CENTER FOR INVASIVE PLANT MANAGEMENT
FINAL REPORT 2003

Project Title: Ecological Approaches for Prevention and Management of Artichoke Thistle (*Cynara cardunculus*) Invasion by Seed

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Specific Objectives:

1) Use completed data to construct a phenological model to predict the timing of seed emergence and seedling development and validate the model over one growing season in coastal grasslands;
2) Conduct experiments on seedling mortality following burning, mulching, mechanical control, and chemical control in order to develop effective management techniques;
3) Combine ecological data from Objectives 1 and 2 to initiate practical experiments to prevent and manage artichoke thistle seedlings, which will be monitored beyond the time frame of this grant program.

Objective 1—Data from previously completed experiments on germination and phenology were combined with field temperature data to construct phenology models for artichoke thistle using the University of California/Integrated Pest Management IMPACT Degree Day Program. These models require inputs of a biofix (date to begin accumulating degree-days), daily temperature, method of calculation (in this case, single-sine method to represent daily fluctuations in temperature), low temperature threshold, and upper threshold cutoff method (i.e., how the plant responds to high temperature). The best fit models were obtained when the biofix was set to be the first day of a significant rainfall event. Numerous models were tested using a range of lower and upper temperature thresholds and the best models were chosen based on minimum variance between predicted and actual events observed in the field. Reliable models were obtained for seedling emergence, 2 leaves, and three leaves; further analysis is underway to model bolting and flowering. However, as these stages rarely occur in the first year, we will also develop models to predict development from resprouted adults using other data sets (not a part of this proposal).

Using funds from this CIPM grant, field data were collected at Crystal Cove State Park in Laguna, California, for use in validating these degree-day models. In March/April of 2002, three 50-meter transects were established on each of two hillsides with opposing eastern and western aspects. Along each transect, 10 plots were established to record phenology characteristics for

each of four life stages in artichoke thistle rosettes: newly-emerged seedlings, re-emerged juveniles, immature rosettes that have not yet flowered, and mature rosettes that have produced flowers. Emergence date, leaf number, and senescence date were recorded for seedlings, juveniles, and immature rosettes in order to determine the number of years and/or size of plant required for initial flowering. For mature rosettes, emergence date, date of first bolt, flowering date, and senescence were recorded. The first year of data established the study plants, and data recording began again at first emergence of rosettes in November 2002. Data were recorded weekly or biweekly depending on precipitation and growth activity and continued through the growing season. Using temperature data from a nearby NOAA weather station, the degree-day models were used to predict emergence and growth at Crystal Cove State Park; the field phenology data were then used to validate these models by calculating the deviation between predicted and observed days to each stage of development. Using this method, a degree-day model with a 6C low temperature threshold and 22C upper vertical cutoff predicted emergence within 5 days of actual emergence, regardless of the calendar date of emergence.

This degree-day approach is widely used to predict crop and pest development for timing management operations; it is less widely used to predict weed development. We are unaware of any applications of this approach to wildlands invasive weeds. Based on our work, this approach appears to have great potential to allow the prediction of artichoke thistle emergence and development, which would allow land managers to choose and time their control operations based on the biology of the plant rather than a calendar schedule.

Objective 2—Several experiments have been conducted on artichoke thistle seedling emergence and mortality and an experiment is currently underway at the UCR Agricultural Experiment Station to evaluate artichoke thistle resprouting response to various control methods (burning, herbicide, and clipping). A greenhouse experiment was undertaken to determine how surface conditions and planting depth affect emergence and establishment of artichoke thistle. Surface condition treatments included covering the surface with artichoke thistle thatch, *Bromus* (brome grass) spp. thatch, or no thatch (bare soil); planting depths were 0 or 1 cm. Germination percentage was greatly reduced in the bare soil treatment with seeds planted on the soil surface. Regardless of planting depth, both thatch treatments resulted in extension of artichoke thistle shoot apices above the soil line, while buried seeds with no thatch covering had shoot apices below soil. These results suggest that disturbing or burning thatch could provide seedling control by promoting germination to exhaust the seed bank and elevating the shoot apex, leaving it exposed and vulnerable to removal.

Objective 3—Experiments under this objective will not begin until the modeling and control experiments are completed. We anticipate initiating this research with our collaborators at Crystal Cover State Park during 2003-04.

Publications—Abstracts arising from this project:

White, V. A. and J. S. Holt. 2003. Approaches for assessing the invasive threat of *Cynara cardunculus* in California grasslands. Western Soc. Weed Sci. Abstr., Ann. Meeting, p. 89.

White, V. A. and J. S. Holt. 2003. Prediction of *Cynara cardunculus* seedling development using a degree-day approach. Proc. Calif. Exotic Pest Plant Council, Annual Symposium, Vol. 7, In press.