QAPP Quality Assurance Project Plan

CONTROLLING THE SPREAD OF SWALLOW-WORT

The Nature Conservancy
State University of New York-College of Environmental Science and Forestry
Environmental Protection Agency

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A3 - DISTRIBUTION LIST

The following are to receive copies of QAPP and any subsequent revisions of this portion of the project:

EPA: Louis Blume, QA Manager
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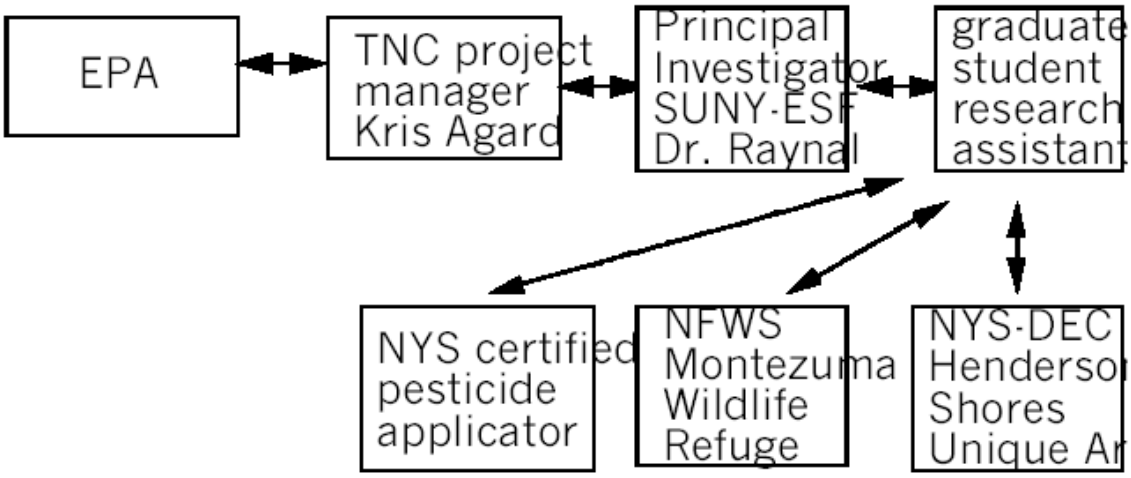
Wildlife Refuge

A4 - PROJECT/TASK ORGANIZATION

This project, Controlling the Spread of Swallow-wort, is one of a larger, three part project, Restoration of Habitats and Natural Processes on the Great Lakes Plain of New York State, Assistance ID# GL985591-01-0, to be executed under the auspices of The Nature Conservancy (TNC). Research is subcontracted to the State University of New York at the College of Environmental Science and Forestry (ESF). Kris Agard is Director of Science and Stewardship at TNC and will be project manager. Dr. Dudley Raynal, Distinguished Teaching Professor, is the Principal Investigator Technical Representative for ESF. He will be providing professional oversight for the work of the graduate research assistant. Frances Lawlor, graduate research assistant will be doing the field work, statistical analysis and preparing reports to the funding agency and project principals. Quality Assurance will be managed by Dr. Dudley Raynal for ESF and TNC.

The following organizational chart shows the relationships and the lines of communication among all project participants. Project design, field work and reports will be generated by the graduate research assistant. All work will be reviewed by the Principal Investigator before being sent on to TNC and EPA. Study location management will also receive reviewed reports.

Figure 1. Relationships and lines of communication among cooperators.



A5 - PROBLEM DEFINITION/BACKGROUND

Swallow-wort (Cynanchum rossicum) is an exotic herbaceous twining perennial herb found on calcareous soils in the northeastern U.S. and adjacent Canada. A member of the milkweed family, the species, introduced from Europe more than a century ago, exhibits highly invasive characteristics and is capable of displacing native species over extensive areas. The species is expanding through much of the Great Lakes area.

Capable of forming dense monocultures, swallow-wort grows well under a wide range of light conditions on limestone derived soils. It occurs beneath forest canopy, in thickets and in many open habitats. It produces copious amounts of wind-dispersed seeds, making control difficult once populations become established.

While the distribution and life history characteristics of swallow-wort have been investigated (Sheeley 1992, Sheeley and Raynal 1996), effective control methods have not been developed. Preliminary control experiments at one of The Nature Conservancy's preserves have shown that both hand pulling and herbicide application alone are ineffective. Cleared areas are quickly reinvaded by swallow-wort or other invasive weeds, including garlic mustard (Allliaria petiolata) and buckthorn (Rhamnus cathartica). It is likely that effective control measures will require both herbicide treatment and the planting of desirable native plants.

We need to know which herbicide treatments are most effective in controlling swallow-wort. We also need to obtain information on effective restoration techniques that will encourage establishment of native species after swallow-wort is removed.

Swallow-wort has invaded roadsides, state parks and wildlife management areas, federal lands such as the Montezuma Wildlife Refuge as well as state and private lands in

central New York. The plant has invaded significant habitats such as Great Gully in Cayuga county, Rush Oak Openings in Monroe County, and the alvar communities in Jefferson County. Further it threatens sites in Onondaga County that support state and federally protected plant species. Land managers require information about effective control of swallow-wort and control technique details. Knowledge of swallow-wort control is essential to provide a basis for maintaining ecological integrity in central New York and throughout the Great Lakes Basin where swallow-wort is spreading.

A6 - PROJECT/TASK DESCRIPTION

In order to standardize herbicidal application, two herbicides will be tested for effectiveness in controlling swallow-wort under three different light conditions, i.e., under forest canopy (70% to 100% canopy cover), edge (30% to 70% canopy cover), and full sun (0 to 30% canopy cover). Glyphosate, in three concentrations of Roundup (2.5%, and5% and a 50% cut stem application), and triclopyr, in two concentrations of Garlon 4 (25% cut stem application and 1% foliar spray) will be tested. Glyphosate is a broad spectrum herbicide, whereas triclopyr is limited to killing broadleaf plants. Treated plots will be subdivided and seeded with one of three nurse crop species to test establishment of a cover crop for the prevention of re-establishment of swallow-wort. A baseline survey of site and plot characteristics including vegetation presence and percent cover, percent swallow-wort cover, density, soil type, light exposure, aspect, slope, topographic position, moisture regime, and disturbance history will be made. Changes in vegetation coverage will be monitored throughout the project. The cover crop establishment will be measured for percent coverage at the end of each growing season.

Field activities will be conducted in accordance with state, local, OSHA requirements, and industry guidelines for environmental and health safety and operator training. Herbicides will be U.S. EPA registered. All waste and hazardous waste materials, containers, and equipment associated with pesticides or herbicides will be treated or disposed of in an environmentally sound manner at approved facilities consistent with federal and state law and regulations and local ordinances.

Personnel trained in plant identification and field sampling techniques, as well as being certified in pesticide application, will be required.

Assessment of field work will be provided by the graduate research assistant's steering committee, including Dr. Dudley Raynal, Kris Agard, and Dr. Don Leopold, also of SUNY-ESF and on the Board of Directors for TNC, Central and Weatern New York Chapter. Herbicide application technical oversight will be provided by George Spak, N.Y.S. certified pesticide applicator.

The work will be performed according to the following schedule:

A. Develop research program
1. Select 3 potential research locations 9/97

2. Identify plants for use in restoration	9/97
3. Collect/obtain seeds of restoration plants	9/97-10/98
4. Conduct literature review	9/97 ongoing
5. Submit QA/QC plant for EPA review and approval	180 days from contract origin

B. Implement research program

1. Initiate monitoring program	5/98
2. Initiate swallow-wort control	6/98 - 10/98
3. Implement restoration	6/98 - 10/99

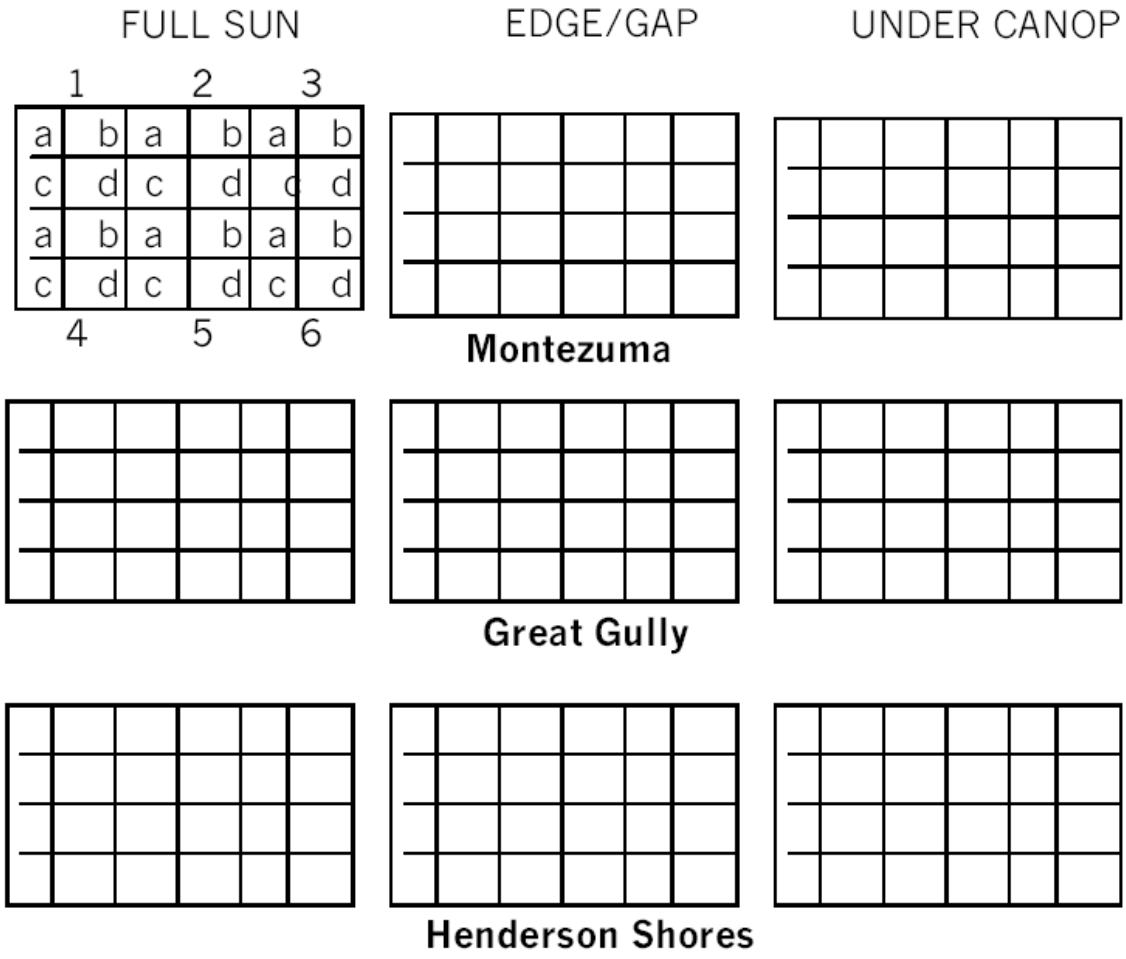
C. Analyze and report results

1. Summarize data from field season	12/98
	12/99
2. Summarize restoration techniques	12/98
	12/99
3. Complete final research results	12/99
4. Document progress in photographic slides	6/98 - 10/99
5. Prepare quarterly report	1998, 1999

A7 Quality Objectives and Criteria for Measurement Data

Three sets of study sites, one for each of the three light conditions, under forest canopy, edge/gap, and full sun, will be established at three locations, Montezuma Wildlife Refuge, Henderson Shores Unique Area, and Great Gully Preserve. Study sites will be divided into six 2m x 2m plots, each to receive a different herbicidal treatment. Plots will be further subdivided into 4 subplots, each to be seeded with a different cover crop treatment. Each location is considered a replication, providing 3 repetitions for each treatment. The following diagrams illustrate the study site design with 3 sites per location, one for each light condition:

Figure 2. Schematic diagram of study. Numbered plots are herbicidal treatments. Lettered subplots are nurse/cover crop treatments.



All study sites will be on land with public access and in management areas that will provide the least possible disruption of study plots. Plots will have at least 70% swallow-wort cover. Treatment will be assessed for effectiveness by percent cover of swallow-wort after treatment and one year after treatment. Species composition and percent of the vegetation will be surveyed before treatment, after treatment effect, at the beginning of the second field season and the end of each field season. Nurse crop establishment will be assessed at the end of September during both field seasons. Percent cover and density of establishing species will be visually estimated.

Herbicide study field data sheets (Appendix 1)--

Pre-study site characteristics will be noted including: percent canopy cover (light regime), swallow-wort population percent cover and density, woody and herbaceous species and per cent cover; physical characteristics of slope, aspect, topographic position; soil designation, texture and pH; moisture regime (mesic through xeric); evidence of herbivory or disturbance. At spray time, date, time, temperature, soil moisture, time since most recent rain, cloud cover, humidity, wind speed and direction, herbicide used,

concentration, application rate, hours until rain after spray, amount of rain within 24 hours, days until maximum apparent effect will be documented. During the herbicide effect period on siste rain guages and maximum and minimum thermometers will measure rainfall and temperature. The daily and nightly temperature and humidity, as recorded at the closest NOAA weather stations will be also be recorded. Study sites will be surveyed again after maximum herbicide effect for woody and herbaceous vegetation per cent cover changes, density of live stems of swallow-wort, percent herbicide effect on swallow-wort during the first season will be recorded. Additional vegetation survey will be done at the end of each swallow-wort growing season (early September), including any additional signs of herbivory or disturbance.

Post control restoration study field sheets (Appendix 2)--

Species seeded, rate of seeding, date seeded, date germinated, approximate percent germination, weather data as above during germination and establishment, signs of herbivory on nurse crop, percent cover of nurse crop at end of first season, on spray anniversary, at end of second season, and the per ent cover and density of swallow-wort will be recorded for each subplot.

Voucher specimens of predominant plant species will be collected and preserved in the SUNY-ESF herbarium. Pilot plots will be used to refine application techniques before use in field. Random resampling of 5 plots will be done to check for survey accuracy. Photographic slides will provide a visual record of herbicide effect.

A8 - Project Narrative

see sections A5-A7.

A9 - Special Training Requirements/Certification

Taxonomic skill and field sampling skills have been assured through successful completion of appropriate courses at SUNY-ESF. The field worker has completed the 30-hour pesticide applicator's training course and has provisional certification.

A10 - Documentation and Records

Sample Field record sheets are included in Appendix 1. Voucher plant specimens will be kept in the SUNY-ESF Herbarium. Calibration of pesticide application rate will be done according to equipment manufacturer's instructions. Pesticide concentrations will be according to manufacturer's instruction.

B1 - Sampling Process Design (Experimental Design)

Three locations have been selected for the study: Henderson Shores State Unique Area, Jefferson County, NY (longitude 76 degrees, 16', latitude 43 degrees, 51'); Great Gully Preserve, Cayuga County, NY (longitude 76 degrees, 40' , latitude 42 degrees, 48'); Montezuma National Wildlife Refuge, Seneca County,NY(longitude 76 degrees, 44', latitude 42 degrees, 58'). All locations have been selected for the presence of large populations of swallow-wort, for ease of public access and low probability of site disturbance. At each location, study plots will be established under 3 light conditions: under forest canopy (70%-100% canopy cover), forest gap or forest edge (30%-70% canopy cover), and full sun (0%-30% canopy cover). In locations with large areas of at least 70% swallow-wort cover, one study site from a selection of three sites for each light condition will be randomly established. In locations with smaller areas of dense swallow-wort cover, the study site will be established where space allows. Each of the three locations, Henderson Shores Unique Area, Great Gully and Montezuma Wildlife Refuge, provides a replication of light requirements for the herbicide and nurse crop establishment study. Once the sites are established, site characteristics will be recorded, including the following: light regime, swallow-wort percent cover, swallow-wort density, slope, aspect, topographic position, soil characteristics (texture, drainage, pH), moisture regime (mesic to xeric). Overstory and shrub layer woody vegetation will be sampled by species presence and percent cover, both total and by species. The herbaceous layer will be likewise sampled.

Six plots will be established in each study site, one for an untreated control and five for the herbicidal treatments: 2.5% glyphosate, 5% glyphosate, 50% glyphosate cut stem application, triclopyr 1% and 25% triclopyr cut stem application. Treatments will be randomly assigned to the 6 plots. Herbicides will be applied with a D.B. Smith "Field King" backpack sprayer. Recommended timing for related milkweed family species, Asclepias syriaca, is at peak flower bud stage (Cramer and Burnside 1981). Lowest second year survival of A. syriaca after glyphosate treatment is when treatment is at flower bud stage of growth (Bhowmik 1982). 2.5% concentration has been selected for trial because a study with Canada thistle, Cirsium arvense, has indicated that greater concentrations are toxic to leaf tissue and herbicide translocation is impeded (Boerboom and Wyse, 1988). Five percent glyphosate is the recommended concentration for milkweed. The cut stem applications will direct the herbicide to the exact plat desired without spray drift concern. Triclopyr is commonly used in natural areas as a broadleaf herbicide and has less soil residual problem than most broadleaf systemic herbicides. If graminoid species are unaffected by the herbicidal treatment, reestablishment of invasive plants may be slowed as the grasses are able to use resources released from uptake by the competing invasives. Triclopyr concentration will be at label recommended concentration, applied when plants are in flower.

Herbicide applications will be documented according to concentration, application method, application rate, time of day and date applied, temperature, soil moisture and cloud cover at time of application, as well as hours or days since last rainfall, hours until rain after spray, amount of rain if rain occurs within 24 hours of

spray. Also recorded will be days until maximum apparent effect is obtained, density of live stems and per cent effect of each treatment. Treatment effects to be looked for will include yellowing, mottling, distortion of leaves and stems, early senescence and any atypical symptoms as compared to the no herbicide treatment control plots. Vegetation species composition and cover changes will be measured in the shrub and herbaceous populations. The vegetation will be sampled after a 15 day burndown period and again at the end of the swallow-wort growing season, when most neighboring swallow-wort plants are showing signs of senescence, usually the end of August to beginning of September in our area.

After the herbicide treatment has had maximum apparent effect, three herbicide treatment plots will be divided, creating 4 subplots in each selected plot. These subplots will be used to study the feasibility of using a nurse crop to prevent re-establishment of invasive species and to set the stage for succession of native plants. One subplot will be used as a control for herbicidal treatment with no seeding treatment. The other subplots will be seeded with one of three graminoid nurse crop species. Treatments will be randomly assigned to the subplots. The three wild ryes, Elymus virginicus, Elymus villosus and Elymus hystrix are native to central New York and occur in all counties involved in the study (New York State Flora Association, 1990). Rather than seed all 6 herbicide treatment plots, I will only seed the label rate glyphosate plots, the triclopyr plots and the 20% glyphosate bundled and cut stem plots. This will reduce the number of seeding subplots from 216 to 108. The comparison in these subplots is seeding treatments. It will be assumed that the herbicide treatments are effective. The no herbicide treatment control plots will not be seeded, as swallow-wort has demonstrated ability to exclude successful competitors, hence its success as an invader. Date seeded, rate of seeding, date of germination, percent germination, percent cover at end of first season, percent cover at spray anniversary, and percent cover end of second year, evidence of disturbance or herbivory of nurse crop will all be documented.

The end of study summary evaluation of the combined effect of the herbicidal treatment and nurse crop treatment on swallow-wort coverage and effect on the plant community in general. Successful herbicidal treatment will show a persistent decrease in swallow-wort presence by 90% or more. Success of cover crop treatment will be assessed by ability to prevent the establishment of new swallow-wort seedlings.

The split plot design of nine study plots with 6 subplots will allow 30 degrees of freedom for the light and herbicide treatments, and 54 degrees of freedom for the light and herbicide/seeding treatment. Study uncertainties will be in quantifying percent cover, in taxonomy, and in herbicide and seed application rates. A blind recheck of plant identification and per cent cover estimates of 5 out of 54 plot surveys will be done to assure accuracy and precision. The pilot spray and seeding plots will assure proper application rates. The herbicide pilot plots will be done under the supervision of George Spak, New York State certified pesticide applicator in horticultural and forestry classes.

B2 - Sampling methods Requirements

Estimate of percent cover is subjective, but will be randomly verified. Plant identification will be according to Gleason and Cronquist (1991). The project has sufficient replication to minimize unforeseen events.

B3 - Sample Handling and Custody Requirements. N/A

B4 - Analytic Methods Requirements N/A

B5 - Quality Control Requirements

Voucher specimens, pilot plots for herbicide and seed treatments, oversight by New York State certified applicator for herbicide rate application. See section B1 for details.

B6 - B7 - B8 - N/A

B9 - Data Acquisition Requirements (Non-direct Measurements) N/A

B10 - Data Management

Sun, edge and shade study sites are levels of the whole plot factor of light in a completely randomized block design at 3 locations. Herbicide plot treatments are the subplot factor. Seeding subplot treatments are the sub-subplot factor. The split-plot further divided into a split-split-plot satisfies the need to maintain spatial control of the plots. Degrees of freedom (df) are provided as follows:

Herbicide treatment:	df
block	2
light	2
Error A	4
Herbicide	5
Herbicide x light	10
Error AB	30
TOTAL	53

Seeding treatment:	df
block	2
light	2
Error A	4
Herbicide(3 treatments)	2
Herbicide x light	4
Error AB	12
Seeding	3
Light x seeding	6
Herbicide x seeding	6
Light x herbcde x seedg	12
Error ABC	54
TOTAL	107

There is low power to detect differences in light treatment, as indicated by Error A test, but this comparison is a low priority objective. Error AB and Error ABC have large enough numbers of degrees of freedom that meaningful biological differences will be detectable. The herbicide and herbicide X light are tested by the AB error term. Seeding (establishment), light X seeding, herbicide X seeding, light X herbicide X seeding use the Error ABC term. Significance level for hypothesis testing will be 0.05. This study is a screening process to identify useful treatments. There are no critical health issues and we do not want to restrict candidate treatments by using a too small alpha level. The null hypothesis will be that all treatments are equal. The alternative hypothesis will be that at least two treatments differ. Overall, an F-test will be used against the null hypothesis. Further, Waller Duncan tests will be used against pairs of treatments. It is expected that SAS or Minitab will be used for statistical analysis of the data.

C1 - Assessments and Response Actions

The results of the first season work will be the basis for the research assistant's Master's thesis. Execution of this project will be subject to oversight by the steering committee listed on page 5 in section A6. Oversight of possible uncertainties will be as described in section B1, page 13. The quarterly and final reports will be reviewed by the TNC project manager and the SUNY-ESF principal investigator.

C2 - Reports to Management

See section A6 (C).

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