POPULATION AND HABITAT MONITORING OF WATER HOWELLIA (*HOWELLIA AQUATILIS*) AT THE HARVARD–PALOUSE RIVER FLOOD PLAIN SITE, IDAHO: FIFTH-YEAR RESULTS

Idaho Conservation
Data Center
Idaho Department of
Fish and Game
PO Box 25
Boise, Idaho
83707

Juanita Lichthardt
Karen Gray

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ABSTRACT

Water howellia (*Howellia aquatilis*) is an aquatic macrophyte that is listed as threatened by the U.S. Fish and Wildlife Service (USFWS). It occurs in internally drained ponds that dry out each year. The single known Idaho location of the species occurs on the flood plain of the Palouse River in northern Idaho, in three small ponds formed by fluvial processes. The ponds are the low points of abandoned channels or channel migration scars. Threats to the population include invasion by two aggressive, rhizomatous species–reed canarygrass (*Phalaris arundinacea*) and sweet flag (*Acorus calamus*). Water howellia populations and pond water depths at the site have been monitored since 1999. Photopoints were established in 2000. This is the fifth annual report documenting monitoring results. In 2003, flowering took place in late June when the water was 1-3 dm deep. Although absent from pond 1 for the second consecutive year, water howellia was present in the other two ponds at levels similar to those in 2002. In 2003, transects were installed in ponds 2 and 3 for measuring cover and frequency of water howellia and associated species, and for detecting expansion of reed canarygrass and sweet flag. Photos were taken from established photopoints on June 30th. Weed suppression measures for reed canarygrass and sweet flag were continued and maintained at ponds 2 and 3. For reed canarygrass these consist of excavation and covering. Experimental clipping was begun on sweet flag in 2003. Monitoring results, along with results of weed suppression measures, will provide a basis for possible future management of the site.

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INTRODUCTION

Water howellia (*Howellia aquatilis*) is an annual aquatic plant belonging to a monotypic genus in the family Campanulaceae. It has very specific habitat requirements and has been rare throughout the period of botanical record. It is currently known from 14 sites in western Montana, northern Idaho, eastern and western Washington, and California (Shelly and Moseley 1988). It is rare throughout its range, occurring in ephemeral ponds and at the margins of permanent ponds, which in most cases are glacial potholes (Shapley and Lesica 1997). The ponds are shallow, the bottoms vegetated with aquatic, emergent, and wetland plants, and are surrounded by deciduous shrubs and trees. A detailed description of the plant, its biology, and habitat can be found in Shelly and Moseley (1988). Water howellia is listed as threatened by the U.S. Fish and Wildlife Service. A habitat and population monitoring program is one of the recovery actions specified in the draft Recovery Plan (Shelly and Gamon 1996).

The life cycle of water howellia is tied to the hydrology of the ephemeral ponds that comprise its habitat. Ponds must dry out in order for germination to occur. As an annual plant, viability in the short term depends on hydrologic conditions necessary for seed production and germination. Habitat management for water howellia requires an understanding of pond hydrology and geometry (Shapley and Lesica 1997) and the effects of colonization by exotics (Lesica 1997).

In Idaho, the only known water howellia site is on the flood plain of the Palouse River, in ponds formed in depressions left by the gradual migration of the river channel (Lichthardt and Moseley 2000). Three ponds, each less than 0.1 hectare (0.25 ac) in area occur on a parcel of private land occasionally used for pasture. The site is tracked by the Idaho Conservation Data Center (IDCDC) as the Harvard-Palouse River Flood Plain Conservation Site.

In 1999, the fluvial processes of the flood plain were examined by looking at historical photos, mapping vegetation at the site, and surveying a cross-section of the flood plain (Lichthardt and Moseley 2000). Water depth gages were installed in each pond. Reed canarygrass (*Phalaris arundinacea*) and sweet flag (*Acorus calamus*), aggressive rhizomatous spreaders found within the ponds, were identified as a major conservation concerns. Cover and distribution of water howellia have been monitored annually since 1999 as have water levels. In 2001, accurate diagrams of the ponds were made for the purpose of monitoring pond vegetation (Lichthardt and Gray 2002). Also in 2001, we began using excavation and covering to control the spread of the two primary weed targets. The land owner is kept appraised of the status of the water howellia populations and our activities at the site. This reports contains data on population and water levels recorded from 1999 to 2003 and describes ongoing weed control activities at the site.

POND DESCRIPTIONS

The three ponds occur on a broad floodplain of the Palouse River. All three are depressions set within elongate, arcing meander scars. The entire scar holds water in the winter months. Each pond consists of an irregularly oval portion and a narrower, channel-like portion–the pond “tail”–which is partly to mostly shaded (Appendix 1).

The pond bottoms support herbaceous emergent vegetation dominated by inflated sedge (*Carex vesicaria*), water parsnip (*Sium suave*), short-awn foxtail (*Alopecurus aequalis*), American water-plantain (*Alisma plantago-aquatica*), simple-stem bur-reed (*Sparganium emersum*), and, at pond 3, common spikesedge (*Eleocharis palustris*). Ponds are surrounded by tall shrubs–Pacific ninebark (*Physocarpus capitatus*), Bebb’s willow (*Salix bebbiana*), Drummond’s willow (*Salix drummondiana*), black hawthorn (*Crataegus douglasii*), and thinleaf alder (*Alnus incana*)–and a few large conifers including grand fir (*Abies grandis*), Engelmann spruce (*Picea engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), and lodgepole pine (*Pinus contorta*). A complete species list can be found in Lichthardt and Moseley (2000). Each pond has its own characteristic vegetation as described below.

Pond 1: The central area of the pond is occupied by large clumps of inflated sedge, along with water parsnip and scattered clumps of reed canarygrass (Appendix 1). Prior to 2001, only a small amount of water howellia has occurred along the southeast edge. North, east, and south edges of the pond are relatively abrupt and bordered by shrubs. On the west side the edge tapers gradually, and supports sparse growth of reed canarygrass and willow. Areas of partially submerged reed canarygrass surround the pond. Reed canarygrass may increase within the pond as it dries down.

Pond 2: This is the largest pond, the open portion being approximately 650 m^2 in area, with a very long, gradually narrowing tail to the west (approximately 190 m^2; Appendix 1). About 80 percent of the main pond is occupied by sweet flag and reed canarygrass. Most of the area occupied by reed canarygrass is above the late-spring water level and therefore not part of the pond proper, although it may have been at one time. Sweet flag is a clonal emergent up to 2 m tall, that forms a dense sward very similar to cattails (*Typha* spp.) and is displacing most other pond vegetation. It has only tentatively been identified as *Acorus calamus*, an exotic. The sweet flag provides a high level of shade and in fall its residue covers the pond bottom. In spite of this, water howellia was found growing throughout the sweet flag sward in 2001, 2002, and 2003.

Pond 3: The main pond is about 100 m^2 in size with a short, narrow tail approximately 6 m long that is partly shaded (Appendix 1). The main pond is occupied by a dense sward of common spikesedge which is not found in the other two ponds. A solid growth of reed canarygrass adjoins the pond in two separate places that may once have been part of the pond, and from these places the grass is continuing its colonization of the pond, especially where it can take hold in rotting wood.

In early to mid-summer, pond 3 is covered by an algal surface bloom. This is probably caused by runoff from a feedlot across the road to the east. When the water is high in spring, the pond is likely connected to water coming off the feedlot through a culvert just to the south.

MONITORING

Populations

Populations were surveyed on June 30, 2003 when water was 1-3 dm deep at the deepest point in each pond and water howellia was in flower and early fruit. We moved carefully through each pond, flagging locations of water howellia with wire flags. Data were used to update the element occurrence record for water howellia (Appendix 2). The aerial extent of water howellia in each of the past four years is shown in Table 1. Results are also discussed below for each pond.

Table 1. Approximate area (m^2) occupied by water howellia over five years.

	Pond 1	Pond 2	Pond 3
	Square meters		
1999	0.5	50	0.5
2000	No data	110-130	0.5
2001	3.0[1]	345	1.0[2]
2002	0	440	4.4
2003	0	390	4.6

[1] Four plants estimated.
[2] Eight to twelve plants estimated.

Pond 1: No water howellia was found in pond 1. Other aspects of the pond appeared normal.

Pond 2: The entire inundated area of pond 2 was again occupied by water howellia, in varying densities. We flagged the most marginal plants we could find to track its distribution. Then we meandered through the pond to see how continuous or patchy it was. We followed its distribution up the pond tail 30 m to where dense reed canarygrass filled the narrow channel.

As in previous years, it was most abundant in the pond tail where it formed nearly continuous cover at the water surface. It was more or less continuous for 20 m into the tail where a dead alder lies across the channel. There were a few plants in a small pool 7 m further up. Our distribution map from 2002 showed it to be continuous for 30 m into the tail, and this constitutes the entire difference of 50 m between 2002 and 2003 figures in Table 1.

Water howellia occurred with lower density within the sweet flag sward and under cover of shrubs at the pond margins. It was observed growing in depressions formed by removal of reed canarygrass clumps in 2002.

Pond 3: At this pond we flagged each occurrence of water howellia and estimated the canopy area. Where it occurred in large patches we attempted to flag the perimeter and estimate the size of the patch. At the north end of the pond, where water howellia has occurred every year of monitoring, there were 2 patches of about 30 and 50 dm^2, plus 8 more small groups consisting of maybe 3-5 plants each. The larger patches consist of a tangle of stems with flowers blooming at the surface and only small gaps where there are no stems or flowers visible. Near the gage were 2 plants, one at a previous flag and one not. For the purpose of Table 1, 4 dm^2 were allocated for each of these scattered small groups. Under the overhanging alder at the tail entrance there was a 3 dm^2 patch, and a separate 10 dm^2 patch at the entrance to the tail. In water within the tail of the pond, plants were scattered over approximately 3 m^2, and there were at least 6 plants flowering in the mud above the water line. At the end of August we returned to the pond and recorded the distance and azimuth from the gage to each group of flags (Table 2).

Table 2. Distance and azimuth from the gage to water howellia locations, pond 3.

Meters from gage	**Azimuth from gage * (º)**	**Area defined by flags m^2**
5.7	24	0.3
5.3	32	1 flag
3.5-4.3	37-57	0.8
3.4	65	0.3
0.35	87	1 flag
1.2	111	1 flag
11.0	177	1 flag
8.6-10.3	179	0.5
11.0	185	0.05
9.7	185	1 flag
8.5	185	0.3
4.9	188	0.1
5.0	193	0.02
2.4	225	1 flag
2.0	236	0.03

* 19º E declination.

Discussion: On the Flathead National Forest in Montana, 10 years of monitoring showed extreme variation in frequency and cover of water howellia (Mantas and Sutter 1998). Also, there was a close relationship between population size and the previous year's climate, with high summer precipitation resulting in low abundance the following year. High summer rainfall would presumably cause the ponds to dry out later. Water level data should give us a similar means to relate drying time to plant abundance or population vigor.

Water levels

Water levels in the three ponds are recorded at each visit (Appendix 3). Water level is read directly from a vertical section of PVC pipe located in the deepest part of the pond. The pipe extends 1 m above ground and marked off in 1 cm increments. The gage can generally be read from a distance using binoculars, but the marks fade and need to be remarked annually. Whenever depth readings are taken, the U.S. Geological Survey Water Resources web site is checked for current discharge rate and stage of the Palouse River (Appendix 3). These data are for a point on the river 24 km downstream.

Pond drying is shown graphically in Figure 1. The earliest date at which the ponds have been visited is March 27, so the time scale is represented as "days from March 26." Drying occurs at a fairly steady rate until late June, the time at which water howellia begins flowering, then drying is rapid. Ponds 1 and 3 are dry or nearly so by mid-July, pond 2 by the end of July.

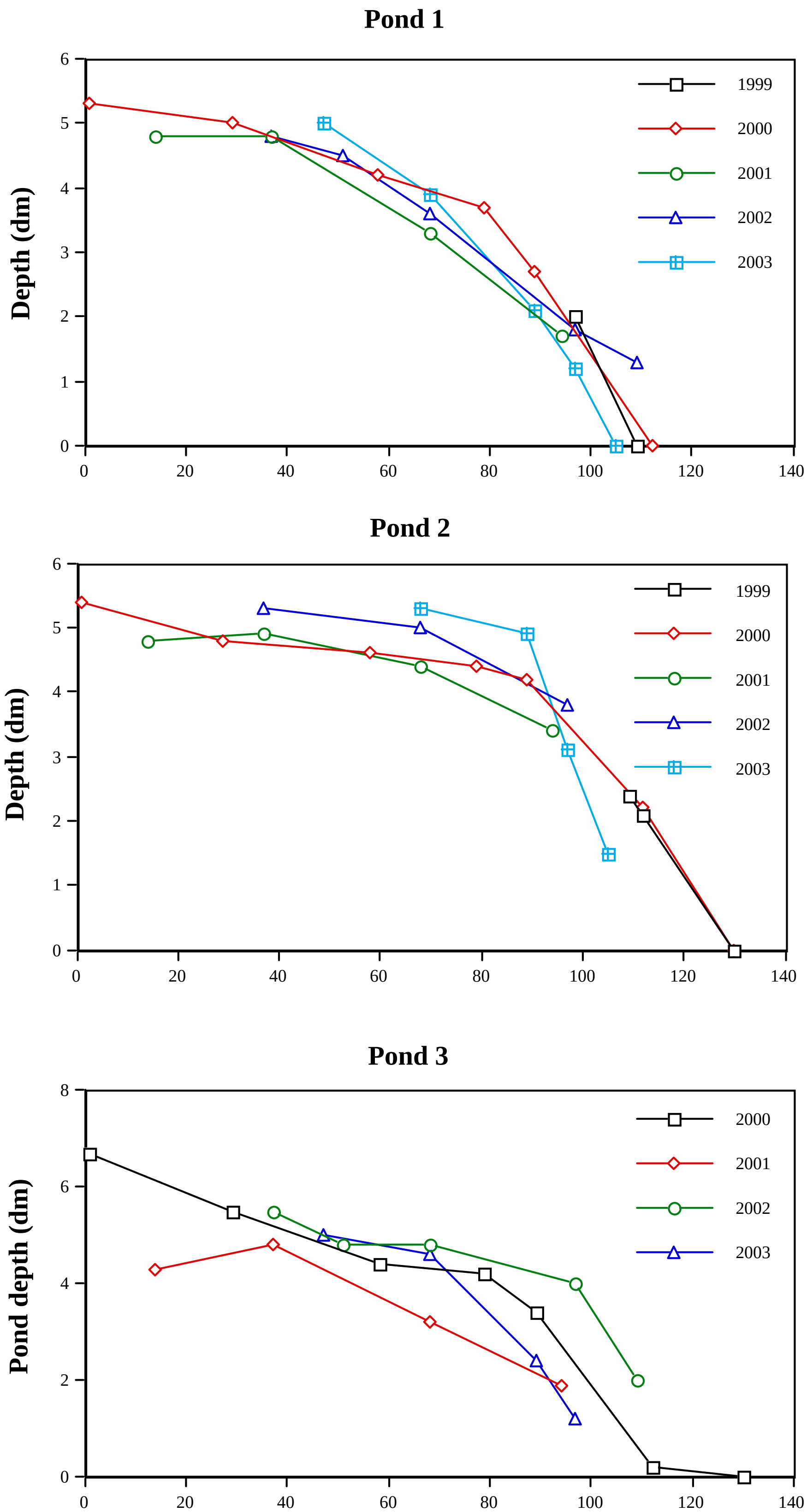

Figure 1. Depth of water in ponds (dm) between March 27th and August 3rd.

Plant communities

Vegetation of the ponds was mapped in 2000 (Appendix 1) by measuring distance and azimuth from the pond gage to the boundaries of the various plant communities which are generally distinct. During 2003, transects were installed in ponds 2 and 3 in order to more easily detect the expansion of exotics within the ponds and to described changes related to our weed control work.

Methods. At pond 2, two transects, 5 m apart, run in a direction of 263º[1] and are marked at each end with metal fenceposts (Appendix 1, Figure 2). Transects were sited to intersect a number of communities as well as some of our weed control work. They both intersect the leading edge of the sweet flag colony where it sharply transitions to a native community. They both end at the edge of the pond which is evident as a distinct break in grade and vegetation. The beginning of transect 1 is 9.2 m at 83º from the gage, and the end is 19.8 m at 263º from the gage. It is 29 m long and passes through the gage. The beginning of transect 2 is 15.8 m at 65º from the gage and the end is 8.0 m at 304º from the gage. It is 25 m long. A tape is run between two fenceposts marking the transect, and the distance in meters is read at each change in community. This is a fairly objective determination, because the boundary between communities is generally abrupt. A line intercept 2 dm wide (1 dm either side of the tape) is used to maximize intercepting plants rather than empty space.

Because reed canarygrass is considered a primary threat, it is recorded whenever it is intercepted by the line, even when it occurs within some other community type. A distinction is made between reed canarygrass that is part of a colony or that which is a small "pioneer" plant.

At pond 3, five such transects were installed. Transects run east to west and are 3 m apart. Transects 1-3 intersect the area where reed canarygrass excavation has taken place. In addition recording transitions between communities, these transects were used to place 50 x 50 cm quadrats for estimating cover. The corner of the quadrat is placed on the north side of the tape at each meter tick starting at zero (east end). In each microplot, canopy cover is estimated for each species present, as well as bare soil and wood. Canopy cover is estimated to the nearest 5%, or to 1% when less than 10%. Overhead canopy cover is not considered.

In 2003, transects were sampled in late September through early October. In the future sampling should be done in August, after the ponds dry.

Results. Appendix 4 tables contain data on plant communities for the two transects in pond 2, and on both plant communities and cover for the five transects in pond 3. Three main native communities were recognized, along with reed canarygrass and, in pond 2, sweet flag. Reed canarygrass and sweet flag appear to form nearly pure stands, but water howellia grows within the sweet flag colony. Native plant communities recognized were as follows:

Common spikesedge (*Eleocharis palustris*) community: The open portion of Pond 3 is dominated by a nearly pure stand of common spikesedge which is not evident when water howellia is flowering, but emerges as the pond dries down.

[1] 18º east declination was used for bearings.

Short-awn foxtail (*Alopecurus aequalis*) community: This is a diverse community of aquatic and emergent plants that, after drying, becomes a grassy lawn dominated by short-awn foxtail. It occupies a major portion of the central portion of pond 2 as well as lightly shaded portions of the tail. Other major elements of this community include western mannagrass (*Glyceria occidentalis*), small bur-reed (*Sparganium emersum*), and scattered American waterplantain (*Alisma plantago-aquatica*). At pond 2 the highest densities of water howellia are associated with this community.

Inflated sedge (*Carex vesicaria*) community: Inflated sedge occurs in all three ponds, but not to the same extent as in pond 1, where it dominates the central portion. It forms large, tall clumps which do not begin growth until the base is near the water surface. In other ponds it occurs more as an inclusion within the short-awn foxtail community.

Photopoints

Photos were taken on July 1 and copies will be stored and the IDCDC and the Fish and Wildlife Service. Photopoint locations are described in Appendix 5.

WEED CONTROL

The most imminent weed threats are due to reed canarygrass and sweet flag. Climbing nightshade (*Solanum dulcamara*) is another aggressive weed that could present problems in the future. About 100 m^2 of pond 2 is occupied by a monoculture of sweet flag. Thus far, water howellia coexists with sweet flag, but sweet flag is displacing other vascular plants in pond 2. Reed canarygrass is invading all three water howellia ponds and has apparently already filled in portions of ponds 2 and 3. It is usually present under the shrubs at the pond edge, but in the open it has developed dense swards raised well above the pond bottoms. Most of the areas mapped as reed canarygrass in the pond diagrams (Appendix 1) are dense monocultures and are free of standing water by May.

Potential weed control measures at the water howellia ponds are limited. We are probably limited to small equipment or hand tools. Burning would require landowner's approval and is likely too large a liability risk. To do any significant excavating of either or both of the target weeds would require a small crew of volunteers or other labor. In 2001 we began experimenting with several measures on a very limited scale to assess their feasibility. Weed control work has been done in late July and early August, after water howellia has produced seed and there was no standing water in the ponds. In 2003, weed control efforts were continued in ponds 2 and 3.

Pond 2

In addition to the raised area of nearly solid reed canarygrass on the north edge of the pond, reed canarygrass also occurs as satellite islands raised well above the pond bottom. In 2002 we removed four such islands, 0.5-0.75 m in diameter, from the west edge of the main body of the pond, by excavation (Lichthardt and Gray 2003). In 2003, water howellia completely occupied the depression left by one such island. Unfortunately, it appears that sweet flag will rapidly fill any space freed of reed canarygrass. Past removal of satellite islands of sweet flag appears to have been successful.

In pond 2, we mapped a satellite colony of sweet flag and then clipped it twice on July 9 and August 25, in an effort to starve the rhizomes. This method has apparently been used with some success in the control of cattails (*Typha* spp.). A small satellite was selected for this test, because we could clip the entire thing, leaving no leaves standing to feed the rhizomes. Pulling the leaves was faster and more effective than cutting. Often, the crown would come off with the leaves, depriving the plant of some of its reserve as well as its ability to photosynthesize.

Pond 3

In pond 3 it appears that our efforts to halt reed canary incursion have been successful. Reed canarygrass occupies higher ground adjoining the west edge of the pond (Appendix 1, Figure 3) and from this source was formerly spreading into the pond. The plastic panel acting as a border at the west pond edge stayed in place (Figure 2). The canvas tarp (placed over slightly higher area with reed canary excavated) allowed some plants to emerge and many of these were natives.

In 2003 we continued excavation along the west side to remove reed canarygrass and to expand the pond area. We dug a channel to the level of the pond bottom, extending behind the weed block without disturbing it significantly.

Reed canarygrass is also spreading from higher ground on the east side of the pond into the pond tail. In 2002 we used shovels to create an abrupt edge, then covered the edge and about a 2-m width of reed canarygrass with plastic tarp anchored by woody debris. The tarp was in place and appeared to be suppressing growth of reed canarygrass. This area might be a second potential target for excavation of reed canarygrass rhizomes. Weed blocking installations will require periodic maintenance.

RECOMMENDATIONS

We recommend that monitoring be continued on an annual basis and that weed control measures be maintained. At a minimum, reed canarygrass at pond 3 can be held in check by removing new plants and curtailing its advance through the use of weed blocking materials. At pond 2, removal of satellite islands of sweet flag and reed canarygrass should continue.

Seed should be collected from the major sedge species, inflated sedge, and grown out for reclaiming portions of the pond bottom where reed canarygrass has been removed.

A more accurate means of measuring population size of water howellia may be desirable. However, it is very difficult to count plants with any accuracy. Stems break easily when handled, although this may not have much effect on seed production and might serve to disperse seed.

Even if population size could be determined with reasonable accuracy, this may not even be the best measure of population vigor. Isolated plants are undoubtedly more highly branched and produce more flowers, making cover a better measure of population vigor than stem number. A qualitative method that captures variability in the entire pond is preferable to one that intensively samples only portions of the pond (Mantas and Sutter 1998). In 2004 a more accurate estimate of plant cover will be made within transects set up in 2003. However, complete pond searches and censuses, based on area occupied by howellia, will also be done.

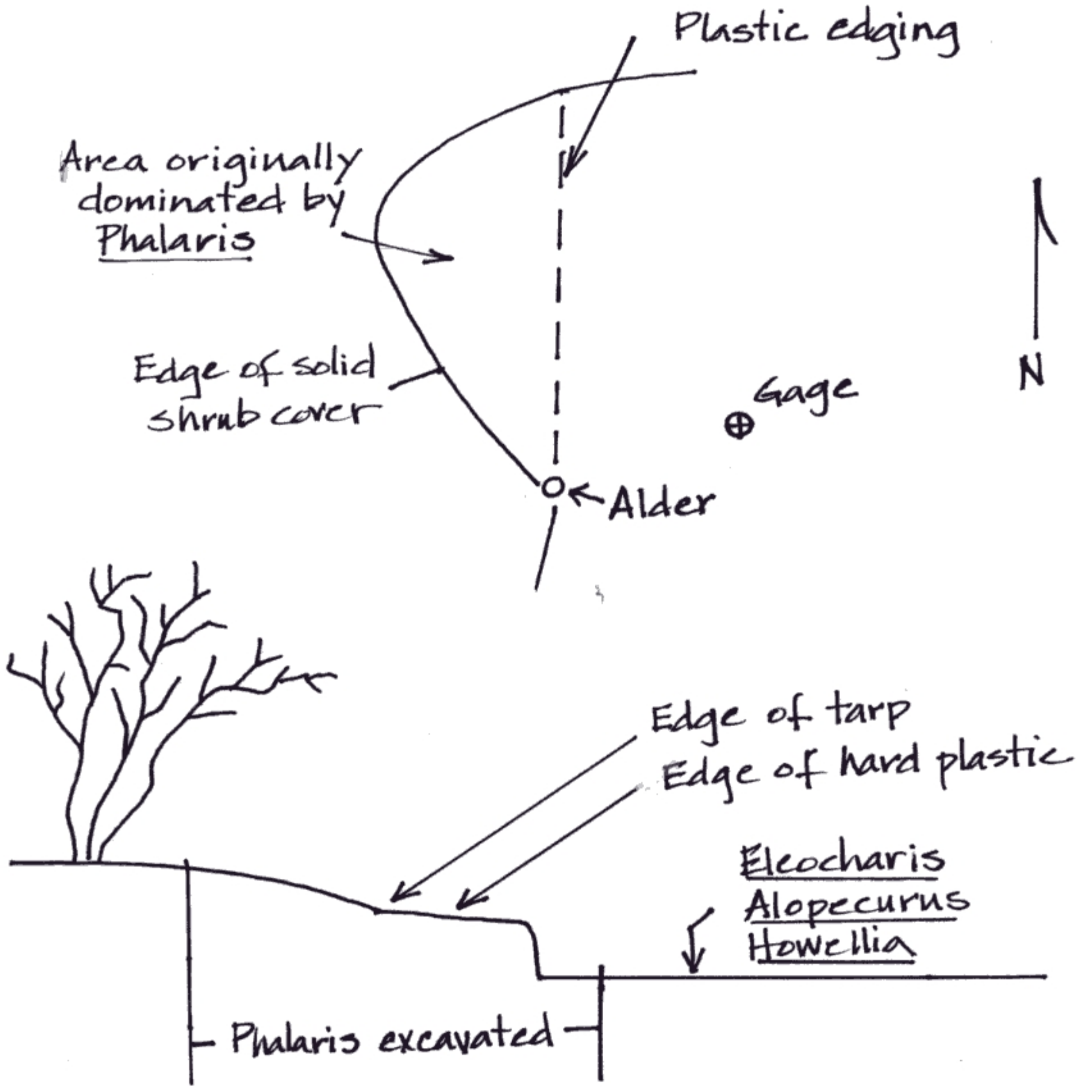

Figure 2. Reed canarygrass control work along the west edge of pond 3.

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