Mechanical Control Methods

U.S. ARMY CORPS OF ENGINEERS **Building Strong®**

ANS Control: Mechanical Control Methods – Harvesting, Shredding, Mowing, Rototilling, Rotovating, and Chaining[1]

Mechanical harvester removing tussock material from Lake Hicpochee, FL

Targeted Species: Mechanical control methods may be applied to emergent, floating, and submersed aquatic vegetation. Specific ANS of Concern – CAWS[2] that may be controlled by this method include swamp sedge *(Carex acutiformis)*, reed sweetgrass *(Glyceria maxima)*, dotted duckweed *(Landoltia (Spirodela) punctata)*, marsh dewflower *(Murdannia keisak)*, Cuban bulrush *(Oxycaryum cubense)*, and water chestnut *(Trapa natans)*.

Selectivity: Mechanical control methods described in this fact sheet can be applied to plant ANS and are non-selective. A trained machinery operator, carefully identifying and avoiding non-target vegetation, can achieve a minimal level of selectivity.

Developer/Manufacturer/Researcher: A variety of mechanical harvesters are currently available for specialized wetland and aquatic applications. Shredders, such as tiger cutters and cookie cutters, are generally custom-made machines tailored to specific harvesting activities. Rotovators are custom-made machines tailored to a specific activity. Mowing, rototilling and chaining activities use commercial available equipment such as mowers and tractors.

Brief Description: Mechanical control methods involve the complete or partial removal of plants by mechanical means, including: harvesting, shredding, mowing, rototilling, rotovating, and chaining. Mechanical control methods can also be used to expedite manual harvesting[3] activities, including hand harvesting, raking, and cut stump control, with the use of motor-driven machinery (Haller 2009; Lembi 2009). These management techniques for plants rarely result in localized eradication of the species, but rather, reduce target plant abundance to non-nuisance levels. A range of machinery for managing and controlling aquatic vegetation is in use today, designed for specific plant types (floating, submersed, and emergent vegetation) and for operation in specific aquatic habitats (open water, canals, shorelines, and wetlands).

Mechanical Harvesting – A mechanical aquatic harvester (harvester) is a type of barge used for a variety of tasks, including aquatic plant management and trash removal in rivers, lakes, bays, and harbors. Harvesters are designed to collect and unload vegetation and debris using a conveyor system on a boom, adjustable to the appropriate cutting height, up to 6 feet below the surface of the water. Cutter bars collect material and bring it aboard the vessel using the conveyor; when the barge has reached capacity, cut material is transported to a disposal site and offloaded using the conveyor.

[1] Another form of mechanical control, dredging, is described in the fact sheet titled "Dredging and Diver Dredging."
[2] For a complete list of the 39 specific ANS of Concern – CAWS, please see Table 1 of the main report.
[3] For more information on this control technology, please see the fact sheet titled "Manual Harvest."

Harvester barges are typically driven by a diesel engine, which powers a paddle wheel for propulsion and hydraulics for operating the conveyor system and cutter bars.

Mechanical harvesting provides good control of floating vegetation, but the effort will not result in eradication of a plant species. The size and nature of the equipment does not allow operators to target individual plants or small infestations.

Shredding – Cookie cutters and Tiger cutters are small barges designed to shred aquatic weeds, equipped with engine-powered, front-mounted blades. The cookie cutter was developed in Florida to address emergent aquatic vegetation and floating islands of vegetation and sediment, and to cut openings in shoreline and wetland areas through emergent wetland plants (USACE). Tiger cutters are similar to shredding barges, with the added advantage of being generally more maneuverable.

Shredding equipment is designed to shred weeds blocking the flow of water, including floating vegetation such as tussocks, emergent vegetation in soft soil or detritus, and submersed vegetation. The equipment is able to target smaller populations of vegetation than mechanical harvesters, but it cannot achieve complete eradication of target vegetation.

Mowing – Mowers can be an effective tool for managing emergent vegetation under certain environmental conditions. The concept is the same as in turf management - to reduce weeds and promote growth of desired species. Mowing vegetation provides non-target species temporary relief from the canopy of weeds or target ANS, allowing them the opportunity to establish; mowing has the added benefit of forcing many types of mowed vegetation to use energy reserves for regrowth in the same location rather than spreading to new areas. Mowing is most effectively used in conjunction with other control methods, such as hand harvesting and/or herbicide application.[4]

Rototilling – Rototilling is an effective method of managing both perennial vegetation with large rhizomes or tubers, and annual vegetation before seed production. Care should be used when implementing rototilling, as it is not selective in managing individual types of vegetation, and can cause large amounts of soil disturbance and possible ecological consequences. This method is ideal for situations where a monoculture of a plant ANS exists, or when target perennial species have an extensive rhizome system.

Mechanical harvester removing floating and emergent vegetation from a USACE boat basin in Clewiston, FL

Rototilling as a Control is most effectively executed in combination with follow-up herbicide applications. Typical equipment used to conduct this work ranges from specialized tilling machines,

[4] For more information on Herbicides, please see the fact sheet titled "Herbicides."

which operate in the same manner as a garden tiller, or standard farm equipment, such as tractors equipped with plows or discs.

Rotovating – Rotovating is similar to rototilling, with the distinction of targeting submersed vegetation. Specialized equipment has been developed to conduct this work in shallow lakes with large infestations of submersed weeds. Rotovating work may be very intrusive to an underwater ecosystem, in the same manner as rototilling, and is only effective for dense underwater infestations.

Chaining – Chaining is a vegetation clearing method used in water supply and flood control canal systems to conduct non-selective control of submersed and emergent aquatic vegetation. A large chain is dragged across the channel bottom, guided by trucks or tractors on each side of the channel. The chain is sized so that it has sufficient weight to remain in place as it scours the channel bottom, shearing vegetation at or below the surface.

Prior Applications: Mechanical removal is used for management of aquatic vegetation in a variety of habitats including streams, rivers, lakes, and canals. The equipment is limited by the depth of water in which it can navigate.

Mechanical Harvesting – Mechanical harvesting has been used throughout the United States to manage a variety of floating, submersed and emergent vegetation problems, as well as to collect organic and inorganic flood debris.

Shredding – Shredding is used throughout the world to manage weeds that impede navigation, or for flood control functions. These tools are also common tools used to manage vegetation in lakes, rivers, and waterways. Cutters are used in Florida to manage floating mats of Cuban bulrush as well as other floating and emergent vegetation.

Chaining – Chaining has been used to non-selectively control vegetation in flood control and water supply canals throughout the United States.

General Effectiveness: Mechanical control is an effective method for managing vegetation, but this Control has limited ability to target isolated populations. This trait of non-selectivity does not allow mechanical control methods to be as effective in mixed communities of target and non-target plants, because there is limited area over which the equipment can be used without harming non-target plant communities.

Tiger cutter barge and mechanical harvester working in conjunction to control aquatic vegetation in Monkey Box Run Lake Okeechobee, FL

Proper timing of mechanical control operations can improve control and reduce the spread of propagules. Vegetative debris fragments must be contained onsite, in order to prevent plants that reproduce vegetatively from infesting downstream.

Mechanical Harvesting and Shredding – Harvesting and cutting equipment can be used together for a more effective control of floating or matted vegetation. Cutters, a type of shredder, are able to dismantle the vegetation, while mechanical harvesters collect and dispose of the materials. This system allows the mechanical harvester to operate more quickly, because it does not have to cut the vegetation it is collecting. Although this operation is more expensive, it allows the least amount of vegetative material to spread outside the targeted area.

Operating Constraints: The use of mechanical control equipment is limited by environmental and site conditions. Mechanical control activities are non-selective.

When operating mechanical control equipment near water intake structures or flood control channels, the direction and velocity of flow must be considered to prevent vegetative debris from blocking the structure or channel. In addition to potentially preventing the downstream establishment of plant ANS, collecting vegetative fragments generated by mechanical control methods prevents the accumulation of decaying plant material in the channel, which may pose water quality issues.

Mechanical Harvesting – Most harvesting equipment needs approximately 36 inches of water (for a loaded barge) to operate, and enough room to maneuver a barge 30 feet long by 10 feet wide. The control mechanism is highly effective for controlling vegetation, but cannot selectively remove target plant or animal species from weed infestations. Harvesting is traditionally used for emergent vegetation and SAV in lake or riverine systems. The equipment is not as effective at managing shoreline or marsh vegetation in shallow or seasonal water systems.

Shredding – The primary operational considerations for cookie cutters are water depth and maneuvering room. Operation of these machines requires less water and little maneuvering room relative to mechanical harvesters. The cookie cutter does not have any type of harvest capability; it only cuts mats of vegetation. As such, biomass is still present in the water system and there is often a need for a harvesting machine to support this type of operation (USACE).

Mowing and Rototilling – Mowing and rototilling require site conditions with firm enough soil to operate a rubber-tired piece of equipment; this may be possible in standing water, but water depth and soil types must be evaluated before starting work. Significant ecosystem damage may occur if the operation is not carried out properly, including soil disturbance that may allow for ANS establishment. Special consideration should be given to suspension of sediment and sediment management when using this technology to control invasive vegetation in wetland or aquatic habitats.

Rotovating – Rotovating requires enough depth to float and operate the piece of equipment (which is similar in size to a harvester), but also cannot be too deep, as the rotovating head has limited reach. Special consideration should be given for suspension of sediment, and sediment management, when using this technology to control invasive vegetation.

Chaining – Chaining requires unobstructed paths on both sides of a canal, so that trucks or tractors can be operated with minimal downtime over long distances. Chaining stirs sediment causes turbidity and disturbs aquatic species that live in the targeted area.

Cost Considerations:

Implementation: Implementation costs would include planning, equipment, and labor for initial application of mechanical control activities. Mechanical control methods for aquatic plants are usually priced per acre, based on a variety of environmental conditions and site-specific logistics, as well as equipment types and quantities required. Harvesting of floating aquatic plants is also priced per acre, based on density of vegetation and travel distance between collection and disposal sites. Other cost considerations can include decontamination of equipment to prevent spread of ANS and construction or development of an existing disposal site near the harvest area. Large volumes of harvested vegetation require significant amount of temporary storage; after the material dries, its volume is reduced and can then be left on the nearby disposal site to compost (if permitted), or hauled to a permitted compost facility or landfill. The cost of hauling material is dependent on distance, volume, and level of difficulty required to access the disposal site.

Planning and design activities in this phase may include research and development of this Control, modeling, site selection, site-specific regulatory approval, plans and specifications, and real estate acquisition. Design will also include analysis of this Control's impact to existing waterway uses including, but not limited to, flood risk management, natural resources, navigation, recreation, water users and dischargers, and required mitigation measures.

Operations and Maintenance: Operation and maintenance costs would include monitoring effectiveness of the Control method, modifying application parameters if necessary, and scheduling and completing periodic reapplications.

Mitigation: Design and cost for mitigation measures required to address impacts as a result of implementation of this Control cannot be determined at this time. Mitigation factors will be based on site-specific and project-specific requirements that will be addressed in subsequent, more detailed, evaluations.

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