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To Tree, or Not to Tree...

The use of discarded Christmas trees for dune stabilization

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Summary

For many decades discarded Christmas trees have been used for dune stabilization (with mixed success) in Massachusetts, other regions of the US, as well as countries around the world. Within the last 20-30 years the practice has fallen out of favor locally due to the high potential for negatively impacting habitat areas as well as the likelihood of making the erosion worse if improperly sited. Location is key if this method is to have a chance to provide a net benefit to a coastal resource area. Typically sand fence is a more appropriate choice, however Christmas trees can relatively cheaply and efficiently accumulate sand if installed properly in one of the rare locations in Massachusetts that is suitable for this technique. This extension bulletin leads the reader through the history, mechanics, and Best Management Practices for using discarded Christmas trees for dune stabilization in Massachusetts.

In the late 1960s and early 1970s discarded Christmas trees were used on Duxbury Beach (MA). By the late 1970s the use of Christmas trees was discontinued as they were considered ineffective for longterm stabilization (Rosen et. Al., 2009, Krahmer, 2000, images from Krahmer, 2000).

Introduction

Ever since the glaciers started retreating millennia ago, the sandy shorelines of Massachusetts have been eroding. As the ocean advances closer to houses, roads and other infrastructure, the urge to slow, or even attempt to stop, this inexorable march becomes ever more frantic. In the past this concern has led to some successful innovations which protected private property, however even the best intentions can lead to negative consequences. Massachusetts regulations have prohibited hard armor (e.g., revetments, seawalls, etc.) on beaches and dunes for many decades due to the tremendous potential for making erosion worse for beaches, dunes, salt marshes and other areas, while protecting the landward side of the structure. This constraint has led to a need to stabilize the shoreline more naturally by using materials to slow down the wind and thereby drop out sand. This sand can then provide a buffer for inland areas during storms as well as material for other dunes and beaches.

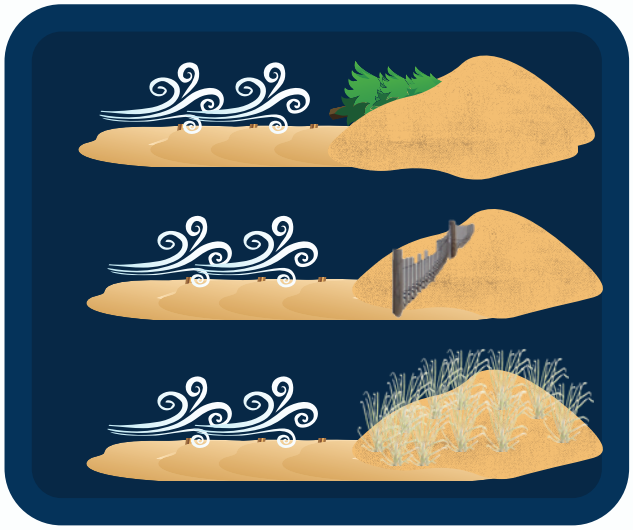
Enhancing sandy dunes with fencing is a common approach. While relatively inexpensive, the standard beach fencing (twisted wire with wooden slats) does have some associated material cost and also contains some non-biodegradable materials, which can become debris. It is primarily for these reasons that, for more than 70 years, coastal managers have been experimenting with Christmas trees as a sand fence alternative.

The earliest experiment the author identified was performed in 1949 using pine branches on the side of a dune (Couppis, 1955), however trees likely have been utilized in less formal experiments well before that.

In January of each year, thousands of Christmas trees need disposal. This consistent annual source of free material for trapping wind-blown sand is alluring. Even the National Christmas Tree Association touts the use of discarded Christmas trees in dune restoration efforts in its Christmas Tree Recycling Manual (2006). The practice can be effective in some locations, but if all of the many factors are not considered the erosion can worsen and vulnerable species can be negatively impacted.

Capturing Sand from the Wind to Build-up Dunes

In Massachusetts, we experience increased winds in the fall and winter. Along sandy coastlines this blows sand off the beaches and towards the land. This sand may blow into houses and yards, marshes, and inlets, or it can build dune systems higher and wider, if it is slowed down... in the right spot.



Over the long term, vegetation, such as beach grass, is most effective at retaining sand in a dune. Before grasses can be established other techniques, such as sand fences, are used to hold and accumulate sand. Sand fences are designed to imitate the natural accumulation that beach grass provides to the dune. There are many different types of fencing used for erosion control. Slat fencing, installed with small posts, has 50 percent porosity which slows down the wind, causing sand to accumulate near the fence. Sand fences (and likely Christmas trees) initially trap higher volumes of sand than beachgrass for the first year after the grass is planted. In its second year and beyond, 'Cape' American beachgrass typically captures more sand than fencing (Knutson, 1980). Most practitioners highly recommend complementing any non-living method (fencing, dead Christmas trees, etc.) with living vegetation that has a dense root system and can survive occasional saltwater inundation.

Speaking in general terms, Christmas trees act like sand fences in that they are temporary sand traps that slow down the wind, causing sand to accumulate. The dense needles of Christmas trees are effective at slowing wind and thereby trapping sand. These needles typically fall off in the first year (Rogers and Nash, 2003), but the rest of the tree takes longer (>4 years) to decay (Bleeker et al., 2013). To be effective, this technique requires the needles to stay on the tree long enough for the accumulated wind-blown sand to bury the tree. While the needles and branches may only take a few years to decompose, the trunk can take decades.


Wave-eroded scarp


Wind-eroded blowout (HESP, 2016).

How Dunes Erode

Storms create higher water levels upon which waves can erode the seaward toe of the dune. Further away from the beach, and higher up in the dune system, erosion can occur that has little to do with wave action. Wind can scour out circular sections of dune, often called "blowouts." Blowout evolution on Cape Cod tends to occur at a bare patch in an otherwise vegetated dune and develop into a saucer-shaped blowout, with further erosion transitioning the feature to a bowl blowout (HESP, 2016).

Discarded Christmas trees and straw bales reduce the downslope slide of sand in a wind-scour blowout feature at Castle Park Reserve, MI (from Bleeker et al., 2013).

In these steep blowout areas Christmas trees, more so than sand fences, have the potential to reduce further erosion.

Windblown sand accumulates at Christmas trees and sand fencing at similar rates (Bleeker et al., 2013); however, on a steep slope, sand tends to slide through fencing. A stable embedded object, such as a straw bale or Christmas tree, can stop the slide of sand, stabilize the dune surface, and thereby reduce slope failure.


Discarded Christmas trees in a spur configuration enhance sand fence (image:Mitasova et al., 2005).

Combining Christmas Trees & Sand Fencing

It has been established that, for a time, Christmas trees can trap sand in a similar way to sand fence. Adding Christmas trees landward of a sand fence is, in effect, creating an array similar to a double row of fence. Additionally, Christmas trees can be arranged in a spur configuration to reduce wind speed from a variety of directions. Studies have shown that adding spurs or an additional row of sand fencing can slightly increase the volume of trapped sand, however the construction cost does not make this economical (Savage, 1963; Knutson, 1980; Miller, et al, 2001). By using a free material, such as discarded Christmas trees, enhancing the standard row of straight (parallel to the dune) sand fence may become economically feasible.

Sand fences enhanced by discarded Christmas trees to mimic a double row of sand fence. Image from 1992 courtesy of Massachusetts Beach Buggy Association.

Another well-studied method is Brushwood fences, which are typically made by securing branches (often pine branches, think Christmas trees) in a row between poles and fastening the section to posts.

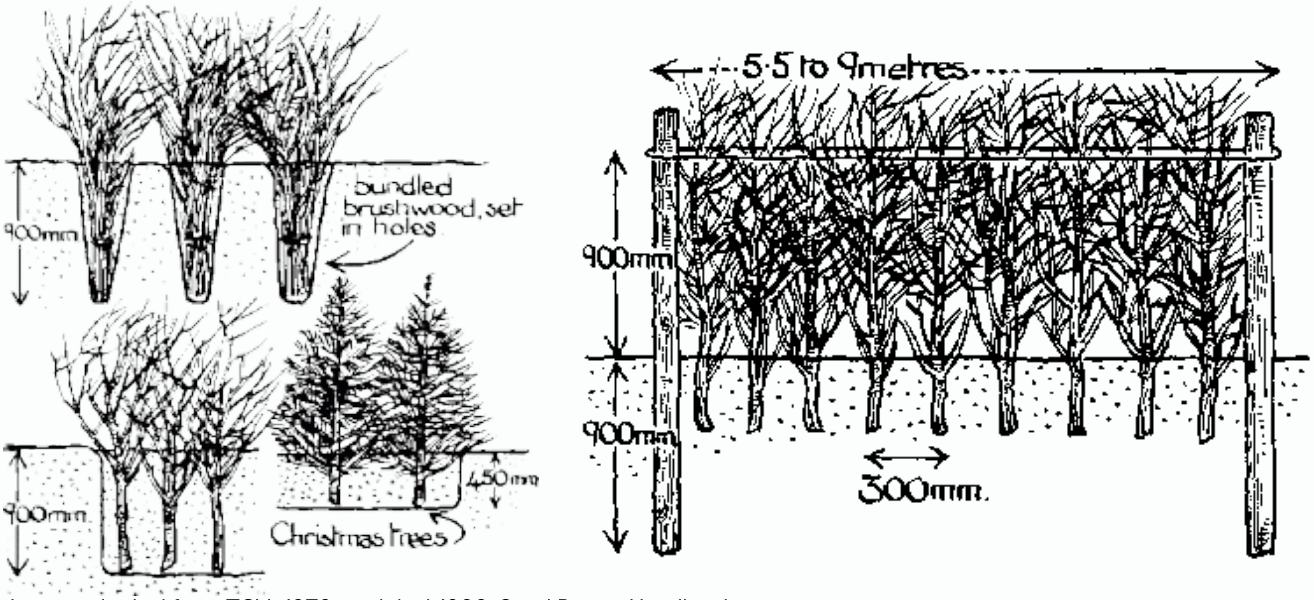


Image adapted from TCV, 1979, updated 1986. Sand Dunes Handbook.

A simpler, and often shorter-lived method is to partially bury the pine branches in a trench. Both methods have been used extensively (Stratton and Hollowell, 1940) and if properly designed they are very efficient sand trappers. Savage (1963) found them to trap slightly more sand than the slat type but cost almost twice as much due to the high labor requirements. In the 1970s it was determined that sand fence catches sand more consistently than brush fence and still required less labor to install than brush fence (Woodhouse, 1978). In the 50 to 60 years since these studies the price of labor has gone up at a significantly higher rate than the cost of materials, therefore it is still unlikely that the use of brush fencing could be economically justified, unless the labor is made up almost entirely of volunteers. In the U.S., brush fences have largely been replaced by rolls of prefabricated fence that can be quickly and cheaply secured to posts.

The more basic method of “Dune Thatching” is popular in many European Union countries. It consists of placing pine branches (or even whole small pine trees) on the bare sand of an eroded dune to act as alow wind barrier to trap sand and protect newly planted vegetation. Brush is laid over bare sand in a shingle arrangement with the tops of each successive layer overlapping the butts of the preceding layer. The trees and/or branches can be partially buried with sand or staked down if there is a site concern about displacement. This method has a high labor requirement and can interfere with subsequent planting; therefore, it should be limited to small blowout areas (Woodhouse, 1978).

Massachusetts Guidance

The use of Christmas trees on a coastal dune or beach, as with most methods for slowing coastal erosion, requires approval by the local Conservation Commission. A project that is also located in an area mapped as Priority Habitat by the state will need to file with the Natural Heritage & Endangered Species Program (NHESP) to ensure

compliance with the Massachusetts Endangered Species Act (MESA) filing. Additional approval may also be required from other federal, state, and local departments. While these agencies are typically supportive of methods that trap windblown sand to build dunes, a project would have to be located such that they will not get washed away during minor storm events and show no negative impacts to protected species. This can be difficult. In Massachusetts, this method was popular many years ago but fell out of favor with regulatory agencies. There are, however, a variety of sources in the state with guidance regarding the use of Christmas trees:

- Applying the Massachusetts Coastal Wetlands Regulations: A Practical Manual for Conservation Commissions to Protect the Storm Damage Prevention and Flood Control Functions of Coastal Resource Areas, otherwise known as the Coastal Manual. (2017)
- StormSmart Properties Fact Sheet 3: Planting Vegetation to Reduce Erosion and Storm Damage (2013)
- StormSmart Properties Fact Sheet 6: Sand Fencing (2013)
- StormSmart Coasts Fact Sheet 6: Landscaping to Protect Your Coastal Property from Storm Damage and Flooding (2009)
- Guidelines For Barrier Beach Management In Massachusetts A Report Of The Massachusetts Barrier Beach Task Force (1994)

Lessons Learned From Other States

Despite **New Jersey** having a long history of using Christmas trees to build dunes, they are now not recommended as they "do not readily decompose, become an eyesore if not covered by sand, and present a fire hazard." In a 1984 assessment it was determined that the practice had "unintentionally transformed dune fields into dumping grounds." Most communities now forbid the practice; however, several communities still allow dead trees and other shrubs to be used as drift fences. (NJDEP, 1985; Psuty and Rohr, 2000).

In the past, the use of Christmas trees in **Delaware** was promoted by beach managers, however they "have learned that this practice does not really help as well with established dunes as the use of native vegetation and sand fencing and it can smother existing beachgrass ... also ... that dead trees and brush are fire hazards that can lead to the destruction of established dunes."
(http://www.dnrec.delaware.gov/swc/shoreline/pages/duneprotection.aspx)

Fort Fisher, North Carolina - No more trees sign.
Photo credit Spencer Rogers.

In southeastern **North Carolina** 8,000 trees and in northeastern Florida more than 40,000 trees were placed on dunes in the 1980s. The 10-year program at Fort Fisher State Park in North Carolina sought to repair the damage from off-road vehicles. Once the repair was accomplished, the program was discontinued as it was starting to "favor a few species at the undesirable expense of others." At **Florida** sites, concerns over threatened and endangered species necessitated extensive monitoring efforts to ensure the processes caused no detriments to the species (Barnett et al., 1989).

Proponents of utilizing discarded Christmas trees to help stabilize sand dunes often refer to the method as a "win-win", as it provides a beneficial reuse of the Christmas tree and at the same time helps build volume in coastal areas. (This assumes the trees are "clean" of tinsel, flocking, ornaments, etc., which can do significant harm if introduced into the marine environment.) While both aspects are true, this practice actually has advantages and disadvantages that need to be considered before being permitted.

The use of discarded Christmas trees has become a rarity in Massachusetts. For an applicant to successfully gain permission to use this method, all these potential negative impacts must be accounted for -- a daunting task.

PROS (FROM LITERATURE)	CONS (FROM ABOVE GUIDANCE DOCUMENTS)
A WAY TO GET RID OF DISCARDED CHRISTMAS TREES	BECOME A SOLID WASTE NUISANCE ALONG THE COAST
CAN RAPIDLY ACCUMULATE SAND FOR COASTAL DUNES, THEREBY INCREASING RESILIENCE TO STORMS	IMPEDE THE ESTABLISHMENT AND GROWTH OF LIVE PLANTS (EFFECTIVE PROTECTION REQUIRES LIVE PLANTS)
CHEAPER THAN INSTALLING SAND FENCE (IF USING VOLUNTEER LABOR)	LEAVE LARGE, DESTABILIZING HOLES IN THE DUNE WHEN THEY ARE RIPPED OUT BY WAVES
POTENTIALLY LESS METAL INVOLVED THAN SAND FENCING	REPRESENT ACTUAL PHYSICAL BARRIERS TO PLOVERS
FOSTERS COMMUNITY INVOLVEMENT IN COASTAL REASOURCE AREA RESTORATION	DEGRADE NESTING HABITAT FOR PROTECTED SHOREBIRD SPECIES BY PHYSICALLY OCCUPYING OTHERWISE SUITABLE NESTING HABITAT AND IMPEDING CHICK MOVEMENT

Best Management Practices (BMPs)

Site considerations

Location is key when determining if the site may be suitable for using Christmas trees to stabilize the dune. After a storm, some steep, scarped areas might benefit from a method (e.g., fencing, Christmas trees) that builds volume to get the dune back to a more stable angle before beach grass can effectively grow.

The following site parameters are indicators that Christmas trees might be appropriate:

- Where there is a need to repair pedestrian and vehicular pathways;
- Where there is no conflict with state-protected species or their habitats. A conflict, as well as if a potential "conflict" could be resolved with conditions, which would be determined by the Division of Fisheries and Wildlife's Natural Heritage & Endangered Species Program as part of the MESA Project Review Process.;
- Where there is enough wind-blown sand to trap and build dune volume;
- Where there is enough distance between the seaward toe of the dune and the highest tides;
- Where the long-term erosion rates are low enough so that the trees will have a chance to decay before being exposed.

Design considerations

Even if the location may be appropriate, there are many components of the design that must be considered. The following guidance is provided to minimize any impacts to coastal resource areas and the species that utilize them:

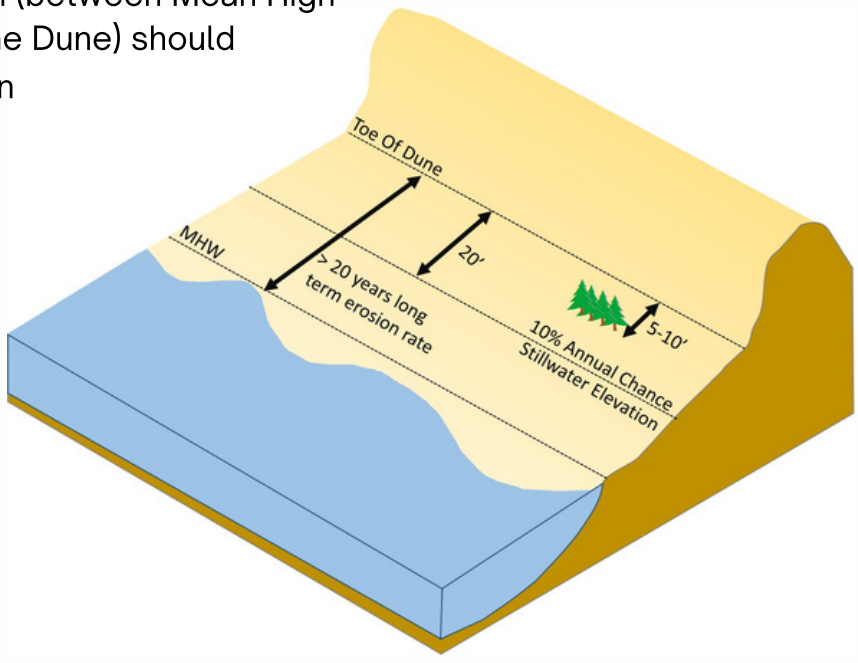
- Make sure the trees are not so tightly spaced so as to "carpet" the dune and prohibit the growth of live dune vegetation (e.g., beach grass);
- In areas unlikely to be disturbed, the trees can be placed on their sides and secured by placing sand over the lower branches. Other areas call for the trees to be fastened together, staked down, or otherwise secured. Even with substantial efforts at securing the trees, major storms can easily remove them, along with any accumulated sand and live vegetation;
- The trees do not need to stand higher than 3 feet and should still have enough needles for a porosity (proportion of holes) of about 50 percent to properly slow the wind;

Best Management Practices (BMPs)

Design considerations (continued)

- If the trees become exposed after installation, and have already lost their needles, they should be removed so long as removal would not affect the stability of the dune;
- For maximum efficiency, the Christmas tree array alignment should run at right angles to the wind. However, a configuration parallel to dune that will better restore the previous dune geometry is also acceptable;
- Christmas trees, as well as fencing, are temporary measures and should be supplemented with live plantings (e.g., beach grass) as soon as site conditions and the growing season permit. Growing plants with extensive roots systems are the best way to stabilize a dune in the long term;
- Placing trees seaward of an eroding dune scarp will result in washed out trees and debris on the beach. If possible, trees should be placed 10-20 feet landward of the existing vegetation line. Care should be taken than live vegetation (preferred over dead trees) is not adversely affected. A more seaward location may be acceptable if long-term erosion rates are very low or a recent storm has exceeded the 10-year return frequency.

If Christmas trees are proposed on the seaward toe of the dune/beach interface, then adequate distance from the water (both vertically and horizontally) is very important. There should be enough distance (>20' horizontally) between the 10% Annual Chance Stillwater Elevation (aka 10 Year Storm) and the toe of the dune to provide a buffer for storm erosion. The beach width (between Mean High Water (MHW) and the Toe of the Dune) should have at least 20 years based on long term erosion rates. This should provide enough potential longevity to allow most of the tree to naturally degrade before becoming exposed.



Conclusions

- There is a regulatory review and permitting process that must be completed before the placement of trees can occur within the dune/beach environment.
- Christmas trees can effectively trap sand in the short term, but live vegetation must be included to promote long term stabilization of the dune.
- Wind-scoured blowout areas are likely more suitable locations than dunes eroded by waves. Higher in the dunes, landward of the vegetation line, and further from the waves, this technique may be effective in repairing off-road vehicle and pedestrian damage and any resulting wind scour blowouts.
- Using discarded Christmas trees to trap sand will only rarely provide a net long-term benefit to the dunes, beach, and the species that utilize them. This method can increase dune volume but doesn't address the underlying causes of erosion. The most likely use of this technique is right after a big storm, to accumulate several feet of sand before planting an area that has seen minimal erosion in the past.
- If a beach experiences frequent overwash or has a consistently high erosion rate it is not a good candidate: eventually these trees will wind up being washed into the water during a storm. Most of the shoreline in Massachusetts is experiencing long term erosion, and therefore, there are likely few appropriate locations for this technique.

After the intense winter storm in February of 1978 discarded Christmas trees used for dune stabilization on Duxbury Beach (Mass.) were unearthed and became a solid waste nuisance along the coast (image from Krahmer, 2000).

Other uses for Christmas trees

The methods described above for coastal stabilization will never be able to make use of all the available discarded Christmas trees. Some potential other uses are described below. For almost any use, it is important to ensure that the tree was not treated with fire retardant, flocked, and all ornaments/tinsel have been removed.

Feed for goats

Check and see if you have a nearby goat farm that is looking for Christmas trees. Goats enjoy eating the green needles from pine trees more than the hay they typically get in winter months. Four goats can finish off a fresh Christmas tree in about an hour, and each goat will eat multiple trees each year. However, this can vary depending on the volume of the tree and size (and appetite!) of the goats.

Fuel for Fires

Pine needles burn like tinder (quickly and fiercely) and the branches have lots of sap, which can burn explosively and lead to a chimney fire. For these reasons never burn your Christmas tree in or near your house (e.g., fireplace or wood stove). However, the branches can be an excellent fire starter for camp-style fires. Be careful how many branches you put on at once and always have a water source to handle an out-of-control fire. Also, be sure to have clear surroundings and vertical clearance. Putting an entire Christmas tree on a fire at once is not recommended as it can cause an intense flame tens of feet high.

Mulch

Discarded trees are often collected at the curb by community groups or by private trash haulers. They are then grinded into a mulch and added to other organic materials for sale. Trees that are dropped off at transfer station are ground into mulch and either sold to a vendor or provided to residents.

Other

Looking for more ideas? Check out the latest Christmas Tree Recycling Manual published by the National Christmas Tree Association (currently 2006).

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