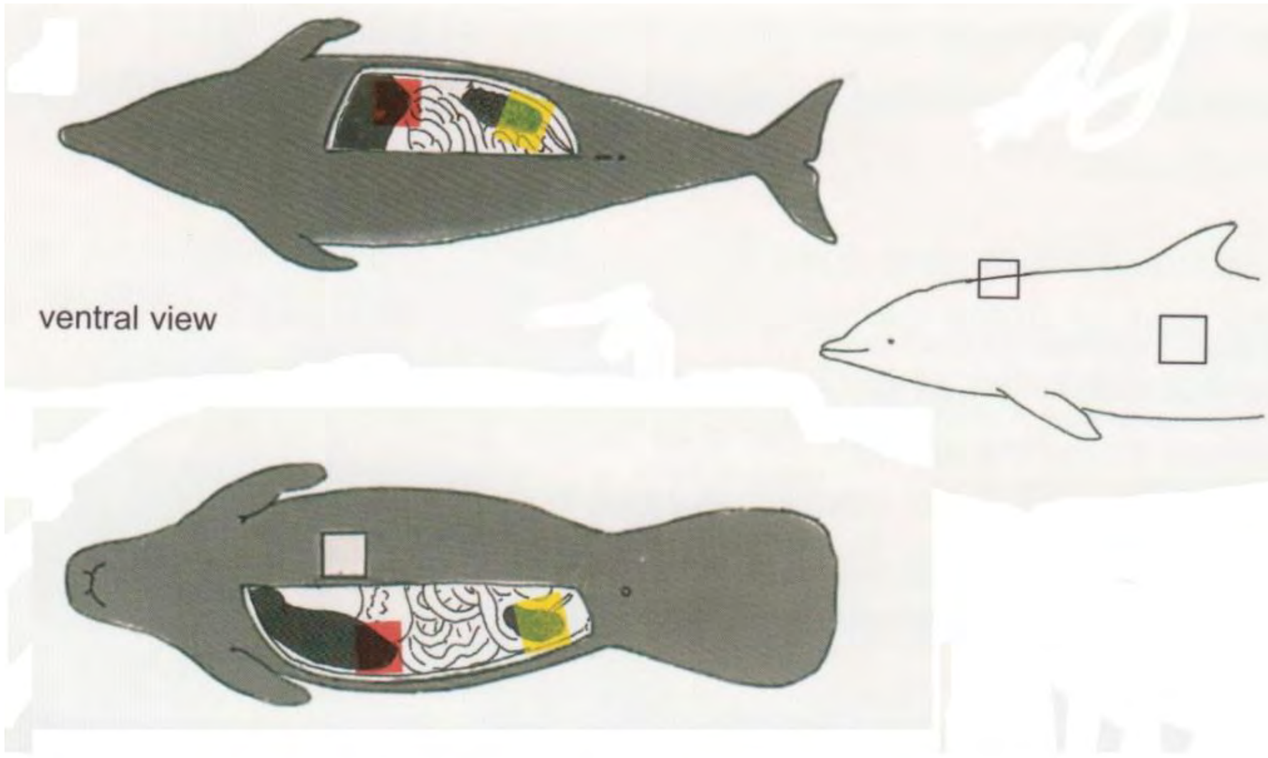
Precautions:

Adhere strictly to the protocol, measure uniformly, and always from the same specified point (e.g., from the midpoint of the genital slit and not from either end). **Units of measurement must be consistent and clearly indicated.** In mass stranding, having one or several specified teams perform all measurements will ensure uniformity.



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Sterilizing tissue surface by searing



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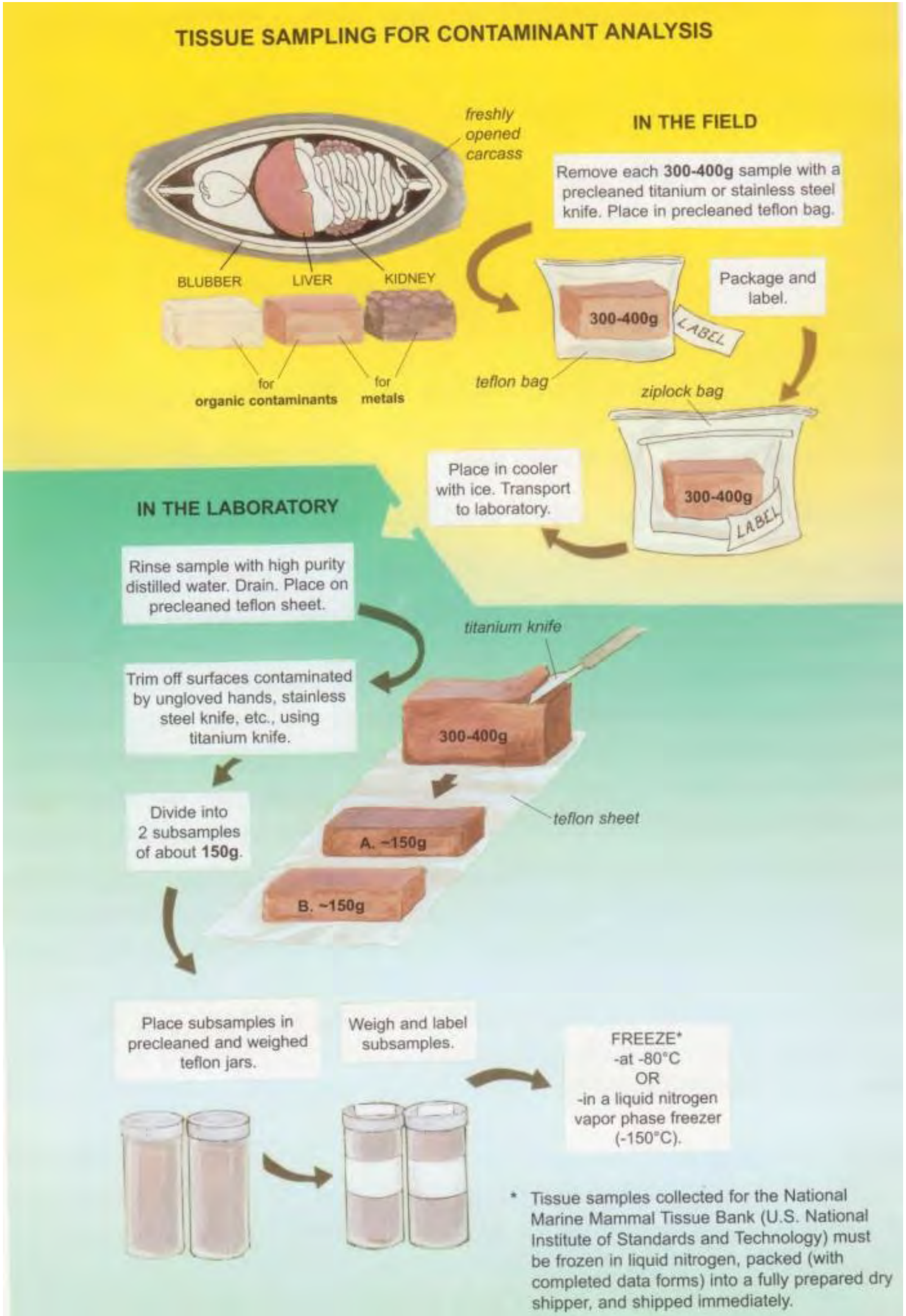
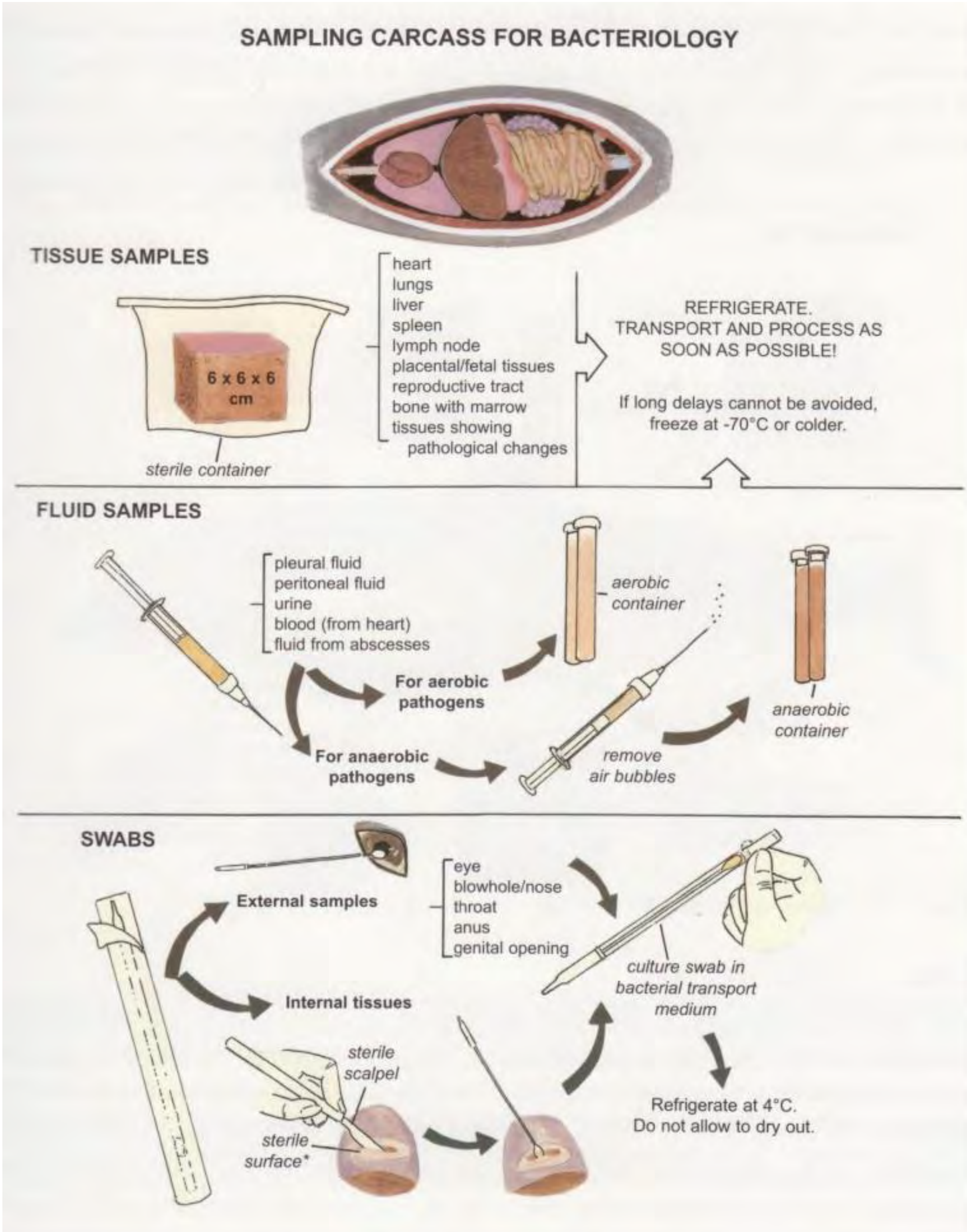
Sites for collecting tissues for contaminant analysis. Sampling site for liver (Red) and kidney (Yellow) of cetaceans, seacows. Sampling site for blubber (White) of seacows and cetaceans

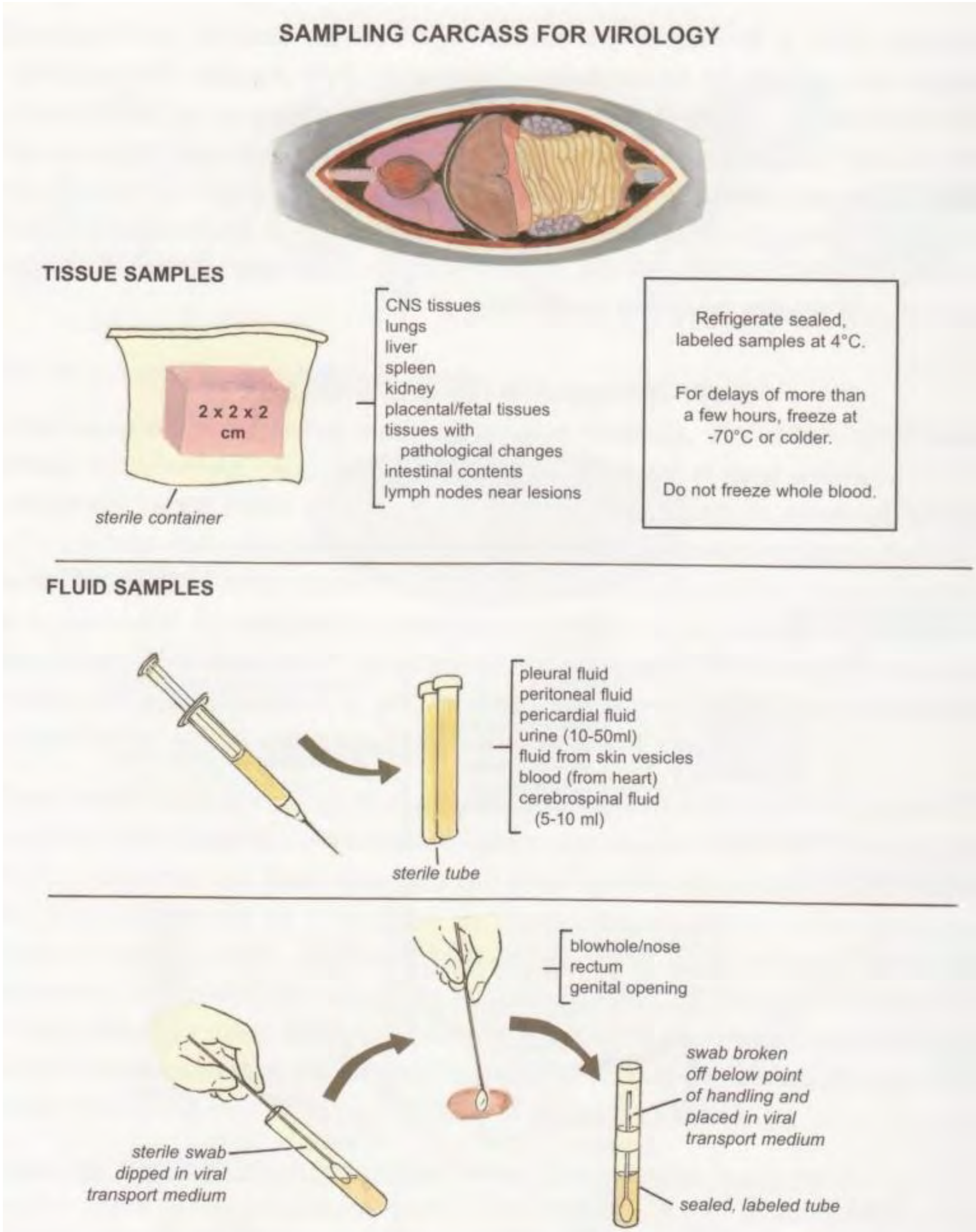


Collecting tissue samples for toxicology



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Collecting samples for bacteriology



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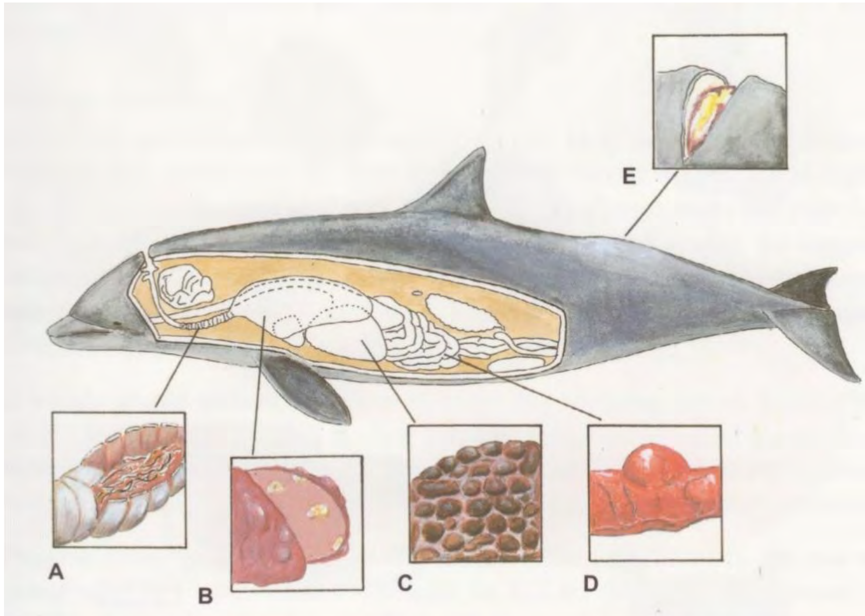
Collecting samples for virology

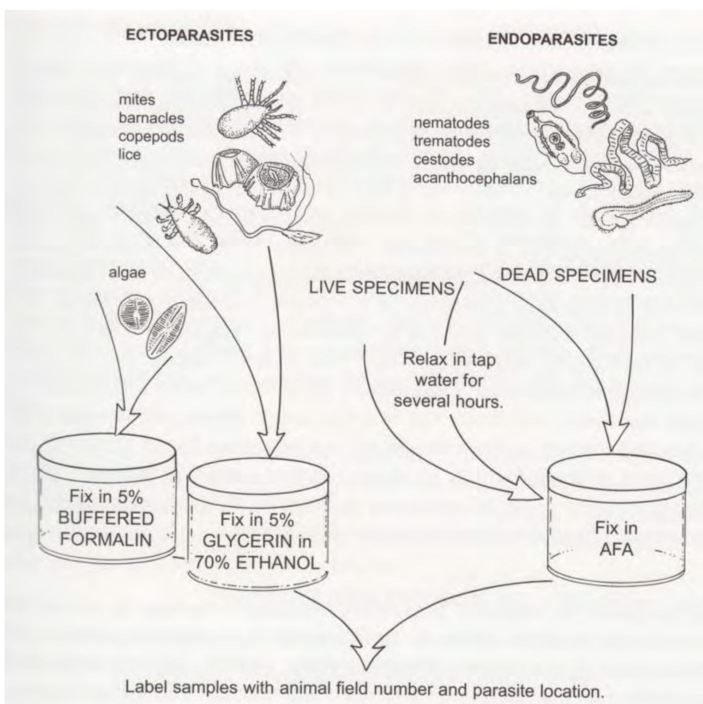
Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Collecting tissues for histo-pathologic examination



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

The internal examination: examples of pathologic conditions and their description. A. Trachea: a tangled mass of nematodes (worms) partially obstructs the trachea. B. Lung: the lung contains a number of abscesses filled with cottage cheese-like exudate, under the surface and throughout the organ. C. Liver: the liver surface is cobblestoned because of a mixture of scarring (the depressions) and regeneration (the nodules). D. Gut: a smooth nodule (probably a tumor) protrudes from the external surface of the intestine. E. Back: incision of a swelling visible on the back behind the dorsal fin reveals a mixture of pus and blood in the blubber and underlying muscle



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Collecting parasite samples

LIFE HISTORY:

Information on age, genetics, reproductive status, and feeding habits is vital to understanding the general biology of the species, developing demographic models, identifying discrete stocks, and planning conservation and management strategies. Certain life history information makes interpretation of pathologic and toxicologic data more meaningful. In general, biological data are additive; the more we can obtain on a given specimen, the more meaningful each element becomes.

Live animals: Code 1 limited.

Live animals are an invaluable resource for obtaining measurements, information on social organization (i.e., age and sex composition of groups) and blood or biopsies for DNA analyses.

Carcass selection: Code 2, 3 ideal; 4, 5 limited.

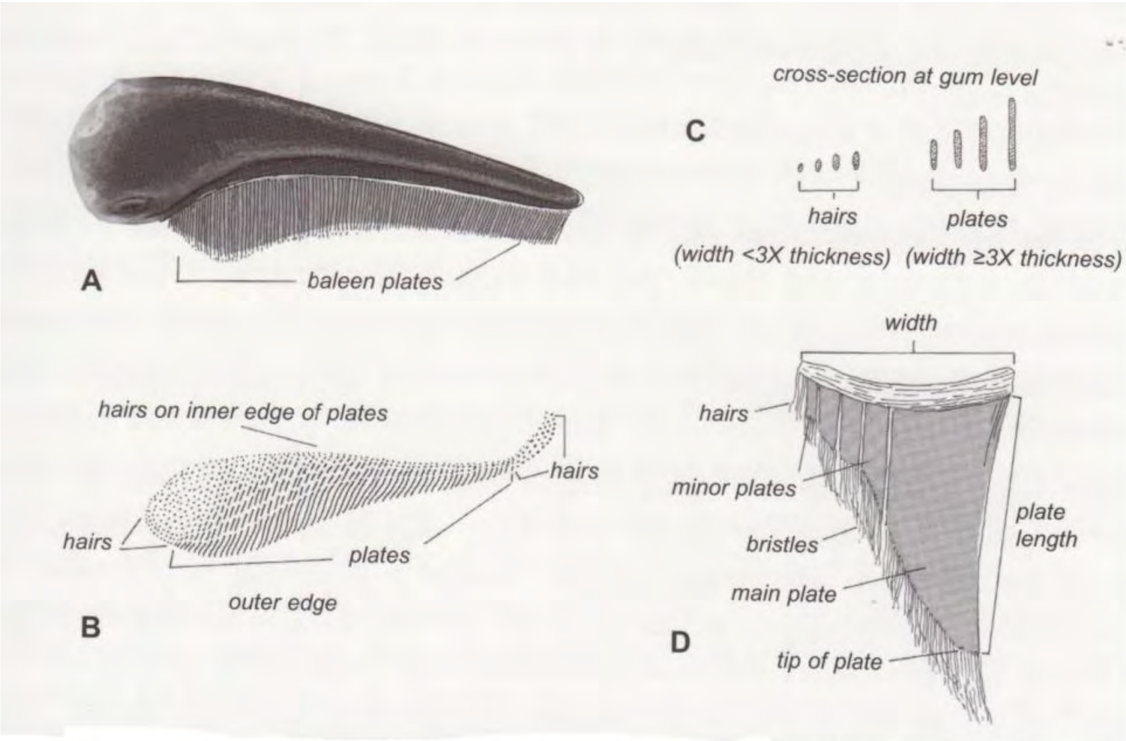
Most carcasses provide suitable samples of teeth, claws or skeletal parts for age determination, or tissues for DNA analysis. Code 2 animals are required for earplugs of baleen whales. Gonads and uterine samples can be taken from Code 2 and possibly Code 3 carcasses. Stomach contents can be collected from Code 2, and some from Code 3, 4, and even Code 5 carcasses (e.g., otoliths and squid beaks).

Sampling:

Tooth samples for age determination can be obtained by persons with minimum training. In the field, teeth (or sections of skull or mandible) can be placed temporarily on ice, frozen, or packed in salt to retard tissue decomposition. In the laboratory, teeth can be extracted, cleaned in an enzyme preparation such as trypsin, labelled, and stored in 70 percent ethanol. It is wise to avoid drying, prolonged boiling, or use of solutions containing glycerine. **Bone** specimens for aging studies can be frozen, preserved in 10 percent formalin or alcohol, or cleaned and dried without affecting the clarity of periosteal layers. The sample should include a bone end incorporating a cartilaginous growth plate or a scar of an old growth plate. Removing **earplugs** of baleen whales requires skill and sometimes heavy equipment to position the skull. Earplugs should be preserved in 10 percent neutral buffered formalin. **Skin** samples for DNA study are optimally placed in a normal urea solution (example recipe below). If this cannot be obtained from a DNA laboratory or the ingredients are unavailable, tissue can be preserved in a saturated NaCl solution (with 5 percent DMSO if possible) or frozen at -20°C.

Formol-urea solution:

- 4M urea
- 0.2M NaCl
- 0.1M Tris-HCl, pH 8.0
- 0.5 percent n-lauroylsarcosine
- 10mM EDTA



Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Counting and measuring baleen. A. Baleen series extend along each side of upper jaw; plates at front and rear become smaller and less easily distinguished, eventually just hairs. B. Examined in cross-section at gum level, baleen plates have a width at least 3X their thickness; those with width less than 3X the thickness are termed hairs. C. Typical baleen plate, consisting of main plate along outer edge, one to several minor plates, and hairs along inner margin; bristles extend from plate margins to form filtering network. Plate length is taken as the straight line distance from the outer edge at gum level to the tip of solid portion of mainp late. D. Simplified view of arrangement (at gum level) of rows of baleen plates (main and minor plates, hairs) and baleen hairs. Counts are taken along the outer edge of the plates

In small animals, remove, weigh and preserve (in 10 percent neutral buffered formalin) the entire **reproductive tract and organs**. In all cases, preserve both ovaries and a sample of mammary tissue. Measure, weigh if possible, and preserve entire testes; repeat for epididymis. Collect baculum (penis bone). Slice large testes to ensure proper fixation. Measure, weigh, and determine the sex of the **fetus**. Open the **stomach** carefully and gently flush the contents into a plastic bag. It may be necessary to scrape the mucosa to obtain the small but diagnostically important otoliths (ear bones of fish). Contents may include recognizable prey species, macerated flesh, skeletal fragments, otoliths— some so small as to be in apparent to the naked eye, numerous parasites, and a variable amount of fluid. (In cetaceans, the contents needed for dietary analysis are almost exclusively in the first stomach chamber.) Collect and package the entire stomach contents of small animals, including non-food items. A representative sample may be all that is possible to collect from large animals. **Stomach content samples for life history studies can be frozen or preserved in 70 percent ethanol**. Be prepared to remove a subsample (whole fish, macerated flesh) for toxicology, and samples of parasites and lesions to satisfy other protocols.

Ideal:

Obtaining complete samples for life history study is a realistic goal when the carcass quality permits it. There are usually enough stomach contents to meet the needs of other protocols.

Practical:

A stomach full of food decomposes rapidly, leaving unmanageable foul-smelling fluid. Collecting and weighing stomach contents of large animals is an ordeal. When decomposition is advanced, reproductive organs may still be useful for determining sexual maturity (look for fetus or corpora albicantia; check size of testes). Obtaining teeth from large odontocetes requires an energetic approach with rugged tools, and dissecting earplugs demands considerable skill. Collection of life history samples from fresh carcasses may interfere with other procedures, e.g., samples of reproductive organs for histopathology or stomach contents for toxin analysis. In these circumstances, **investigators must agree on sampling priorities**.

Precautions:

Establish sampling priorities. Once the stomach is open, contents including fluids and parasites will quickly contaminate other organs if they are not contained. **Do not preserve stomach contents of fish-eating species in formalin, since this may dissolve small bones.** Ovaries and testes should be packaged separately and labelled “left” or “right”. Though perhaps obvious to the collector, it is wise to label the origin (position) of tooth samples. Teeth and gonads collected in a flurry of activity from many animals can easily be mislabelled and mismatched—with bizarre results.

PACKAGING AND LABELING:

Package each specimen to comply with the appropriate protocol. Label clearly with indelible ink. Preferably "double-bag" (i.e., bag within a bag) tissue samples, placing a waterproof (and oil proof) label in each bag. Samples for contaminant analysis are exceptions; no label should come into contact with the tissues. Jars with preserved materials should be labelled on the outside but also contain a duplicate label inside. Do not label lids only, as they can be inadvertently switched. Secure tags directly to voucher specimens such as skulls or mandibles; tag large items (e.g., skulls) in more than one location.

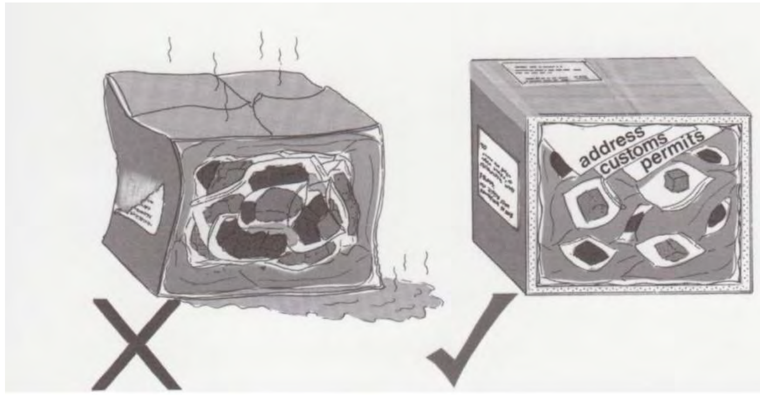
Include on the label:

- Animal identification number
- Species
- Date and time (mm/dd/yy/military time) and location
- Tissue

Shipping:

Shipping containers must be sturdy. Clearly print name, address and telephone numbers of both the shipper and receiver. Place a duplicate address label inside, along with all required documentation (i.e., loan form, permits and customs documents). Enclose a copy of the stranding report form to provide pertinent information on species, size, sex and observed pathologic conditions. Arrange for pick-up at destination before shipping perishable specimens. Pack samples in a manner to prevent loss, crushing or deterioration and to protect persons involved in subsequent handling. Clean all surfaces of harmful substances (e.g., formalin).

Bone specimens can be wrapped in protective paper or plastic, and packed in Styrofoam chips. Fixed tissues are rinsed with distilled water or fresh preservative, wrapped in cheesecloth or gauze, moistened with preservative, and double-bagged. Pack perishable samples in a sturdy ice chest with ample amounts of blue or dry ice interspersed among specimens. Arrange rapid transport (i.e., courier or air express). Be aware of current airline regulations concerning biological and hazardous substances (e.g., formalin) and restricted coolants (e.g., dry ice). Make arrangements for obtaining necessary forms, labels and documentation before taking material to the shipper.



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Proper packaging is essential to protect frozen specimens. Use a well insulated container with liberal amounts of blue or dry ice interspersed among the tissues

Precautions:

Samples arriving at their destination without positive identification and documentation are useless, as are those that become decomposed or contaminated by inadequate or improper packaging. Consider the day of the week specimens will arrive at their destination before shipping, planning so parcels arrive when they can be unpacked immediately— **this is essential for frozen tissue**. Clearly indicate on the package the day and night telephone numbers of the recipient. When traveling by air, try to arrange direct flights, avoid airports where long delays are common and, if possible, package specimens in small carryon containers. Days of toil have been lost by samples gone astray with errant luggage.

Carcass Disposal

The simplest way for a carcass to disappear is to turn your back on it and walk away. That approach is fine in remote areas, but what if the scene is a bathing beach or someone's backyard?

Let it lie:

Leave it where it is and let weather, tide and scavengers do the work. This is a common practice in uninhabited areas where there is no concern about a smelly mess or public health hazard. The process is fast; even massive carcasses decompose quickly.

Another reason for opening a carcass is so that it will sink in the event the surf steals it back to the sea. A bloated whale floats high on its back, the dorsal fin acting like a keel, as it sails before the wind like a 10-meter yacht. These "floaters," as they are called, cause endless confusion as they are rediscovered, renumbered, and relocated.

Bury it:

Conventional wisdom suggests that a quick way to conceal a carcass and have it decompose is to bury it. Maintain good public relations and avoid costly unearthing and re-burial by first agreeing on a site and obtaining permission from local authorities. Choose a place where destruction to the beach, vegetation, dunes, and wildlife (*i.e.*, nesting birds) by the equipment or the hole it digs is trivial enough to justify the procedure. Complete all studies and sampling before the equipment arrives, because after the hole is dug, the remains will likely be buried, ready or not. Some public landfill sites and private operators accept animal carcasses. Be aware of regulations and local statutes. Establish a time of delivery and make financial arrangements in advance. Advise the operators of any potential health risk, and bury under at least one or two meters of earth.

The rate of decomposition depends on the character of the remains, depth of burial, the terrain, and water and air temperature. A carcass that is rich with blubber will tend to rise in soft wet sand, even when split open and weighted down with tons of rocks.

Move it:

When a carcass is a nuisance, hazard or public health risk, it may be possible simply to shift it to a more appropriate site. Permission at one or more levels of government may be required for any transfer, especially across state lines. Small or rare animals are often removed intact to a facility for further study or preservation. This is normally done with dugong carcasses because of the endangered status of the population. Large carcasses will probably have to be moved in pieces.

Tow it out to Sea:

A large carcass can be towed out to sea, providing it is released far enough offshore so that currents and winds will not bring it back, it is clear of a shipping lane, and has enough ballast to sink it.

The Coast Guard or Marine Police may be willing to assist with towing a carcass to sea. It would be wise to consult them before making the attempt.

Render it:

Some rendering plants and commercial incinerators may accept marine mammals. It will probably be necessary to pay for this service, using licensed collectors to pick up and transport the carcasses. Disposal by rendering may require arrangements with federal and local authorities.

Blow it up:

It might seem logical to blow up a carcass, theoretically at least, into tiny pieces that no one will notice or care much about.

Burn it:

Bulldozers can be used to push the carcasses into large pits dug in the shore.

Afterward:

Any person involved with the disposal of a carcass is bound to contact oils with lingering qualities, some more pleasant than others.

Conclusion:

The best way to deal with a carcass is to bury, remove, render or tow it. Few large-scale disposal operations will turn out as planned. It seems that for the near future at least, any advances to overcome these problems will continue to develop at a slower pace than the memorable stories of what went wrong.

Courtesy: Adapted from Geraci, J.R., and V.J. Lounsbury. 2005. Marine Mammels Ashore: A Field Guide for Strandings, Second Edition. National Aquarium in Baltimore, Baltimore, MD.

Various methods of carcass disposal, including moving to an alternate site, burial (after opening body cavity), cutting into smaller pieces for disposal, and towing out to sea (after opening body cavity).

Health and Safety

Hazards to the Public:

By definition, a stranded animal is in trouble. With that, its behaviour is unpredictable, and even a normally docile species may be frightened enough to attack. Even experienced persons have been seriously hurt by the thrashing flukes of a struggling whale or the unexpected rolling of a Dugong. Such risk increases, of course, for one unaccustomed to the animal's behaviour and untrained in rescue procedures. Apart from injury is the potential for infectious agents to be transmitted to persons coming into physical contact with a stranded animal. Those who would consider a stranded animal as edible should be cautioned that even apparently healthy animals can be a source of trichinosis (a parasitic infection) and harmful toxins from Salmonella sp., Clostridium sp. and other bacteria.

Any risk to the public, including that of disease transmission, can be avoided by establishing a safe boundary within which only the response team should operate. This can be accomplished and still satisfy the inevitable curiosity of observers. Failure to take appropriate action may be viewed as inattention to public safety, forcing others in authority to take sterner measures.

Inappropriate scenes can be avoided by good planning that will protect the public while looking after the well-being of the animals, and by proper and rapid disposal of carcasses. Do not underestimate the benefit of public education in the form of posters or pamphlets dealing with these issues.

Hazards to the Team:

Team members responding to a stranding face situations that can be risky. A person might be struck by a whale's flukes with appalling force, raked by teeth, rolled upon, knocked into the surf, suffer sunstroke or hypothermia, aches, strains and bruises, catch a face full of blowhole discharge, and chance cuts by instruments and bone fragments. Despite such risks, few serious injuries or illnesses have been reported as a result of working with stranded animals. The greater the experience and training of the team, the better their regard for proper precautions, the less likelihood of a mishap.

Designating safety and staff support coordinators at stranding involving a large number of volunteers will help to ensure that the team does not try to exceed its limitations. Ultimately, providing adequate support for the team will greatly diminish the chance of injuries. Fatigue and other discomforts, such as results from drinking too much coffee when no facilities are available, wearing wet, gritty clothing, or being hungry, can reduce morale and concentration, and thus increase the chance of accidents. The longer the operation or the more adverse the environmental conditions, the more vital essential comforts will become to the health and well-being of the response team.

Transmissible Disease:

Marine mammals harbour a variety of bacteria, fungi and viruses. Few of these organisms are routinely pathogenic when the term is taken to mean causing disease whenever present. Some, however, have been transmitted from live animals and carcasses. The risk of disease is low for persons who are healthy and free of disease conditions or medications (steroid hormones, immunosuppressive agents) that lower resistance to infection. Risk can be further reduced by taking the following preventive measures:

- Wear (un-torn) gloves when handling animals, carcasses, tissues or fluids
- Wear waterproof outerwear to protect clothing from contamination
- Cover surface wounds with protective dressings
- Wash exposed skin (and clothing) after handling animals
- Seek medical attention for bites, cuts and other injuries, and inform medical attendants of the injury’s source

Any illness that develops after exposure to marine mammals should be brought to the attention of a physician, preferably one familiar with conditions potentially transferable from these animals. The occurrence should also be reported to stranding network officials who maintain records of physicians with such experience and record these incidents for future reference.

Exposure:

Workers on the beach normally protect themselves against overexposure to sun and heat by wearing proper clothing, using sun-screening agents, temporarily escaping into shade, and liberally drinking fluids. Hyperthermia (heatstroke) is seldom encountered except in those few who disregard these common sense precautions.

The greater threat is hypothermia, especially for persons who are wet and wind-chilled, or working in the water where heat is quickly lost to the surroundings. The earliest indication of cold stress is shivering, which occurs when body temperature is reduced by as little as 1° to 2°C. Eventual effects include skin reactions, allergic responses, lower blood pressure, and reduced heart rate and kidney function. Persons may appear confused, sluggish and disoriented, perhaps believing themselves still physically able to work. Such behaviour can, of course, place other team members at risk.

Prolonged exposure to cold air and water and reduced activity - precisely the circumstances encountered when rescuers must support animals in shallow water for prolonged periods - promote hypothermia. Going without food, or indulging in alcohol or drugs can also amplify the effects, in addition to impairing judgment.

Workers must be protected against the cold with adequate clothing (layering is best) and waterproof outerwear, gloves and boots. Special gear must be worn by personnel working in the water for any prolonged exposure at temperatures less than 30° to 32°C. Wind-surfing suits offer some protection for brief periods of immersion. Wet suits work best for people who are literally up to their necks in water by actively heating the insulating water layer. The neoprene also provides buoyancy, which is useful when trying to keep animals at the surface. Dry suits are superior for persons standing still for long time periods.

A rotation schedule should be established for those holding animals in the water, with limits set on the time that any individual might be in the water in one day. Exposure times will vary, depending on ambient temperatures and how well the crew is dressed and equipped. As a general rule, a worker in a dry suit can spend twice as long in the water as one in a wet suit. Recovery time afterwards is generally double the exposure time.

Meeting the personnel needs for a comfortable rotation schedule may not always be possible, even for a small stranding response. Consider a situation where the “in-water” time is limited to one hour, and 5 support personnel are required to hold each whale. Holding 10 whales for 5 hours would require 250 people if no staff were rotated, or 150 people rotated on a schedule of one-hour on, two-hours off. If adequate personnel cannot be enlisted for such a procedure, the response team must resist the temptation to “stretch themselves.”

Injury:

Stranding afford numerous opportunities for injury. Moving along slippery shorelines, lifting or rolling large animals and working with heavy equipment all present hazards to team members, particularly to those inattentive to the risks. Little can be done to make a stranding site safer, other than to mark off obstacles such as holes or bring in spotlights when the work carries on into the night. The designated safety officer should be continually on the look-out for potentially dangerous conditions or practices, and take appropriate action to reduce the chance of injury to personnel.

Heavy lifting equipment is usually, but not always, in the hands of experienced operators who will ensure that the loads are properly secured. Even so, ropes may break or knots fail, and no one should be allowed to stand under an overhead load. All personnel must stay clear when winching a carcass across a beach in case the line snaps.

The risk of drowning can never be disregarded. Heavy surf and dangerous undertows can quickly turn an innocent attempt to help into a personal tragedy. Except for actions along the shoreline, no one should enter the water unless there are boats available to provide assistance if necessary.

Procedures and equipment needed for euthanizing animals can also be hazardous to personnel. Firearms and drugs must remain in the possession of authorized individuals who will take responsibility for their safe use. Only those with the authority and expertise to do so may perform such actions; people uninvolved in these activities will best avoid danger by leaving the area completely.

The basic equipment for a stranding response will include a first aid kit appropriately stocked to deal with cuts, abrasions, minor twists or sprains, and other routine injuries. The safety officer and stranding coordinator must know the location of nearby medical facilities, clinics and hospitals in the event of more serious mishaps. Police radios and portable phones are the best way to summon an ambulance.

Injury Reporting and Liability:

Accidents can occur in any field operation. Each stranding network should consult professionals to establish the legal framework for volunteers to operate. The safety officer or stranding coordinator should document and track the outcome of all injuries. Such information may be needed in the event that any result in legal action.

Train and Plan for Safety:

Training programs for those involved in stranding must include information on the hazards of the job. Injuries can be avoided through instruction on animal behaviour and proper handling techniques. Learning to recognize dangerous situations such as soft mud, heavy surf, or a beach of broken shells will prepare one to take appropriate action. Accidents can be reduced by being aware of human limitations and setting realistic goals.

Task assignments must be made on the basis of training. People must not become involved in potentially hazardous duties (i.e., handling animals, taking samples from live animals, working in the water) for which they are unqualified. The use of coded badges to indicate level and area of training will discourage this from happening, both on the part of the eager helper and on the part of the frustrated team leader desperate for another pair of hands. Assignments must also take into consideration the availability of sufficient numbers of personnel for the task at hand, as determined by the safety officer or stranding coordinator. This is particularly crucial when the response involves work in the water during cold weather. When working in hazardous situations (e.g., heavy surf, cold water, or in darkness), organize workers in pairs (*i.e*., "buddy system") for additional safety.

The effects of exposure are of primary importance for coordinators planning field schedules. During mass stranding, 8 to 10 hours "in the field" followed by an 8 to 10-hour rest period generally works best, but this may need to be tailored to the conditions. Ironically, if field support is good, volunteers may wish to spend longer periods in the field, risking physical and mental fatigue.

One person should keep track of the exposure time and rotation of workers, as the latter are likely to be too busy to check them. In addition, the safety officer or assistants should watch personnel closely for early signs of hypothermia, particularly uncontrolled shivering. Anyone showing signs of shivering, stiffness or lack of coordination should be required to return to the support centre for a period of recovery.

Recognizing Limitations:

Certain operations may need to be discontinued or plans modified if human safety is jeopardized. Attempts to carry or pull large animals with insufficient or fatigued personnel, or continued work in the water under weather conditions that have become adverse, are just two situations where the response goal must be weighed against staff safety. Once the safety and stranding coordinators determine the best course of action, other team members and participants must comply with this decision. At no point in the response effort can "blind heroism" be allowed to obscure rational judgement.

Follow-Up

The file on a stranding event is never closed until all information has been archived for easy retrieval, tissues are safely stored for later analyses, team members are recognized for their efforts and informed of the outcome, and the community is thanked for its support.

Collection and Distribution of Data:

The story of an event is best written while memories are fresh and documents are readily accessible. Once everyone has retired from the scene, first-hand information is lost, and what the account gains in the re-telling, it loses in accuracy.

An informal "debriefing" meeting will elicit individual points of view, experiences, criticisms and suggestions. The person assigned to this task should have the skills to filter through the volume of information, recognize what is important, and condense it into useful form for the report.

Reports often are not prepared or completed for fear they may not meet the scrutiny of a colleague searching for critical details, impeccable precision and literary style. But that is hardly the purpose of the exercise. What is required immediately is a summary of the essential findings from each of the coordinators, including that from the debriefing meeting, accompanied by the kind of documentation that can later be organized, analysed and refined. This summary is made available to team members, the relevant federal agencies, and if it merits, to other stranding networks. The report can be continually updated as new information becomes available, until it eventually emerges as a completed document.

Points summarized in the report are:

1. Notification of the stranding.
2. Eyewitness accounts.
3. Nature, timing, effectiveness of the initial response.
4. Account of the scene as first viewed by the team.
    - Exact location
    - Pattern of stranding
    - Condition of animals
    - Environmental conditions
5. The action taken and reasons for the decisions.

- Intended plan
- Impediments to implementation
- Eventual action
- Intended follow-up (monitoring released animals or following progress of rehabilitation)

6. Necropsy findings and any available laboratory results.
7. Types of data and specimens collected and their location.
8. Supplementary information.
    - Maps, photographs, sketches
    - Reports from independent groups, e.g., police, coast guard, wildlife authorities.
9. Critique of methods and success; suggested improvements

The Sample Trail:

Samples from stranding may be dispersed quickly to research and analytical laboratories, museums, universities, and tissue banks. Important opportunities to gain information have been lost because specimens have deteriorated, been poorly labelled or lost, the analyses not done or their results not reported. To avoid such misfortune:

- Match codes (accession number) that each laboratory assigns to the same animal; keep records
- Establish a system for tracking specimens (some pass through a series of laboratories)
- Protect samples in your care from deteriorating (repackage as necessary; top-up preservatives)
- Encourage expedient analysis
- Assure that results will return into the central data bank, if necessary by contractual arrangement with the recipient.

Who Pays?

The stranding network is responsible for settling all financial matters arising from any action taken under its authority. Some institutions have a budget for this purpose; others may rely on donations and other sources of funding.

Maintain the support of loyal team members by immediately reimbursing personal expenses as pre-arranged. Settle accounts promptly with any contractor, laboratory, local business and private individual (veterinarian, equipment operator, diver), who should not be expected to absorb the costs (although many do).

A Press Conference:

The media coordinator should consider organizing a press conference soon after any stranding event that has captured public interest. Informing the press and public of the response team's findings will encourage cooperation and support, and will promote public awareness. Allow for interviews and make copies of the condensed stranding report available to the press.

A Word of Thanks:

Nearly everyone on the team devotes untiring effort for which the only compensation is the satisfaction of helping. Beyond that, authority of the town may have unleashed costly resources, the police worked unscheduled overtime, the community provided food and beverages, the motel keeper bore the criticism of cleaner guests, and beach residents endured the trampling of their summer gardens. Compile a list of everyone involved. There is little we can do for their inconveniences that is more gratifying than providing each a summary of the incident and an expression of sincere thanks.

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