

Marine Mammal Carcass Disposal Best Practices

Executive Summary

Every year in the United States, thousands of marine mammals strand dead or strand alive and subsequently die. The Stranding Network does not and cannot respond to every stranded marine mammal, and this Best Practices document is not intended to require the Stranding Network to dispose of every stranded marine mammal carcass. While not all carcasses can or will be disposed of due to a variety of factors (*e.g.*, location, available resources, etc.), when disposal is feasible, it should be conducted properly. There are a variety of methods that can be used to dispose of marine mammal carcasses, but they generally fall into two categories- *remain in the environment* and *remove from the environment*. Every method has benefits and drawbacks and no one method is suitable for every stranding situation. **Planning for general carcass disposal should be part of normal stranding response planning efforts with disposal methods and facilities pre-identified for normal carcass types encountered. For rare live strandings (*e.g.*, large whales) planning for carcass disposal should begin as soon as the responders determine that the animal will not survive the stranding event or the animal has expired.** This document will weigh the benefits and drawbacks of all carcass disposal methods, which can help you make decisions as to the best course of action, given a particular stranding scenario.

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1. Introduction

1.1 Background

From 2009-2017, an average of 3,800 marine mammals stranded each year within the United States, either dead or alive but subsequently died. Marine mammals may carry infectious diseases that can spread to humans or domesticated animals, if the public or domesticated animals interact with the carcass. Additionally, some marine mammal species may carry loads of contaminants in their tissues. Lastly, some of the marine mammals that strand are euthanized using veterinary drugs. Chemical euthanasia, including sedation and euthanasia drugs, may have impacts on the environment if the carcass is not disposed of properly.

Carcass disposal methods for stranded marine mammals fall into two main categories- *remain in the environment* and *remove from the environment*. *Remain in the environment* methods use decomposition to slowly breakdown the carcass over many months or years. While these methods mimic what would have naturally happened to a carcass that had no stranding response, there are some disadvantages to using these methods. Conversely, *remove from the environment* methods use controlled means to breakdown a carcass faster than would naturally occur. However, these methods also have some disadvantages including effectively removing the carcass from the ecosystem and associated food webs. No one method is recommended for every stranding, and several factors will need to be considered in order to determine the best carcass disposal option for each particular stranding event.

1.2 Legislation Pertinent to Marine Mammal Carcass Disposal

Congress delegates the responsibility for implementing the Marine Mammal Protection Act (MMPA) to the Secretary of Commerce and the Secretary of the Interior. Cetaceans and pinnipeds, exclusive of walrus (*Odobenus rosmarus*), are the responsibility of the National Marine Fisheries Service (NMFS). Walrus, polar bears (*Ursus maritimus*), manatees (*Trichechus manatus*), and sea otters (*Enhydra lutris*) are the responsibility of the United States Fish and Wildlife Service (USFWS). This document only addresses best practices for marine mammal species under NMFS jurisdiction – cetaceans and pinnipeds excluding walrus.

For NMFS species, MMPA Section 112(c) Stranding Agreements (SAs; formerly Letters of Agreement or LOAs) are formally established between the *NMFS Regions* and *Stranding Network Participants* as part of Title IV under the MMPA. The NMFS SA states that the Stranding Network Participant will obey

laws, regulations, and guidelines governing marine mammal stranding response and rehabilitation. This includes requirements for communications with NMFS, humane care, husbandry, and veterinary care of rehabilitated marine mammals, and documentation of each stranding response and rehabilitation activity. Additionally, federal, state, and local government authorities may respond to stranded marine mammals under Section 109(h) of the MMPA. Neither 109(h) authority nor the SA authorizes the taking of any marine mammal species listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), as amended. However, authorization to take ESA-listed species by the Stranding Network is currently provided under a NMFS MMPA/ESA Permit issued to the NMFS Marine Mammal Health and Stranding Response Program (MMHSRP), and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal. **Understanding and following the MMPA and implementing regulations, policies, and guidelines, is the responsibility of all persons involved in marine mammal response.** These best practices are founded on and support the MMPA and related regulations. Nothing should be construed in these best practices to preempt state and local laws.

1.3 Purpose and Intended Uses

These best practices have been developed to serve as guidance and recommendations. This document is not intended for independent use as a training manual, and does not by itself qualify the reader for any actions or authorizations. These best practices balance the need for standardized procedures while allowing flexibility to address specific needs of different situations for diverse species and habitats, as well as unforeseen circumstances. In some situations, responders may choose a course of action not outlined in these documents, but consultation with NMFS is encouraged if the course of action will vary greatly from the best practices outlined in this document. These best practices are a “living document,” and as such, we plan to periodically review and update them as new information becomes available. Responders should never stop striving for innovative and new methods and training to increase safety and success, and nothing in these best practices should prevent or limit advances in technology, techniques, and training.

The proper disposal of marine mammal carcasses is an important aspect of stranding response. There are several carcass disposal methods that can be employed, and the appropriate choice will vary based upon different factors, such as the species, the number of carcasses, the size of the animal, location of the carcass, and other logistics. Another important consideration when weighing options is if the carcass contains drugs (euthanasia or other medications). These Best Practices are provided by NMFS’ MMHSRP for use by authorized marine mammal stranding network organizations (including

rehabilitators), other natural resource management agencies, On-Scene Coordinators, and necropsy team leaders, as a guide and recommendations to choosing the best carcass disposal method based upon a variety of factors in a specific case. More specifically, these Best Practices provide key information to standardize activities of carcass disposal based upon several factors, including:

- The size of the carcass;
- The accessibility and conditions at the location where the stranding occurred; and
- The amount and type of drugs in the carcass (if any)

These best practices are a “living document” and are not intended for independent use as a training manual. They have been developed to serve as guidance and recommendations for appropriate marine mammal carcass disposal, as such, we plan to periodically review and update them as new information becomes available.

1.4 Funding

Marine mammal stranding events can present challenges in carcass disposal, often requiring personnel and equipment resources of local or state agencies. Authorized marine mammal stranding response organizations may choose to collect or perform a necropsy in the field on select carcasses to aid in scientific data collection, in which they will be responsible for arranging or coordinating with partner agencies for disposal. Local or state government agencies may be responsible for disposal of marine mammal carcasses stranded on public property, and likewise, federal agencies are responsible for disposal of carcasses that strand on federal property. If the marine mammal is listed as an endangered or threatened species, local, state, or federal government agencies are required to consult with NMFS to acquire authorization for disposal activities, and coordinate appropriate disposal methods with the local marine mammal response organization.

Many local or state governments have annual funds allocated to wildlife carcass disposal, and it is recommended for coastal communities to consider allocating funds toward marine mammal carcass disposal. Coastal communities may experience an increase in stranding events during disease outbreaks or Unusual Mortality Events (UME), requiring handling and disposal of an increased amount of marine mammal carcasses. Coastal communities should coordinate with local stranding response organizations to prepare for increased demands and costs for disposal activities associated with elevated marine mammal mortality.

Costs associated with carcass disposal during a Marine Mammal UME are not reimbursable through the

UME National Contingency Fund (in accordance with section 405 of the MMPA). For additional information regarding UME expense reimbursement, contact the UME Executive Secretary or the NMFS regional or national stranding coordinator. The John H. Prescott Marine Mammal Rescue Assistance Grant Program is an annual competitive grant program that is also available as a funding source for marine mammal stranding response. Funds awarded under the Prescott Grant Program can be used for carcass disposal. More information on this program can be found on the following website: <https://www.fisheries.noaa.gov/grant/john-h-prescott-marine-mammal-rescue-assistance-grant-program>.

2. Planning, Types of Carcass Disposal, and Euthanasia Concerns

2.1 Planning for Carcass Disposal

Plans for general carcass disposal should be evaluated annually by the stranding network organization to identify the appropriate methods and facilities to be used for carcass disposal based upon common carcass types encountered. This could include pre-identifying facilities that can receive carcasses or equipment needed to bury or remove carcasses from the beach. Communication with respective state, federal, or local land management agencies within the area covered by the stranding network organization should also be part of the planning process to ensure that appropriate plans or permits as necessary for stranding response activities within managed areas are established prior to a stranding incident. Additionally, in many areas of the United States, coordination with Native American, Alaska Natives, and cultural practitioners may be necessary to ensure that they are able to conduct their customs and cultural practices on the animal. Planning for carcass disposal for rare strandings (*e.g.*, live large whales) should begin as soon as the responders determine that the animal will not survive the stranding event, especially if chemical euthanasia methods are considered.

In some instances, certain disposal methods may not be possible due to the geography or logistics at the stranding location. Moving the carcass may help to increase the disposal options and/or minimize the drawbacks of a desired carcass disposal method. In these instances, the carcass may be transported to a secondary location before the appropriate disposal methods are employed. Carcasses can be transported by boat, road, or on foot, and the size and condition of the carcass as well as the distance from the stranding location and the secondary site will help to determine the best way to transport the carcass. The accessibility to foot, boat, or vehicle traffic at both the stranding location and the secondary site should be considered if the carcass will be moved.

Regardless of the specific carcass disposal method chosen, responders should be sure to use sufficient

protection against infection with zoonotic pathogens, contaminants, and other risks associated with handling decomposing carcasses. When conducting any carcass disposal activities, responders should wear protective clothing, gloves, face masks and safety goggles, as necessary. Additionally, any equipment used to move and dispose of carcasses should be cleansed and disinfected to remove any zoonotic pathogens or contaminants.

2.2 Types of Carcass Disposal

Carcass disposal methods fall under two broad categories, *remain in the environment* methods and *remove from the environment* methods. *Remain in the environment* methods involve leaving the marine mammal carcass to decompose naturally. While it may take months or years for a carcass to fully breakdown, these methods are often more cost-effective, less complicated, and allow all of the nutrients in a marine mammal to be recycled into the natural environment. However, all toxins, medications, and certain euthanasia drugs (*e.g.*, pentobarbital) in the carcass may eventually be re-released into the environment or become a source of secondary poisoning for scavengers. *Remove from the environment* methods entail moving the carcass from the stranding site for disposal through controlled, often industrial, means. Removing and shipping a carcass to a proper disposal facility can be costly, but any toxins, medications, and euthanasia drugs in the carcass will be removed from the immediate environment.

2.3 Euthanasia and Carcass Disposal

Euthanasia is only administered after considering all aspects of the case, including the welfare of the animal, human safety, eco-toxicological hazards of euthanasia on-hand, carcass disposal options, and the availability of trained and licensed individuals (NMFS-OPR-56 [1]). Euthanasia methods for marine mammals have been summarized previously (AVMA 2020, Barco *et al.* 2016, Harms *et al.* 2018). When chemical euthanasia is used for wildlife, depending upon the chemicals used, precautions should be taken to minimize secondary poisoning of the environment and to minimize risks to scavengers. Animal scavengers may be adversely impacted by certain drugs, particularly euthanasia chemicals such as barbiturates, which may kill or severely injure any wildlife and domestic pets that prey upon a chemically euthanized marine mammal carcass (O'Rourke 2002, Bischoff *et al.* 2011, Harms *et al.* 2014). Certain chemical euthanasia methods, such as saturated potassium chloride solutions in conjunction with heavy sedation, have a low risk of secondary poisoning for scavengers and may be used when other methods of disposal of the remains (*e.g.*, deep burial, rendering, incineration) are not available (AVMA 2020, Harms *et al.* 2014, Barco *et al.* 2016). Additionally, federal laws, such as the Migratory Bird Treaty Act, the Endangered Species Act, and the Bald and Golden Eagle Protection Act, protect wildlife from secondary

poisoning from animals that have been chemically euthanized with barbituates, and violations may result in imprisonment for up to two years and fines up to \$250,000 for individuals and \$500,000 for organizations. Therefore, it is imperative that animals that are euthanized with chemicals known to cause secondary poisoning (*e.g.*, pentobarbital) are disposed of in a responsible manner (*e.g.*, rendering, incineration, composting) that removes the risk of secondary poisoning from the environment. Similarly, some animals may be euthanized using physical methods (*i.e.*, ballistics), and lead ammunition may be poisonous to scavengers. Therefore, non-lead ammunition is recommended. If lead ammunition is used, it should be removed from the carcass prior to using *remain in the environment* disposal methods.

2.4 Considerations for Remain in the Environment Methods

Remain in the environment methods use natural decomposition to dispose of marine mammal carcasses. These methods include:

- *Remain in place* – the carcass is left above ground, in the tidal zone, or in shallow water areas, either in the original stranding location or moved to another site
- *Burial* – the carcass is buried
- *Return to the sea* – the carcass is towed offshore and released floating at sea
- *Sinking* – the carcass is towed offshore and sunk

Remain in the environment methods have many benefits. First, these methods allow for the carcass to naturally break down, which allows nutrients to return to the environment. Marine mammal carcasses are an important component of the ecosystem serving as an important food and nutrient source for terrestrial scavengers when on a beach (including ESA-listed species such as the California condor), insects, and microbes. Marine mammal carcasses that sink at sea are an important food and nutrient source for entire seafloor communities (Stockton and DeLaca 1982; Smith and Baco 2003; Fallows *et al.* 2013). A single large whale carcass provides a substantial contribution of nutrients to the environment; while pinniped and small cetacean carcasses are individually smaller, the volume of these species also provide a significant contribution. As large whale carcasses may be too large to easily remove from the stranding location, leaving them in the environment to naturally decompose can also be cost-effective. Similarly, marine mammals may strand in remote or inaccessible areas, which may also prevent or make unnecessary the removal of the carcass from the stranding location. In these situations, leaving the carcass to slowly decompose will help to conserve the responding organization, local, state, or federal agencies' resources and allow the carcass to serve multiple ecological functions. Ideally, with approval from the proper authorities, steps should be taken to ensure that a carcass left at the stranding site is not easily accessible to humans or domesticated animals, to prevent the possibility of infectious disease

transmission.

There are some drawbacks to disposal methods that leave carcasses in the environment. These methods rely on microbes, and in some cases scavengers, to breakdown the carcass. As a result, these methods take longer to fully dispose of a carcass when compared to *remove from the environment* methods.

Another potential disadvantage when using these methods is that all of the components of the marine mammal carcass are returned to the environment. Marine mammal carcasses may contain toxic chemicals and substances that may be present in high levels through the process of bioaccumulation (Gray 2002). When these carcasses are allowed to remain in the environment to slowly breakdown, these chemicals are released back into the environment. Some larger marine mammal species, such as whales, may contain significant loads of these materials. It is important to note that if the marine mammals did not strand ashore, but died and sank at sea or came ashore in a remote location where it was not observed, these chemicals would be released back into the environment and, therefore, are generally part of the natural cycle.

Similar to toxic material that may bioaccumulate in marine mammal tissues over the animal's lifetime, certain chemical euthanasia drugs (*e.g.*, pentobarbital) that were administered to the animal may also be released into the environment if these disposal methods are employed. Consequently, the MMHSRP does not recommend that *remain in the environment* methods are used if the animal was euthanized using pharmaceuticals, such as pentobarbital, that are known to cause secondary poisoning in scavengers.

Return to the sea methods and sinking carcass disposal require authorization under the Marine Protection, Research and Sanctuaries Act (MPRSA), sometimes referred to as the Ocean Dumping Act. The MPRSA prohibits the transport of any material, including marine mammal carcasses and parts, for the purpose of ocean dumping, except as authorized by a permit. The Environmental Protection Agency (EPA) has issued a general permit under the MPRSA to authorize the transport and disposal of marine mammal carcasses in ocean waters under specified conditions.¹ The general permit authorization is available for any officer, employee, agent, department, agency, or instrumentality of federal, state, tribal, or local unit of government, as well as any MMHSRP Stranding Agreement Holder, and any Alaskan Native, who already may take a marine mammal under the MMPA and ESA, to transport the marine mammal carcass from the United States and dispose of it in ocean waters. The general permit is intended to expedite required authorizations for ocean disposal when there is a need for such disposal. For certain situations where the general permit may not be applicable, EPA may issue MPRSA emergency permits for the

¹ <https://www.epa.gov/ocean-dumping/ocean-dumping-permits#ocean>

ocean disposal of marine mammal carcasses. EPA's permit process, among other things, requires consideration of hazards to navigation and may include coordination with the United States Coast Guard (USCG). For more information about the MPRSA general permit and EPA contacts for marine mammal carcass ocean disposal inquiries, please see: <http://www.epa.gov/ocean-dumping/ocean-disposal-marine-mammal-carcasses>.

If a marine mammal carcass strands in a highly public area, and *remain in the environment* methods are determined to be an appropriate disposal method, efforts should be made to bury or remove the carcass to a more remote location, if practicable. If a carcass is located in a public area that precludes burial (e.g., rocky beaches, areas with high water tables, protected or sensitive habitats, areas with protected cultural resources, etc.), if feasible, the animal could be moved to a nearby location that would allow burial or sinking.

2.5 Considerations for Remove from the Environment Methods

Remove from the environment methods involve physically moving the marine mammal carcass from the stranding location to a disposal facility. These methods include:

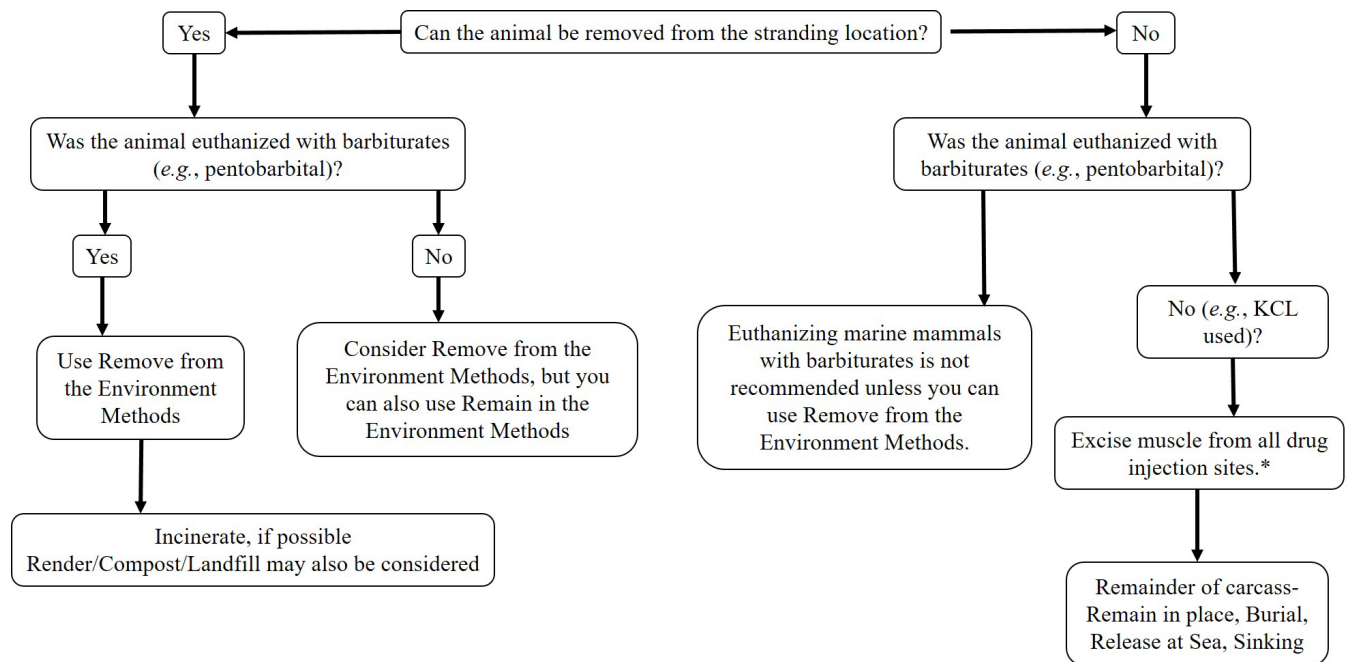
- *Landfill* – the carcass is buried in a licensed landfill
- *Render* – the carcass is brought to a rendering plant, where the tissues are repurposed for other uses
- *Incinerate* – the carcass is brought to an incineration plant
- *Compost* – the carcass is composted in a designated compost facility or site, or carcass digester

One benefit of these methods is that the carcass is removed from the environment, minimizing the likelihood of infectious disease transmission to humans, domesticated animals, and wildlife. These methods either sequester the carcass or destroy the carcass and any associated pathogens. Therefore, these methods should be considered if the animal is suspected to have died from a disease that can easily spread to human or other animal populations. This can also be beneficial if the carcass is thought or known to contain toxic chemicals, such as certain chemical euthanasia agents (e.g., pentobarbital), as some of these methods will effectively remove these substances from the environment. It should be noted that not all of these methods fully mitigate the dangers of some euthanasia chemicals, such as barbiturates. Therefore, networks should work with their local disposal facilities to ensure that those facilities are able to accept carcasses that contain these chemicals and will be able to mitigate the risk of secondary poisoning of scavengers and domesticated animals.

One of the drawbacks to these methods is that they are often more costly and may have more logistical constraints than *remain in the environment* methods. Additionally, they do not allow the carcass to serve as a food source for scavengers and recycle the nutrients contained within the carcass. Another drawback is that the removal method may have some adverse impacts to the surrounding habitat, especially if heavy machinery is used.

2.6 Decision Matrix

This decision tree is intended to help outline how to determine the best option(s) for carcass disposal of a single animal in a given situation. All decisions on a specific disposal option should also take into account all federal, state, and local regulations as well as local disposal facility capabilities and coordination with appropriate officials.



**Dispose of this tissue with remove from the environment methods*

2.7 Quick Reference Table

Method	Type	Size	Appropriate for Animals Euthanized with Drugs known to Cause Secondary Poisoning (e.g., pentobarbital)?	Estimated Expense
Remain In Place	<i>Remain in the Environment</i>	Large or small	Not recommended	\$
Burial	<i>Remain in the Environment</i>	Large or small	Not recommended	\$-\$\$
Return to the Sea	<i>Remain in the Environment</i>	Large	Not recommended	\$\$-\$\$\$
Sinking	<i>Remain in the Environment</i>	Large	Not recommended	\$\$\$\$
Landfill	<i>Remove from the Environment</i>	Large or small	Yes, if the facility's policy allows	\$\$
Render	<i>Remove from the Environment</i>	Small	Yes, if the facility's policy allows	\$\$\$
Incinerate	<i>Remove from the Environment</i>	Small	Yes	\$\$\$\$
Compost	<i>Remove from the Environment</i>	Large or small	Yes, if the facility's policy allows	\$\$

3. Remain in the Environment Methods

3.1 Remain In Place

The remain in place method is the most basic carcass disposal method. This method involves leaving the marine mammal carcass to naturally break down in the same, or similar, area in which it was found stranded. This method requires minimal resources from the stranding network and landowner (if the

stranding location is on private land). This method can be used for both small and large animals, and can be useful if the size of the animal or remoteness of the location creates logistical issues. This method can also be useful in protected and sensitive habitats, where minimal disturbance to the natural environment is preferred or where disturbance may impact another endangered species (*e.g.*, Snowy Plovers).

However, care must be taken when employing the remain in place method. This disposal method should not be used for animals that were chemically euthanized with drugs known to cause secondary poisoning, such as pentobarbital. The natural decomposition process often attracts scavengers, which may be secondarily poisoned by pentobarbital (AVMA 2020; Harms *et al.* 2014). Pets may also be attracted to the carcass, and may also be secondarily poisoned from pentobarbital (Bischoff *et al.* 2011). However, the remain in place method can be used with carcasses that have been euthanized with certain chemical euthanasia methods, such as saturated potassium chloride solutions in conjunction with heavy sedation, which have a low risk of secondary poisoning for scavengers (AVMA 2020, Harms *et al.* 2014, Barco *et al.* 2016).

Another consideration is the location of the stranding. Marine mammals may be vectors of infectious diseases which can be transferred to responders and domestic animals (Hunt *et al.* 2008). This method may allow the spread of these diseases to humans or domesticated animals, as the carcass is exposed and allowed to slowly breakdown on the beach. However, many pathogens naturally breakdown or are no longer viable after ultra-violet (sunlight) exposure, changes in temperatures (too hot or too cold), and anaerobic and acidic environments that may occur in a decomposing carcass, so the amount of viable pathogens present in a carcass diminishes over time. Therefore, this method can generally be employed if the carcass is in an inaccessible or remote area, with minimal exposure to humans or domestic animals.

If the carcass is in a highly visible area, the smell may cause a negative public reaction. There has also been public concern in recent years that decaying marine mammal carcasses on beaches may attract sharks to the area, increasing the likelihood of shark-human interactions. However, there are no studies that have demonstrated that sharks are attracted to decaying marine mammal carcasses on land, and more research is needed to determine if marine mammal carcasses on land attract sharks (Tucker *et al.* 2018).

Application of hydrated lime, or calcium hydroxide, can control odorous smells and facilitate faster decomposition. Hydrated lime has been applied to decaying large whale carcasses that are left in place to naturally decompose. This technique has also been used in remote areas that are inaccessible to heavy equipment, areas where burial is not an option, or the carcass was not in a condition to allow for towing offshore for disposal. While this product is easily obtained from hardware retailers, care should be taken

when applying hydrated lime, as it can irritate skin and cause respiratory issues. Therefore, it is recommended that gloves and a mask are used when applying hydrated lime.

For larger carcasses, gas build up inside the body cavity could become problematic and eventually lead to safety concerns. Therefore, it is recommended to pierce the body cavity (if feasible) to allow for more efficient off-gassing.

Benefits	Drawbacks
Cost-effective	Should not be used for animals euthanized with chemicals known to cause secondary poisoning (<i>e.g.</i> , pentobarbital)
Minimal effort	Does not reduce disease transmission
Minimal disturbance for protected and sensitive habitats	May be unsightly and cause offensive odors, leading to a negative public reaction
Nutrient source in ecosystem for scavengers, etc.	Possibility of vandalism and illegal harvesting of marine mammal parts
May be logistically necessary	
Ideal for inaccessible or remote areas	
May be required in some areas (<i>i.e.</i> , protected and sensitive habitats)	

3.2 Burial

The burial method is one of the more cost-effective carcass disposal options. This method involves burying the carcass in the same, or similar, location where the animal stranded. This method is useful when the size of the animal makes it difficult to safely or easily move, and the carcass is not located in an area that is recommended for Remain in Place (*i.e.*, is located in a highly trafficked area).

Burial offers some advantages. First, burying the carcass creates a barrier that reduces the likelihood of infectious disease transmission. Burial also reduces the likelihood of attracting scavengers, as the smell of the decaying carcass is minimized (Vantassel and King 2018). This may be advantageous in areas where attracting scavengers can become a nuisance or a danger to the public.

While this method may reduce predation on the carcass, burying carcasses of animals euthanized with euthanasia drugs that are known to cause secondary poisoning to scavengers (*e.g.*, pentobarbital) is still not recommended. Pentobarbital may leach into the surrounding sediments and water table, and these

substances may persist in the environment for a long time (Peschka *et al.* 2006). However, the burial method can be used with carcasses that have been euthanized with certain chemical euthanasia methods, such as saturated potassium chloride solutions in conjunction with heavy sedation, which have a low risk of secondary poisoning for scavengers (AVMA 2020, Harms *et al.* 2014, Barco *et al.* 2016).

Another consideration is that similar to the remain in place method, public perception of beach burials is that the decaying carcass will attract sharks. However, a recent study suggests that buried carcasses are unlikely to attract sharks, as the leachate plume is very small if the carcass is buried above the high tide line and above the groundwater table (Tucker *et al.* 2019). Therefore, it is recommended that marine mammal carcasses are buried deeply but as far from the high tide line as possible. Carcasses should also be buried above the groundwater table, as the leachate plume may spread farther if it comes in contact with groundwater. If these recommendations are followed, beach burial can be a safe and environmentally responsible way of disposing of a marine mammal carcass.

While burial may have advantages when compared to the remain in place method, there are some drawbacks to this method. One issue is that this method can only be used in areas with fine sediments; if the animal is stranded along a rocky coastline, another carcass disposal method must be used. Similarly, heavy machinery will be required to bury large carcasses, and some locations may preclude the use of this equipment (*e.g.*, a remote area with limited access or an area with very soft substrate, such as a marsh). Additionally, if burying on a beach frequented by members of the public, a perimeter should be established to ensure public safety around heavy machinery and the hole.

Benefits	Drawbacks
More cost-effective compared to other methods	Should not be used for chemically euthanized animals with drugs that cause secondary poisoning (<i>e.g.</i> , pentobarbital)
Minimal effort compared to other methods	Cannot be used along rocky shorelines, may not be used in protected or sensitive habitats
May reduce disease transmission	Need for greater resources to ensure that carcasses are buried above the high tide line and above the groundwater table
Reduces the possibility of attracting scavengers	May not always be logistically feasible
Nutrients remain in environment	

3.3 Return to the Sea

In some areas, access to a carcass stranding site from the land is limited (no roads, high cliffs, etc.), but access from a vessel on the ocean is more straightforward. If a carcass cannot be moved to a secondary site and left above ground or buried, it can be towed offshore and released at sea, if the carcass condition allows (*e.g.*, the carcass is fresh enough that it won't break apart, it has an intact peduncle, etc.), where it may float for a while but will eventually sink. In areas where this method is feasible, it allows marine mammal carcasses to remain in the environment and contribute the nutrients contained within the animal to the environment. This may be especially beneficial for large whale carcasses, as whale falls can be a significant food source to a wide community of scavengers and microbes (Smith and Baco 2003). As the ultimate goal of the return to the sea method is for the carcass to sink, it is recommended that the body cavity of the animal is pierced. This will aid sinking, as the carcass can off-gas more easily. Accelerating the sinking will help prevent the carcass from restranding.

Care must be taken to choose a proper release site, to ensure that the carcass will eventually sink in an appropriate area. Drift modeling can be employed before towing a carcass to select the best release location, which will help prevent the carcass from being pushed back onshore and restranding, becoming a hazard to navigation, and damaging protected and sensitive habitats. The United States Coast Guard should be consulted to ensure that the chosen release site will not allow the carcass to become a hazard to navigation. Additionally, proper planning will help to reduce the possibility of human-shark interactions, as floating carcasses have been known to attract sharks (Fallows *et al.* 2013). In areas with strong onshore currents and winds, the carcass must be towed very far offshore before it can be released. This will be very time consuming and could be cost prohibitive. In general, this method is more involved and more costly than other *remain in the environment* methods, and therefore is most practicable for large whale carcasses.

Towing a large whale carcass off of its stranding site (either off of a beach or intercepting a floating carcass and towing it to a new location) is potentially dangerous to human responders and bystanders. Experience dealing with lines under tension is ideal, and only trained experts should attempt to tow carcasses. It is important to evaluate the condition of the carcass, select the appropriate equipment (vessel), select ideal environmental conditions including high tide, and, if necessary, to prepare the beach to facilitate the carcass' path to the water. Once the carcass is floating, the tow is relatively straightforward, but may be more time-consuming than anticipated. Once the carcass reaches the location where it will be released, the line used to tow the carcass should be removed, or cut as short as possible, so that it does not become an entanglement threat for other marine life.

In the United States, return to the sea methods require authorization from the EPA under the MPRSA. The MPRSA prohibits the transport of any material, including whole marine mammal carcasses or parts, for the purpose of ocean dumping, except as authorized by a permit. The EPA has issued a [general permit](#) under the MPRSA to authorize the transport and disposal of marine mammal carcasses and parts in [ocean waters](#) under specified conditions. The general permit authorization is available for any officer, employee, agent, department, agency, or instrumentality of federal, state, tribal, or local unit of government, as well as any MMHSRP Stranding Agreement Holder, and any Alaskan Native, who already may take a marine mammal under the MMPA and ESA, to transport the marine mammal carcass from the United States and dispose of it in ocean waters. For certain situations where the general permit is not applicable, EPA may issue a MPRSA [emergency permit](#) for the ocean disposal of marine mammal carcasses. EPA’s permit process requires consideration of hazards to navigation and may include coordination with the USCG. Therefore, if return to the sea is the disposal method proposed, you must contact your regional stranding coordinator for permission to use the EPA MPRSA general permit or to request an MPRSA emergency permit for ocean disposal from EPA. More information on the EPA general permit as well as EPA contacts for inquires about the ocean disposal of marine mammal carcasses can be found here: <https://www.epa.gov/ocean-dumping/ocean-disposal-marine-mammal-carcasses>.

Benefits	Drawbacks
Promote nutrient cycling	Can be expensive and time consuming
Carcass can serve as an important food source	Must have a good understanding of local geography and conditions to select release site, to avoid the carcass restranding
Can be logistically more feasible than land removal	Should pierce body cavity to promote sinking
	Must use EPA MPRSA general permit or acquire a MPRSA emergency permit for ocean disposal (may delay disposal)
	Should not be used for animals euthanized with chemicals known to cause secondary poisoning (e.g., pentobarbital)
	Cannot be used for carcasses in a state of advanced decay, as they may break up during the tow
	Requires experience with lines under load; can be safety hazard to responders and other personnel

Benefits	Drawbacks
	Possibility of vandalism and illegal harvesting of marine mammal parts

3.4 Sinking

Intentionally sinking a carcass is similar to return to the sea, as the ultimate goal for both methods is to have a marine mammal carcass sink and contribute nutrients back into the marine environment. One additional benefit with this method is that the location where the carcass is sunk can be chosen and therefore controlled, which can maximize its benefits to the environment, while also avoiding damage to protected and sensitive habitats. This method is also more desirable if the stranding location is in a semi-enclosed body of water (*e.g.*, Puget Sound), where towing the carcass to a release location where it would not restrand is not possible. However, the sinking location must be chosen carefully, so sinking requires more planning and resources than releasing a carcass to float until it naturally sinks in a random location. As this method can have even higher costs and more intensive planning compared to return to the sea, this method is also most commonly used for large whale carcasses.

When selecting a site to sink a carcass, you must ensure that the carcass is submerged in deep enough water that it does not become a hazard to navigation. Similar to return to the sea, the United States Coast Guard should be consulted when planning to sink a carcass. Additionally, protected and sensitive habitats (*i.e.*, coral reefs, essential fish habitat, etc.) should be avoided when selecting a site. Sinking methods in ocean waters require authorization from the EPA under the MPRSA. As noted above for return to the sea methods, the EPA has issued a [general permit](#) under the MPRSA to authorize the transport and disposal of marine mammal carcasses in [ocean waters](#) under specified conditions. If a determination is made that the carcass must be sunk, rather than released at the disposal site, the transportation and disposal of materials necessary to ensure the sinking of the carcass are also authorized for ocean dumping under the MPRSA general permit. The permittee must first consult with and obtain written concurrence (or if a time-critical safety situation by telephone) from the applicable EPA Regional Office on the selection of materials used to sink the carcass. For some circumstances where the general permit is not applicable, EPA may issue a MPRSA [emergency permit](#) for ocean disposal of marine mammal carcasses. More information about the MPRSA general permit can be found here: <https://www.epa.gov/ocean-dumping/ocean-disposal-marine-mammal-carcasses>.

Another consideration is how the carcass will be weighted down. Even when the body cavity is pierced to allow for more efficient off-gassing, without weights, the carcass could float for some time. Therefore,

weights need to be used to hold down the carcass on the seafloor until it is more decomposed. A carcass will only need to be weighed down for a limited amount of time, and all weights that do not breakdown over time will become marine debris once the carcass has decomposed. A wide range of weights can be used to ensure the carcass does not refloat, depending upon the size of the carcass. For larger carcasses, heavier, non-decomposable weights such as chains and concrete blocks, may be necessary to ensure that the carcass does not refloat. For smaller carcasses, lighter but decomposable weights may be used such as sandbags and jute rope. Information on the types of items that can be used for sinking carcasses can be found here: https://www.epa.gov/ocean-dumping/ocean-disposal-marine-mammal-carcasses#What_type.

Benefits	Drawbacks
Promote nutrient cycling	Very expensive and time consuming
Carcass can serve as an important food source	Must ensure will not be a hazard to navigation
Can serve in future scientific studies of whale fall communities	Should pierce body cavity to promote sinking, should use weights that degrade
	Must use EPA MPRSA general permit or acquire an emergency permit for ocean disposal (may delay disposal)
	Should not be used for animals euthanized with chemicals known to cause secondary poisoning (e.g., pentobarbital)
	Cannot be used for carcasses in a state of advanced decay, as they may break up during the tow
	Requires the addition of sinking materials (i.e., weights, chains, concrete, etc.) to the environment.

4. Remove from the Environment Methods

4.1 Disposal in Licensed Landfill

The most widespread *remove from the environment* method is disposal in a landfill. With this method, the carcass is removed from the stranding location and brought to a nearby landfill in a lined or contained transport vehicle. This is one of the more cost-effective *remove from the environment* methods. As with all *remove from the environment* methods, this method is more practical if the animal is small enough to be easily transported from the stranding location. While it is possible to cut a larger carcass into smaller sections for transport, the stranding location must also be easily accessible for a lined vehicle to remove

the carcass and transport it to a licensed landfill. While these are similar requirements for removing a carcass to a secondary site, there are some benefits to bringing the carcass to a landfill.

One of the drawbacks for all *remain in the environment* methods is that toxic substances contained in carcasses, including euthanasia drugs (e.g., pentobarbital), may be released back into the environment. Disposal in a licensed landfill can minimize the impact of releasing these substances, as they will be contained to one location. However, not all licensed landfills may be able to accept animals that have been euthanized with barbiturates. Therefore, local landfills must be contacted to ensure that they can accept carcasses that contain these drugs. It is also recommended that all chemically euthanized carcasses are placed in a 3mm plastic bag before they are disposed of in the landfill (Vantassel and King 2018). This will minimize odors and reduce the likelihood of attracting scavengers.

Benefits	Drawbacks
Removes any toxic substances from the environment	Does not allow for nutrient recycling
Can sometimes mitigate the use of barbiturates as a euthanasia drug	Carcass not available as a food source
More cost-effective than other <i>remove from the environment</i> methods	More difficult for larger animals; may be space limitations
	Cost

4.2 Composting

Composting marine mammal carcasses has become more widespread in recent years. This method may involve bringing a carcass to a licensed commercial composting facility², to a site set aside specifically for marine mammal carcasses, or composting in a carcass digester. In order to compost marine mammals

² Salvaged marine mammal parts may not be sold or traded for commercial purposes (pursuant to regulations at 50 CFR 216.22 and 50 CFR 216.37). However, commercial facilities that repurpose marine mammal carcasses or parts thereof (i.e., composting and rendering facilities) significantly alter the marine mammal carcass or part so that the resulting byproducts are no longer considered marine mammal parts, as these processes destroy the marine mammal DNA. Therefore, these commercial enterprises may sell the byproducts that were originally sourced from marine mammal carcasses or parts, provided that those byproducts do not contain and are not marketed as containing marine mammal parts.

there are several things that should be considered in finding a suitable location (King *et al.* 2018).

The composting method combines many of the benefits of landfill disposal, with fewer drawbacks. In general, composting, while similar to disposal in a landfill, has the added benefit that the nutrients contained within the carcass will eventually be made biologically available. Similar to landfills, compost facilities serve to effectively sequester toxic materials and infectious diseases that may be contained in the carcass. Given enough time, toxic substances, including barbiturates such as pentobarbital, will often break down, either due to the heat generated by the compost pile or through microbial activity (Schwarz *et al.* 2013). Once these substances have broken down, the compost can be safely used. However, it is important to notify your composting facility that a carcass contains euthanasia drugs, as some facilities may not be able process these carcasses effectively to ensure that the toxic materials have fully broken down. Additionally, consultation with the local facilities should occur to ensure that all marine mammal compost will be used in accordance with local and state regulations on wildlife compost.

The major shortcoming of this method is that commercial composting facilities are not common in many regions. However, if a smaller facility is identified in the local area, ensuring that marine mammal disposal needs will fit within their policies and guidelines is recommended. For example, some facilities may only be able to compost larger animals if they are first broken into smaller pieces. Another consideration is the distance from the stranding site to the composting facility, as longer distances may increase transportation costs.

Benefits	Drawbacks
Removes any toxic substances from the environment, excluding heavy metals	Not widely available
Can mitigate the use of barbiturates as a euthanasia drug, given enough time	Carcass not available as a food source
Can effectively remove infectious diseases from the environment	More difficult for larger animals

4.3 Rendering

Rendering is an industrial process in which livestock and wildlife carcasses are broken down and recycled into new products³. This process uses all parts of the animal and often creates a protein by-product (*e.g.*,

³ Salvaged marine mammal parts may not be sold or traded for commercial purposes (pursuant to regulations at 50 CFR 216.22 and 50 CFR 216.37). However, commercial facilities that repurpose marine mammal carcasses or parts

protein meal) and a fat by-product (e.g., tallow and grease). So while this process does not allow the carcass to contribute to nutrient recycling, like the composting method, the carcass will be recycled into useful products. Rendering can be very expensive, and these plants are not commonly found in all areas of the United States. Therefore, the cost may be prohibitive when transporting marine mammal carcasses to a rendering plant, especially for larger carcasses. However, in areas where these facilities do exist, rendering can be a useful carcass disposal option, and it may be helpful to work with your local facility to identify ways in which you may be able to offset some of the costs.

One of the main benefits of the rendering method is that this process exposes the carcass to high heat, which will eliminate any pathogens. Therefore, if the animal is suspected to carry infectious diseases, this option can be considered. As one of the products of rendering is often protein meal that is used in animal feed, some facilities may not be able to accept or process carcasses that contain certain veterinary drugs, if they will not be effectively broken down in the rendering process. Therefore, it is imperative that preplanning and consultation with the local rendering facility occurs to fully understand their policies for disposal of animals that were chemically euthanized (e.g., pentobarbital).

Benefits	Drawbacks
Carcass is recycled into other useful products	Not widely available
Prevents the spread of infectious diseases	Not every facility will accept animals that contain barbiturates
	Expensive
	More difficult for larger animals

4.4 Incinerating

Incinerating is similar to the Rendering method, in that it is an industrial process in which livestock and wildlife carcasses are broken down by burning. Unlike rendering, the incineration method completely destroys the carcass and the remaining ashes and hard parts (i.e., teeth, bones, etc.) are buried in a landfill. This process does not allow the carcass to contribute to nutrient recycling. This can be beneficial as it also helps to prevent the spread of diseases, toxic materials, and veterinary drugs contained in the carcass from entering the environment. Incinerating can be very expensive, and these plants are not commonly found in

thereof (i.e., composting and rendering facilities) significantly alter the marine mammal carcass or part so that the resulting byproducts are no longer considered marine mammal parts, as these processes destroy the marine mammal DNA. Therefore, these commercial enterprises may sell the byproducts that were originally sourced from marine mammal carcasses or parts, provided that those byproducts do not contain and are not marketed as containing marine mammal parts.

all areas of the United States. Therefore, the cost may be prohibitive when transporting marine mammal carcasses to an incinerator, especially for larger carcasses. However, if the marine mammal was administered euthanasia drugs known to cause secondary poisoning (*e.g.*, pentobarbital), incinerating can be a useful carcass disposal option. Marine mammal, especially large whale remains have high blubber/fat content that may pose a problem for an incineration facility due to the high flash point of the oil. The biological load that the incineration facility can handle should be discussed in advanced to determine the weight and content of carcass material that can be safely disposed of at each facility.

Benefits	Drawbacks
Removes any toxic substances from the environment	Not widely available
Prevents the spread of infectious diseases	Very expensive
	More difficult for larger animals

5. Conclusion

The proper disposal of carcasses is an important aspect of marine mammal stranding response. Proper disposal prevents the spread of disease, minimizes the effects of harmful substances on wildlife and the environment, and can maximize the benefits that marine mammal carcasses provide to the environment. Stranding networks, in consultation with local and state agencies, should be comfortable using a combination of disposal methods, as no one method is recommended or required to be used in every single stranding situation. However, preferred disposal methods may vary by geographic regions, coastal topography, and highly populated areas. Planning for general carcass disposal should be part of normal stranding response planning efforts with disposal methods and disposal facilities pre-identified for normal carcass types encountered. For uncommon strandings (*e.g.*, large whales and mass stranding events), planning for carcass disposal should begin as soon as it becomes apparent that it will be warranted in a specific stranding event, and factors should be considered to determine which disposal option(s) may be most appropriate.

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Appendix A: Carcass Disposal Questions and Answers

Q: Who should people contact if they encounter a sick, injured, stranded, or dead marine mammal and what can they do?

A: Immediately contact your local Stranding Network, local authorities, or the NOAA Fisheries 24-hour Stranding Hotline to report a live or dead-stranded marine mammal:

- For the Southeast Region, call 877-WHALE HELP (877-942-5343)
- For the Northeast Region, call (866) 755-6622
- For the West Coast Region, call (866) 767-6114
- For the Alaska Region, call (877) 925-7773
- For the Pacific Islands Region, call (888) 256-9840

Members of the public should NOT attempt to help live marine mammals themselves and should instead immediately call authorized professional responders. Only responders who have been authorized by NOAA Fisheries and who have the training, experience, equipment, and support needed should attempt to assist live marine mammals. Response efforts also rely on support from many state and federal agencies (including law enforcement agencies and the United States Coast Guard), non-governmental organizations, and others working together to respond to live and dead-stranded marine mammals.

The NOAA Fisheries [Office of Protected Resources](#) coordinates marine mammal response efforts around the country through the [National Marine Mammal Health and Stranding Response Program](#).

Regardless of the species, responding to marine mammals is dangerous, and should only be performed by trained professionals.

Here are the steps to follow:

- Stay in the boat or on the shore—***never get in the water*** to help a whale, dolphin, seal, sea lion, or sea turtle.

- Note the GPS coordinates of the location of the stranded marine mammal and direction of travel.
- [Call your local responder](#) via the national Stranding Network.
- Wait for trained, authorized personnel—do not attempt to free a marine mammal on your own.
- You can also download the Dolphin & Whale 911 Stranding App (iOS) to help report a stranding.
- Monitor the situation—if a response is possible, authorities may ask that you stand by and watch the marine mammal from a safe distance (greater than 100 yards and not directly behind the animal).
- Note the number of animals if possible and if there are animals swimming nearby.
- Document—if possible take photos and video of the animal from a safe and legal distance (*e.g.*, 100 yards). This can provide valuable information to Stranding Network responders.
- Do not touch the marine mammal.
- Don't allow pets to approach the marine mammal.

Q: There is a dead marine mammal on the beach – will the Marine Mammal Stranding Network respond?

A: Local Stranding Network organizations document all reports of stranded animals and, when safe and possible, may respond onsite to the location. In some cases, the Stranding Network may remove a dead animal from the beach so a thorough necropsy (animal autopsy) can be conducted at or near a laboratory. In other cases, the Stranding Network may leave a carcass on site after all of the pertinent data have been collected – in these cases, it may be marked with paint or twine to prevent counting the same animal multiple times. Different local jurisdictions across the country have site-specific requirements – some municipalities want all dead animals removed from public beaches for human health concerns, whereas others want carcasses left onsite to maintain

the natural balance of the ecosystem.

Q: Who is responsible for removing or ensuring proper disposal of a dead marine mammal?

A: Different local municipalities handle the removal and disposition of dead marine based on their individual preferences, needs, and resources. If the animal is fresh and is a good candidate for necropsy, the Stranding Network may remove or help dispose of the carcass. In many cases, the marine mammal will not be removed from the beach due to limited resources. Carcass disposal is not the responsibility of the Stranding Network. If the animal is in moderate or advanced decomposition, the Stranding Network can take all critical samples and data on the beach, and then communicate with the landowner or land manager on what disposal options are available to them.

Q: What are the potential health hazards surrounding marine mammal carcasses?

A: As with any dead animals, potential health hazards can arise from contact with the carcass. Marine mammals may contain zoonotic diseases (bacteria, viruses, fungi that can spread from animals to humans and/or pets). For more information on zoonotic diseases please visit: <https://www.cdc.gov/onehealth/basics/zoonotic-diseases.htm>. If you and your pets stay clear from dead marine mammals, they will not harm you. Any potential hazards can be mitigated by following a few simple guidelines:

- Do not touch a carcass
 - Zoonotic diseases can spread from carcasses to humans through contact
- Do not let your pet come in contact with the carcass
 - Zoonotic diseases can be spread to your pets
- Do not ingest the carcass
 - Illnesses have been reported after ingesting marine mammal meat that was too decomposed for safe consumption
- It is illegal to collect marine mammal parts without permission from NOAA Fisheries,

unless you are an Alaska Native

- If you or your pet come into contact with a dead marine mammal, wash your hands and look out for symptoms of zoonotic diseases.

Q: What are the options for disposing of a marine mammal carcass?

A: There are two broad choices in disposing of a marine mammal carcass: (1) leave it in the environment, or (2) removal. Leaving the animal in the environment to decompose naturally can occur at the original stranding site or following relocation (depending on local restrictions). Removing the carcass from the environment may not always be possible and often depends on the location and size of the animal. Removal can be time-consuming, and may involve heavy equipment (*e.g.*, bulldozers) which can be expensive or restricted in certain locations. For larger whales, pre-selected sites for relocation may or may not be available depending on the time of year or available resources.

Q: What are the options for removing a marine mammal carcass from the environment?

A: If a marine mammal carcass is small enough to transport, an authorized individual can take it to a facility or location that accepts animal carcasses. These options may or may not be an option in your immediate area and may require payment.

- *Licensed Landfill* – the carcass is buried in a licensed landfill and they accept marine mammals for disposal.
- *Rendering* – the carcass is brought to a rendering plant, where the carcass is broken down and repurposed for other uses.
- *Incineration* – the carcass is brought to an incineration plant and burned.
- *Compost* – the carcass is composted in a designated compost facility or site, or carcass digester.

Q: What are the different options for leaving a marine mammal carcass in the environment?

A: If the marine mammal carcass is large, inaccessible, or cost-prohibitive to move, the animal will be left to decompose naturally. These methods include:

- *Remain in place* – the carcass is left above ground, in the tidal zone, or in shallow water areas, either in the original stranding location or moved to another site for natural decomposition.
- *Burial*– the carcass is buried on site above the high tide line. The carcass should be buried deeply to prevent scavenging and reduce the likelihood of disease transmission. This is one of the more cost-effective disposal options.
- *Release at sea* – the carcass is towed offshore and released floating at sea and requires an [ocean dumping permit from the Environmental Protection Agency](#) (requirements may differ per state).
- *Sinking* – the carcass is towed offshore and sunk. This also requires an [ocean dumping permit from the Environmental Protection Agency](#). This is an extremely costly option and will be utilized only if there are the resources to do so.

Q: How long will a marine mammal carcass take to decompose if left on the beach or at an approved decomposition site?

A: This depends on the size and stage of decomposition when the animal comes ashore, the stranding location (intertidal, above the high tide line, tidal or wave activity, etc.), scavenger activity, weather, and many other factors. Large marine mammal carcasses may take months to possibly over a year to slowly break down.

Q: What are the benefits of allowing a marine mammal carcass to remain in the environment?

A: The natural decomposition of a marine mammal carcass allows nutrients to return to the environment. Marine mammal carcasses are an important component of the ecosystem serving as an important food and nutrient source for terrestrial scavengers when on a beach, insects, and microbes, or entire seafloor whale fall communities when the carcass sinks at sea.

Q: If the animal cannot be removed from the beach, can it be buried onsite so it is out of sight?

A: Smaller seal, sea lion, and cetacean carcasses can be buried above the high tide line by hand, and larger animals can be buried using heavy equipment (check with local requirements if heavy equipment can be used in specific areas). This would allow the carcass to decompose without the tide uncovering the animal. The carcass should be buried deeply (but above the water table) to ensure it is not uncovered by scavengers. While this will hide the sight of a decomposing marine mammal, it may not prevent smells, depending on the burial depth.

Q: Will a buried marine mammal carcass attract sharks close to the beach?

A: There is currently no scientific evidence to suggest that sharks are attracted to decomposing marine mammal carcasses buried on land. While more research is needed to determine if sharks can sense buried carcasses, [a recent study](#) suggests that is unlikely as the chemical signal from the decomposing mammal that reaches groundwater and then goes into the ocean is very small if the carcass is buried above the high tide line and above the groundwater table.

Q: Do euthanized carcasses harm the environment?

A: If an animal was euthanized by chemical agents (*e.g.*, pentobarbital) that may cause secondary poisoning to scavengers (*e.g.*, birds, coyotes, sharks that might feed on a carcass), then the carcass needs to be disposed of in a safe manner that prevents risk to wildlife or the environment. Carcasses containing high concentrations of pentobarbital euthanasia solutions must be incinerated, rendered, composted, or buried in licensed landfills that accept pentobarbital carcasses to prevent the accidental poisoning of scavengers (Geraci *et al.* 2005). If carcasses must be left in place or will be buried on the beach, the use of intracardiac potassium chloride is the preferred chemical method in large cetaceans, small cetaceans, or larger pinnipeds because there is little risk of secondary poisoning to scavengers (Harms *et al.* 2014; WC Network Guidance 2018; Whitmer *et al.* 2021). If a carcass is too large to move, and sedatives were administered, the sedative injection site should be excised and disposed of appropriately.

All carcass disposals should follow local, state, tribal, and federal laws and regulations. An

animal euthanized by physical methods can be disposed of by beach burial, leaving in place, landfill, towed out to sea, rendering, composting, or incinerating depending on the situation and physical access.

Q: What about returning marine mammal carcasses back to sea, so they decompose naturally in the marine environment?

A: Towing a marine mammal carcass offshore can allow the nutrients to recycle back into the ocean as the animal decomposes, sinks, and is scavenged underwater. However, towing large marine mammals (*i.e.*, whales) is not an easy task. The necessary resources such as the appropriate vessels and an [ocean dumping permit from the Environmental Protection Agency](#) are required for these options and can be very costly. The carcass may also return to the beach, depending on currents and tides, if it is not towed to an appropriate location before being released.

Q: What type of materials can be used to sink a marine mammal carcass?

A: If a determination is made that the carcass must be sunk, rather than released at the disposal site, the transportation and disposal of materials necessary to ensure the sinking of the carcass requires an [ocean dumping permit from the Environmental Protection Agency](#) (requirements may differ per state). The permittee must first consult with and obtain written concurrence (or if a time-critical safety situation by telephone) from the applicable EPA Regional Office on the selection of materials used to sink the carcass. When considering your options for materials, please be aware that (1) materials described in 40 CFR Section [227.5](#) and [227.6](#) may not be used, and (2) materials should not have external features extending away or outward such that there is a snagging hazard to trawl line, nets or anchors. It is recommended that the body cavity of the animal is pierced. This will aid sinking, as the carcass can off-gas more easily. Accelerating the sinking will help prevent the carcass from restranding. Care must be taken to choose a proper release site, to ensure that the carcass will eventually sink in an appropriate area.

Q: What can we learn from dead marine mammals?

A: Marine mammals are important sentinels of the marine environment. Since they are

mammals like us, swim in many of the same waters we use, and eat many of the same fish that we consume, monitoring their health can help inform us of potential threats in the ocean that could impact people. Responding to and investigating dead stranded marine mammals is important to fundamentally determine cause of death, and whether it is natural vs. human-caused.

In some cases, the animal may be too decomposed to collect some types of samples or thoroughly investigate its health. There are other times, we can perform necropsies (animal autopsies), collect samples, investigate health, collect reproductive biology data, life history information (diet, age, number of pregnancies), exposure to contaminants, and other biological and physiological information.

By performing necropsies, we can also document human interaction cases that may include vessel collisions, entanglements, marine debris, fishery interactions, and gunshot injuries. Data collected from stranding responses help NOAA Fisheries monitor and understand wild marine mammal stocks and populations, as well as make more informed decisions for their management and conservation. Various publications have been written by the Stranding Network on the data collected from stranded marine mammals and more information can be viewed at the NOAA Fisheries Marine Mammal Protection website (<https://www.fisheries.noaa.gov/topic/marine-mammal-protection>).