

Tahoe Yellow Cress (*Rorippa subumbellata*)

2001 Annual Survey Report

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Technical Advisory Group
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Tahoe Yellow Cress 2001 Annual Survey Report

INTRODUCTION.....	1
2001 FIELD SURVEYS	2
Methods	2
Results and Discussion	3
Conclusion.....	5
2001 ACTIVITIES BY AGENCY	5
<i>California Department of Fish and Game</i>	6
<i>California Department of Parks and Recreation</i>	6
<i>California State Lands Commission</i>	6
<i>California Tahoe Conservancy (CTC)</i>	6
<i>Nevada Natural Heritage Program</i>	7
<i>Tahoe Regional Planning Agency</i>	7
<i>United States Fish and Wildlife Service</i>	7
<i>United States Forest Service</i>	8

Appendix A - Archival and Annual Survey Sheets

Appendix B - Tahoe Yellow Cress Annual Survey Assessment (1979 to 2001)

Appendix C - Qualitative Description of Known Tahoe Yellow Cress Sites (1998 to 2001)

Tahoe Yellow Cress 2001 Annual Survey Report

INTRODUCTION

Tahoe yellow cress (TYC) (*Rorippa subumbellata* Roll.) is a rare plant species endemic to the shores of Lake Tahoe in California and Nevada. It was listed as endangered by the State of California in 1982 (California Fish and Game Code 2050 *et seq.*) and is considered endangered (List 1B) throughout its range by the California Native Plant Society (Skinner and Pavlik, eds. 1994). TYC is state-listed as critically endangered in Nevada (Nevada Revised Statutes (NRS) 527.260 *et seq.*), and is considered threatened by the Northern Nevada Native Plant Society (Nevada Natural Heritage Program (NNHP 2001).

In 1980, the U.S. Fish and Wildlife Service (USFWS) identified TYC as a category 1 candidate species for listing under the Endangered Species Act of 1973, as amended (ESA), indicating sufficient information on biological vulnerability and threats were available to support a listing proposal (45 FR 82479). During a 1994-1995 periodic review, the USFWS assessed the need to propose TYC for listing as a threatened or endangered species. During that same period, a regional drought resulted in a significant drop in lake elevations. The lower lake elevations exposed large expanses of contiguous potentially suitable habitat for TYC. The species responded by colonizing many of these areas. As a result of the species' response to low lake elevations, as well as changes to the USFWS' method of categorizing species, TYC was downgraded from category 1 candidate status to a species of concern in 1996 (61 Federal Register 7595).

The drought ended in the mid-1990s and lake elevations began to rise, inundating most established TYC occurrences and its shoreline habitat. Prolonged periods of inundation coupled with increased recreation in the shorezone prompted the USFWS to again review the status of the species. In 1999, TYC was again added to the candidate list (64 FR 57533). Surveys conducted in September 2000 documented 14 occupied sites, down from a high of 35 sites in 1993 and 51 known historic sites. Based on those surveys, it was determined that TYC occupied only 33 percent of the known, historic sites (see Attachment A of Appendix B). Evidence suggests the decline in the number of sites occupied by TYC is due to a variety of causes, including the combined effects of sustained high lake elevations and increased human use of lakeshore habitats. Because of the imminent threats facing the species, a task force was formed to develop and implement a conservation strategy (CS) and memorandum of understanding (MOU) for TYC (Pavlik et al. 2002).

This report, as required by the CS, describes the status of TYC in 2001. It includes a summary of the number of populations identified and individuals estimated during the annual field survey. It also summarizes conservation activities undertaken by each agency, staff time spent during 2001, and future conservation activities anticipated for 2002. Appendix B offers an overall assessment of the surveys conducted between 1979 and 2002, and Appendix C gives a qualitative description of the known TYC sites.

2001 FIELD SURVEYS

Methods

Various surveys and studies of TYC have been carried out on the beaches around Lake Tahoe since 1979. Many historic locations of TYC have been well documented, providing long-term presence/absence data for the region (Baad 1978, 1979; Knapp 1979, 1980; Reed 1982; Ferreira 1987, 1988). However, inconsistencies in sampling methods over the years (non-consecutive survey years, incomplete surveys, and differing methodology) have made direct comparisons of data difficult.

As part of the CS, an effective survey/monitoring protocol was developed and implemented this year that includes a census of known populations and systematic searches of unoccupied but potentially suitable habitat areas. The protocol was designed to expand on previous efforts through the collection of data on habitat variables that will assist in explaining the distribution and abundance of TYC. The protocol includes the use of archival and annual survey sheets (Appendix A). The archival data sheet is designed to record important biotic and abiotic environmental components that are unlikely to vary significantly in the future. The annual data sheet is used to collect information on population census and other dynamic habitat variables.

The 2001-lakewide surveys for TYC were conducted September 3 through September 7 and October 25, 2001. Participants included: Maurya Falkner, Sarah York, and Eric Gillies of the California State Lands Commission (CSLC); Jerry Dion of the Tahoe Regional Planning Agency (TRPA); Jody Fraser of the USFWS; Daniel Burmester of the California Department of Fish and Game (CDFG); Gail Durham of the U.S. Forest Service (USFS); and Alison Stanton of BMP Ecosciences. TRPA contributed sub-metric Global Positioning System (GPS) equipment and CSLC, CDFG and USFS contributed various hand-held GPS equipment. GPS information was provided to TRPA for download and map creation. Finally, BMP Ecosciences led a seed collection effort of TYC at most occupied sites around the lake.

Teams ranging from one to nine individuals surveyed each site, covering the entire width of the beach, from water's edge to the backshore habitat. Physical (slope, aspect, substrate type, and soil moisture), biological (species composition and cover), and land use (type and percent disturbance) attributes were collected at each site. Search effort was also recorded for each site, which is defined as the number of person minutes spent actively searching for and/or collecting data on TYC. Data were recorded on the archival and annual survey sheets. Additional species-specific information including, but not limited to, life stage, rosette diameter, and distance to water was collected at sites supporting TYC. High-resolution GPS measurements were collected at most of the sites, delineating population extent and habitat occupancy. Finally, seeds were collected from several locations for use in propagation and outplanting research beginning in 2002. Outplanting experiments are expected to begin in 2003 following a year's growth in the nurseries.

Results and Discussion

The geographic boundaries of most of the sites were delineated using GPS technology. Site boundaries, in general, are determined by either natural features (river mouths or changes in substrate) or anthropogenic features (jetties, fences, or land ownership) that restrict the surveyor's lateral movement along the lakeshore.

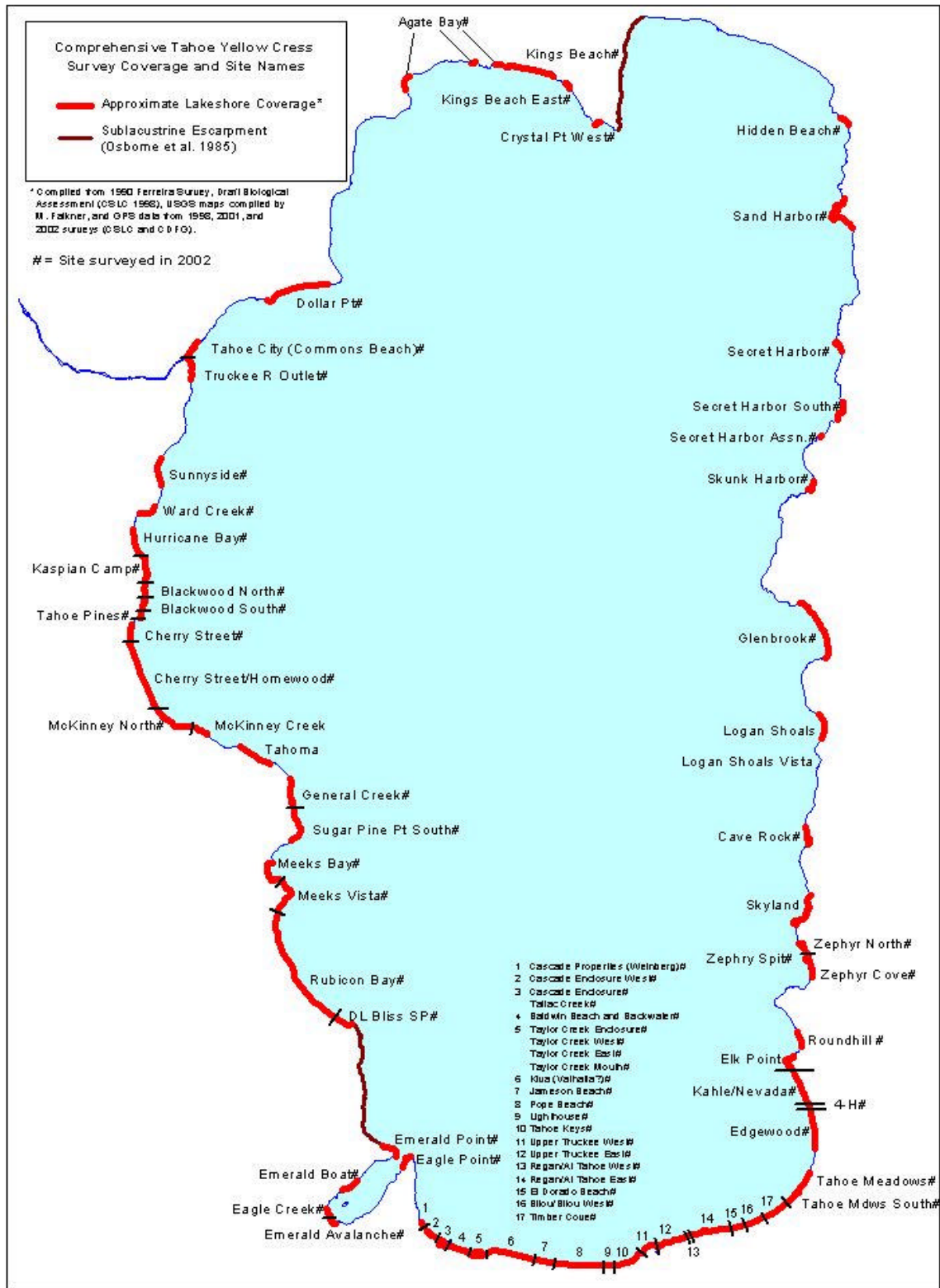
Lake elevations ranged between 6,224.97 and 6,225.07 feet (ft) during the survey period. This is the lowest recorded lake elevation since 1994. As a result of this and the increased survey effort, all but five of the historic sites identified in the CS were searched in 2001. Four of the five sites not surveyed are located on private property where access was denied.

Previous survey efforts have focused on sites where TYC has been observed in the past. A goal of the 2001 survey effort was to intensively survey as much of the shoreline as possible. Figure 1 provides a comprehensive map of the shoreline coverage and site names. Surveyors spent a total of 3,625 person minutes during the survey (Table 2), which amounts to approximately 60 person hours. Because the core sites typically support the highest number of plants, these areas required more survey time (1,590 person minutes).

The intensive 2001 survey identified TYC at 31 of 58 sites surveys (53 percent occupied), up from 14 sites (33 percent occupied) in 2000. Eleven of the sites (i.e., Kaspian Camp, Emerald Bay sites, Pope Beach, Regan/Al Tahoe) are located in areas that were inundated during annual surveys dating back to 1997 (Falkner, CSLC, pers. comm.). These sites are described as "low water island populations" in the CS: As lake elevation drops, the amount of available habitat and the likelihood of colonization by TYC increases (see Figure 2 and Figures 1 and 2 of Appendix B).

This year's effort also included surveys of 14 "new" named sites. Seven of the "new" sites supported TYC. The other seven sites are considered potentially suitable habitat, though substrate type and disturbance varied among them. It is important to note that although the 14 "new" sites have not been identified in past reports, these sites were likely included in the 1993 intensive shorezone survey conducted by TRPA. Table 2 provides the survey results by ranking priority as defined in the CS as core, high, medium, low, and unranked sites. Additionally, the implementation of CSLC's "TYC Project Review Guidelines" required staff to conduct site-specific surveys of 23 private properties. While most of the sites support potentially suitable habitat, TYC was observed on only one property. The results of those surveys are summarized in Table 3.

Figure 1. 2002 Sites



The distribution of TYC by lake quartiles was highest for the southwest and southeast sectors, with all but one population represented in these two sectors. The remaining population was located in the northwest sector. No populations were identified in the northeast sector. Four of the sites occurred in Nevada, with the remaining 27 sites located in California. Property ownership/management of the sites that support the species is almost equally divided between public and private entities.

An estimated 6,136 "individuals" were counted in 2001, up from 4,587 in 2000 (Figure 1). Individual counts per site ranged from a low of one (e.g. Kaspian Camp, Emerald Point) to a high of 3,171 (Upper Truckee East), with a calculated mean of 218 stems/site.

Seed collection was conducted at all the core sites (Blackwood North, Blackwood South, Tallac Creek, Taylor Enclosure, Upper Truckee East, Edgewood), one high priority site (Cascade Enclosure), and two medium priority sites (Lighthouse and Truckee Meadows). Seeds were collected from a total of 177 plants at these sites and sent to 3 native plant nurseries for propagation. The facilities include the Nevada Division of Forestry Washoe Valley nursery, the USFS Placerville nursery, and Sierra Valley Farms Nursery. Each nursery was asked to grow out 9 plants from each of 177 seed lots. The seed lots were individually packaged in manila envelopes and labeled. A total of up to 1,600 plants are expected to be grown.

Approximately 1,420 of these plants are expected to be ready for outplanting by April 15, 2003, with the remainder to be maintained at the nurseries until use in outplanting experiments in future years. All individuals to be used for outplanting will be hardened off in shade or lathe houses for at least 30 days prior to being transferred.

Conclusion

The low lake elevation at (6,225 ft) and intensive survey effort resulted in the greatest number of sites visited (57) and the third highest individual plant count (6,136) since surveys have been conducted for this species. Previous efforts surveyed up to 44 sites and recorded individual counts of 6,472 and 11,110 stems in 1988 and 1990, respectively (Pavlik et al. 2002).

Based on the annual survey results, TYC status is at Level 2 of the Imminent Extinction Contingency Plan, which is defined as 6 core populations and less than 15 (inclusive of the core populations) total populations (each with >30 reproductive stems) or less than 60 percent occupied (Pavlik et al. 2002). Attachment A of Appendix B provides the historic levels from previous survey years.

2001 ACTIVITIES BY AGENCY

As required by the CS, the following is a summary of staff time spent on conservation and management activities specific to TYC during 2001. Activities anticipated for 2002 are also included.

California Department of Fish and Game

CDFG staff spent approximately 240 hours on TYC management and conservation activities during 2001. Activities included, but were not limited to: Attending TYC Executive and TYC TAG coordination meetings; assisting in the development and implementation of annual survey and monitoring program; and conducting site visits to key TYC occurrences to assess proposed management activities. CDFG contributed \$5,000 to assist in the development of the CS/MOU, and staff issued a permit to BMP Ecosciences for the collection and propagation of TYC.

CDFG staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

California Department of Parks and Recreation

CDPR staff spent approximately 160 hours on TYC management and conservation activities during 2001. Activities included, but were not limited to: Attend TYC Executive and TYC TAG coordination meetings; assisting in the development and implementation of annual survey and monitoring program; and redesigning and reconstructing existing enclosures on CDPR lands. CDFG contributed \$5,000 to assist in the development of the CS/MOU.

CDPR staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

California State Lands Commission

CSLC staff spent approximately 575 hours on TYC management and conservation activities during 2001. Activities included but were not limited to: Attending TYC Executive and TYC TAG coordination meetings; organizing and participating in the annual survey effort; collecting and analyzing data and preparing the TYC Annual Survey Report; reviewing, revising, and implementing construction and access guidelines to provide more protection to TYC sites; developing and implementing "Beach Raking Guidelines" (English and Spanish versions); and developing educational and training material for various stakeholders (i.e., landscape professionals, private property owners). CSLC contributed \$6,000 to assist in the development of the CS/MOU. Finally, CSLC approved 68 leases at Lake Tahoe during 2001, 5 of which were for pier reconstruction or modifications. Thirty-eight of the lease approvals were for continued or existing uses, and the remaining 30 approvals were new leases.

Anticipated activities in 2002 include preparing the 2001 Annual Survey Report; continuing project/lease reviews that may affect TYC or its habitat; attending TYC Executive and TYC TAG meetings; participating in the 2002 annual surveys; participating in finalizing and preparing the final CS/MOU item for board approval; coordinating the stewardship program; and preparing the 2002 Annual Survey Report.

California Tahoe Conservancy (CTC)

CTC staff spent approximately 1,580 hours on management and conservation activities during 2001. Activities included, but were not limited to: Attending TYC Executive and

TYC TAG coordination meetings; designing and constructing enclosures on CTC lands; implementing beach patrols on the Upper Truckee East site to educate the public and minimize impacts to TYC and its habitat; conducting public hearings regarding conservation actions on CTC lands; developing and implementing site-specific TYC monitoring protocols for CTC sites; and coordinating the 2001 Tahoe-Baikal Institute TYC Outreach Project.

CTC staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

Nevada Natural Heritage Program

NNHP staff spent approximately 130 hours on management and conservation activities during 2001. Activities included, but were not limited to: Attending TYC Executive and TYC TAG coordination meetings; and updating range-wide TYC databases with new survey and monitoring data as received and ensuring these data are available to all interested entities.

NNHP staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

Tahoe Regional Planning Agency

TRPA staff spent approximately ____ hours on management and conservation activities during 2001. Activities included, but were not limited to: Organizing and facilitating TYC Executive and TYC TAG coordination meetings; leading the development and implementation of the CS including contributing \$____ to that process; assisting in development and implementation of annual survey and monitoring program; assisting in the development and implementation of outreach/education programs; and assisting in development of research priorities. Finally, the Board permitted 92 shorezone projects at Lake Tahoe during 2001.

TRPA staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

United States Fish and Wildlife Service

USFWS staff spent approximately 700 hours on management and conservation activities during 2001. Activities included, but were not limited to: Attending TYC Executive and TYC TAG coordination meetings; assisting in development of the CS, including editing and revising the document; assisting in the development and implementation of annual survey and monitoring program; assisting in development and implementation of outreach/education programs, including conducting public meetings; assisting in development of research priorities; and funding Forest Service for redesign and installation of fences and partial funding for ongoing activities performed by BMP Ecosciences.

Upcoming activities include funding the expanded genetics analysis (\$19,000), participating in the 2002 annual surveys, and participating in the stewardship subcommittee of the TAG. USFWS staff will also continue to participate in finalizing the CS/MOU.

United States Forest Service

USFS staff spent approximately 658 hours on management and conservation activities during 2001. Activities included, but were not limited to: Attending TYC Executive and TYC TAG coordination meetings; assisting in the development and implementation of annual survey and monitoring program; assisting in development and implementation of outreach/education programs; redesigning and reconstructing existing enclosures on USFS lands; and assisting in developing, funding, and implementing the *ex situ* seed propagation program with BMP Ecosciences.

USFS staff will continue to participate in finalizing the CS/MOU, and activities anticipated for 2002 will be commensurate with those conducted in 2001.

Table 1. 2002 Annual Survey by Named Sites

Occurrence Name	Ranking	Date	Elevation	# Stems	%Juv	% FI	% Fr	% FI/Fr	% Sen
Sunnyside	Unranked	9/6/2001	6224.98	0					
Ward Creek	High	NS							
Hurricane Bay*	Unranked	9/6/2001	6224.98	0					
Kaspian Camp	Unranked	9/6/2001	6224.98	1				100	
Blackwood North	Core	9/6/2001	6224.98	100	31	4	4	55	6
Blackwood South	Core	9/6/2001	6224.98	205	49	1	19	27	4
Tahoe Pines*	Unranked	9/6/2001	6224.98	0					
Cherry Street/Homewood	Unranked	9/6/2001	6224.98	0					
McKinney Creek/North	Unranked	9/6/2001	6224.98	0					
Tahoma	Medium	9/6/2001	6224.98	0					
General Creek*	Unranked	9/6/2001	6224.98	8	100				
Sugar Pine South*	Unranked	9/6/2001	6224.98	5	60	20	20		
Meeks Bay	High	9/6/2001	6224.98	6	1				
Meeks Vista	Unranked	9/7/2001	6224.97	0					
Rubicon	Medium	9/7/2001	6224.97	4	1				
DL Bliss	Unranked	9/6/2001	6224.98	7	29		14	14	43
Emerald Point	Medium	9/6/2001	6224.98	1	1				
Emerald Boat	Unranked	9/6/2001	6224.97	5	80			20	
Eagle Creek	High	9/7/2001	6224.97	21	33		10	38	19
Emerald Bay Avalanche	Unranked	9/7/2001	6224.97	30	80	7	3	3	7
Eagle Point	Medium	NS		0					
Cascade Prop (Weinberg)*	Unranked	9/7/2001	6224.97	20					
Cascade West*	Unranked	9/4/2001	6225.04	8	80	10	10		
Cascade Enclosure	High	9/4/2001	6225.04	182	18	6	27	42	7
Tallac Creek	Core	9/4/2001	6225.04	200	42	0	25	28	5
Baldwin Beach/Lagoon	Medium	9/4/2001	6225.04	4			1		
Taylor Enclosure	Core	9/4/2001	6225.04	882	86	3	0	10	1
Taylor West of Creek*	Unranked	9/4/2001	6225.04	44	36	27	9	27	
Taylor East of Creek*	Unranked	9/4/2001	6225.04	8	60	40			
Kiva/Valhalla	Low	9/4/2001	6225.04	0					
Jameson*	Unranked	9/7/2001	6224.97	0					
Pope	Low	9/4/2001	6225.04	4	75	25			
Lighthouse	Medium	9/6/2001	6224.98	474	36	25	4	18	17
Keys	Medium	9/6/2001	6224.98	Yes					
Upper Truckee West	Medium	9/6/2001	6224.98	453	6	19	7	12	2
Upper Truckee East	Core	9/5/2001	6225.02	3171	59	12	8	16	5
Regan/Al Tahoe	Low	9/5/2001	6225.02	25	68	4	4	20	4
El Dorado	Low	9/6/2001	6224.98	0					
Bijou*	Unranked	9/6/2001	6224.98	0					
Timber Cove	Medium	9/6/2001	6224.98	0					
Tahoe Meadows South*	Unranked	9/5/2001	6225.02	0					

Table 1. Cont.

Occurrence Name	Ranking	Date	Elevation	# Stems	%Juv	% Fl	% Fr	% Fl/Fr	% Sen
Tahoe Meadow	Medium	9/5/2001	6225.02	36	16			75	9
Edgewood	Core	9/5/2001	6225.02	178	64	8	10	4	10
4-H	Medium	9/5/2001	6225.02	44	89	4	7		
Kahle/Nevada	High	9/6/2001	6224.98	0					
Elk Point	Unranked	NS							
Round Hill	Misc	NS							
Zephyr Cove	Medium	9/5/2001	6225.02	0					
Zephyr Spit*	Unranked	9/5/2001	6225.02	4	75			25	
Skyland	Unranked	NS							
Cave Rock	Unranked	9/27/2001	6224.59	6	50	33		16	
Logan Shoals Vista	Misc	NS							
Logan Shoals	Medium	NS							
Glenbrook	High	9/3/2001	6225.07	0					
Skunk Harbor	Unranked	10/25/2001	6224.10	0					
Secret Harbor	Low	10/25/2001	6224.10	0					
Sand Harbor	Low	9/3/2001	6225.07	0					
Crystal Point East	Unranked	9/4/2001	6225.04	0					
Crystal Point West	Unranked	9/4/2001	6225.04	0					
Kings Beach East*	Unranked	9/3/2001	6225.07	0					
Kings Beach	Unranked	9/3/2001	6225.07	0					
Agate Bay	Unranked	9/3/2001	6225.07	0					
Dollar Point	Unranked	9/3/2001	6225.07	0					
Tahoe City*	Unranked	9/7/2001	6224.97	0					
Truckee R. Outlet*	Unranked	9/6/2001	6224.98	0					
TOTAL 2001 SURVEY				6136					

* Represents "NEW" sites for 2001

Key:

Occurrence Name = Sites are in order beginning at Sunnyside following counterclockwise around the Lake, Date = Date Surveyed, Elevation = Lake elevation on day of survey, # Stems = Total stem count Juv = Juvenile, Fl = flowering, Fr = Fruiting, Fl/Fr = Flowering and Fruiting, Sen = Senescent

Table 2. 2002 Annual Survey by Ranking Priority

Occurrence Name	Ranking	Date	Elevation	# Stems	% Juv	% Fl	% Fr	% Fl/Fr	% Sen	Effort (min)
Blackwood North	Core	9/6/2001	6224.98	100	31	4	4	55	6	60
Blackwood South	Core	9/6/2001	6224.98	205	49	1	19	27	4	90
Tallac Creek	Core	9/4/2001	6225.04	200	42		25	28	5	60
Taylor Enclosure	Core	9/4/2001	6225.04	882	86	3		10	1	150
Upper Truckee East	Core	9/5/2001	6225.02	3171	59	12	8	16	5	1080
Edgewood	Core	9/5/2001	6225.02	178	64	8	10	4	10	150
TOTAL CORE SITES				4736						1590
Ward Creek	High	NS								
Meeks Bay	High	9/6/2001	6224.98	6	100					40
Eagle Creek	High	9/7/2001	6224.97	21	33		10	38	19	40
Cascade Enclosure	High	9/4/2001	6225.04	182	18	6	27	42	7	90
Kahle/Nevada	High	9/6/2001	6224.98	0						15
Glenbrook	High	9/3/2001	6225.07	0						135
TOTAL HIGH SITES				209						320
Tahoma	Medium	9/6/2001	6224.98	0						20
Rubicon	Medium	9/7/2001	6224.97	4	100					15
Emerald Point	Medium	9/6/2001	6224.98	1	100					5
Eagle Point	Medium	NS								
Baldwin Beach	Medium	9/4/2001	6225.04	4			100			60
Lighthouse	Medium	9/6/2001	6224.98	474	36	25	4	18	17	90
Keys	Medium	9/6/2001	6224.98	Yes						
Upper Truckee West	Medium	9/6/2001	6224.98	453	6	19	7	12	2	225
Timber Cove	Medium	9/6/2001	6224.98	0						20
Tahoe Meadow	Medium	9/5/2001	6225.02	36	16			75	9	90
4-H	Medium	9/5/2001	6225.02	44	89	4	7			60
Zephyr Cove	Medium	9/5/2001	6225.02	0						30
Logan Shoals	Medium	NS								
TOTAL MEDIUM SITES				1016						615
Kiva/Valhalla	Low	9/4/2001	6225.04	0						20
Pope	Low	9/4/2001	6225.04	4	75	25				20
Regan/Al Tahoe	Low	9/5/2001	6225.02	25	68	4	4	20	4	60
El Dorado	Low	9/6/2001	6224.98	0						20
Secret Harbor	Low	10/25/2001	6224.1	0						15
Sand Harbor	Low	9/3/2001	6225.07	0						120
TOTAL LOW SITES				29						255
Sunnyside	Unranked	9/6/2001	6224.98	0						15
Hurricane Bay*	Unranked	9/6/2001	6224.98	0						20

Table 2. Cont.

Occurrence Name	Ranking	Date	Elevation	# Stems	% Juv	% Fl	% Fr	% Fl/Fr	% Sen	Effort (min)
Kaspian Camp	Unranked	9/6/2001	6224.98	1					100	15
Tahoe Pines*	Unranked	9/6/2001	6224.98	0						5
Cherry Street/Homewood	Unranked	9/6/2001	6224.98	0						20
McKinney Creek/North	Unranked	9/6/2001	6224.98	0						15
General Creek*	Unranked	9/6/2001	6224.98	8	100					45
Sugar Pine South*	Unranked	9/6/2001	6224.98	5	60	20	20			45
Meeks Vista	Unranked	9/7/2001	6224.97	0						20
DL Bliss	Unranked	9/6/2001	6224.98	7	29		14	14	43	10
Emerald Boat	Unranked	9/6/2001	6224.97	5	80			20		10
Emerald Bay Avalanche	Unranked	9/7/2001	6224.97	30	80	7	3	3	7	60
Cascade Prop (Weinberg)*	Unranked	9/7/2001	6224.97	20						15
Cascade West*	Unranked	9/4/2001	6225.04	8	80	10	10			20
Taylor West of Creek*	Unranked	9/4/2001	6225.04	44	36	27	9	27		150
Taylor East of Creek*	Unranked	9/4/2001	6225.04	8	60	40				80
Jameson*	Unranked	9/7/2001	6224.97	0						20
Bijou*	Unranked	9/6/2001	6224.98	0						25
Tahoe Meadows South*	Unranked	9/5/2001	6225.02	0						
Elk Point	Unranked	NS								
Zephyr Spit*	Unranked	9/5/2001	6225.02	4	75			25		30
Skyland	Unranked	NS								
Cave Rock	Unranked	9/27/2001	6224.59	6	50	33		16		10
Skunk Harbor	Unranked	10/25/2001	6224.1	0						15
Crystal Point East	Unranked	9/4/2001	6225.04	0						15
Crystal Point West	Unranked	9/4/2001	6225.04	0						15
Kings Beach East*	Unranked	9/3/2001	6225.07	0						45
Kings Beach	Unranked	9/3/2001	6225.07	0						40
Agate Bay	Unranked	9/3/2001	6225.07	0						15
Dollar Point	Unranked	9/3/2001	6225.07	0						40
Tahoe City/Commons*	Unranked	9/7/2001	6224.97	0						15
Truckee R. Outlet*	Unranked	9/6/2001	6224.98	0						15
TOTAL UNRANKED SITES				146						845

Miscellaneous Records

Round Hill	Misc	NS
Logan Shoals Vista	Misc	NS

TOTAL 2001 SURVEY

6136

3625

* Represents "NEW" sites for 2001

Key: Date = Date Surveyed, Elevation = Lake elevation on day of survey, # Stems = Total stem count

Juv = Juvenile, Fl = flowering, Fr = Fruiting, Fl/Fr = Flowering and Fruiting, Sen = Senescent

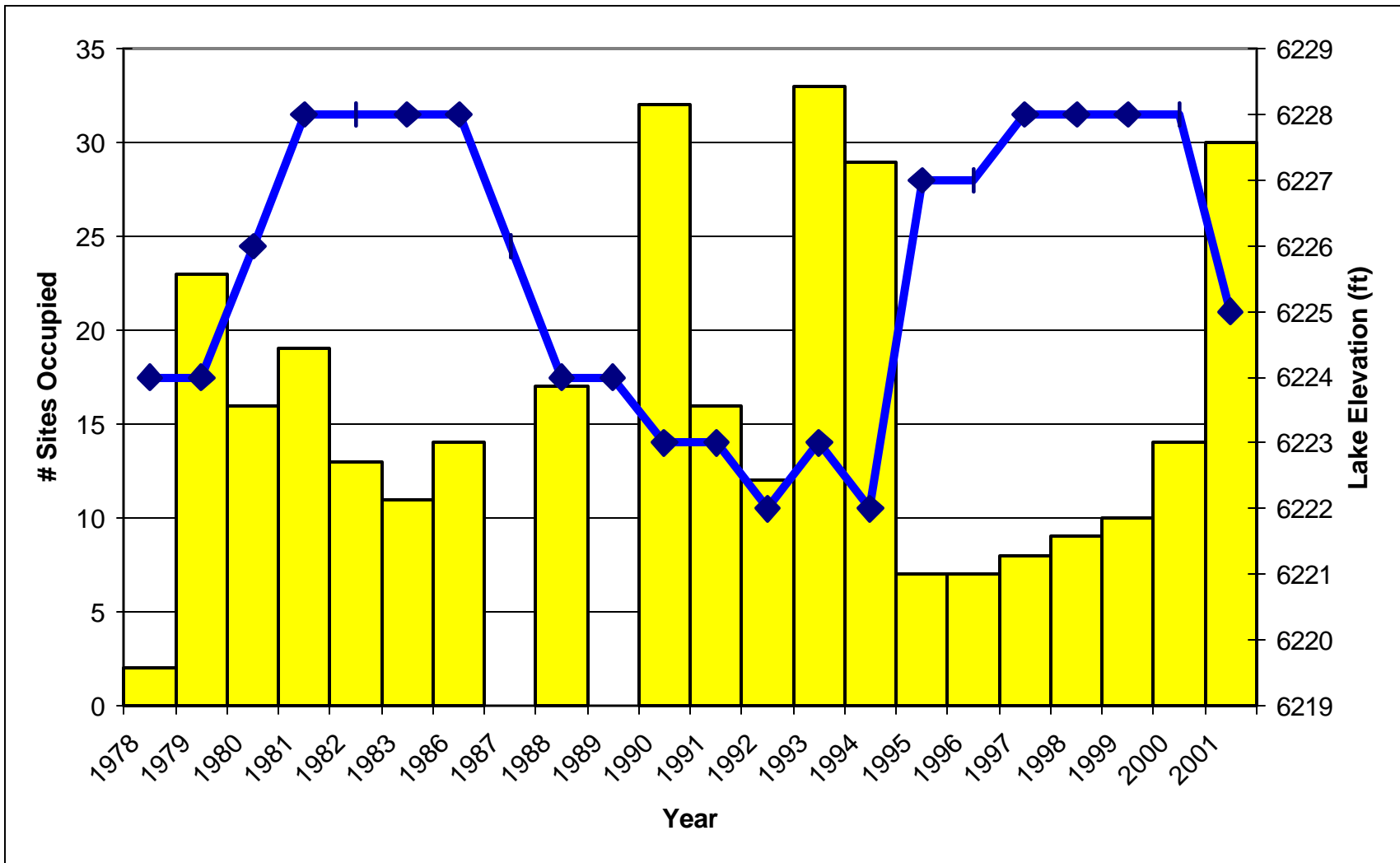


Figure 2. Lake Level and Number of TYC Sites Occupied by Survey Year (Blue line = lake level in ft)

Table 3 - Private properties surveyed by CSLC staff as a part of their "TYC Project Review Guidelines" for lease applications.

Sites by Owner	APN	County	# Stems	TYC Habitat
West Lake Investors	83-173-13	Placer	0	Yes
Gordon/Lanini	90-231-30	Placer	0	Yes
	90-231-31			
Desautels	90-324-2	Placer	0	Yes
	90-324-3			
	90-324-4			
Brockway	90-380-5	Placer	0	No
	90-380-9			
Frazer	91-153-5	Placer	0	Yes
Millham/TCPUD	93-94-38	Placer	0	Yes
Westphal	94-140-32	Placer	0	Yes
Sloop	94-140-34	Placer	0	Yes
Kearns	94-140-9	Placer	0	Yes
Dill	94-263-2	Placer	0	Yes
Timberlake	94-520-1	Placer	0	Yes
	116-10-1			
Agate Pier & Swim Club	116-10-2	Placer	0	Yes
	116-8-8			
Tahoe Valley Inn	117-110-14	Placer	0	No
Walsh/N. Tahoe Marina	117-130-53	Placer	0	No
Bowman	16-081-29	El Dorado	0	No
	16-101-49			
Fry	16-101-50	El Dorado	0	Yes
	16-142-28			
Frankel	16-142-28	El Dorado	0	Yes
Cap's	16-401-21	El Dorado	0	Yes
Thompson	17-21-4	El Dorado	0	Yes
Lane	17-21-5	El Dorado	0	Yes
Swanson	17-21-6	El Dorado	0	Yes
Johnson (Bow Bay House)	17-21-81	El Dorado	0	Yes
Weinberg/Silviera	18-191-14	El Dorado	~20	Yes
	18-191-16			

Appendix A - Archival and Annual Survey Sheets

**Appendix B - Tahoe Yellow Cress Annual Survey Assessment (1979 to 2001)
Prepared by E. Gillies (CSLC)**

The 2001 annual survey for Tahoe yellow cress (TYC) (*Rorippa subumbellata* Roll.) was the 19th survey that has been conducted over a 23-year period, with more sites surveyed than in any other year (58 sites). Following the 2001 annual survey for, an analysis of data collected between 1979 and 2001 was performed. The purpose of the analysis was to determine if there is a relationship between how many sites are surveyed and the number of sites that support TYC, as well as provide a comparison between low and high lake elevation years to illustrate the significant relationship between lake level and presence of TYC (Pavlik et al. 2002). The purpose of this analysis may also serve as a tool for future survey efforts for this species.

Results

Simple linear regression was used to analyze all existing data between 1979 and 2001. These data can be found in Appendix D of the Conservation Strategy (CS) (Pavlik et al. 2002) and the 2001 Annual Survey Report and are summarized in Attachment A. Based on the analyses, the optimal lake elevations to ensure persistence of TYC populations is between 6,222 feet (ft) and 6,224 (Lake Tahoe’s natural rim is 6,223 ft) (Table 1). Lake elevations between 6,225 to 6,226 ft appear to be the levels at which populations of TYC begin to become limited. Above 6,226 ft there is a significant decline in the number of populations (ANOVA $P = <0.001$) (Table 1; Figures 1 and 2). Based on the information in the CS and for purposes of this analysis, lake elevations at or below 6,225 ft and at or above 6,226 ft are considered low water and high water elevations, respectively (Table 1; Figures 1 and 2; Pavlik et al. 2002).

Table 1. Comparison of low (<6,225 ft), medium (6,225 – 6,226ft), and high lake elevation (>6,226 ft) levels (1979 to 2001).

	Low Lake Elevation (n = 7)	Medium Lake Elevation (n = 2)	High Lake Elevation (n = 10)
Mean Lake Elevation (ft LTD)	6223.0	6225.5	6227.8
Number of sites with Tahoe yellow cress (mean ± s.d.)	25.0 ± 7.7	23.5 ± 10.6	11.2 ± 3.8**
% Presence of Tahoe yellow cress (mean ± s.d.)	78.3 ± 8.5	55.5 ± 2.1*	35.8 ± 16.3**

Single-factor ANOVA: * $P = 0.01$; ** $P = <0.001$

Figure 1. Relationship between the total number and mean number of sites with occupied Tahoe yellow cress and lake elevation (1979 to 2001).

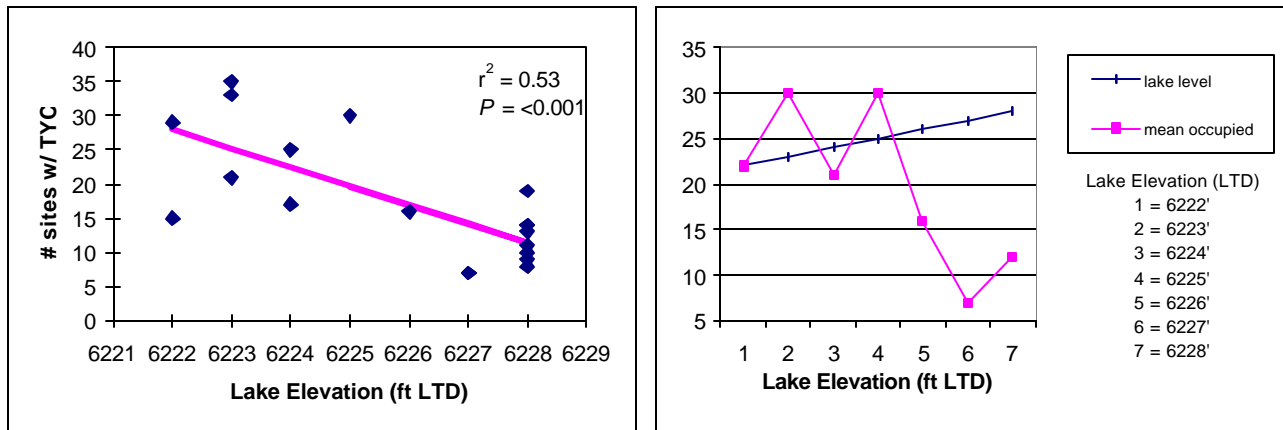
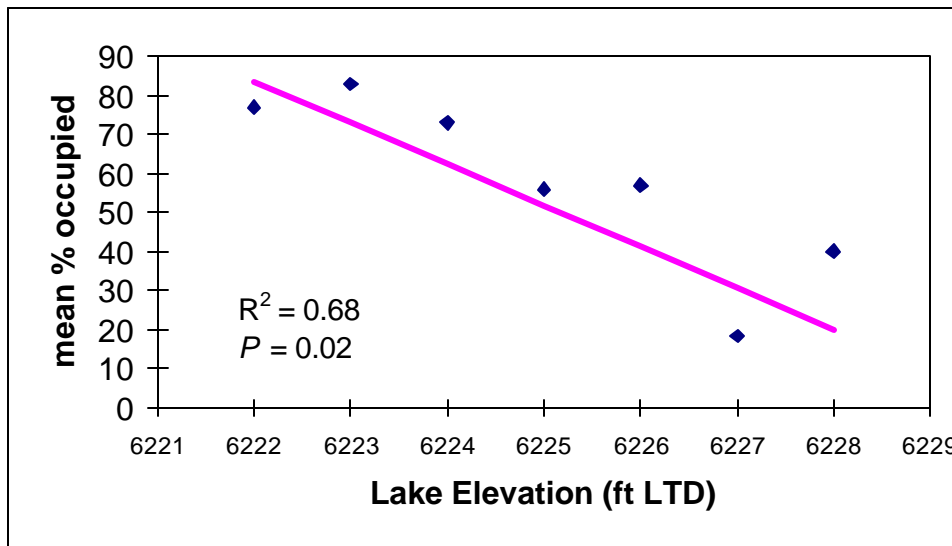
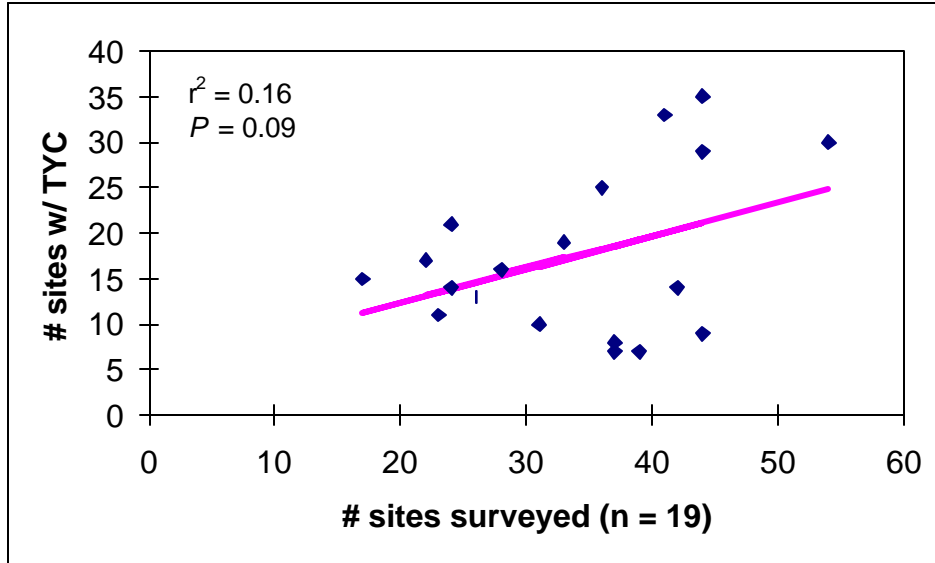


Figure 2. Mean percent occupied sites of Tahoe yellow cress and lake elevation level between the 1979 and 2001 survey period.



Based on the data described above and provided in Attachment A, there is a linear relationship between the number of sites surveyed and the number of sites where TYC is observed, which is significant at the 90% confidence level ($P = 0.09$) (Figure 3). This suggests that as more sites containing suitable habitat are surveyed around the lakeshore during low lake elevation years, the likelihood that TYC would be observed at more sites increases.

Figure 3. Relationship between the number of sites surveyed and number of sites with Tahoe yellow cress (1979 to 2001).



This relationship was much more significant ($P = <0.01$) when 4 survey years with very low TYC presence were omitted from the analysis (Figure 4). These 4 years were from 1995 to 1998, which were high lake elevation years and TYC was observed at less than 10 sites each year (Appendix A). For unknown reasons other than high lake levels, these years were the worst for TYC during the survey period, having significantly lower percent presence (ANOVA $P = <0.001$) and number of sites (ANOVA $P = <0.01$) than all other years with high lake levels combined (Table 2).

Figure 4. Relationship between the number of sites surveyed and number of sites with Tahoe yellow cress excluding four years with very low Tahoe yellow cress presence (<10 sites) (1995 to 1998).

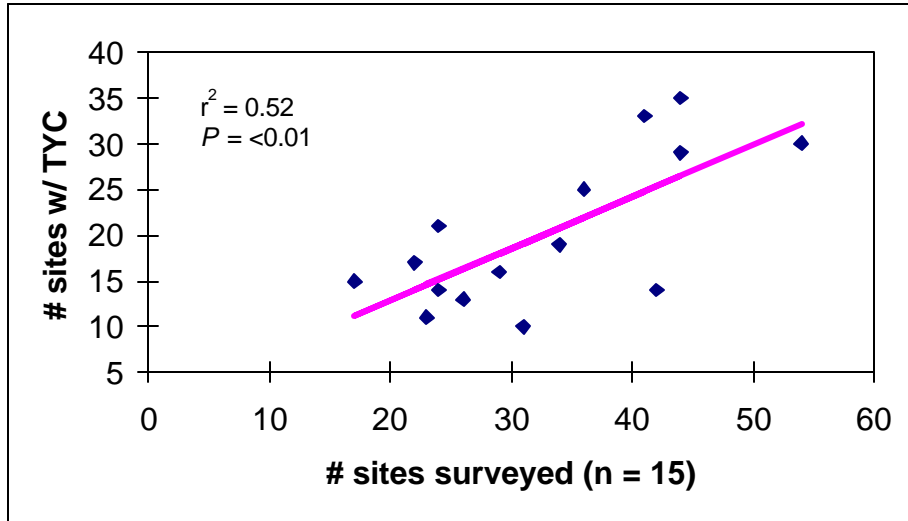


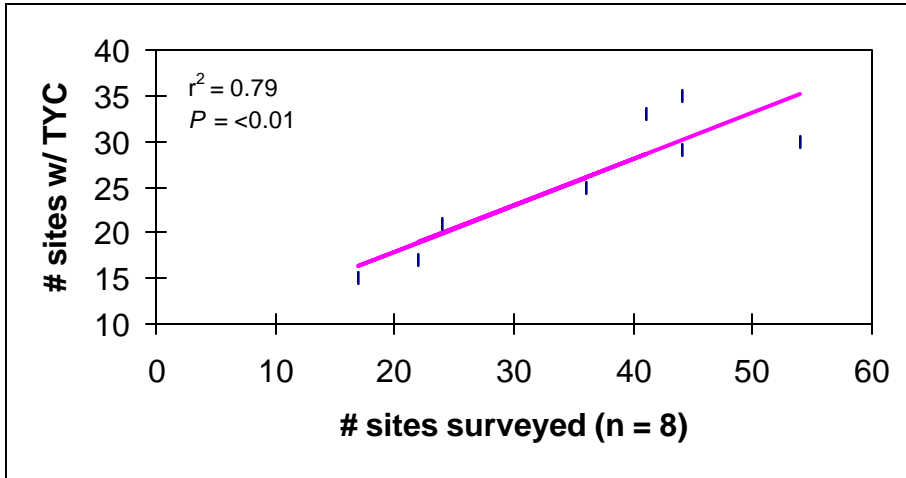
Table 2. Comparison of high lake elevation (6,226 ft) between 1995 and 1998 and all other years of high lake elevation during the survey period (1979 to 2001).

	Other Years with High Lake Elevation (n = 7)	High Lake Elevation 1995-1998 (n = 4)
Number of sites with Tahoe yellow cress (mean \pm s.d.)	13.86 \pm 3.02	7.75 \pm 0.96*
% Presence of Tahoe yellow cress (mean \pm s.d.)	47.43 \pm 10.77	19.80 \pm 1.71**

Single-factor ANOVA: * $P = <0.01$; ** $P = <0.001$

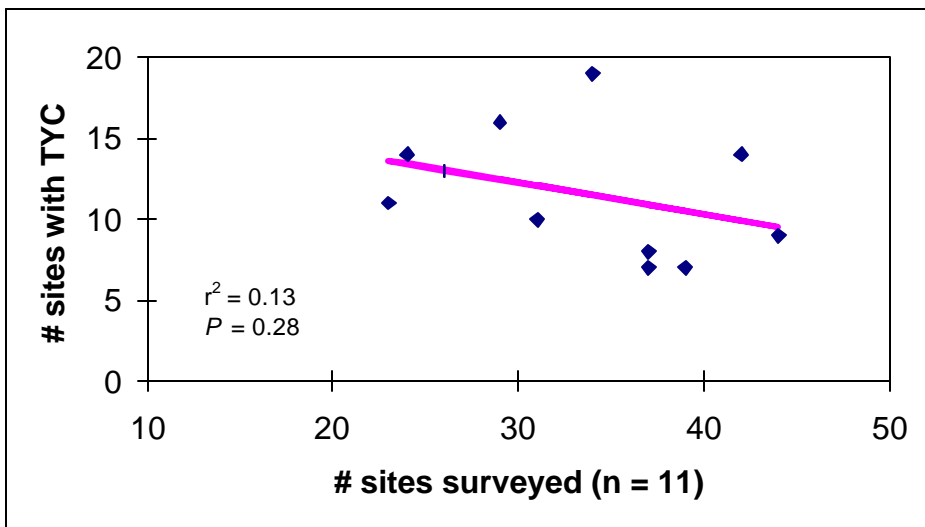
This relationship was also significant ($P = <0.01$) when the analysis considered only low lake elevation years (6,225 ft) (Figure 5). This would indicate that the more sites surveyed during low lake elevation years would likely result in observations of TYC at more sites around the lake due to more habitat exposure. The lower lake elevations also more closely relates to the natural rim of the lake, which the species is likely more adapted to.

Figure 5. Relationship between the number of sites surveyed and number of sites with Tahoe yellow cress during low lake elevation years (6,225 ft; 1979, 1988, 1990 to 1994, 2001).



When the analysis examined the results of annual surveys conducted during high lake elevation years ($> 6,226$ ft), there was a negative trend with the number of sites surveyed and occupied TYC sites (Figure 6). This correlates to Figure 7 of the CS (Pavlik et al. 2002) and Figure 1 of this report depicting the same relationship that when lake level is high, presence of TYC is significantly lower ($P = < 0.01$). This suggests that during periods of high lake elevations, many of the sites experience prolonged inundation limiting habitat exposure or timing of emergence.

Figure 6. Relationship between the number of sites surveyed and number of sites with Tahoe yellow cross during high lake elevation years ($> 6,226$ ft; 1980-1983, 1986, 1995 to 2000).



Discussion

This analysis was conducted to determine if there is a linear relationship between the number of sites surveyed during low lake elevations and the probability of observing TYC. The results of this analysis, in fact, show that high lake elevations negatively affect the presence of TYC, which is consistent with the findings in the CS (Pavlik et al. 2002). Lake elevations between 6,222 and 6,224 ft appear to be optimal for TYC persistence. Between these elevations, more habitat is exposed and available for colonization by TYC. In addition, lower lake levels allow surveyors to cover more lakeshore area. Another relationship reflects the trend that as more sites are surveyed during high water elevations, the likelihood of observing TYC is reduced. This is due to large expanses of habitat being inundated or habitat conditions that are too wet when elevations reach or exceed 6,225 ft. High lake elevations that reduce beach exposure coupled with concentrated recreation use exacerbate the negative effects on TYC.

The question facing CS partners is whether or not the level of effort for conducting annual surveys should be adjusted according to the lake level. For instance, during years with high lake levels, perhaps surveys efforts should concentrate only on the core, high, medium priority, and newly discovered sites (depending on the new site's elevation relative to lake level) since there is a strong likelihood that low elevation and other unranked sites would not support TYC. Whereas, surveys should be more intensive and cover more lakeshore areas during years with low lake levels to account for the likelihood that more sites would support TYC when additional habitat is exposed. Limiting the number of sites visited during the annual surveys based on lake elevation may also reduce the variability of percent presence, which is one of the indicators for categorizing the level of imminent extinction (Attachment A; Pavlik et al. 2002).

Attachment A: Summarized Annual Survey Data (1979 to 2001)

Year	Lake level (ft)	# Sites surveyed (X+0)	# Sites w/ X (TYC)	% Occupied	Imminent extinction level*
1979	6224	36	25	69	3
1980	6226	28	16	57	2
1981	6228	33	19	58	2
1982	6228	26	13	50	2**
1983	6228	23	11	48	2**
1986	6228	24	14	58	2
1988	6224	22	17	77	1
1990	6223	41	33	80	1
1991	6223	24	21	88	1**
1992	6222	17	15	88	1**
1993	6223	44	35	80	1
1994	6222	44	29	66	1
1995	6227	37	7	19	4
1996	6227	39	7	18	4
1997	6228	37	8	22	4
1998	6228	44	9	20	3
1999	6228	31	10	32	2
2000	6228	42	14	33	2
2001	6225	58	31	53	2

(Data source: Conservation Strategy 2002 and Draft 2001 Annual Survey Report)

*Imminent extinction level is based on number of core sites and percent presence following the 4 level criteria in the Conservation Strategy Section II.I.

**Assumes that several of the core sites (e.g., Upper Truckee east, Blackwood sites) not surveyed had plants.

Level	# yrs
1	6
2	8
3	2
4	3
Total	19

Appendix C

Qualitative Description of Known TYC Sites (1998 to 2001)

The following includes a brief qualitative description of the various Tahoe yellow cress (TYC) (*Rorippa subumbellata* Roll.) sites around the lake and are based on surveys conducted since 1998.

Kaspian Camp: No plants were observed at this site during the 1998, 1999, and 2000 surveys. In 2001, one 7.5-inch diameter plant was located approximately 80 feet the lake (6,225 ft). The plant appeared very healthy and was flowering and fruiting. Although this is a public beach managed by the USFS, very little beach use was noted, possibly due to the cobble and small boulder substrate.

Blackwood Creek North: No plants observed during 1998 and 1999 surveys. In 2000, 25-30 plants found approximately 65 feet north of the stream mouth. Plants were found primarily in medium to large cobble, underlain by fine sand. In 2001, 100 plants were counted ranging in size from 0.4 to 14 inches in diameter.

Blackwood Creek South: This site is greatly affected by seasonal creek flow and channel alteration. The majority of the plants are located in the backshore area adjacent to private property, though it is common to find plants along the "bathtub" ring around the lake as it recedes over the course of the year. Substrate in this area is composed of black, very fine-grained sands and silt. Soil in the backshore area is generally very dry. The number of rosettes observed since 1998 have remained fairly constant at about 200 to 300 stems. Small plants (0.4 to 3 inches in diameter) dominate this site and are frequently observed in the flowering and/or fruiting stages. Plants in general appear stressed - small, yellow, wilted - compared to other sites around the lake.

Meeks Bay Enclosure: According to historical records, the USFS planted 500 individuals of TYC within this enclosure in 1988. By 1990, the number of plants had decreased to 215 and was described as small and chlorotic. No other records are known for this site between 1991 and 1997. Since 1998, the number of plants observed within the enclosure has ranged between 1 to 6 individuals. Depending on when the survey is conducted the number of individuals varies. Early in the growing season, the stems are far enough apart to suggest multiple plants; however later in the growing season, these stems mature and resemble one perhaps two plants. Due to the apparent dryness at this site, the plants flower and set fruit relatively earlier than sites located on the south and west side of the lake.

Rubicon Bay (Greene Property): This site is located approximately 550 feet north of the D.L. Bliss State Park, west of a channelized creek. Plants are found in the backshore, under the shade of several large pine trees, next to a manmade slough wall. Numbers at this site have ranged from about 30 individuals in 1999 to 4 plants in 2001.

D.L. Bliss State Park: According to historic records, CDPR constructed an enclosure north of the park and outplanted 1,168 individuals in 1989. A survey conducted in 1999

documented 832 plants, but by 2001, only 7 plants were observed and those were found within the litter-layer at the northern most portion of the enclosure. Due to the dryness of this site (located over 40 feet from the water's edge), the plants appear moderately stressed and seem to have an accelerated growing season. Typically, by the time the annual survey is conducted, the plants have already set seed and are becoming senescent.

Cascade Enclosure: This site is referred to as "Tallac Creek" in historical records. Records indicate that in 1988, 500 plants were outplanted by USFS alongside 68 naturally occurring plants within an enclosure. By 1990, the number of outplanted individuals had dropped to 64, due in part to the lowering of the lake level and encroachment by other plant species. In 1998, over 100 plants were identified in the enclosure. In 1999, the enclosure was found to be in a state of disrepair and believed to be interfering with natural sand movement across the beach because of the fence design. Subsequently, encroachment into TYC habitat by other plant species appeared to inhibit TYC growth. The enclosure was rebuilt using 4-strand wire fence, allowing more natural sand movement across the beach profile. In 2001, approximately 182 plants were observed within the enclosure.

Tallac Creek: Plants were identified at this site in 1998 along the margins of the backshore wetland. Historic records indicate plants were observed in this area in 1981, prior to the lake level rising. Four plants were noted in 1990 in the same general location. In 1998, approximately 50 plants were identified along the margins of the creek, in the open sand near the abandoned barbed wire fence, and near the manhole cover. By 2001, over 200 plants were counted at this site. Many of the larger plants were found growing along the margins of the meadow with grasses and grass-like plants. The plants previously identified near the manhole cover were absent in 2001; likely due to the heavy substrate disturbance evident in the area.

Baldwin Beach: In 1998, two plants were identified outside the Taylor Creek enclosure. In 2000, when the Taylor Creek enclosure was reconstructed, these plants were included in that site. In 2001, four plants were identified along the margin of Baldwin Lagoon.

Taylor Creek: This site has expanded considerably since 1998, when approximately 50 plants were observed. During the 2001 survey, field staff counted nearly 900 plants within the enclosure. Plants were generally large and healthy looking. Prior to 2000, before the enclosure was reconstructed, plants were primarily found near the margins of the enclosure and in a very small backshore depression. Since reconstruction of the enclosure, the plants appear to be expanding throughout the enclosure.

Several expanded areas were observed during 2001, which were identified as Taylor Creek West and Taylor Creek East. Taylor Creek West is located west of the creek and south of the enclosure. In 2001, 44 plants were observed. Taylor Creek East is located on the eastern bank of the creek where eight plants were observed during 2001.

Pope: In 2001, 4 plants were identified on the eastern edge of this beach, approximately 10 ft from the water's edge. During 2002 survey, 14 plants were observed. From 1998 through 2000, this area was completely inundated. Plants were large (up to 6 inches in

diameter) and appeared very healthy. Historic records show 25 plants immediately south of where the current plants are located. The original site is dominated by willows and does not support TYC.

Lighthouse: Nearly 500 plants were located at this site in 2001, which is divided into 2 subpopulations. One subpopulation is located along the western edge of the beach, in an isolated backshore depression that contains water throughout much of the growing season. The second subpopulation is located along almost the entire length of the beach, adjacent to the manicured lawns and rock gardens. These plants are may be utilizing water used for landscaping and lawn maintenance. The plants are generally large and appear healthy. Some of the beaches that are obviously raked support few, if any, TYC.

Upper Truckee West: Plants have been identified periodically at this site since 1979. During the 1999 survey, no plants were identified at this site. In 2000, eight plants were found at the mouth of the river, growing among various herbaceous species. By 2001, over 450 plants were observed at the site, primarily in the backshore areas that had been inundated in 2000.

Upper Truckee East: This is an important source site for TYC where plants are able to colonize exposed sand bars because of the relative absence of disturbance. Many healthy plants have been noted at this site dating back to 1980. Numbers have ranged from a low of 50 plants in 1979 to over 6,500 plants in 1990. In 2001, 3,171 plants were recorded.

Tahoe Meadows: Plants are located along the drainage ditch/unnamed creek at the northern edge of the property (abutting the marina). Plants are relatively healthy and large and have been observed in the same general area since 1979.

Edgewood: Plants are primarily located at the northern portion of this site, in a backshore depression that holds water during much of the year. Plants are very healthy and large. Several smaller pockets of TYC have been identified along the beach, often found in the "bathtub ring" where litter accumulates.

Cave Rock: In 2000, 18 plants were identified at this site. Plants were primarily found among the riprap boulders of the jetty at the south end of the site. However, a few plants were located in the grass, adjacent to the jetty path. In 2001, only six plants were found.