ORIGINAL

Removal of Lippia nodiflora (Mat-grass) from Vernal Pools, Jepson Prairie Preserve (Solano County)

Contract No. FG-9508

Submitted to:

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Natural Heritage Division
Department of Fish and Game

Submitted by:

The Nature Conservancy
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RESEARCH PROGRAMS

OBJECTIVE

The primary objective is to determine the most effective strategy of controlling *L. nodiflora* in areas where it may be a threat to rare and endangered species. In pursuit of this objective, three goals are:

1. Find the most effective treatment(s) for *L. nodiflora* while minimizing damage to threatened species.

2. Estimate the potential for establishment of *L. nodiflora* in habitats of rare and endangered species.

3. Determine if *L. nodiflora* will need to be controlled if it is not directly threatening State- and Federally-listed species.

EXPERIMENTAL DESIGN

A. **TREATMENTS**

1. Glyphosate (Roundup) in 1% and 2% concentrations applied in a close spray to stratified-randomly selected patches of *L. nodiflora*.

2. Glyphosate (Roundup) in 8% and 12% concentrations applied by sponge (wick-on method) to stratified-rendomly selected patches of *L. nodiflora*.

3. Scraping of patches (severing stems from shoots) by means of a hula hoe.

4. An untreated control group.

B. **TIMING OF TREATMENTS**

1. Treatment in mid-June

2. Treatment in mid-July

C. **TREATMENT BLOCKS**

Blocks were established for the two treatment times consisting of 100 randomly-chosen patches of *L. nodiflora*, for a total of 200 patches. An additional 42 patches were randomly chosen for the wick-on treatment added on in July. The patch sizes ranged less than 0.10 m to more than 3.0 m in diameter. The majority of patches were located within a band 15 meters on either side of the high-water mark in west

Olcott Lake, where *L. nodiflora* appeared to have its greatest abundance. This area includes the habitat for the Delta Green Ground Beetle. The remainder of patches were distributed throughout the lake interior, mostly near the lake "islands." Known locations of *Tuctoria mucronata* and *Neostapfia colusana* were excluded from patch selection with the exception of one control.

D. MEASUREMENTS

Measurements taken in each patch included 1) floral phase and density; 2) patch size; 3) total cover; 4) green cover (to determine top kill); 5) lake location; and 6) presence of other vegetation. Measurements will continue to be made to one year following the treatments to determine effectivness. These will include measurements of clonal regrowth, and covariates as listed above.

E. PROCEDURES

1. MECHANICAL TREATMENTS

The mechanical treatment consisted of severing the stems at the soil surface by scraping with a stirrup hoe while not removing the material from the site. 50 patches were treated this way, half in June and half in July.

2. HERBICIDAL TREATMENTS

The herbicide, glyphosate (Roundup), formulated in concentrations of 1% and 2%, was applied with a close-range backpack sprayer using a large spray tip and kept at low pressure to minimize drift. Each treatment level and time consisted of 25 randomly-selected patches for a total of 50 patches treated with the herbicide in June and 50 patches in July.

The wick-on treatment consisted of a sponged-on application of 8% and 12% concentrations of Roundup, applied to 15 patches each. A measured amount of solution was applied to each patch, based on the patch size, and covering the entire patch surface. An additional exploratory treatment was made to attempt to determine differences in the manner of sponged-on applications.

RESEARCH PROGRAMS: COMMENTS

The research is still in progress. Any new experimental treatments will not be able to be conducted until the spring or summer of 1992 after the rainy season and drying of Olcott Lake.

MANAGEMENT NEEDS

These depend upon the outcome of the research program and will be considered in detail then.

MANAGEMENT NEEDS: COMMENTS

Roundup initially appeared to be more effective earlier in the season, and prior to or during the flowering phase. The 2% solution appeared more effective than the 1% solution, based on top kill. Neither appeared to be completely effective, however, and by late October most treated patches were developing new leaves, regardless of herbicide concentration or method of application. The choice of surfactant and time of treatment are major considerations that are currently being examined. We have not excluded another herbicide or combination of treatments, although glyphosate still appears to be the superior choice.

As with the spray treatments both wick-on treatments proved ineffective by late October. The wick-on method of treatment may be easier than the spray procedure and also may be less contaminating to the soil. This may prove to be an effective alternative when winds are persistant.

Scraping of *Lippia* with a hula hoe at the ground level appears to be, in itself, largely ineffective. It may be effective against very small individuals, or in combination with other treatments. It may be the only available treatment in the *Tuctoria mucronata* areas, or where conditions prohibit herbicidal treatments. Any substantial remaining rhizomes will probably resprout, however, so digging all the roots up is preferable where possible. Digging up *Lippia* in the lake bed of Jepson Prairie will be very difficult due to the extent and location of growth. The habitat of the Delta Green Ground Beetle would be disrupted, and the procedure would be extremely intrusive to the lakebed soil structure.

Our experience indicates that eradication of *L. nodiflora* is likely to be very difficult. The species thrives in environments required by the endangered species it threatens without an obvious treatment that will guarantee its eradication. Further work on the control of garden lippia is essential.

MANAGEMENT PROCEDURES

HERBICIDAL

RESEARCH PROGRAM OUTCOME: In progress

LITERATURE:

A single postemergence application of diuron (5 kg/ha) and paraquat (2 liters/ha) was found to have good control of weeds, including amongst them *L. nodiflora* (although there is reason to believe this may be *L. lanceolata* or *L.incisa* by Munz and Keck's description, for 60 days in an arabica coffee plantation in Cuba (Cairo et al., 1985).

MECHANICAL

RESEARCH PROGRAM OUTCOME: In progress

LITERATURE:

Johnson (1973) recommended plugs or sprigs for establishment of *Lippia* as ground cover. Therefore scrapings should possibly be regarded as a source for re-establishment. After establishment, clippings are considered a vector for fungal spread (Johnson, 1973), and so this also should be considered in any mechanical control method, since increased fungal activity may also adversely affect desirable vegetation.

BIOCONTROL

LITERATURE:

L. nodiflora is listed as a host of a powdery mildew in Cuba, although it is analyzed as only having been slightly affected by the mildew. The potential of these fungi as a biological weed control is analysed (Gonzalez, 1984).

BIOLOGICAL MONITORING PROCEDURES

A 1 m^2 Daubenmire quadrat was used along permanent transects established on lake-to-upland ecotones, and open lake bed areas. Lake-to-upland transects were located near islands and the lake shoreline. A long-lake, cross-section belt transect was established using a 5 m^2 quadrat. In all transects, the quadrats were sampled continuously. In all but the cross-lake transect the procedure was to sample until no more *L. nodiflora* was encountered in the quadrat for 5 meters.

Measurements taken were: (1) cover of *Lippia*, (2) cover of all other vegetation, dead or alive, (3) "brown class" of *Lippia* (a measure of senescent or dry material, with four percentage ranges we created to aid in quickly and, hopefully, accurately estimating dead or dying material cover), (4) linear spread of *Lippia*, as measured by a 1-meter-wide line intercept of *Lippia* anywhere along the one m running width (ie., the plants didn't have to be continuous themselves...they only had to be spotted somewhere along the width held perpendicular to the running transect tape measure); gaps in continuity for less than 5cm were ignored, and a 5 meter break meant the transect run was over, and (5) number of *Lippia* flowers and presence/absence of *Lippia* seedheads and buds.

The transects were marked using 2' pieces of rebar covered on the top with a ball of duct tape to prevent injury, a duct tape flag, and permanent marker. Also used for stakes were 12"-18" redwood stakes where rebar might be considered dangerous to hikers. The rebar was preferred because they were invulnerable to sheep or other curious animals, and would not decay in water.

Lakebed markers were made as follows:

All patches and lakebed transect markers were tagged using white-coated mason jar covers, 6" steel nails, and a black china marker. All treated patches were temporarily flagged with colored plastic tape to facilitate treatments. Patches subsequently were flagged with steel wire stakes with aluminum (at ground level to enable use of a metal detector if neccessary) and plastic flagging for the duration of the inundation period to facilitate relocating them in the spring.

All points were measured (compass direction, distance, and helpful descriptions) off permanent poles, fenceposts, stakes, and so on and also placed on a map. It was helpful to measure the points off two different points, and to also describe the location.

BIOLOGICAL MONITORING PROGRAMS

ECOLOGICAL STUDY

Representative transect sites were established in Olcott Lake to run the duration of the research period. Factors used to locate the transects included presence of *L. nodiflora*, general alignment with water-inundation-period gradients in Olcott Lake, and presence of competing vegetation.

Estimating the establishment potential of *L. nodiflora*, as well as the need to control it when it is not directly

threatening rare and endangered species will be accomplished by analyzing sampling data on the rate and mode of *Lippia* dispersal.

RESEARCH NEEDS

1. A new treatment regime is in the process of being developed to meet the objective of controlling *L. nodiflora* at the Jepson Prairie Nature Conservancy Preserve.
2. Research into the role sheep may play in *Lippia* dispersal, and also in its control may be useful in determining future grazing plans at the Jepson Prairie Nature Conservancy Preserve.

RESEARCH NEEDS COMMENTS

1. As of October, 1991, it became apparent that all herbicidal treatments and mechanical treatments thus far had failed to kill the *L. nodiflora* plants (see MANAGEMENT NEEDS COMMENTS section). Extensive consultation with Monsanto will be in order to determine whether continued experimentation with glyphosate (Roundup) is best. Further consultation with weed specialists in UCD Weed Control Extension will help determine other potential avenues of control.

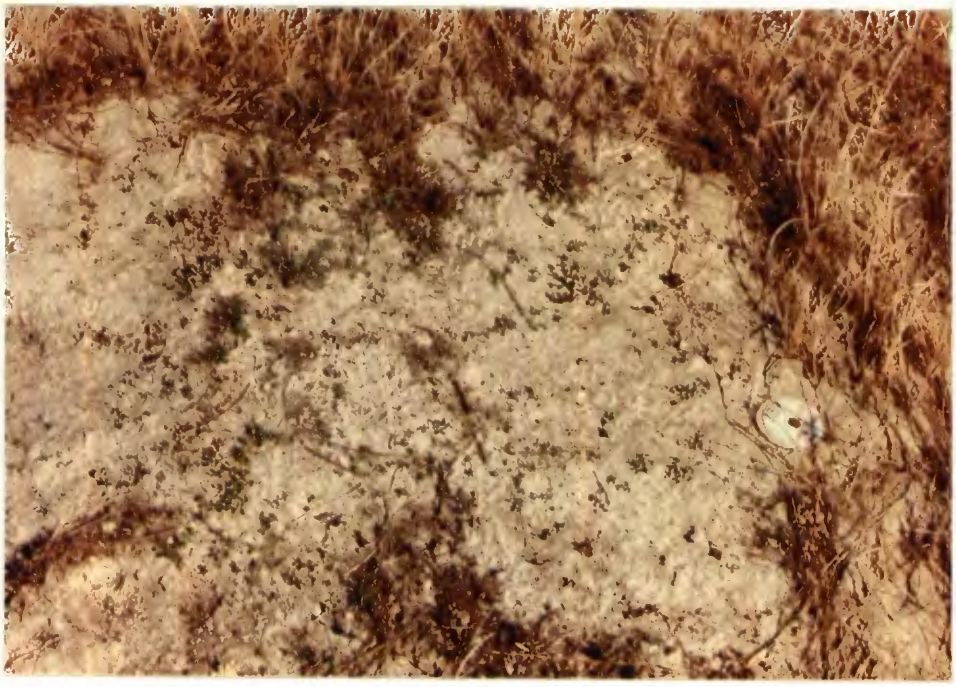
2. The northern pool east of the road has *Lippia* clones extensively throughout the entire lake bed. The southern pool east of the road has almost no *Lippia* present even though it is growing moderately well along the road adjacent to both the north and south pools. The visual differences between the pools are that the southern pool is largely devoid of intact mud flakes. These are still present in both the northern pool, and the larger west-side lake. The reason for the loss of flakes appears to be due to the trampling from sheep present only in the southern pool, and the wind, or both. The thickness of the flakes, and also the soil composition, may also be different in the different pools. Animal vectors of various kinds may also be responsible for the spread of *Lippia* seeds, transporting them by foot by walking across the plants and sticky mud during moist rainy seasons. The region also may have been flooded so thoroughly as to carry the floating seeds from the slough system to Olcott Lake. *Lippia* is not presently found in an adjacent similar large playa lake northwest of Olcott Lake.

Taking initial size measurements of a patch prior to treatment.

Using a 1m x 1m Daubenmire quadrat in transect sampling.

Mechanical treatment - scraping a patch with a hula hoe.

Mechanical treatment - immediately after scraping.



Mechanical treatment monitoring - approximately 4 months following scraping.

Spray treatment - spraying Roundup (glyphosate) solution using a backpack sprayer with a modified cone attachment.

Wick-on treatment on a lakebed patch - sponging on Roundup (glyphosate) solution.

Wick-on treatment on a patch in grasses - sponging on Roundup (glyphosate) solution.