

**Techniques from TNC Stewards for the eradication of  
*Lythrum salicaria* (purple loosestrife) and *Phragmites australis*  
(common reed/Phrag) in wetlands**

Edited by Mandy Tu  
Wildland Invasive Species Program  
The Nature Conservancy  
Dept. of Vegetable Crops & Weed Sciences  
University of California at Davis

This past summer (2000), Betsy Lyman, the Assistant Director of Science & Stewardship for TNC's Pennsylvania Field Office, sent out a call in both Stew News (an in-house TNC publication) and on TNC's Invasive Species Listserve requesting control information for *Lythrum salicaria* and *Phragmites australis*. There was a large response to these questions, and we gathered this information, and lightly edited it. If you have either of these weeds on your preserve, you may benefit from reading about others' control experiences.

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## I. Betsy's original inquiry and questions

### Many *Lythrum salicaria* questions (Pennsylvania)

Pennsylvania has a fen complex which contains federally and state-listed plants and reptiles. We have both *Phragmites australis* and *Lythrum salicaria* (purple loosestrife) in several of these fens. We have used groups of volunteers to cut the offending plants (for *Phragmites*, we cut in mid-June and mid-September; for loosestrife, we cut in late July/early August when it is blooming). However, the US FWS does not like the idea of hordes of volunteers trampling through the fens, since they could easily harm the nests of the endangered turtle. So we are looking into using herbicides—i.e. Rodeo (glyphosate).

- 1) Are there any studies on the effects of glyphosate applications on turtles?
- 2) What methods (manual, herbicides, etc.) have you used that were effective in controlling the weeds, but which have not negatively impacted the native vegetation? What worked best?
- 3) Have you done your control work stepwise (i.e. a little bit each year) or have you done the herbiciding all at once?
- 4) Have you followed up with any planting of native plants?

### IIA. Case study: Control efforts in Indiana

We have worked with those two wicked invasive plants in fens and other wetlands. We have had great success with killing *Phragmites australis*. We use 1.5% Rodeo applied from backpack sprayers with 5 foot wand extensions. (The long wands are necessary to reach the tops of the plant). Our best results have been after late-season spraying, close to, but before, the plants senesce. In Indiana this is the first 3 weeks of September. This technique has been used in large monotypic stands (5-20 acres) where the understory is degraded (mostly *Phragmites* duff) and we have measured over 97% mortality after the first year of spraying. We then burn the duff the next spring to make follow up easier and to allow the native seed bank to germinate.

In areas where the *Phragmites* is occasional and intermingled with the natives, we use our best discretion - either carefully spray small stands or hand-cut the stems and drip 25% Rodeo into the stump. Hand-cutting is very time consuming if the stands are really big and is less effective (50-75% mortality), but there is no overspray. We have found that workdays with a lot of hands makes it less tedious and more practical to achieve results. If you decide to spray, which is much more time efficient, the sprayer should be experienced, and overspray can be controlled pretty well.

We have been less successful with purple loosestrife (*Lythrum salicaria*). My opinion is that hand-cutting and pulling are a complete waste of time and lead to great frustration. Foliar spray with 1.5-3.0% Rodeo is our current technique. In two years of intensive work, we have pushed purple loosestrife from a dominant plant to an occasional plant, but eradication is still many years away. This is due to the incredible seed bank. These plants are tough and sometime require a second application of herbicide to kill them. We generally patrol a site three times in the summer as they do not all flower at the same time. So, we spray once in early July, early August, and early September. (the two loosestrife eating insects are also an option. I am personally opposed to introducing another exotic organism to our systems, but many in TNC think it is the only option. I can send you a contact if you like).

In general, I have found fens to be tricky places to use herbicide - especially foliar application. Grasses and sedges are particularly sensitive and you can get large brown-outs if you are not careful. As I said above, dense stands of *Phragmites* are better targets for foliar spray as the overspray is less important. If the *Phragmites* is intermingled with native species, and you can get the help, hand-cutting may be the way to go. I think you have to bite the bullet with purple loosestrife and accept a small amount of overspray in order to control it. We have found that oversprayed areas are re-colonized by natives pretty quickly. As a colleague always reminds me, doing nothing is a management strategy also - in the case of purple loosestrife means the end of your natural area - and this may be the most important thing you can impress on folks.

I have tried to locate info on herbicides and turtles with no luck. A couple of ideas that you may have already thought of : (1) does FWS know where the preferred nesting grounds are? These are often the high and dry parts of the fen complex and can be avoided, (2) These species are usually in low densities, so your chance of spraying individuals directly is very low, (3) I have yet to encounter a turtle in a stand of *Phragmites* - it is too difficult to get into.

Chip O'Leary  
Restoration Coordinator, TNC – Indiana Chapter

## **IIB. Case study: Control efforts in Indiana**

Here in Indiana, I manage several fens with invasive plant problems. I have never read anything that said glyphosate was bad for turtles. The story is that the surfactant used in RoundUp (glyphosate) is bad for amphibians and other wetland animals, so that is why Rodeo (glyphosate) is used, which is basically RoundUp without the surfactant.

We have been spraying *Phragmites australis* in the early fall, September through October, when the seed head is fully emerged, with Rodeo at recommended rates with a solo backpack sprayer with a 5-foot wand. If you spray the top leaves of the plant they die really easily within a few weeks and then one moderate follow-up treatment is needed the next year. If you are careful, you rarely get any herbicide on other plants. We treated areas up to 5-6 acres in size and have had great success. The next year native plants

come back from the seed bank under the mat of dead vegetation. A follow-up prescribed burn can also help to remove the large mat of dead *Phragmites*.

Sometimes for *Phragmites*, we cut the plant a few inches above the ground and drip herbicide into the cut stem at about 25%, and that has about 50% success, and this is helpful in areas you do not want to overspray or are sensitive. I think herbicide is the best control method for *Phragmites*. It works well and overspray can easily be minimized in thick stands.

For purple loosestrife (*Lythrum salicaria*) we have been spraying in a similar way when the flowers appear on the plant. Herbiciding is done frequently throughout the late summer and early fall, especially on flowering plants. It will take several years of spraying to make a real impact on the site. If you are careful and use an adjustable spray nozzle you can really minimize overspray. It is tough when you see some browning around the area of natives, but just remember they are generally tougher than exotics, and will come back soon! You can also replant the area with native plugs and that helps out a lot. Loosestrife is tough and there is generally some overspray, but native plants quickly come back. It has a large seedbank and takes many years to deplete. I would not replant a loosestrife area with natives for awhile, since the seedbank can take several year to deplete.

Some DNR people in Indiana have released the beetle that eats loosestrife, and have seen pretty good success so far. The beetle may help deplete the seed bank quicker than herbiciding. Our herbicide work on TNC property for loosestrife is coming along really well after only two years of spraying.

Mike Norris, Restoration Specialist, Southern Lake Michigan Rim Project

## **IIC. Case study: Control efforts in New Jersey**

### **What methods have you used that have been effective in controlling the weeds, but don't negatively impact the native vegetation?**

In northern New Jersey, we have used cut-stem treatment to control both *Phragmites* and purple loosestrife at several wetland sites. We have found that injecting the cut stems of *Phragmites* with Rodeo (50%) after the tassel stage (mid-September-October) is very effective. We thought of removing flowering spikes from the site but since staff was limited, we did not follow through with this idea. Later we learned that seeds are often not viable and germination and successful seedling establishment is rare, so we thought it was not worthwhile to remove the flowers.

The cut-stem treatment appears to have killed most of the underground root system because there has been little to no re-sprouting 2 years after control. While this method results in minimal off-target damage, it is **very** labor intensive. It will take us three years to treat several small infestations of *Phragmites* on one of our preserves using both volunteers and 4 full-time staff. This method is probably not worthwhile for people who have large infestations.

This year we also began controlling purple loosestrife in an emergent marsh using cut-stem treatment. Stems were cut near the base and Rodeo (30%) was squirted onto cut stems when plants began flowering (July-August). Herbicide was applied only to stems of target plants, thereby reducing exposure to other species. Cut plant material was bagged and removed from the site. Since control was initiated this year, we do not have information about the effectiveness of this method yet.

**What is the most effective means of controlling the weeds (manual, pesticide, combination)?**

We have found a combination of manual removal (i.e. cutting) followed by pesticide application to be most effective. See answer to #2.

**If you're herbiciding, have you done your treatments stepwise or have you done the herbiciding all at once? It would be useful to hear how large the areas are that you are treating.**

Whenever possible we have treated the entire infestation at once. In situations where we don't have enough time or staff to treat the whole area we have been working on patches of the infestation in a stepwise manner.

The *Phragmites* infestations vary in size. We have treated small patches with only several dozen stems to patches 50 X 25 m. This fall we plan to use volunteers to help us finish treating a *Phragmites* infestation that is approximately 40 X 40 m. Most of the *Phragmites* infestations are dense monocultures with only a few other native species present.

The area where we treated purple loosestrife was approximately 0.5 acres. However, this area had scattered clumps of purple loosestrife throughout (approximately 250 stems).

**Finally, have you followed up with any planting of native plants or have they filled in the blank spots left when the weeds are killed? This ties in with question #4.**

To date (1-2 years after treatment) only a handful natives have moved in where the dense *Phragmites* clones once stood. It appears that it will take sometime before natives fully repopulate the area.

Melissa Morris, Science and Stewardship Assistant, TNC-New Jersey

**IID. Case study: Control efforts in Washington State**

I've been involved with purple loosestrife (*Lythrum salicaria*) control for about three years on some private property here in Washington State, and the most effective method we've found is winter pulling. We have not tried any herbicides, but have done summer pulls and found winter pulls to be much more effective because: 1) the area is much wetter and plants uproot more easily and completely; 2) less biomass has to be removed and disposed of; and 3) the area can be revisited the following summer for removal of root remains that have re-sprouted. Here, the wetland freezes only sporadically

during the winter, and we make a Christmas-time party out of it to get volunteers. Incidentally, we have also tried release of loosestrife-eating beetles (*Galerucella pusilla*, *G. californiensis*), for bio-control, but although I've heard good reports about them in other areas, they didn't seem to have been able to persist after the first release on our site.

### **Questions:**

**How do you uproot these monsters...just grab and pull...since all that is left in the winter are the brown dead stalks? Do you use a spade? Is there much soil disturbance with this method?**

Indeed, it's grab and pull. I've found that this is much harder in the summer, and you have to use a spade, but here the area is wet enough in winter, and there's enough of a stalk left, that a good, careful pull gets almost all of the root-ball out. The few bits that break off you can catch the next summer when they reveal themselves by re-sprouting. The grab and pull is actually quite satisfying! And since it's so wet, it's much easier to get the excess soil off. I've done this for two winters now and will never go back to summer pulls or cuts (tried cuts too and found them much less effective).

**Are the old seed heads bagged first? Or have the dead seed heads already dispersed their seeds?**

One winter, we pulled in the same place where we had earlier cut seed heads, so they were already gone. The next year (this last one), we did not deal with the seed heads separately at all. I suppose to be most thorough, this would be a good idea, but I've found the winter pull (followed by summer touch-up) so much more effective than anything else that we didn't put extra energy into bagging seed heads, reckoning we'll be monitoring this situation for many years to come and will catch seeds if they get far enough to come up. (Also, there are nearby loosestrife areas not being controlled, and they'll be producing plenty of seed we can't control)

**Is there a lot of re-sprouting the next year? Can you actually eradicate this species after a number of years?**

In two years (July 98-now) in the area where we've been doing this method, we've pretty much gotten rid of the loosestrife, although as I said I'm sure there will be a need for ongoing monitoring of stray seed- and root-sproutings. The loosestrife in this area when we started was established and rapidly-expanding, but not yet an uninterrupted mat; now it's open water, rushes and other emergents again. This is in contrast to adjacent areas where there's been some cutting of seed heads and some no-control-at-all, where the loosestrife is continuing its relentless takeover. I plan to try another beetle release in some of these other areas, where the loosestrife mat is very dense, and continue to use the winter-pull method to reduce infested areas at the edges and stop any new invasions.

**How do you keep volunteers out in the cold water? Is there any danger of hypothermia? Do you wear wetsuits (or drysuits)?**

Yes, the cold is something to consider. We were thigh-high in water, and simply made sure there were plenty of warm dry clothes and hot cocoa waiting--but it would probably be better to use wetsuits or waders. The only other factor to consider is that the bottom can be quite mucky and my boots got stuck several times before I decided to take them off. But it was only in the low-50's when we attempted the winter-pulls. It worked well to have only a few people actually that deep in the water, and several others wearing knee-boots at the edges, catching the plants the others pulled from the deep. You can make a great game of it--the root-ball makes a weighty mass at one end and the stalk is the handle--throw it javelin-style, or twirl it and let it fly in the direction of those waiting! (As you can see, we actually had fun with this, and got the loosestrife out to boot!)

Marcy Summers, The Nature Conservancy of Washington

### **IIIA. Methodology: Applications of herbicide (Michigan)**

One of our fen sites has a federally-endangered butterfly, so we have had to evaluate the impacts of herbicide and trampling. We use ACCORD, which is glyphosate and wetland approved, and half the price of RODEO. Our methods have been simplified so that volunteers can do the work without a lot of thought process.

For both loosestrife (*Lythrum salicaria*) and *Phragmites*, we use a an active mix of 5% or less (ACCORD is 41% active in concentrate and we dilute 1 part concentrate to 7 parts water). Each plant is cut and treated. Loosestrife is cut "high" (just below inflorescence) so that plant will keep growing and absorb herbicide. If cut too low, the individual "gives up" on the leader and re-sprouts from the roots. For *Phragmites* all stems are cut low (even if they appear dead) and treated. We use a

PVC applicator with sponge tip (design available from my MI office, contact Sara Ross, or off-of Intranet tools of the trade). The loosestrife is wiped up the stem and then the cut is also treated; only the cut is treated on the *Phragmites*., but more herbicide is used on *Phragmites* so that the strawlike structure absorbs the mix.

We also use this PVC applicator and ACCORD on woody plants, 14% active in mix (1:2) with great success. Our treatment is in patches and stepwise throughout growing season, but most intense when loosestrife is blooming (easier to locate), and in late July/August for *Phragmites*. To reduce trampling we try to travel through the densest patches as we treat, and have a 1 or two person team for the isolated bunches.

As for glyphosate and herps...we try to avoid dripping any mix into water, and use the wipe method since we can more carefully control the herbicide. We do not spray unless we are in solid patches, and that is on a case-by-case decision.

Jack McGowan-Stinski, Michigan Chapter, The Nature Conservancy

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We do some control with Rodeo (glyphosate) - using what we call the Bloody Glove method, which we got from Jack McGowan-Stinski at the Michigan chapter. We are not dealing with any rare herps, but we're still looking for the best strategy for controlling the loosestrife. We do the herbiciding immediately after snapping off the flower heads, but we only work in the highest quality sites where the infestations are small.

Dave Borneman, Coordinator, Ann Arbor Department of Parks and Recreation

### **The Bloody Glove technique**

We use a 5% solution of Rodeo (glyphosate; ai = 53.8%) in a spray bottle, which we add dye to. The herbicider wears chemical resistant nitrile or latex gloves on both hands covered by a fleecy, cotton glove on one of the hands. The herbicider follows behind the person removing and bagging the flower heads. Grab the loosestrife by the hand with the cotton glove and spray the herbicide into that hand (trying not to hit non-target plants). Then wick the loosestrife up the top 1/3 of the plant. As the cotton glove becomes saturated with herbicide, you can spray less often. After herbiciding, we put the cotton gloves in a plastic container and leave the lid cracked. (If you put the lid all the way on, it can become moldy.) We can usually re-use the cotton ("bloody") gloves for quite awhile. And of course you can just rinse off the nitrile or latex gloves.

The most challenging part of the herbiciding process is not getting the herbicide all over you. Sometimes it can get tricky to tell where you have herbicided and you find yourself walking through herbicide coated loosestrife. Because of this, we require our crew to wear chemical resistant Tyvek when controlling loosestrife since it can get messy. That aside, we have found this technique to be very effective.

Kristin Condict, Technician, Ann Arbor Department of Parks and Recreation

### **IIIB. Adaptive management for weed control**

I am working on a similar problem in an inland salt marsh, which has some obviously different properties from a fen. Below, see the adaptive management approach we have been using for the last 5 years, and are seriously adapting this year.

The repeated mowing had reduced the vigor of the *Phragmites* stand slightly but was adding lots of organic matter to the system, lots of trampling and really was not accomplishing what we needed it to. We are not managing purple loosestrife in the system, which is abundant but does not infiltrate the core salt marsh area. Beetles have been introduced in the area by USFWS, however, so we will see about that...

Bill Patterson, Field Representative, TNC - Central/Western New York Chapter

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## **Carncross Preserve Project Plan: Developing Capacity for Invasive Plant Monitoring and Control**

### **Project Plan**

Carncross Preserve contains a globally rare, inland salt marsh community unique in its status as the highest quality example the community type in the Montezuma Wetlands complex and New York State. Distinct in species composition and ecological function from coastal salt marsh systems, inland salt marsh communities are formed by localized underlying salt deposits. Acquisition at Carncross of 100 acres of salt marsh habitat and buffer by The Nature Conservancy (TNC) in the 1980's has protected the site from salt mining, agriculture, and hydrologic alteration. However, the viability of the site remains threatened by the presence of invasive species including purple loosestrife and phragmites. Purple loosestrife, with its low salt tolerance, represents only a mild threat to the core salt marsh area, yet the highly invasive and salt tolerant phragmites clones present at the site threaten to obliterate the salt marsh community if left unmanaged.

To address the phragmites problem at Carncross, TNC staff and volunteers began mowing the phragmites in 1995 and laid out 3 twenty-meter transects to evaluate the results. While mowing has visually reduced the vigor of phragmites, no advance or retreat of the phragmites is observed due to mowing. Monitoring of transects confirms this observation. Based on information available in The Nature Conservancy's Element Stewardship Abstracts, herbicidal control of phragmites is highly effective and can be implemented with minimal residual damage.

#### Management Objective:

Restoration and maintain the native inland salt marsh plant community at Carncross salt pond to 100% of potential area by eliminating (0% cover) invasive phragmites clones by spring 2003.

#### Monitoring Objectives:

1. Through the use of existing aerial photos and site visits, determine the extent of the potential and existing inland salt marsh community as a target for restoration.
2. Track effectiveness of herbicide applications over mud flats through the use of transects to locate the position of three representative phragmites clones.
3. In 2000 evaluate three separate methods for herbicide treatment of phragmites over native salt marsh plants while minimizing residual damage.

Note: Similar transects with photos were completed in 1995, 1996, 1997, 1998, and 1999. Data from the transect are summarized in Jim Marks' report dated November 13, 1998. Various sequences of photos from these years can be found in the Carncross files.

**1. Aerial Photos-** Aerial photos from 1999, 1989, and earlier if available to will be analyzed to map the current and potential extent of inland salt marsh

community potential habitat. Location of phragmites clones will be overlaid to show extent of invasions. Identification of boundaries will occur on the ground and be related to aerial photos by GIS digitizing if available. Inland salt marsh community will be defined as the presence of a suite of inland salt marsh community indicator species such as *Spartina sanisarodies*, *Hordeum jubatum*, *agropyron repens*, *quenapodium sp.*, *Scirpus americanus*, *Scirpus meridamus*, among others and is generally found between a lower mud flat boundary and an upper boundary defined by the salt intolerant purple loosestrife.

## 2. Phragmites Clone Transects-

- a. Three transects A, B, and C were established in 1995 according to the appended diagram.
- b. Transects consist of 10 rebar stakes 2 meters apart. Numbered 1-10 as indicated on the diagram.
- c. Transects are monitored as follows.
  - i. Extend a tape measure the length of transect- this assists visual determination of perpendicular.
  - ii. Estimate the salt marsh-ward end of the phragmites clone and mark it with a string or flexible rope.
  - iii. Measure to the nearest decimeter, the distance (perpendicular to the base line of the transect) to the string marking the end of the clone.
  - iv. Measure to the nearest decimeter the distance (perpendicular to the base line of the transect) in the opposite direction (from measurements in #3) to the edge of the mud flat where the inland salt marsh community species first intersect the tape measure. Be sure to keep tape measure perpendicular to the base line.
- d. Transect Photomonitoring
  - i. Take photos with a Kodak DC-290 digital camera at the "better" (level 2 of 4) quality setting. Zoom lens should be all the way out (widest-angle possible).
  - ii. Place a 3-meter tall range pole marked every 50cm. at the far end of the transect, the field of view should be centered horizontally on the pole. Vertically the field of view should focus low on the phragmites patch with only a small amount of sky showing above the 3-meter pole.
  - iii. One photo should be taken at each end of the 3 transects looking back down the transect.
  - iv. A panoramic photo is taken from the lone rebar located on the mud flat between the north basin and the south basin between transects A and B. Again the camera lens is zoomed all the way out (wide angle) and the first photo of the sequence is centered on a second lone rebar located North of the camera location. Tripod should be *centered* 30 degrees clockwise for each successive photo (center on 0, 30, 60, 90, 120...330). The range pole should be held at 10 meters from the lens and height of the phragmites clone at that point should be estimated on the range pole for that point and noted on the data sheet.

Notes:

- Photomonitoring and transect measurements should occur in July or early August each year before any new treatments occur.
- Time for transects and photomonitoring with two people = +/- 4 hours.

### 3. Evaluation of Herbicide Treatments

A variety of phragmites herbicide application techniques will be developed and evaluated depending on characteristics of the vegetation in the immediate area.

- a. All phragmites clones over pure mud flats will be sprayed with glyphosate in September 2000 using a back pack sprayer. Clones will be mowed in early August to allow resprouts to attain a convenient height for herbicide application (between knee and waist high). Success will be evaluated by transects described in part 2.
- b. Phragmites clones mixed with native plant communities will be controlled in 10-meter plots during year one using three experimental techniques. The most effective and time efficient techniques will be used in 2001 and 2002 to complete the restoration efforts across the entire affected area.
  - i. **Method 1-** In a subjectively selected location with only few widely spaced phragmites stems, use stakes to mark a 10x10-meter plot. Individually clip all phragmites stems within 10 m plot while simultaneously applying glyphosate concentrate with a Klip Kleen system. Count each stem clipped with a hand held counter. Monitoring will consist of counting phragmites stems within the plot same plot in August 2001. Photographs and visual estimates will be used to document the level of collateral damage to native plants. Photos should include close-ups of any collateral damage as well as before and after treatment diagonals showing plot corners. Logistical considerations and the amount of time to complete treatment of plot will be noted.
  - ii. **Method 2-** In a subjectively selected location with dense phragmites stems over native vegetation, use stakes to mark a 10x10-meter plot. Mow the entire plot in early August 2000. Broadcast spray resprouts with a backpack sprayer before phragmites senesce in 2000. Photomonitor as in method 1, stem counts will not apply.
  - iii. **Method 3-** In a subjectively selected location with dense phragmites stems over native vegetation, use stakes to mark a 10x10-meter plot. Mow the entire plot in early August 2000. Use a wet glove or cloth herbicide application method to treat all individual phragmites stems and monitor as in method 2.

During summer 2001, the most efficient (least time and least residual kill compromise) will be used to eradicate phragmites from the potential inland salt community area.

### IV. Suggested references

**Melissa Morris (New Jersey Chapter Office) suggests these references on the effect (or lack thereof) of glyphosate or other herbicides on**

### **herptiles, specifically turtles:**

Brooks, J.J., A. S. Johnson, and K.V. Miller. 1993. Effects of chemical site preparation on wildlife habitat and plant species diversity in the Georgia Sandhills. Pp. 605-612 in J.C. Brissette, ed. Proceedings of the Seventh Biennial Southern Silviculture Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SO-93.

Cole, E.C., W.C. McComb, M. Newton, C.L. Chambers, and J.P. Leeming. 1995. Responses of small mammal and amphibian capture rates to clear cutting, burning and glyphosate application in the Oregon range. Pp. 155-157 in R.E. Gaskin and J.A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

Howell, D., Miller, K., Bush, P. and J. Taylor. 1996. Herbicides and Wildlife Habitat (1954-1996): An Annotated Bibliography on the Effects of Herbicides on Wildlife Habitat and Their Uses in Habitat Management. USDA Forest Service. Technical Publication R8-TP 13 (revised).

### **Further reference suggestions:**

I don't have experience using herbicides in fens, but I have seen some literature on the residence time of some of the herbicides and the residues they break down to in the soil. Some can last a fairly long time, despite the manufacturer's claims. There is also some evidence that plants translocate the stuff down to their roots, making treating cut-stems a problem.

My recollection was that most of the fens were in pretty good shape with isolated areas of invasives. I think it might be useful, if you haven't done it already, to monitor bog turtle movement and nesting using radio tracking and other means. Also, I think your idea of treating in stages, while not optimal, may be a good compromise.

I would think if the volunteers were careful, trampling shouldn't be a problem if you have some idea where nesting is occurring. Nesting at one site, as I recall, was in a rather small area, though maybe your studies have shown otherwise since then. So, if that's true at your site, you could treat other areas outside of the nesting areas. Anyway, check out the literature on residence time of these chemicals.

Michael S. Batcher, M.S., A.I.C.P., Consulting Ecologist and Environmental Planner

### **V. Contact Information**

Michael S. Batcher, M.S., A.I.C.P.  
Consulting Ecologist and Environmental Planner  
1907 Buskirk-West Hoosick Rd.  
Buskirk, NY 12028  
Ph: (518) 686-5868; FAX: (518) 686-1802; E-mail: mbatcher@netheaven.com

Dave Borneman, Coordinator  
Natural Area Preservation Division  
Ann Arbor Department of Parks and Recreation  
1831 Traver Rd.  
Ann Arbor, MI 48105  
Ph: (734) 994-4834; FAX: (734) 997-1072;  
E-mail: [dborneman@ci.ann-arbor.mi.us](mailto:dborneman@ci.ann-arbor.mi.us)

Kristin Condict, Technician  
Natural Area Preservation Division  
Ann Arbor Department of Parks and Recreation  
Ph: (734) 996-3266; FAX: (734) 997-1072

Betsy Lyman, Assistant Director of Science & Stewardship  
The Nature Conservancy – Pennsylvania Field Office  
Lee Park, 1100 East Hector St., Suite 470  
Conshohocken, PA 19428  
Ph: (610) 834-1323 ext. 103; FAX: (610) 834-6533; E-mail: [blyman@tnc.org](mailto:blyman@tnc.org)

Jack McGowan-Stinski  
The Nature Conservancy – Michigan Chapter  
2840 East Grand River Ave., Suite 5  
East Lansing, MI 48823  
Ph: (517) 332-1741; FAX: (517) 332-8382; E-mail: [jmcgowan-st@tnc.org](mailto:jmcgowan-st@tnc.org)

Melissa Morris, Science and Stewardship Assistant  
The Nature Conservancy – New Jersey Chapter Office  
Ph: (908) 879-7262; FAX: (908) 879-2172; E-mail: [mmorris@tnc.org](mailto:mmorris@tnc.org)

Mike Norris, Restoration Specialist  
Southern Lake Michigan Rim Project  
Ph: (219) 473-4312

Chip O'Leary, Restoration Coordinator  
The Nature Conservancy – Indiana Chapter  
2400 New York Ave.  
Whiting, IN 46394  
Ph: (219) 473-4312; E-mail: [c'oleary@tnc.org](mailto:c'oleary@tnc.org) or [olearych@aol.com](mailto:olearych@aol.com)

Bill Patterson, Field Representative  
The Nature Conservancy – Central/Western New York Chapter  
Ph: (716) 546-8030 ext. 24

Marcy Summers  
The Nature Conservancy of Washington  
217 Pine St., Suite 1100  
Seattle, WA 98101  
Ph: (206) 343-4344 ext. 323; FAX: (206) 343-5608; E-mail: [msummers@tnc.org](mailto:msummers@tnc.org)