# Tahoe Yellow Cress (*Rorippa subumbellata*)
# 2004 Annual Report
# October 2005


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## EXECUTIVE SUMMARY

**Great progress was made towards the conservation of Tahoe yellow cress in 2004. The Technical Advisory Committee met throughout the year to coordinate conservation actions, aid research contractors, conduct the annual survey and work on stewardship issues with private landowners. Below is a brief overview of 2004 actions and background information.**

Tahoe yellow cress (*Rorippa subumbellata* Roll.) is a rare plant species endemic to the shores of Lake Tahoe in California and Nevada. The species was listed as endangered by the State of California in 1982 (California Fish and Game Code 2050 *et seq.*) and is listed as critically endangered in Nevada (Nevada Revised Statutes 527.260 *et seq.*). The U.S. Fish and Wildlife Service identified Tahoe yellow cress as a candidate species for listing in 1999 under the Endangered Species Act of 1973, as amended, indicating there is sufficient information on biological vulnerability and threats to support a listing proposal (64 FR 57533). The Tahoe Regional Planning Agency also protects this species under its Code of Ordinances.

Because of the imperiled status of the Tahoe yellow cress, a conservation strategy was completed in 2003 that identifies goals and objectives to meet the recovery needs of the species. These goals and objectives, the research agenda, and other associated activities identified in the conservation strategy, together with an effective adaptive management process, assist land and resource managers in making informed, practical decisions by filling in data gaps and providing an ever increasing knowledge base.

The overall intent of the CS is to preclude the need to list the Tahoe yellow cress under the ESA through restoration of a self-sustaining metapopulation dynamic that allows the species to persist in sandy beach habitat around Lake Tahoe despite high water levels and human-related impacts (Pavlik *et al*. 2002a). A metapopulation dynamic refers to a population structure where some sites persist over long periods time while others come and go. A species with this structure is able to persist only when extirpation events are countered by colonizations. Achieving a positive balance requires understanding the species through surveys and research that directly supports management and restoration activities.

An annual survey protocol was developed and implemented that includes a census of known populations and systematic searches of areas supporting unoccupied, potentially suitable habitat (Pavlik *et al*. 2002a). The CS identified a total of 51 known, historical, and potential Tahoe yellow cress habitat sites that had been recorded at Lake Tahoe between 1941 and 2000. Currently, 64 sites (based on the 2003 naming convention) have been identified. For the 2004 surveys, the survey protocol was refined and the field data sheet was revised. Since 2000, the survey effort has increased considerably, largely due to the CS and elevation of the conservation priority of the species. A total of 24 surveyors representing 10 public agencies dedicated more than 230 person hours on the search effort, almost four times the effort in the 2001 survey.

Tahoe yellow cress presence is cyclical and mostly related to fluctuations in lake elevation. Low lake elevations (< 6,226 ft Lake Tahoe Datum (LTD) expose greater quantities of suitable habitat and can therefore support a greater number of occupied sites than high lake elevations. In addition, recreation is more dispersed at low lake elevations and potential impacts to the species are reduced.

2004 was the fourth consecutive year of low water. During the survey period, lake level dropped one foot from the previous year to approximately 6,223 feet LTD, the lowest recorded elevation since 1994. Tahoe yellow cress was located at 47 of the 64 named sites, the same occupancy as 2003, and the greatest number of occupied sites in recent survey history (1978-present).

The CS established site rankings for the purposes of identifying conservation, restoration, and management priorities. Based on the biological index of viability scores, sites were ranked as Core, High, Medium, and Low priority sites. The rankings are based on the biology of the species and are useful for prioritizing management actions. However, there is no direct link between site rank and actual management of any given site, particularly at private sites that are not being managed for TYC. Stewardship outreach will be necessary to protect Core sites on private property in times of high lake elevation and low population size.

In 2003, the TAG revised the site rankings in Table 13 of the CS to incorporate additional data collected since 2000. Subsequent to the 2003 survey, the dataset encompassed two complete cycles of high and low lake elevations, whereas the 2000 dataset had a greater number of high lake elevation years. Five sites were promoted in rank, 2 were demoted, and 13 remained unranked either because they were considered new or they do not meet the minimum data requirement to calculate the index of viability. The revised rankings of 2003 better reflect the metapopulation dynamics of the species through two complete high and low water cycles. Although the index of viability could be updated each year for all ranked sites, the TAG recommends that the 2003 site rankings should be maintained into the future until another complete high/low water cycle is experienced. Unranked sites will be ranked as minimum data analysis requirements are met.

Research began in 2002 with seed collection and greenhouse propagation of Tahoe yellow cress for the 2003 pilot project. The 2003 pilot outplanting project included an outplanting of 1,424 container-grown plants at four sites, and installation of protective fences and monitoring (Pavlik and O'Leary 2002, Pavlik and Stanton 2004). Information from the pilot project on such factors as nursery propagation procedures, fencing, working with agency personnel, permit compliance, and outplanting and monitoring techniques has greatly informed the 2004 experiments.

In 2004, replication of the 2003 pilot design at Taylor Creek and Sand Harbor was meant to test the ideas of age-structured outplanting and "founder–cost averaging". The age-structure of a rare plant population may be important for the maintenance of high levels of reproductive output. "Founder-cost averaging" is the successive outplanting of founders of any age class in different years. Continued monitoring of the 2003 cohort enabled a comparison of the effects of changing lake level on microhabitat characteristics and demographic performance of TYC. The persistence and reproductive output of 2003 founders was also used to evaluate success in creating new populations or enhancing existing ones. Results indicate that both age-structure and founder-cost averaging are effective tools for reintroducing and enhancing populations of Tahoe yellow cress.

In 2004, Year 1 of the Experimental Reintroduction was initiated (Pavlik and Stanton 2005). While the 2003 pilot project design was site-specific, lacking replication, and meant to address pilot project objectives, the 2004 experimental reintroduction utilized a hypothesis-driven, replicated design to address all five of the Key Management Questions (KMQs) (Pavlik and O'Leary, 2002). The replicated design with "cause and effect" monitoring provides statistical power to evaluate factors

central to those questions : 1) the effects of microhabitat, founder seed source, founder vigor, and founder water status on survivorship and reproduction, 2) the effect of outplanting timing on demographic performance, and 3) the efficacy of precision seeding to enhance or create TYC populations. In this way research hypotheses are only tested if the results immediately benefit implementation of the CS. Results from year 1 of the experimental reintroduction provided preliminary answers for all 5 of the KMQs as presented in the following table:

Key Management Questions for guiding conservation and restoration research on Tahoe Yellow Cress

1) **Can TYC populations occupy any site around the lake margin that has sandy beach habitat?**
   No, TYC performance is not equivalent at all sites. Managers cannot, therefore, assume site equivalency when issuing permits or prescribing mitigation measures that affect the species.

2) **Are there ecosystem factors that can affect TYC performance within an occupied site or microhabitat?**
   Yes, ecosystem factors like depth to the water table affect TYC performance. Microhabitats that provide a shallow depth to the water table that are protected from lake level and human disturbance are more likely to allow high survivorship and reproductive output of TYC. Managers cannot, therefore, assume microhabitat equivalency when issuing permits or prescribing mitigation measures that affect the species.

3) **Can TYC populations be created or enlarged in order to restore the self-sustaining dynamics of the species?**
   Yes, reintroduction to certain microhabitats at a given sandy site appears to be a practical and effective tool for creating or enhancing TYC populations. Managers can, therefore, prescribe carefully designed, executed, and monitored reintroduction for purposes of conservation, restoration and mitigation.

4) **Can any TYC genotype perform equally well at any appropriate site?**
   Yes, the genotype of a source population had no significant effect on TYC performance. Therefore, managers do not have to insist on certain design features to compensate for genetic factors when reintroduction is for conservation, restoration or mitigation.

5) **Can TYC microhabitats/places be found or created that are less likely to be adversely disturbed despite high visitor use or intense shoreline activity?**
   Yes, fencing is mostly effective for protecting TYC conservation and restoration projects. Therefore, managers will need to maintain fencing during all conservation, restoration, and mitigation projects, especially those that require collection of monitoring data.

The data obtained each year through research, annual surveys, and other conservation actions are used to guide regulatory and land management agencies in their conservation and management efforts regarding Tahoe yellow cress and its habitat. Continued commitments from stakeholders and successful implementation of the conservation strategy should preclude the need for the U.S. Fish and Wildlife Service to list the Tahoe yellow cress under the Endangered Species Act and potentially remove the species from the candidate list.

## 1. INTRODUCTION

Tahoe yellow cress (*Rorippa subumbellata* Roll.) is a low-growing, perennial species endemic to the shores of Lake Tahoe in California and Nevada. The species was listed as endangered by the State of California in 1982 (California Fish and Game Code 2050 *et seq.*) and is considered endangered throughout its range by the California Native Plant Society (CNPS 2001). Tahoe yellow cress is state-listed as critically endangered in Nevada (Nevada Revised Statutes [NRS] 527.260 *et seq.*), and is considered threatened by the Nevada Native Plant Society (Nevada Natural Heritage Program [NNHP] 2001). In 1999, the U.S. Fish and Wildlife Service (USFWS) identified Tahoe yellow cress as a candidate species for listing under the Endangered Species Act of 1973, as amended (ESA), indicating sufficient information on biological vulnerability and threats are available to support a listing proposal (64 FR 57533).

A 27 year survey record has been compiled for Tahoe yellow cress, beginning in 1978 through the present. Although data are lacking for some years and survey methods have varied, the dataset is one of the most comprehensive for any endangered plant in the U.S. and possibly the world. A number of agencies have contributed to the effort. In 1993, the Tahoe Regional Planning Agency (TRPA) conducted a comprehensive assessment of 100 percent of the littoral parcels and documented Tahoe yellow cress at 35 sites (California State Lands Commission [CSLC] 1998). Two years later, only 7 of the 35 locations known from 1993 were occupied. In 1997, CSLC took the initiative to coordinate an annual multi-agency lake-wide survey.

In response to low numbers of occupied sites between 1995 and 1999, a Technical Advisory Group (TAG) was formed to develop and implement a conservation strategy (CS) and memorandum of understanding / conservation agreement (MOU/CA) for Tahoe yellow cress (Pavlik *et al*. 2002). Analysis performed during development of the CS demonstrated that the number of Tahoe yellow cress occurrences around the lake correlates directly with fluctuating lake levels. When the lake elevation is at or near the natural rim (6,220 feet [ft] Lake Tahoe Datum [LTD]), wide expanses of beach are available for colonization and the number of occupied sites is generally high. During high water periods (greater than 6,226 ft LTD), less habitat is available and the number of occupied sites declines. The combination of less habitat availability and intensified pressures from recreation in remaining habitat under periods of high water continue to pose a threat to the long-term, continued persistence of Tahoe yellow cress.

Implementation of the CS began in 2001 with an intensified annual survey effort and initiation of the experimental reintroduction component of the CS, which will ultimately inform the restoration phase of the program (Pavlik *et al*. 2002b). Over time, various revisions have been made to the naming conventions of the sites, survey data sheets, and survey and reporting protocols. Annual reports addressing these changes in previous years as well as documents specific to implementation of the CS, key management questions, and research are available upon request from the TAG.

This annual report describes conservation activities conducted in 2004 including the annual survey, continued seed collection and greenhouse propagation, ongoing monitoring of the 2003 pilot project, and the installation of experimental reintroductions at two sites. In addition, agency reporting requirements were streamlined for the 2004 annual report and the Friends of Tahoe Yellow Cress

Stewardship Program continued to expand. This report also contains recommended conservation actions for 2005 and it is being submitted as a requirement of the CS and MOU/CA.

## 2. 2004 FIELD SURVEYS

### 2.1 METHODS

As part of the CS, an annual survey protocol was developed and implemented that includes a census of known populations and systematic searches of areas supporting unoccupied, potentially suitable habitat (Pavlik *et al*. 2002a). The CS identified a total of 51 known, historical, and potential Tahoe yellow cress habitat sites that had been recorded at Lake Tahoe between 1941 and 2000. Currently, 64 sites (based on the 2003 naming convention) have been identified. For the 2004 surveys, the survey protocol was refined (see description below) and the field data sheet was revised (Appendix A). Each data field is now numbered and the protocol for data collection and parameters for each field are explained in detail in a separate sheet called Data Fields and Survey Protocols for Tahoe Yellow Cress Annual Surveys (Appendix B).

The 2004 lake-wide survey for Tahoe yellow cress was conducted on September 7-10, 2004. Participants included: Jody Fraser (USFWS); Shana Gross, Beth Brenneman, Michelle Brown, and Kevin Thomas (U.S. Forest Service [USFS]); Jay Howard, Paul Carmichael, and Jenny Scanland (Nevada Division of State Parks [NDSP]); Roland Shaw and Gail Durham (Nevada Division of Forestry [NDF]); Daniel Burmester, Curtis Hagen, and Susan Levitsky (California Department of Fish and Game [CDFG]); Tamara Sasaki, Scott Scheibner, Nancy Lozano, and Silver Fahey (California Department of Parks and Recreation [CDPR]); Marchel Munnecke and Josie Crawford (Natural Resources Conservation Service [NRCS]); Eric Gillies (CSLC); Jenny Leach (Tahoe Regional Planning Agency [TRPA]); Harry Spanglet (California Department of Water Resources); and Meri McEneny (private). Alison Stanton (BMP Ecosciences) collected seeds for the 2005 propagation and outplanting effort. This high level of participation (24 people) is similar to that contributed in the previous 3 years.

Participants were divided into 5 teams and allocated a portion of the 64 sites. At each site, team members covered the entire width of the beach, from waters edge to the backshore. Land use (type and disturbance) and search effort were recorded at both occupied and unoccupied sites. Search effort is defined as the amount of person minutes spent actively searching for and/or collecting data on Tahoe yellow cress. Site boundaries were delineated using Global Positioning System (GPS) technology. Site boundaries, in general, are defined either by natural (i.e., river mouth or substrate change) or artificial features that restrict the surveyor's lateral movement across the shorezone (i.e., changes in ownership and presence of jetties or fences).

At occupied sites surveyors estimated general habitat parameters across the entire site and recorded GPS data for each Tahoe yellow cress "cluster" within the site boundaries. A cluster is defined as a group of plants that occur within 21 ft diameter of each other. This distance equates to the resolution capability for point data using handheld GPS units. Clusters of plants separated by more than 22 ft (two times the resolution capacity) are considered separate clusters. To better characterize the

occupied habitat, the TAG determined that physical and biological attributes should be recorded for each individual cluster. Biological attribute data included the actual or estimated number plants, actual or estimated number of plants in each phenological stage, and minimum and maximum rosette diameter. Physical attributes were recorded for each cluster including distance to lake, substrate/soil composition, and percent cover of associated plant species. All annual survey forms, including GPS data, were provided to NNHP for addition to the statewide sensitive species and GIS database and are available upon request.

For the 2004 surveys, stem count data was based on the number of stems that were spaced more than 6 inches apart. Stems less than 6 inches apart were considered a single individual. However, because Tahoe yellow cress has the ability to reproduce vegetatively, it is difficult to identify an individual. A single plant may produce many "plantlets" that arise at various distances from the parent plant depending on the length of the various underground roots. Teams did not consistently apply the 6 inch rule and therefore stem counts should be considered rough estimates. Furthermore, it was determined that the 6-inch rule was arbitrary and not based on any biological parameter since some plantlets are undoubtedly more than 6 inches from the parent plant.

## 2.2 RESULTS

The lake level was approximately 6,223 ft (1,897 m) during the 2004 survey period, which is 3 feet above the natural rim and is considered low lake conditions. Tahoe yellow cress was documented at 47 sites, the same number of sites as 2003 (Figure 1), and over 13,000 stems were counted or estimated. This was the third consecutive year of low water, after a period of sustained high water from 1995 to 2000. One goal of the 2004 survey effort was to take advantage of the low lake level and cover as much of the shorezone as possible. In addition, collection of additional data during another low water year would provide supporting information for evaluating the site rankings that were recommended for adoption in 2003. All documented sites were surveyed except for Meeks Bay Vista, Elk Point, and Hidden Beach.

The NNHP compiled the GPS data into a comprehensive map of the shorezone coverage, site boundaries, and presence or absence of Tahoe yellow cress in 2004 (Figure 2). Tahoe yellow cress is most common at the south end of the lake, with the greatest concentration in the southwest quartile. Only five occupied sites were located in the northern two quartiles. Plants had not been recorded in the northeast quartile since 1992 (Secret Harbor) and 1994 (Crystal Point). Eleven of the sites occurred in Nevada, while the majority of occupied sites were located in California.

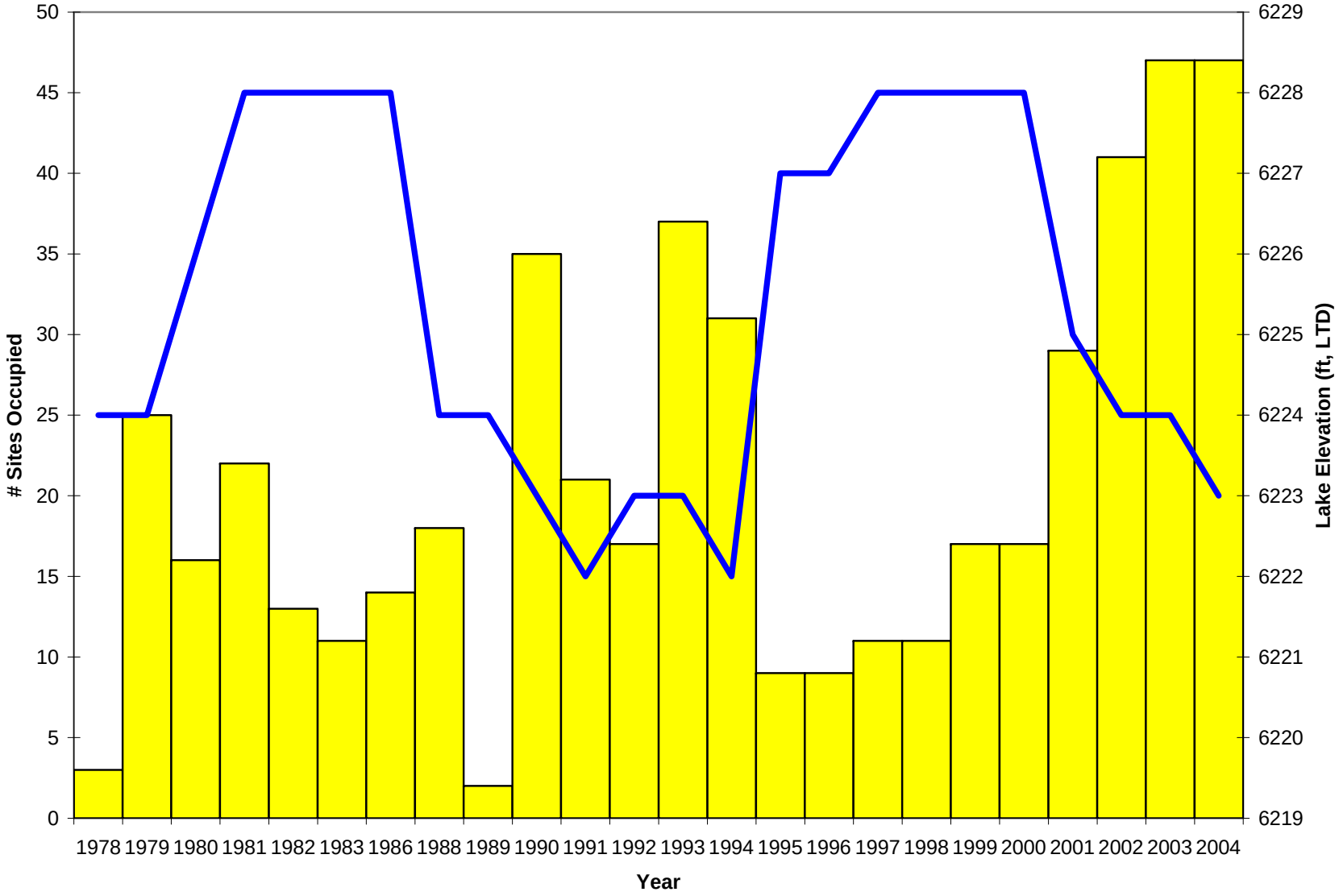


**Figure 1. Lake level and number of Tahoe yellow cress sites occupied by survey year (solid blue line = lake level LTD)**

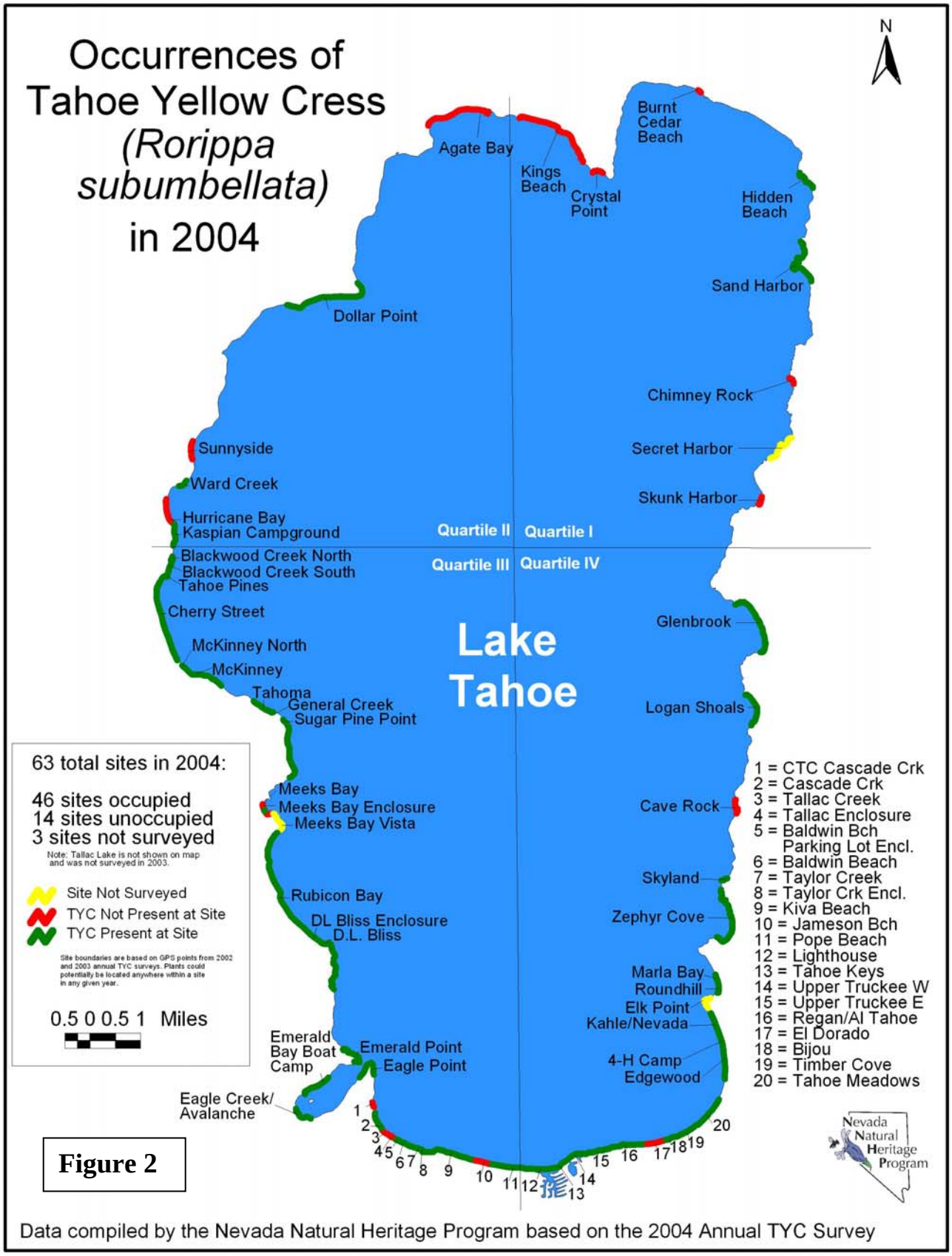
Occurrences of
Tahoe Yellow Cress
(Rorippa subumbellata)
in 2004
N
Lake Tahoe
Quartile II
Quartile I
Quartile III
Quartile IV
Burnt Cedar Beach
Agate Bay
Kings Beach
Crystal Point
Hidden Beach
Sand Harbor
Dollar Point
Chimney Rock
Secret Harbor
Sunnyside
Ward Creek
Skunk Harbor
Hurricane Bay
Kaspian Campground
Blackwood Creek North
Blackwood Creek South
Tahoe Pines
Cherry Street
Glenbrook
McKinney North
McKinney
Tahoma
General Creek
Sugar Pine Point
Logan Shoals
Meeks Bay
Meeks Bay Enclosure
Meeks Bay Vista
Cave Rock
Skyland
Rubicon Bay
DL Bliss Enclosure
D.L. Bliss
Zephyr Cove
Marla Bay
Roundhill
Elk Point
Kahle/Nevada
Emerald Bay Boat Camp
Emerald Point
Eagle Point
4-H Camp
Edgewood
Eagle Creek/ Avalanche
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
63 total sites in 2004:
46 sites occupied
14 sites unoccupied
3 sites not surveyed
Note: Tallac Lake is not shown on map and was not surveyed in 2003.
Site Not Surveyed
TYC Not Present at Site
TYC Present at Site
Site boundaries are based on GPS points from 2002 and 2003 annual TYC surveys. Plants could potentially be located anywhere within a site in any given year.
0.5 0 0.5 1 Miles
1 = CTC Cascade Crk
2 = Cascade Crk
3 = Tallac Creek
4 = Tallac Enclosure
5 = Baldwin Bch Parking Lot Encl.
6 = Baldwin Beach
7 = Taylor Creek
8 = Taylor Crk Encl.
9 = Kiva Beach
10 = Jameson Bch
11 = Pope Beach
12 = Lighthouse
13 = Tahoe Keys
14 = Upper Truckee W
15 = Upper Truckee E
16 = Regan/Al Tahoe
17 = El Dorado
18 = Bijou
19 = Timber Cove
20 = Tahoe Meadows
Nevada Natural Heritage Program
Data compiled by the Nevada Natural Heritage Program based on the 2004 Annual TYC Survey

**Figure 2**

Survey effort, in terms of person minutes, increased for the third consecutive year (Table 1). In 2003, surveyors spent about 10,000 person minutes and this increased to over 14,000 minutes (230 hours) in 2004. The average number of survey minutes at each core site (390 minutes) was much greater than the other ranking categories (303, 257, 139, and 123 minutes at High, Medium, Low, and Unranked sites, respectively). (Please refer to page 53 of the CS for discussion and definitions of site ranking). Appendix D presents the number of person minutes spent searching at each site and the resulting stem count. Approximately 13,610 stems were counted or estimated in 2004.

**Table 1. Summary of person minutes for 2001 through 2004 for surveyed Tahoe yellow cress sites**

| **Survey Person Minutes** | | | | |
|---|---|---|---|---|
| **Ranked Sites/Year** | **2001** | **2002** | **2003** | **2004** |
| Core | 1,590 | 1,570 | 1,865 | 3,905 |
| High | 320 | 540 | 860* | 1,822 |
| Medium | 615 | 937* | 2,275 | 3,638 |
| Low | 255 | 180* | 756 | 1,530 |
| Unranked/New | 845 | 1,790* | 4,374* | 3,150 |
| **Total** | **3,625** | **5,017** | **10,130** | **14,045** |

* Survey time was not recorded on the data sheets for several surveyed sites.

The number of stems counted at each site was classified into 8 abundance categories (Figure 3). While 14 sites were unoccupied, the majority of sites had fewer than 50 stems and 7 sites had less than 3 stems (Kaspian Campground, McKinney Creek, DL Bliss Enclosure, Tahoma, General Creek, Timber Cove, and Nevada Beach Enclosure). Only 6 sites (Rubicon Bay, Taylor Creek, Tahoe Keys, Upper Truckee East, Upper Truckee West, and Logan Shoals) supported over 500 stems each. The mean number of stems per site was 323, but the median number was only 18 stems. Core sites supported more than half of all stems (53 percent), while the 13 Medium priority sites supported about 24 percent of the total stem count. Over 1,566 stems were found at Unranked and New or Expanded sites.

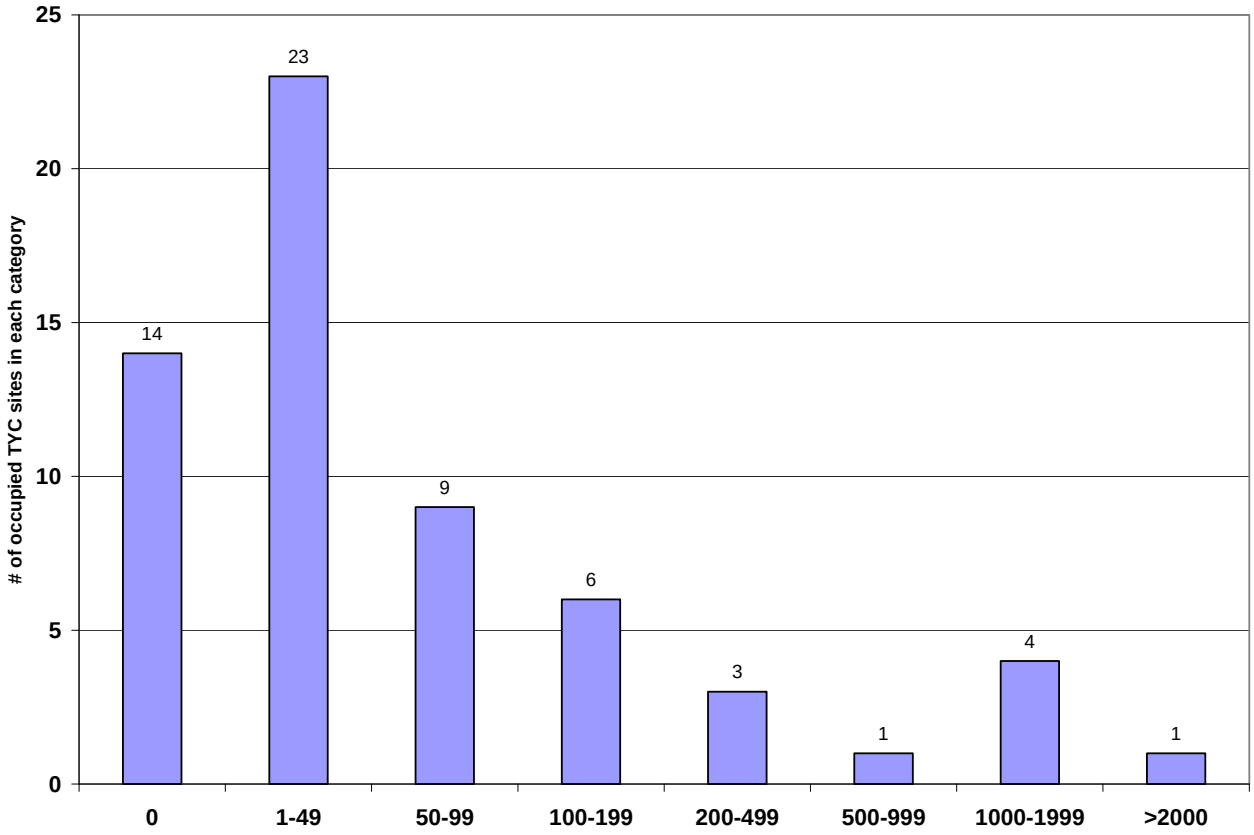


**Figure 3. The number of occupied Tahoe yellow cress sites in 8 stem count abundance categories in 2004.**

The majority of occupied Tahoe yellow cress sites occurred on lands managed by public agencies (Figure 4). The USFS manages the majority of sites, followed by CDPR, and sites that are managed by multiple entities (including private owners) or under legal dispute. Approximately 39 percent of occupied sites were privately owned. Two private sites (Elk Point and Meeks Vista) and one NDSP site (Hidden Beach) were not surveyed.

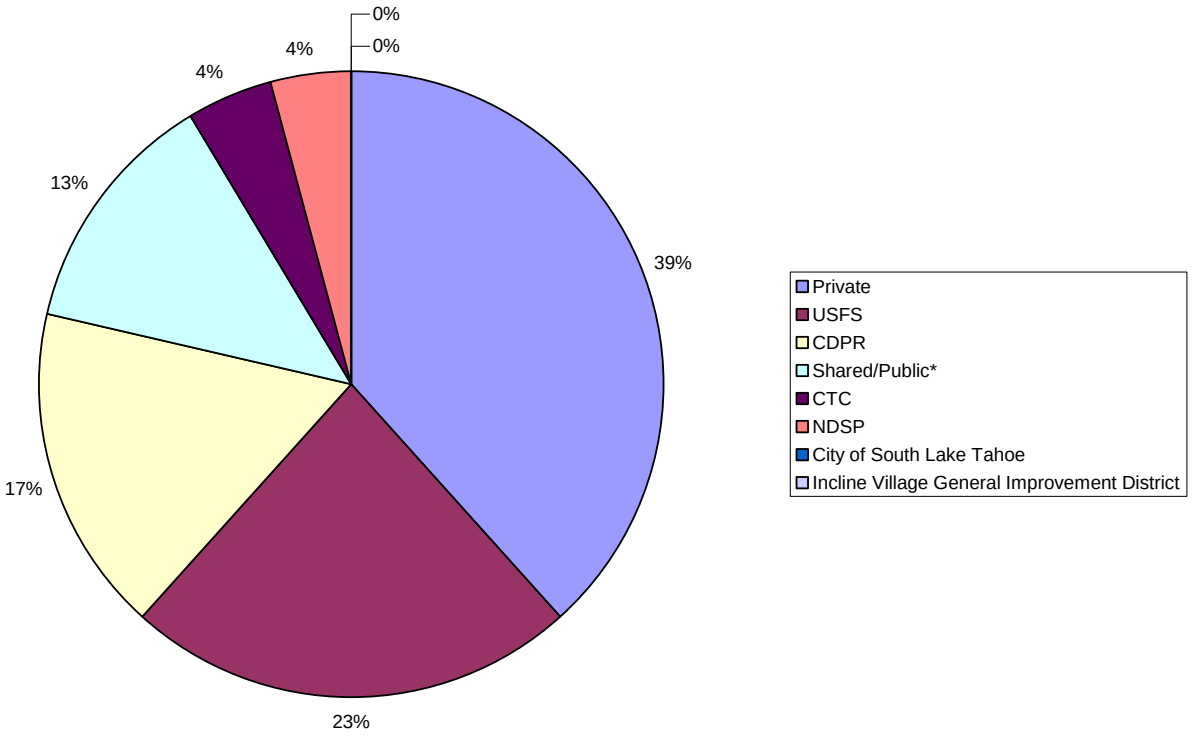


**Figure 4. Ownership of occupied Tahoe yellow cress sites in 2004** (* ownership is under multiple entities or in legal dispute).

The site rankings in Table 13 of the Conservation Strategy were updated in 2003, raising the number of sites in all categories except High (Table 2). Most significantly, the number of Core sites increased from 6 to 10. The naming convention for sites was also reconciled in 2003.Table 3 presents a comparison of the total number of occupied sites and the number of occupied Core sites for each survey year beginning in 1978, for both the 2000 and 2003 rankings and naming conventions. The number of occupied sites is higher in many instances according to the 2003 naming convention, because sites with enclosures are now being tracked as two sites (i.e., one for the enclosure and one for outside the fence). This change is important because it affects the outcome of the Imminent Extinction Contingency Plan defined in the CS (Pavlik *et al*. 2002a). Both the number of occupied Core sites and the total number of occupied sites are used to determine one of four Imminent Extinction Levels. Level 1 is indicative of a stable population trend while Level 4 indicates critically low site occupation. The criteria for each level are based the presence of six Core sites and increasing the number of Core sites to 10 in 2004 means that the status of Tahoe yellow cress may remain at Level 1. The minimum number of Core sites (6) in the Imminent Extinction Contingency Plan was chosen as the low threshold for the species because the lowest number of sites ever occupied in one year was only 7 in 1995-1996 (Table 3).

**Table 2. Number of ranked sites in each category in 2000 and 2003 to 2004.**

| Rank | # of sites in 2000 | # of sites in 2003 |
|---|---|---|
| Core | 6 | 10 |
| High | 6 | 6 |
| Medium | 12 | 14 |
| Low | 5 | 8 |
| Unranked/Miscellaneous | 25 | 26 |
| Total # of sites | 54 | 64 |

**Table 3. Summarized annual survey data comparing the 2000 and 2003 naming conventions and rankings (1978 to 2004)**

| Year | Lake Level (ft) | # of Occupied Sites | | # of Occupied Core sites | |
|---|---|---|---|---|---|
| | | 2003 names | 2000 names | 2003 rank | 2000 rank |
| 1978 | 6,224 | 3 | 3 | 0 | 0 |
| 1979 | 6,224 | 25 | 25 | 7 | 4 |
| 1980 | 6,226 | 16 | 16 | 7 | 5 |
| 1981 | 6,228 | 22 | 19 | 8 | 5 |
| 1982 | 6,228 | 13 | 13 | 5 | 4 |
| 1983 | 6,228 | 11 | 11 | 5 | 4 |
| 1986 | 6,228 | 14 | 14 | 7 | 5 |
| 1988 | 6,224 | 18 | 17 | 8 | 6 |
| 1989 | 6,224 | 2 | 2 | 0 | 0 |
| 1990 | 6,223 | 35 | 33 | 10 | 6 |
| 1991 | 6,223 | 21 | 21 | 4 | 3 |
| 1992 | 6,222 | 17 | 15 | 3 | 2 |
| 1993 | 6,223 | 37 | 35 | 10 | 6 |
| 1994 | 6,222 | 31 | 29 | 8 | 6 |
| 1995 | 6,227 | 9 | 7 | 5 | 3 |
| 1996 | 6,227 | 9 | 7 | 5 | 3 |
| 1997 | 6,228 | 11 | 8 | 8 | 6 |
| 1998 | 6,228 | 11 | 9 | 7 | 5 |
| 1999 | 6,228 | 15 | 10 | 8 | 5 |
| 2000 | 6,228 | 17 | 14 | 9 | 6 |
| 2001 | 6,225 | 29 | 25 | 10 | 6 |
| 2002 | 6,224 | 40 | 48 | 10 | 6 |
| 2003 | 6,224 | 46 | 45 | 10 | 6 |
| 2004 | 6,223 | 47 | na | 9 | 6 |

(Data source: Pavlik *et al.* 2002a; CSLC 2003, 2002)

*Assumes that core sites not surveyed in that year were occupied.

As in previous years, Tahoe yellow cress was observed in a variety of substrates during the 2004 survey. Based on the comprehensive shorezone assessment conducted by TRPA in 1993, suitable

habitat is considered to be composed of at least 30 percent sand. However, the species is adapted to the broad range of habitat conditions on the shores of Lake Tahoe including pure sand, gravel, cobble, and among boulders. It was observed growing from a crack in a large boulder and from a crack in a concrete weir. Plants were frequently found in and among wood and pine needle debris in the beach wrack deposited at the high water line.

Disturbance was also recorded at each Tahoe yellow cress site. The most common disturbances -- footprints, trash, boat dragging, beach raking -- are associated with recreational beach use. Footprint disturbances were recorded at nearly all of the sites. Nonnative plant species were common within some sites, with mullein (*Verbascum thapsus*) recorded at 22 of the occupied sites (47 percent). Despite local restrictions at most public beaches around the lake, dogs or evidence of dogs were noted at many sites. Impacts from Canada geese were also observed.

## 2.3 DISCUSSION

The 2004 annual survey for Tahoe yellow cress was the 22nd survey that has been conducted over the 27-year period from 1978 to the present. No surveys were conducted in three years (1984, 1985, or 1987) and less than three sites were visited in two years (1978 and 1989). Lake level (6,223 ft) was the lowest recorded since 1991 and an effort was made to survey as much of the shorezone as possible. The 47 occupied sites is the greatest number ever recorded in the survey history. However, with an increased number of participants and 61 sites surveyed, the 2003 and 2004 surveys have been the most comprehensive to date. Survey effort increased from 10,000 person minutes in 2003 to 14,000 minutes in 2004. Past analysis has demonstrated that the probability of observing Tahoe yellow cress increased as the number of sites surveyed increased, particularly in low lake elevation years (CSLC 2003). Still, the large number of occupied sites would be expected because the number of occupied sites has been shown to increase independent of search effort as lake elevation decreases and more habitat is exposed (Pavlik *et al*. 2002).

Despite the increase in the number of occupied sites, the total stem count decreased from over 25,000 stems in 2003 to 13,600 stems in 2004. Stem counts did increase rather significantly at several sites (Rubicon Bay, Eagle Creek/Avalanche, Taylor Creek, Upper Truckee West, and Dollar Point), but stem counts from many of the Core and High priority sites decreased (Taylor Creek Enclosure, Tahoe Keys, Regan Al Tahoe, Edgewood, and Glenbrook), indicating that the stem count data was mostly inaccurate due to implementation of the 6-inch rule. The most obvious example is the decrease in stem count at Upper Truckee East from over 13,000 stems in 2003 to only 5,000 in 2004. That site has a very gentle slope and the decrease in lake elevation of over 1 ft, exposed about 350 additional feet of suitable beach habitat. Consequently, the number of stems at that site should have increased significantly given the low water conditions.

As stated in the Methods section, the annual survey protocol was to count stems less than 6 inches apart as one individual (Appendix A). It was later determined that this protocol was not appropriate, as Tahoe yellow cress is capable of vigorous vegetative reproduction and what appears as an individual stem is often connected underground. Excavations of 3-year-old transplanted individuals by Etra (1994) revealed fragile root systems that spread laterally up to 20 inches (50 cm) and downward by the same amount, indicating that a single individual may occupy a fairly large area. It is not known whether seedlings from genetically distinct individuals would germinate in this space,

but there is no evidence to suggest that they would not. Further work on the details of the underground root networks may improve estimates of population size.

The TAG modified the survey protocol and established the 6-inch rule prior to the 2003 survey in an effort to standardize stem counts among teams. However, in 2004, a large number of stems were apparent on the surface across extensive areas that were not separated by 6 inches. It is possible that the overall stem count was lower at some sites because what appeared as many stems in 2003 essentially appeared as a single, large mat in 2004. There is a clear need for the TAG to develop an adequate and reliable measure of abundance for differentiating among Tahoe yellow cress sites and overall population size between years. The 8 abundance categories in Figure 3 may be incorporated into the annual survey datasheets as a way to standardize counting.

The CS established site rankings for the purposes of identifying conservation, restoration, and management priorities. Based on the index of viability scores, sites were ranked as Core, High, Medium, and Low priority sites. (For a detailed discussion on site ranking methods and results, refer to page 53 of the CS.) In 2003, the TAG revised the site rankings in Table 13 of the CS to incorporate additional data collected since 2000. Subsequent to the 2003 survey, the dataset encompassed two complete cycles of high and low lake elevations, whereas the 2000 dataset had a greater number of high lake elevation years. Five sites were promoted in rank (Lighthouse, Upper Truckee West, Tahoe Meadows, Zephyr Cove, and Secret Harbor), 2 were demoted (Glenbrook and Tahoma), and 13 remained unranked either because they were considered new or they do not meet the minimum data requirement to calculate the index of viability. Appendix D presents the 2004 annual survey data by ranking priority.

The revised rankings of 2003 better reflect the metapopulation dynamics of the species through two complete high and low water cycles. Although the index of viability could be updated each year for all ranked sites, the TAG recommends that the 2003 site rankings should be maintained into the future until another complete high/low water cycle is experienced. Unranked sites will be ranked as minimum data analysis requirements are met. The rankings are based on the biology of the species and are useful for prioritizing management actions. However, there is no direct link between site rank and actual management of any given site, particularly at private sites that are not being managed for TYC. Stewardship outreach will be necessary to protect Core sites on private property in times of high lake elevation and low population size.

## 2.4 CONCLUSION

Based on data collected through 2004, lake elevations between 6,222 ft to 6,224 ft (1,896 m to 1,897 m) appear to be optimal for Tahoe yellow cress persistence. Data continue to support the finding that the number of occupied sites increases as lake elevation decreases. The fact that almost 40 percent of the occupied sites are found on privately held lands highlights the importance of the participation of the Tahoe Lakefront Owners' Association in the implementation of the CS and MOU/CA. Incorporating public education and private property stewardship into Tahoe yellow cress conservation and restoration efforts is therefore a critical component in the success of the CS (see section 3.5).

Discrepancies and inconsistencies in stem count data within and among sites indicate a clear need for the TAG to develop an adequate and reliable measure of abundance for sites that support Tahoe yellow cress sites. This is particularly important as the CS specifies a minimal viable population (MVP) target of 1,200 stems for Core sites. While the majority of sites have never supported this number of stems, the MVP may be a useful restoration target at some sites, and it will be necessary to differentiate overall population size between years among ranked sites.

Overall, the population of Tahoe yellow cress appears to be stable under low lake elevation conditions. This supports the recommendation in the CS to reduce the survey effort to a significant sample size when lake elevation is at or less than 6,226 feet (LTD). The TAG expects to develop an appropriate sub-sampling protocol for the 2006 annual survey.

# 3. 2004 CONSERVATION ACTIVITIES

The overall intent of the CS is to preclude the need to list the Tahoe yellow cress under the ESA through restoration of a self-sustaining metapopulation dynamic that allows the species to persist in sandy beach habitat around Lake Tahoe despite high water levels and human-related impacts (Pavlik *et al*. 2002a). Achieving this requires research that directly supports management and restoration activities. Research began in 2002 with seed collection and greenhouse propagation of Tahoe yellow cress for the 2003 pilot project, which included outplanting of greenhouse grown plants, installation of protective fences, and monitoring of the sites (Pavlik and O'Leary 2002, Pavlik and Stanton 2004). An experimental reintroduction in 2004 advanced the research efforts (Pavlik and Stanton 2005). This section presents results from ongoing research and the Friends of Tahoe Yellow Cress Stewardship Program.

## 3.1 SEED COLLECTION

Similar to 2001 and 2002, seed collection was conducted at several sites during the 2003 survey period. Seeds for the 2003 pilot outplanting project were collected in September, 2003 at 9 priority and core restoration sites: Blackwood North, Blackwood South, Cascade, Lighthouse, Tallac Creek, Taylor Creek, Regan Al Tahoe, Tahoe Meadows, and Upper Truckee East. Seed from the Blackwood sites were combined for outplanting purposes. All seed lots were cleaned and hand-sorted into two equal lots in December and stored in manila envelopes at room temperature and humidity. Seed were delivered to two nurseries in the spring.

As part of the ongoing propagule production necessary for an age-structured reintroduction, additional seed were collected in September 2004. The 2004 seeds are currently stored at room temperature and humidity in dry manila envelopes and will be sorted and planted in the summer of 2005.

## 3.2 PLANT PROPAGATION

### 3.2.1 METHODS

Agreements with two nurseries were renewed to continue propagation of Tahoe yellow cress: The Nevada Division of Forestry (NDF) facility at an elevation of 5,000 ft in Washoe Valley, Nevada;

and privately-owned Sierra Valley Farms at an elevation of 5,000 ft in Beckwourth, California. Both facilities propagated Tahoe yellow cress for the 2003 pilot project and followed the same propagation protocols designed to maximize yield of founding plants while minimizing artificial selection and *ex situ* loss of genetic variation. The objective was to raise hardy, rather than productive, founders that would survive transplanting. For further details see the previous report in this series (Pavlik and Stanton 2003).

The nurseries were directed to utilize all seed lots and plant a minimum of 2,400 plants in plastic supercells with standard greenhouse soil-less potting mix (Photo 1). One to two inches of Lake Tahoe beach sand were sprinkled on the supercell surface to cover the seeds. Detailed information associated with the propagules (e.g., seed lot, maternal parent identification) was tracked in order to estimate fitness components (e.g., seed output - plant size correlations) and evaluate the performance of different reintroduced populations.

#### 3.2.2 RESULTS

Sierra Valley Farms delivered 1,742 plants in supercells and 50 2-year-old plants in D-pots to the NDF Washoe Valley nursery in May 2004. Washoe produced 872 supercells initially and was forced to split out over 600 cells only three weeks before the outplanting, to produce a total of 1,566 plants. In May, a combined total of 3,008 plants were available for outplanting.

In early May, the plants were sorted at the Washoe Valley nursery according to seed lot and then assigned a vigor code (low, medium, or high). The vigor code partially reflected variability that resulted from different planting dates. Sierra Valley Farms planted earlier than Washoe and kept the plants in the greenhouse longer. In May, most of the plants from Washoe were small and vegetative, while plants from Sierra Valley Farms had gone to fruit in the greenhouse and were already beginning to senesce.

Overall, 48 percent of plants were classified as low vigor and 52 percent were high vigor. This represents a much higher proportion of low vigor plants than was present in the 2003 pilot project cohort. In that year, only 14 percent of plants were low vigor, while the rest were divided nearly equally into medium and high vigor (43 and 42 percent, respectively).

### 3.3 CONTINUATION OF THE 2003 PILOT OUTPLANTING PROJECT

The 2003 pilot outplanting project was designed to inform subsequent reintroduction experiments for Tahoe yellow cress. Implementation of the pilot project assisted the researchers in identifying and resolving logistical issues associated with propagating, transporting, and reintroducing a rare plant to its historical habitat. Information from the pilot project on such factors as nursery propagation procedures, fencing, working with agency personnel, permit compliance, and outplanting and monitoring techniques has greatly informed the 2004 experiments. Refer to Pavlik and Stanton (2004) for a detailed discussion of the 2003 pilot project.

In 2004, replication of the 2003 pilot design at Taylor Creek and Sand Harbor was meant to test the ideas of age-structure outplanting and “founder–cost averaging”. The age-structure of a rare plant population may be important for the maintenance of high levels of reproductive output (seeds and

clones). Building an optimized age-structure in reintroduced populations can be accomplished by planting multiple age classes (e.g. one year-olds, two year-olds, etc.) in a single year or by promoting survival of founders across years. Members of different classes often differ in size and, therefore, in resources available for reproduction. Presumably, older and larger founders would produce more seeds or clones than younger, smaller founders, and could boost the overall production of new plants in a given year. "Founder-cost averaging" is the successive outplanting of founders of any age class in different years. In this way the risk of outplanting all founders in an unfavorable year (e.g. drought, high lake level) is reduced. This minimizes stochastic effects and is analogous to "dollar-cost averaging" in financial investment. Instead of maximizing monetary return, this ecological restoration technique could be used to maximize "return"(survival and reproductive output) on the investment of founders among all outplant years.

Continued monitoring of the 2003 cohort (referred to as "two year-olds') enabled a comparison of the effects of changing lake level on microhabitat characteristics and demographic performance of TYC. The persistence and reproductive output of 2003 founders can be used to evaluate success in creating new populations or enhancing existing ones.

### 3.3.1 METHODS

Four sites were planted for the 2003 pilot project: Avalanche/Eagle Creek in Emerald Bay (CDPR), Taylor Creek at Baldwin Beach (USFS), Zephyr Cove (USFS), and Sand Harbor (NDSP). The outplanting design was site-specific, lacking replication, and meant to address pilot project objectives rather than the key management questions (KMQs) identified in Pavlik and O'Leary (2002) (Pavlik and Stanton 2004).

Demographic, physiological, and disturbance monitoring techniques developed for the 2003 pilot project were continued. Detailed protocols are available in Pavlik and Stanton (2003). A new datasheet was developed to record the fate of every outplanted individual, allowing subsequent calculations of mortality rates, survivorship to reproduction, and estimates of reproductive output using models previously developed (Pavlik *et al*. 2002b). Plants were evaluated at two weeks and four weeks after planting and thereafter on a monthly basis through October. The water relations monitoring component measured physiological stress levels (i.e., xylem water potentials) of plants established at different hydrotopographic positions with respect to lake level.

In 2004, a new cohort of plants was installed in and among the 2003 pilot project plots at two sites: Taylor Creek and Sand Harbor (Avalanche and Zephyr Cove were not re-planted). Some of the microhabitat descriptions were modified from the 2003 design (see Table 5 in section 3.4.1.2).

### 3.3.2 RESULTS

A total of 827 plants were installed in the last week of May and first week of June at Sand Harbor and Taylor Creek (Table 4).

**Table 4. The number of Tahoe yellow cress plants installed at sites in the 2003 and 2004 (NP=not planted)**

| | Sand Harbor | Taylor Creek | Zephyr Cove | Avalanche |
|---|---|---|---|---|
| **2003 Installation (1,424 plants)** | 297 | 540 | 286 | 300 |
| **2004 Installation (827 plants)** | 281 | 546 | NP | NP |

Including the 2003 installation, a combined total of 2,251 individuals have been outplanted to the four pilot project sites.

With sustained low lake level in 2004, nearly 90 percent of the 2003 founders that survived to the end of the first season returned in the second season and survived to September. That means there were almost 750 established two year olds from the 2003 installation thriving at four sites. Survivorship among the 2003 cohort was still lowest at Sand Harbor and greatest at Avalanche (Figure 5). The important effect of microhabitat on survivorship was still evident at all sites with the best plant performance in the low beach habitat and poor performance in high beach.

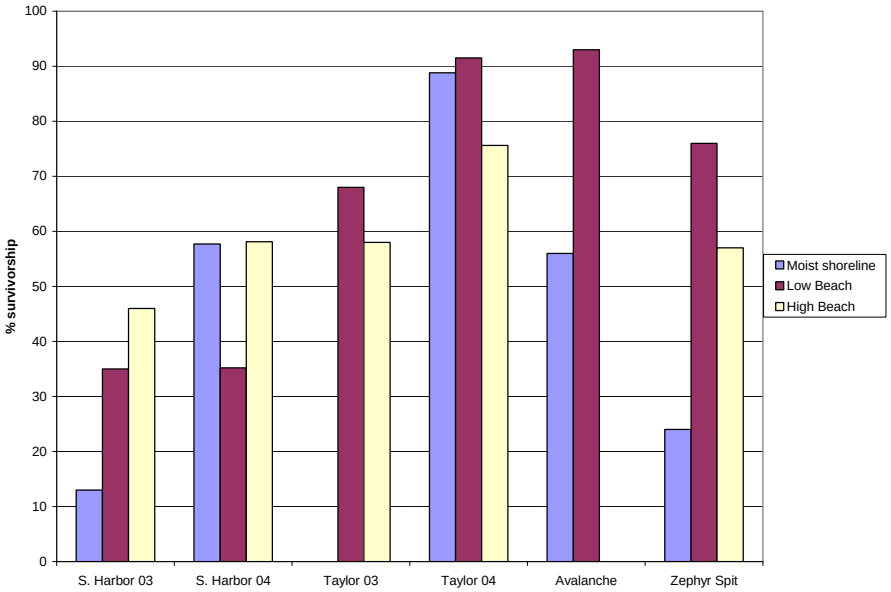


**Figure 5.** Overall rates of survivorship of the 2003 and 2004 cohort at the 2003 pilot sites in September, 2004.

Total survivorship of the 2004 cohorts at Sand Harbor and Taylor Creek was greater than it had been in the 2003 installation, improving from 27 to 43 percent at Sand Harbor and from 58 to 77 percent at Taylor Creek. This was partially due to less inundation in the moist shoreline, but there was also improved survivorship in the high beach at both sites, possibly indicating better water availability in the dry habitat from the higher lake elevation.

The number of founders from the two cohorts (2003 and 2004) that survived to reproduce is an important indicator of the potential of reintroduced plants to persist and form populations of value to conservation. Survivorship to reproduction in September 2004 was greater than 50% in moist microhabitats (e.g. moist shoreline) and less than 50% in dry microhabitats (e.g. high beach) regardless of site location (Figure 6). Furthermore, two year-old founders at Taylor Creek and Sand Harbor had much higher survivorship to reproduction in 2004 (58 and 35%, respectively) than did one year-olds (36 and 7%) in the same low beach microhabitat. This indicates that founders established in moist microhabitats will be more likely to reproduce in subsequent years and more likely to leave behind progeny to maintain the population. The apparent fact that older individuals are more likely to persist and reproduce in years with poor recruitment highlights the importance of age structure in a population. Furthermore, outplanting in multiple years at the same site exposed founders to both optimal (2003) and suboptimal (2004) conditions for long-term persistence, and the differential performance of the two cohorts highlights the importance of founder cost averaging (i.e spreading the risk across years).

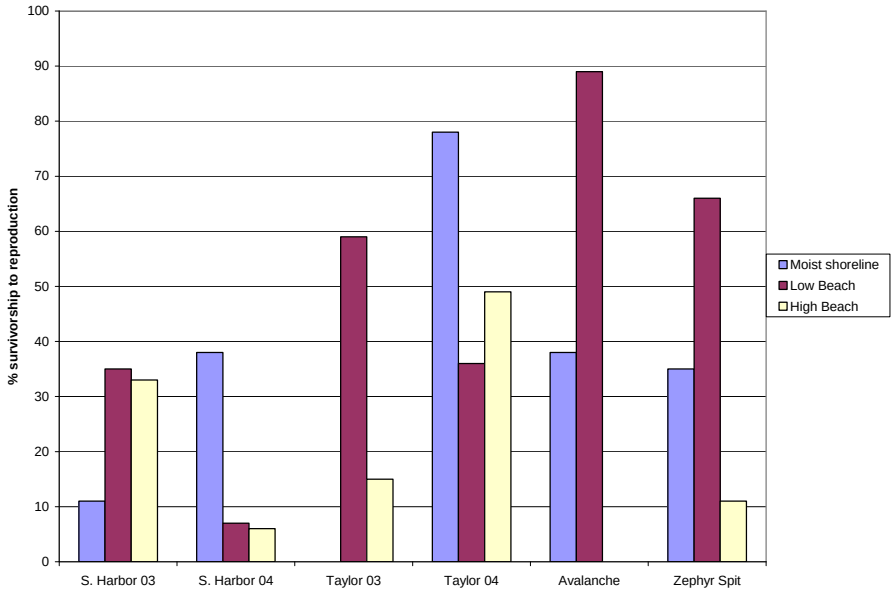


**Figure 6.** Overall rates of survivorship to reproduction of the 2003 and 2004 cohort at the 2003 pilot sites in September, 2004.

### 3.4 2004 EXPERIMENTAL REINTRODUCTIONS

While the 2003 pilot project design was site-specific, lacking replication, and meant to address pilot project objectives rather than the KMQs, the 2004 experimental reintroduction utilized a hypothesis-driven, replicated design to address all five of the KMQs. In conjunction with the statistical power of a replicated design, the demographic and water relations monitoring components were refined in 2004 to better determine the habitat conditions and best management practices that optimize the chances for successful restoration of Tahoe yellow cress.

Experimental reintroduction is a management tool used to address KMQs. The replicated design with "cause and effect" monitoring provides statistical power to evaluate factors central to those questions : 1) the effects of microhabitat, founder seed source, founder vigor, and founder water status on survivorship and reproduction, 2) the effect of outplanting timing on demographic performance, and 3) the efficacy of precision seeding to enhance or create TYC populations. In this way research hypotheses are only tested if the results immediately benefit implementation of the CS. Each of these factors addressed some aspect of at least one KMQ and had an associated hypothesis as discussed in section 3.4.3.

### 3.4.1 METHODS

#### 3.4.1.1 Site Selection

Two new sites were selected in 2004 for installation of experimental plots: Upper Truckee East and Nevada Beach. Similar site selection criteria as the 2003 pilot project were employed with the additional criteria that the sites needed to be large enough to accommodate a replicated experimental design in at least two microhabitat types. Both sites are described below.

Nevada Beach

Nevada Beach (USFS) is on the east shore of Lake Tahoe, just north of Edgewood Golf Course. It is designated a High priority restoration site in the CS with a ranking index of 47. It was initially classified as a Core site; however a stream restoration project constructed near the population inadvertently modified the hydrology of Burke Creek and other characteristics of the site, which now supports upland vegetation. Only one naturally occurring Tahoe yellow cress individual was present in 2004 near the creek. A fence still encloses the upland vegetation and all but the lowest reach of Burke Creek as it drains in to the lake.

Because of recreational concerns and access issues, temporary fencing could not be extended from the existing enclosure all the way to the shoreline. As installed, the fencing extended 70 ft (20 m) from the existing fence, leaving an access corridor of about 40 ft (12m) between the fence and Lake Tahoe. Although moist shoreline habitat along the lake was unavailable, the moist conditions and slight inundations along the edge of Burke Creek were presumably similar to the saturated conditions along the shore of Lake Tahoe. Both low and high beach habitats are present upslope in the coarse sandy beach that is completely devoid of any vegetation.

Upper Truckee East

Upper Truckee East (California Tahoe Conservancy [CTC]) is the expanse of beach on the east side of the mouth of the Upper Truckee River on the south shore of Lake Tahoe. It is designated as a Core site in the CS and has the second highest ranking index (78) because the Tahoe yellow cress population there has been large and persistent over the past 20 years. Large numbers of plants are scattered throughout the site, sometimes forming dense mats late in the season that may be present over several years. In most years plants have also been counted on the beach on the west side of the river (Upper Truckee West), adjacent to the Tahoe Keys. Over 13,600 stems were counted at Upper Truckee East during the annual survey in September 2003.

A complex mosaic of microhabitats is present at the site including: Moist shoreline, berm, low beach, and high beach. Tahoe yellow cress habitat is protected at the site with a fence extending along the length of the adjacent meadow. On the beach, the fence on the east side of the population only extends about 35 ft down slope. Signs along the lake side that designate habitat are moved as the lake recedes, forming an open enclosure. Recreational use is light, mostly from nearby residents walking on the beach, kayakers, and sailboarders. Dogs are allowed on the beach and there is often evidence of dogs inside the enclosure.

3.4.1.2 Design

The first outplanting in 2004 was conducted in early summer, beginning on May 24th and ending on June 3rd. The lake elevation on May 25th (6,224.2 ft) continued to rise over the next 10 days to 6,224.3 ft on June 3rd, the highest level of the season, which was maintained for several weeks. In mid-June, the lake began a slow recession, dropping to a season low of 6,222.6 ft on October 16th. The lake was at 6,223.9 ft at the time of the second outplanting at Upper Truckee East on July 29th (Figure 7).

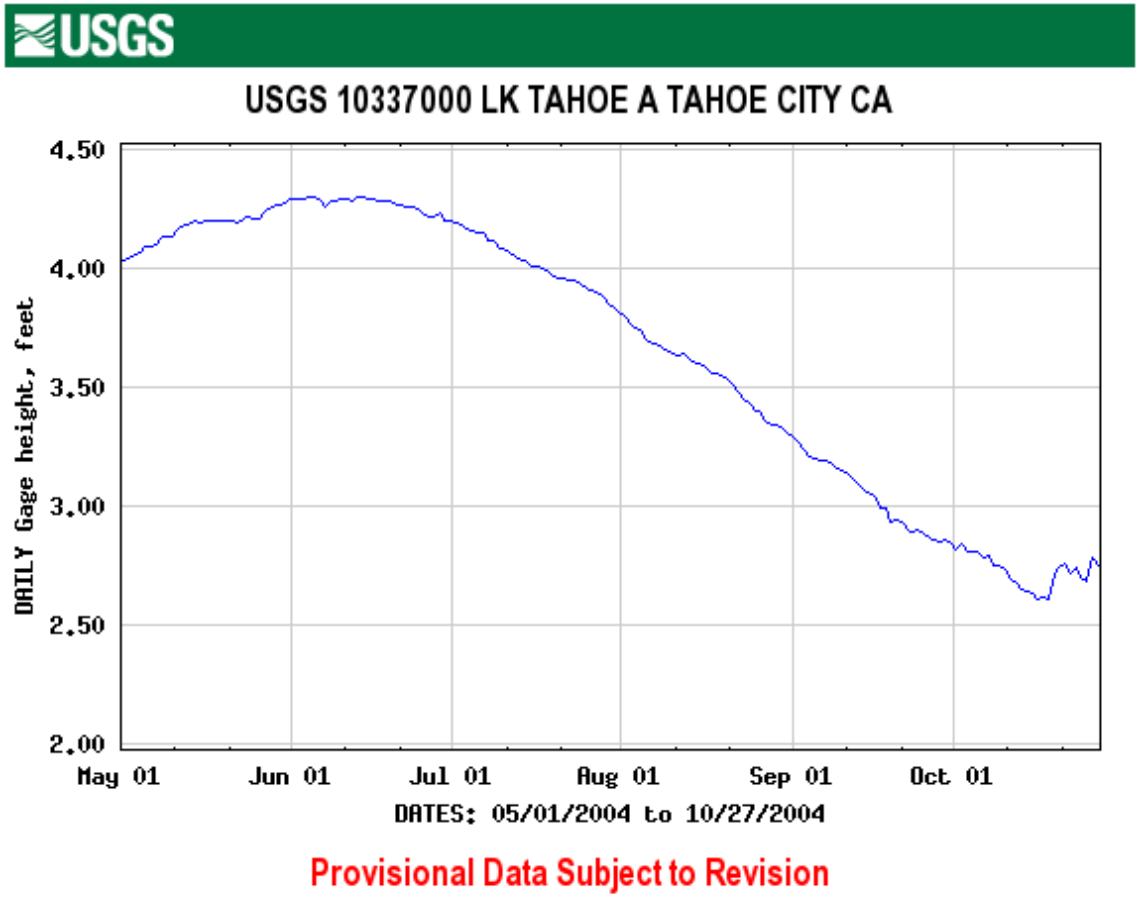


**Figure 7. Elevation of Lake Tahoe showing yearly peak in June and low in October (add 6,220 ft LTD to gage height on the y axis). Graph from the USGS Tahoe City station.**

In the 2003 pilot project six Tahoe yellow cress microhabitats were identified: moist shoreline, low beach, high beach, dune trough, meadow, and dun (Table 5). These designations were revised for the 2004 installation to correlate site microhabitats with elevation and microtopography. The assumption behind this methodology is that the water table is at the elevation of Lake Tahoe and therefore the height of a plot above the lake is equivalent to the depth to the water table. At each site, a laser level was used to determine the elevation of each plot and habitat type using the known elevation of Lake Tahoe on that day as a reference point.

Moist shoreline habitat occurred from 6,224.6 to 6,225.7 ft LTD in plots adjacent to the lake, generally in rows 1 through 5. This of course is an arbitrary habitat location, based entirely on the lake elevation on the day of planting in late May. In 2004, the moist shoreline was characterized by saturated soil conditions and wave inundations for most of the season.

**Table 5. Shorezone elevations and plot locations of seven Tahoe yellow cress microhabitats for six outplanting sites**

| MICROHABITAT | ELEVATION feet (LTD) | PLOT LOCATION |
|---|---|---|
| Moist shoreline | 6,224.6 to 6,225.7 | In plots adjacent to the lake at all sites, generally in rows 1-5. At Nevada Beach, in rows 1-5 adjacent to Burke Creek |
| | | |
| Berm 1 (formed in May) | 6,225.3 | Upper Truckee East, blocks 1-5 |
| Berm 2 (formed in July) | 6,224.7 | Upper Truckee East, blocks 1-6 |
| | | |
| Low beach | 6,225.8 to 6,227.9 | Sand Harbor, rows 15 and less |
| | | Avalanche, all |
| | | Upper Truckee East, blocks 1-5 |
| | | Nevada Beach, blocks 1-3 and rows 6-8 in blocks 4-9 |
| | | Zephyr Cove, plot 1 (planted in2003) |
| | | Taylor Creek, plot 2 |
| | | |
| Dune trough (i.e., back beach depression) | 6,224.6 to 6,226 | Taylor Creek, in back beach plot 3, rows 1-12 and all of plot 4 |
| | | |
| High beach | 6,228 to 6,230.6 | Taylor Creek, plot 2A and plot 3, rows 13 and above |
| | | Upper Truckee East, blocks 1-5 planted in May, and blocks 1-6 planted in July |
| | | Nevada Beach, blocks 10-12 |
| | | Zephyr Cove, plot 2 (planted in2003) |
| | | Sand Harbor, plot 1 rows 16-20 |
| | | |
| Meadow | 6230 | Taylor Creek, plot 5 |

Low beach occurred between the moist shoreline and high beach in the range from 6225.8 – 6228 feet. The maximum lake elevation is approximately 6228 ft so the low beach habitat is susceptible to inundation. High beach habitat (6228-6230.6 ft) is never inundated and provides a refuge in times of high lake levels. Habitat that was identified as dune in 2003, is now included in high beach. Berm habitat only formed at Upper Truckee East where wave run-up deposited benches of sand adjacent to the shoreline. Berms are generally protected from wave action, but still very moist and close to the water table. One berm (6,225.3 ft) had formed at the time of the May outplanting and a second berm formed later in July (6,224.7 ft).

Finally, two other microhabitats, including dune trough and meadow, were only present at Taylor Creek. In the back beach, a persistent lagoon supporting water lilies (*Nuphar* sp.) and other aquatic vegetation has been apparent over the last several years. Plants were installed in the moist sand between 6,224.5 and 6,227.5 ft on either side of the trough. Beyond the dune trough, plants were installed in meadow habitat amongst the stabilized vegetation at 6,230 ft.

A total of 582 founders were outplanted within the temporary fencing around Burke Creek at Nevada Beach on May 27, 2004. Plants were from the Taylor Creek, Cascade, and Tahoe Meadows sources. Three blocks, containing 48 founders each (3 columns by 16 rows), were installed on the north side of Burke Creek in low beach habitat. Six blocks of 48 founders each (6 columns by 8 rows) were placed on the bank of the creek with three blocks on the north side and three on the south. Rows 1-5 were in moist shoreline microhabitat and the upper three rows (6-8) were considered low beach. The beach on the south side of the creek was on significantly higher ground than the north side so three blocks of 50 plants each (10 columns by 5 rows) were installed in high beach habitat. Overall, 180 founders were outplanted in moist shoreline, 252 in low beach, and 150 in high beach microhabitats.

Four microhabitats were present at UTE; moist shoreline, berm, low beach, and high beach. Founders were installed in blocks of 50, replicated five times for a total of 250 plants per microhabitat. In each block, founders were placed one meter apart in 10 columns with one half meter between each of the 5 rows. Each founder was marked with a color-coded wooden stake signifying its source population. Plants from 6 seed sources were used at the site. The moist shoreline contained only plants derived from the UTE source; the berm and low beach microhabitats had plants from UTE, Taylor Creek, and Blackwood; the high beach plants were from Lighthouse beach, Regan Al Tahoe, Tallac, Taylor Creek, and UTE. In addition, 45 two year-old founders from various seed sources were outplanted in the low and high beach microhabitats (for age structuring). Outplanting took place on June 3, 2004.

A second berm of pure sand formed in July at the east end of UTE about 15 meters west of first berm. A second outplanting with founders from the UTE and Blackwood source took place on July 29, 2004. Six blocks of 30 founders each (10 columns by 3 rows) were installed on the new berm and in the high beach for a total of 180 plants per microhabitat. This additional planting brought the total number of founders outplanted at UTE to 1,405.

A precision seeding experiment was also installed at Upper Truckee East at the time of the June outplanting. Plywood planting frames with 100 holes were used as guides for sowing seed in four

microhabitats: Low beach, high beach, berm, and moist shoreline. A frame was placed on the ground and a 1-ft piece of rebar was inserted in each of three small holes (two at the top and one at the bottom) on each frame. The rebar was then permanently fixed in the ground so the frame could be returned to the exact same location for monitoring. Next, a small amount (3 to 10 seeds) of cleaned Tahoe yellow cress seeds were placed on the beach sand surface in each planting hole and lightly covered with a small amount of sand taken from just outside the frame. Three frames were sowed with seed in each habitat for a total of 300 planting holes per habitat. To avoid any shifting of sand, plots were not watered. Plots were monitored one month after sowing.

#### 3.4.1.3 Monitoring

Demographic, physiological, and disturbance monitoring techniques developed for the 2003 pilot project were continued (Pavlik and Stanton 2003). A new datasheet was developed to record the fate of every outplanted individual, allowing subsequent calculations of mortality rates, survivorship to reproduction, and estimates of reproductive output using models previously developed (Pavlik *et al*. 2002b). Three of the land management agencies (USFS, CTC, and NDSP) committed personnel for outplanting and ongoing monitoring efforts throughout the 2004 growing season. Plants were evaluated at two weeks and four weeks after planting and thereafter on a monthly basis through October. Data collection parameters included: Plant position, seed source**,** phenology**,** vigor**,** initial and final plant size**,** and current status. Reproductive output was estimated based on an equation that links canopy size to seed output ($y=3.609x-109.542$, $r = 0.81$) (see Figure 4 in Pavlik, Stanton, and Childs 2002).

The water relations monitoring component measured physiological stress levels (i.e., xylem water potentials) of plants established at different hydrotopographic positions with respect to lake level. Water relations monitoring was conducted twice during the 2004 growing season: Once in July and again in late September during peak reproduction.

Disturbance monitoring was conducted in conjunction with the demographic monitoring. Additional disturbance monitoring was conducted on July 5$^{th}$ in an attempt to document any impacts from the 4$^{th}$ of July weekend. At five times throughout the season, the monitoring crews made notes about the following possible disturbances in the plots: Footprints/body impressions, animal prints (especially dogs and Canada geese), trash, and any acts of vandalism, especially those affecting Tahoe yellow cress plants or the fence/signs. Photographs were taken of any significant disturbances and maps were generated to mark the areas of disturbance. Plot aisles and perimeters were raked smooth after all monitoring to obliterate any signs of disturbance and discourage people from entering the plots.

### 3.4.2 RESULTS

#### 3.4.2.1 Founder Survival and Reproduction

Nevada Beach

Nearly 75 percent of the 582 founders at Nevada Beach survived to September (439 individuals). Of these, 75 percent were reproductive in September, producing an estimated 134,000 seeds. Mean seed output was high (498 seeds per plant) and reproductive individuals were fairly large (mean canopy 151 $cm^2$). The site is only a few miles south of Zephyr Cove and these values are similar to those that were documented there in 2003 (mean seed output was 532 seeds per plant and mean canopy was 172 $cm^2$). The higher first year survivorship at Nevada Beach (75 percent), when compared to Zephyr Cove (58 percent), is likely due to the fact that plants in the moist shoreline microhabitat at Nevada Beach were installed along the shore of Burke Creek instead of Lake Tahoe, and therefore did not experience the strong inundation that occurred in the first year at Zephyr Cove.

Three microhabitats were present at Nevada Beach; moist shoreline, low beach, and high beach. The moist shoreline (6,224.6-6,225.7) was located along the shore of Burke Creek to resemble moist hydrological conditions along the immediate shore of Lake Tahoe. From very early in the season survivorship of founders in the moist shoreline and low beach (84 and 79%, respectively) were significantly higher than the high beach (50%). Further analysis, however, revealed that this difference was primarily due to microtopographic differences with respect to the two sides of the creek. Plants on the north side of Burke Creek were at a slightly lower elevation with respect to the water table compared to plants on the steeper and higher south side. North side plants had significantly higher survivorship (93%) than those on the south side (58%) (Figure 8).

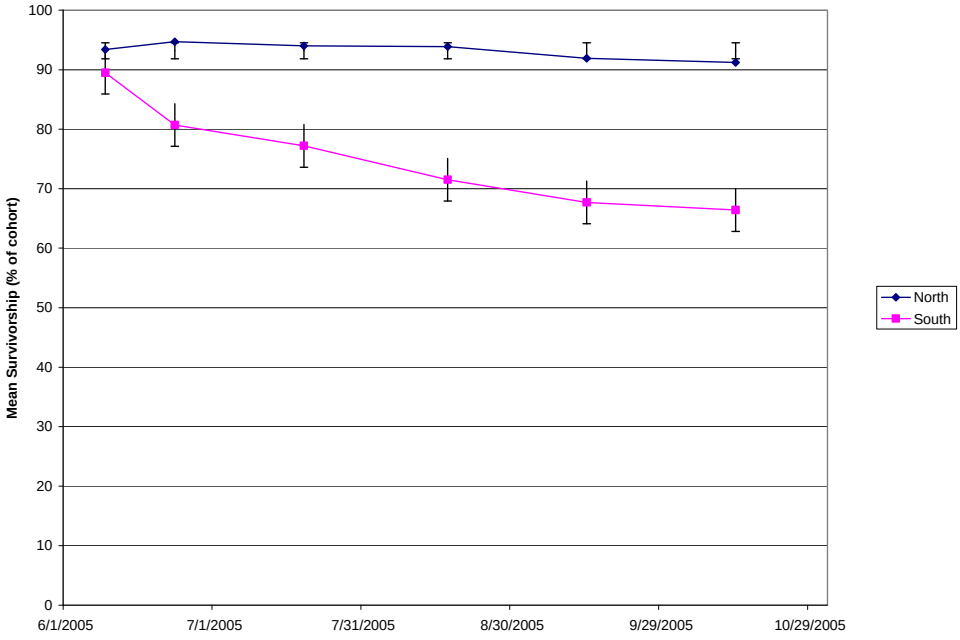


**Figure 8. Mean survivorship of 2004 TYC founders on two slope aspects (north or south side of Burke Creek) at Nevada Beach, 2004. Differences between aspects is significantly different (ANOVA $p<0.0002$) after June.**

Reproduction, as measured by mean seed output, was a significantly higher in the moist shoreline and low beach than in the high beach (Table 6). Founders in the high beach were significantly smaller and produced far less seed. Plantlet production was only high in the moist shoreline, indicating that while plants in the high beach experienced enough water stress to essentially shut down reproduction, plants in the low beach had sufficient resources to set seed, but not for vegetative reproduction.

**Table 6.** Mean canopy area, mean seed output (#/founder), total seed production (#/microhabitat) and total plantlet production (#/microhabitat) in three microhabitats at Nevada Beach in September, 2004. Mean values in a column followed by different letters are significantly different (ANOVA $p<0.02$).

| Microhabitat | # ( and proportion) of Reproductive Plants (#/microhabitat) | Mean Canopy Area (cm2) | Mean Seed Output (#/founder) | Total Seed Production (# /microhabitat) | Total Plantlet Production (#/microhabitat) |
|---|---|---|---|---|---|
| Moist shoreline | 141 (89%) | 167a | 510a | 69.780 | 209 |
| Low beach | 142 (63%) | 153a | 527a | 63,721 | 17 |
| High beach | 44 (43%) | 22b | 61b | 492 | 10 |

Upper Truckee East

Survivorship of the June planting of 1000 plants at Upper Truckee East was 73 percent in September. The late July planting fared almost as well, with 252, or 70 percent of that cohort surviving to September. Surprisingly, only 51 percent (23 individuals) of the 2-year-old founders survived to September bringing the total number of surviving Tahoe yellow cress founders in all plots to 1009, or 72 percent, of the total planting.

Four microhabitats were present at Upper Truckee East: Moist shoreline, berm, low beach, and high beach. The first planting in these habitats occurred in early June and significant differences in survivorship were apparent by late July (Figure 9). By September, survivorship in the moist shoreline and berm habitats, 93 and 97 percent respectively, was significantly greater than the low or high beach. Survivorship in the high beach (66 percent) was also significantly greater than the low beach (38 percent). The low beach experienced large declines in survivorship as the season progressed and the cover of lupine (*Lupinus lepidus*) increased in the plots. Individuals that did survive in the low beach plots were thin, fragile, and often etiolated as they struggled to reach the light. Mean lupine cover in all 11 of the high beach plots (both planting dates) was only 3.5 percent, but in the 5 low beach plots, mean lupine cover was 59 percent, a significant difference (ANOVA $p<0.0001$). Lupines were not present in the berm or moist shoreline plots. Plant cover in the berm plots was almost exclusively Tahoe yellow cress along with occasional western yellow cress (*R. curvisiliqua*) and cinquefoil (*Potentilla* sp.). In the moist shoreline plots mean cover was 29 percent, lower than the low beach but significantly higher than the high beach (ANOVA $p<0.0001$).

The effects of the different amounts of plant cover were evident in founder plant size and reproductive output. Reproduction was most successful in the berm plots where total seed and plantlet production was far greater than the other habitats (Table 7). Nearly all (93 percent) of the surviving founders in the berm plots fruited in September and these individuals were significantly larger and produced more seed (480 seeds/plant). Interestingly, mean seed output in the low beach

(250 seeds/plant) was not significantly lower than the berm, probably because the small number of individuals that did reproduce occurred in gaps in the lupine. Despite differences in vegetation cover, mean survivorship to reproduction in the moist shoreline and berm in September was significantly greater than in low or high beach plots.

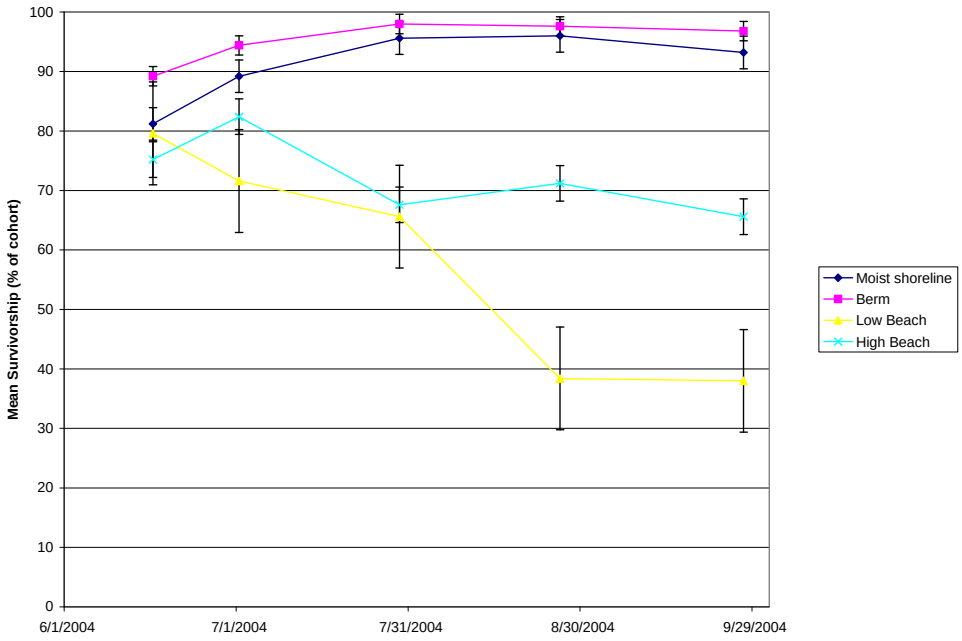


**Figure 9.** Mean survivorship of 2004 TYC founders in four microhabitats at Upper Truckee East, 2004. Differences between moisture shoreline and berm and the other two microhabitats was significantly different (ANOVA $p<0.05$) after July.

**Table 7.** Mean canopy area, mean seed output (#/founder), total seed production (#/microhabitat) and total plantlet production (#/microhabitat) in three microhabitats at Upper Truckee East in September 2004. Mean values in a column followed by different letters are significantly different (ANOVA $p<0.0001$).

| Microhabitat | # ( and proportion) of Reproductive Plants (#/microhabitat) | Mean Canopy Area (cm2) | Mean Seed Output (#/founder) | Total Seed Production (# /microhabitat) | Total Plantlet Production (#/microhabitat) |
|---|---|---|---|---|---|
| Moist shoreline | 193 (83%) | 24b | 52b | 2,734 | 0 |
| Berm | 225 (93%) | 127a | 480a | 82,992 | 374 |
| Low beach | 15 (16%) | 51b | 250ab | 3,747 | 0 |
| High beach | 35 (21%) | 31b | 182b | 3,275 | 11 |

Effect of planting time: Overall survivorship of the late July planting in September was 70 percent, almost equal to the 73 percent of the June planting. However, there was marked variation among habitat types. Regardless of planting time, founders in the berm plots had significantly greater mean survivorship over the entire season than founders in the high beach (Figure 10). Mean reproduction, plant canopy, seed output per plant, and plantlet production was also significantly higher in the berm plots than in the high beach (Table 7).

The effect of planting time was mainly evident in the high beach. Founders planted in late July in the high beach had decreased survivorship in September and October than founders planted in June The few plants that managed to survive in the July cohort did not produce any seed or plantlets. In contrast, canopy size and individual seed output was quite similar between the two cohorts in the berm. However, the rate of reproduction, and therefore overall seed production was reduced in the July cohort. This data strongly suggests that it is better to outplant earlier in the growing season. Furthermore, the window for transplanting is more narrow in sub-optimal habitats such as drier high beach where mitigation would be most likely to occur.

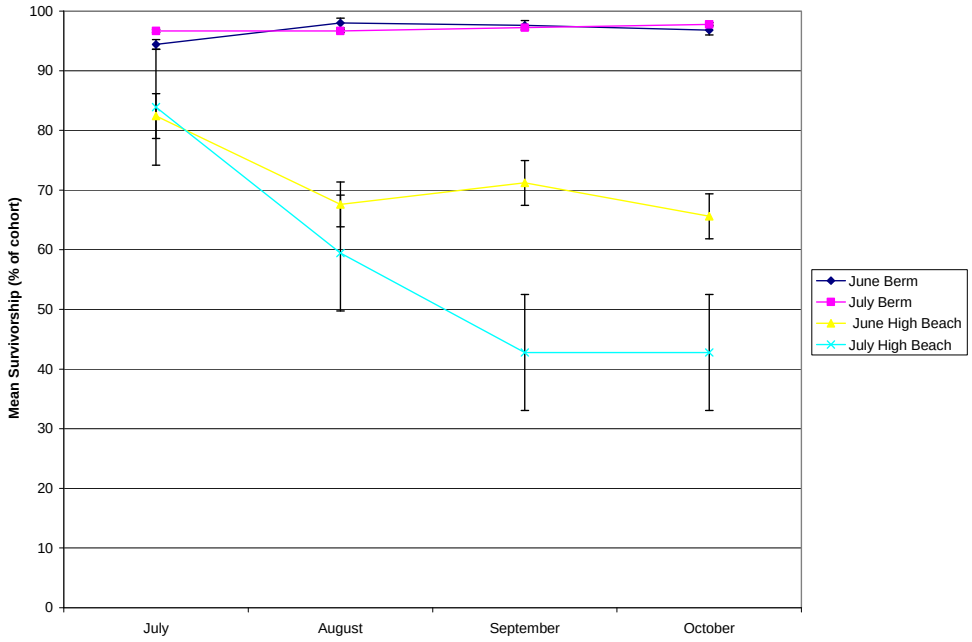


**Figure 10.** Mean survivorship of 2004 TYC founders in two microhabitats planted in early June or late July 2004 at Upper Truckee East. Differences between berm and high beach became significant ( ANOVA $p<0.0001$) after August.

**Table 7.** The effect of outplanting time (June or July) on mean canopy area, mean seed output (#/founder), total seed production (#/microhabitat) and total plantlet production (#/microhabitat) in three microhabitats at Upper Truckee East in September 2004. Mean values in a column followed by different letters are significantly different (ANOVA $p<0.001$).

| Microhabitat/Date | # ( and proportion) of Reproductive Plants (#/microhabitat/date) | Mean Canopy Area (cm2) | Mean Seed Output (#/founder) | Total Seed Production (# /microhabitat) | Total Plantlet Production (#/microhabitat) |
|---|---|---|---|---|---|
| Berm / July | 49 (31%) | 140a | 436a | 32,265 | 152 |
| Berm /June | 225 (90%) | 127a | 480a | 82,992 | 374 |
| High beach/ July | 7 (4%) | 8b | 0 | 0 | 0 |
| High beach/June | 35 (14%) | 31b | 182b | 3,275 | 11 |

3.4.2.2 Effects of Initial Founder Vigor

At the time of outplanting in June 2004, 48% of plants were coded as low vigor and 52% were high vigor. In contrast, only 14% of plants in the 2003 pilot project cohort were low vigor. An attempt had been made to randomly distribute low vigor plants among all plots within a site.

Initial vigor in 2004 did not appear to influence survivorship or reproduction at either Taylor Creek or Sand Harbor (unlike 2003). Survivorship of low and high vigor founders were virtually identical at Sand Harbor (survival= 43% of low vigor and 44% of high vigor) and only slightly different at Taylor Creek (survival= 61% of low vigor and 76% high vigor).

At Upper Truckee East, three codes levels (L, M, H) were used to describe initial vigor of founders. Overall, 66% of low vigor founders survived to September and 55% of those reproduced, while 77% of high vigor founders survived to September and 53% of those reproduced. While overall survivorship was fairly similar, the influence of initial vigor did vary among microhabitats. Unexpectedly, initial vigor made the largest difference in optimal microhabitats (moist shoreline and berm) where low vigor founders had significantly lower survivorship (Table 8). In optimal habitats with plentiful resources (i.e. soil moisture) we thought the effect of initial vigor would be expected to be minimal because ample water would enable low vigor plants to re-establish. The significant results are likely due to the very small variability in the data because survivorship of all founders in those habitats was close to 100 percent.

**Table 8.** The influence of initial vigor on mean percent survivorship (n = 5 blocks) in the TYC June 2004 cohort in four microhabitats at Upper Truckee East, September 2004. Values in a column followed by different letters are significantly different (ANOVA $p<0.001$).

| Initial Vigor Code | Berm | Moist Shoreline | Low Beach | High Beach |
|---|---|---|---|---|
| Low | 86.7b | 92.5b | 40.6a | 61.9a |
| Medium | 98.5a | 98.7a | 35.7a | 59.9a |
| High | 100a | 100a | 486a | 69.1a |

A similar pattern was evident at Nevada Beach where overall mean survivorship of low vigor (72%) and high vigor (79%) founders in September was not significantly different. However, the effects of initial vigor were not apparent in either optimal or sub-optimal habitat. At Nevada Beach the main microhabitat feature that influenced survival rates was slope aspect of the creek channel. The south side of Burke Creek was much higher above the Lake and had significantly lower survivorship than the North side (Figure 4). At the two week monitoring period in June, the effects of initial vigor were apparent on the south side of the creek, where mean survivorship of high vigor founders was 95% and 72% for those with low vigor. On the north side of the creek, however, survivorship of high and low vigor founders was 97% and 93%, respectively. The vigor difference on the south side had disappeared by September. Mean survivorship of low vigor founders (66%) was not significantly different than high vigor individuals (56%) and, therefore, initial vigor does not appear to be the cause of lower survivorship on the south side of the creek. Survivorship remained high on

the north side of the creek and, unlike at Upper Truckee East, initial vigor did not significantly affect survivorship in this optimal, mesic habitat (low vigor=95 %, high vigor =92%).

These results contrast with the pattern observed in 2003 pilot project. In 2003, founders with high initial vigor were two to three times more likely to survive than those with low initial vigor. While plots were not replicated and no statistical validation is possible, the magnitude of the vigor effect suggests that the 2003 patterns were real. The lesser effect of initial vigor in 2004 may have been due to the higher lake level. The higher water table would increase soil moisture at higher microhabitat elevations, thus enabling low vigor founders to become established in greater numbers.

3.4.2.3 Founder Population Sources (Genetic stock)

Founders were propagated from seed from eight sites: Blackwood, Cascade, Lighthouse, Tallac Creek, Taylor Creek, Regan/Al Tahoe, Tahoe Meadows, and Upper Truckee East. Results from the 2003 pilot study indicated that maternal seed source did not affect survivorship. A second year of results from Taylor Creek indicated that survivorship was similar among founders from four different seed lots (the plots were not replicated so statistical validation was not possible). In the replicated experiments at Nevada Beach and Upper Truckee East, the data clearly establish that seed l source does not affect survivorship. Mean percent survivorship in September at Nevada Beach was not significantly different between founders from three seed lots in any of the microhabitats present (Figure 11). Similarly, mean survivorship in the berm and low beach at Upper Truckee East in September was not significantly different (Figure 12). The data strongly suggests that founder genotypes do not play a significant role in the survival of outplanted seedlings. Therefore, until data to the contrary become available, restoration designs need not incorporate seed source as a variable. In order to retain any unique alleles, that may be present in some source populations (see Hipkins and DeWoody 2004), it would be ideal to mix seed from many locations for propagation purposes, but tracking is not necessary.

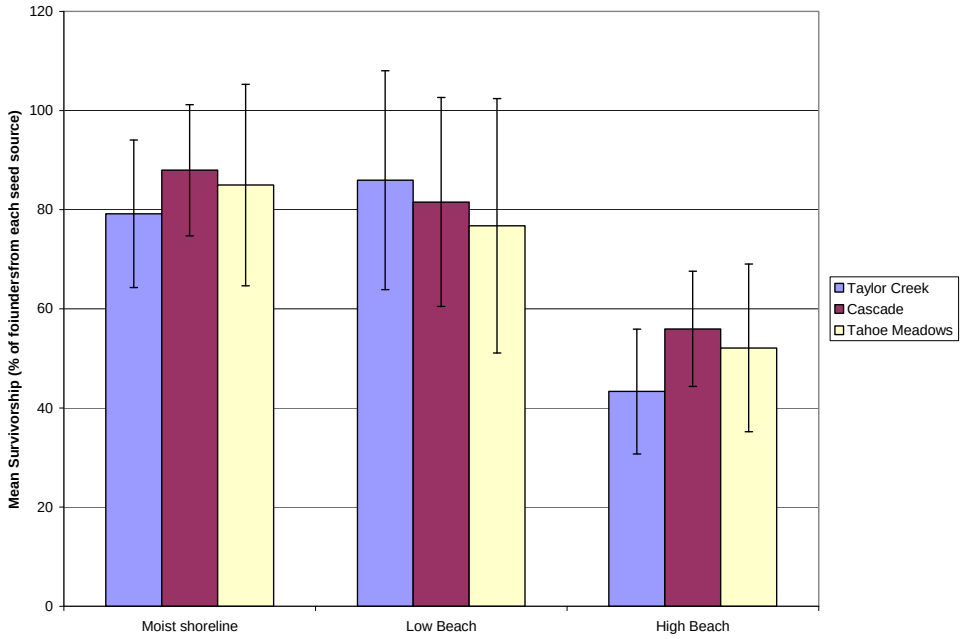

**Figure 11.** Mean percent survivorship of three seed sources in three microhabitats at Nevada Beach, September 2004. Bars indicate ± 1 SD.

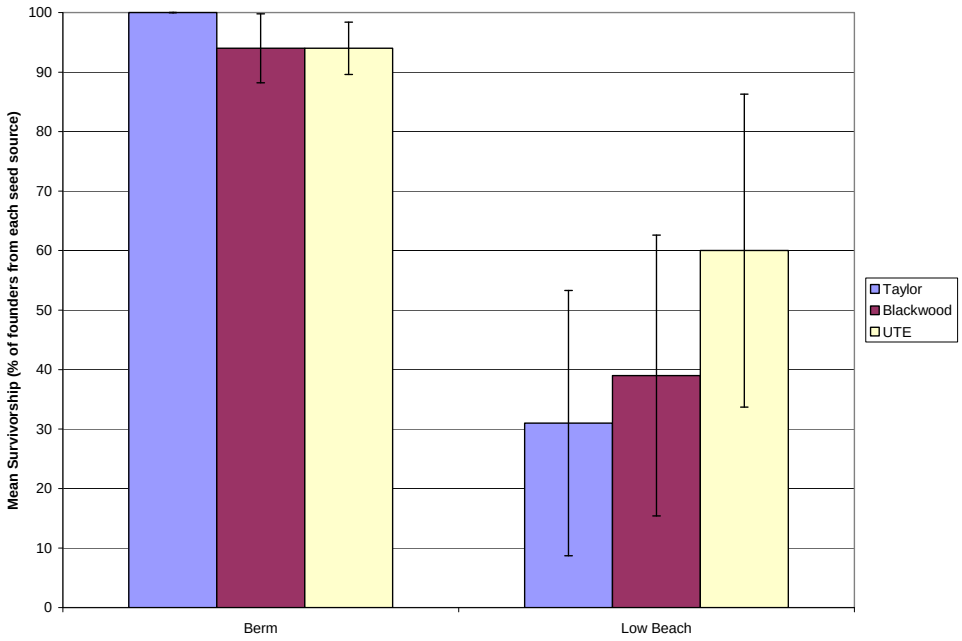


**Figure 12.** Mean percent survivorship of three seeds sources of the June cohort in berm and low beach microhabitats at UTE, September 2004. Bars indicate ± 1 SD.

3.4.2.4 Water Relations

The xylem water potential of Tahoe yellow cress founders was measured as a direct way to evaluate a plant's response to its immediate environment. Since plant water status reflects the ambient soil and atmospheric moisture conditions, it affords an opportunity to directly assess differences in the water availability among various Tahoe yellow cress microhabitats. Well-hydrated plants have higher water potentials [less negative and closer to 0 bars or 0 MPa (megapascals)] because water is moving through the plant under low tension. As water becomes less available, plant water potential decrease (i.e., becomes more negative) and the plant experiences greater stress (e.g., loss of cellular turgor pressure). Water potential for forbs in mesic habitats generally ranges from at or near 0 bars for a fully saturated plant to a lower threshold of –17.0 bars for a sensitive plant that is stressed and near wilting. For the pooled data from all sites, mid-day water potential values were highest in the moist shoreline early in the season in July and this was maintained into September (Figure 13).

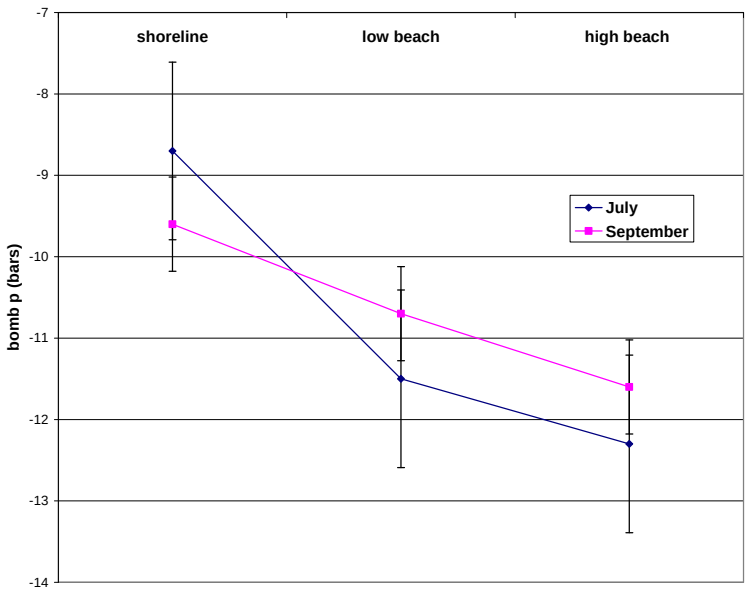


**Figure 13.** Mean mid-day water potentials of Tahoe yellow cress in selected habitats in July and September 2004. Data pooled from all sites. Bars indicate ± 1 SD

Differential survivorship in September within the four microhabitats at Upper Truckee East corresponded to mean midday founder water potentials (Figure 14). Mean survivorship in berm and moist shoreline were significantly greater and founder water potentials significantly higher than in the low beach or high beach. Competition for soil moisture from lupines and other vegetation in the low beach probably reduced survival in the low beach. This reduction was reflected in lower xylem water potentials, indicating that surviving plants were experiencing water stress from moisture competition and not from shading or space restrictions. The pattern at Nevada Beach also indicated a correlation between mean survivorship and mid-day water potentials, but was more typical of that observed at other sites where survivorship in the low beach and moist shoreline were significantly greater and water potentials significantly higher than the high beach (data not shown).

A regression analysis of pooled data for all sites indicates that mean mid-day water potentials may explain up to 30 percent of the variation in founder survivorship in September (Figure 15). Although the relationship is not strong, the overall pattern that mean survivorship decreases as water potentials decrease (and therefore water stress increases) is to be expected because many plants thrive when well-watered and falter when stressed. TYC appears to be sensitive to relatively small changes in xylem water potential, perhaps because it lacks a well-developed mechanism for physiological acclimation (such as osmotic adjustment). In other words, there is no evidence of drought tolerance in TYC and it is clear that factors in addition to water status are also influencing survivorship.

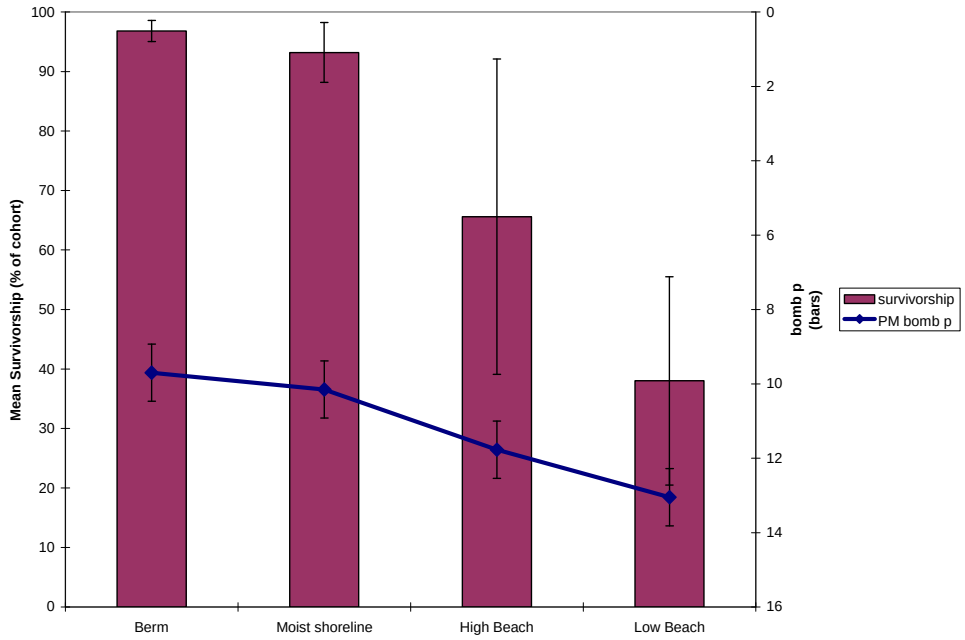


**Figure 14**. Mean founder survivorship and mean midday water potentials (bars X -1) of TYC in selected microhabitats at Upper Truckee East, September 2004. Bars indicate $\pm$ 1 SD. Differences between survivorship in the low beach and the moist shoreline and berm microhabitats are significant (ANOVA $p < 0.001$).

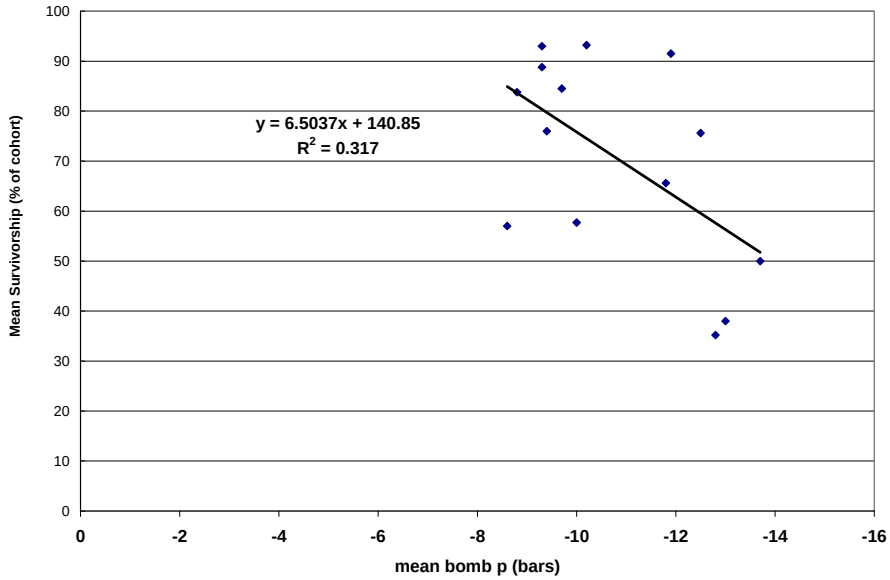


**Figure 15**. Regression of mean survivorship (%) on mean midday water potentials (bars) of TYC founders, September 2004. Data pooled from all sites.

#### 3.4.2.4 Fencing

In 2004, all sites were partially or fully enclosed with fences except for Avalanche (the site was not fenced in 2003 due to its remote location). Fencing helped to reduce impacts from recreational activities among the sites, but three of the enclosures were vandalized during the season. At Taylor Creek, the wire flags marking plants in the dune trough plot within the permanent fence were removed some time in August. The tight spacing of the 2003 and 2004 cohort made it difficult to replace the flags correctly and consequently the August data could not be used in analysis. Some uncertainty remained over plant identity in September, but the summary data was sound. The temporary fencing in the low beach at Zephyr Cove was cut early in the season. No plants were harmed and the USFS repaired the fence quickly. The fence at Nevada Beach also required repairs during the season.

At Upper Truckee East, temporary orange construction fencing was installed immediately after the June outplanting and the fence was cut within two weeks. The CTC replaced the orange fence with permanent plastic-wrapped wire and wood post fencing. This fence remained intact throughout the season; however, signs of dogs and footprints were evident in the plot at every monitoring period.

Maintaining fencing throughout subsequent experimental plantings will be important for data collection continuity. Positive identification of individual plants is required for detecting initial vigor related or genotype-related causes of differential founder survival and it is critical to determining founder longevity and decay curves for reproductive characters.

#### 3.4.2.5 Precision Seeding

One month after sowing, very few seedlings had emerged from seeds in plots at Upper Truckee East. No seedlings were present in any of the low beach or high beach plots. Two seedlings were present in one berm plot, and nineteen seedlings in one moist shoreline plot. However, small amounts of shifting of the beach sand surface (perhaps by wind or water) made it difficult to know for certain if seedlings were actually the products of sown seed. Only one of the seedlings was directly under the planting frame hole in the berm plot and some seedlings in the moist shoreline plot may have come from natural recruitment. Inspection around the area of the frames found new seedlings emerging beyond the edges of each plot. Even if all the seedlings were attributed to sown seed, the maximum of 24 seedlings emerging from a total sowing of 1,200 frame holes (each hole received more than one seed) would constitute very low germination and recruitment (2%). These results indicate that sowing TYC seed on the soil surface is an ineffective method for enhancing or creating TYC populations.

### 3.4.3 KEY MANAGEMENT QUESTIONS

The KMQs outlined in the CS serve as the guide to conservation and restoration research on Tahoe yellow cress (Pavlik and O'Leary 2002), and the data generated from evaluating the KMQs have immediate value to decision-making within an adaptive management framework. While the 2003

pilot project primarily addressed KMQ 3, the 2004 reintroduction addresses all five of the KMQs. The KMQs are as follows:

**KMQ 1) Can Tahoe yellow cress occupy any site around the lake that has sandy beach habitat?**

This KMQ focuses on differences in habitat suitability among sites. The overarching null hypothesis is that Tahoe yellow cress performance is equivalent at all sites. Results from both the 2003 and 2004 efforts are definitive in that survivorship varies among sites. In 2003, total survivorship ranged from 27 percent at Sand Harbor to 86 percent at Avalanche. In 2004, total survivorship ranged from 43 percent at Sand Harbor to 77 percent at Taylor Creek. Despite year to year variation, survivorship was consistently lower at Sand Harbor in both years.

A second, more specific hypotheses related to KMQ 1 is as follows: For a given microtopographic position on the beach, Tahoe yellow cress performance will be the same across all sites. Beach position was characterized by elevation and the elevation gradients present at the 2004 outplanting sites were categorized into three microhabitat types: Moist shoreline, low beach, and high beach. Among the 2004 cohort, Tahoe yellow cress performance in a given microtopographic position on the beach varied among sites. There was uniformly high survivorship in both the moist shoreline and the low beach at Taylor Creek and Nevada Beach, but very low survivorship in the low beach at Upper Truckee East and Sand Harbor. The low survival at Sand Harbor is difficult to explain, but the high mortality at Upper Truckee East was likely due to competition from lupine. By early August, lupine cover in the low beach averaged 61 percent in the five low beach blocks, while it was only 3 to 5 percent in the high beach plots.

Given the results to date, the answer to this KMQ is that all sandy sites around the lakeshore are not equivalent with respect to providing adequate conditions for TYC populations. Managers cannot, therefore, assume site equivalency when issuing permits or prescribing mitigation measures that affect the species.

**KMQ 2) Are there ecosystem factors that affect Tahoe yellow cress performance within an occupied site?**

This KMQ focuses on the suitability of microhabitats within a given site. The null hypothesis is that Tahoe yellow cress performance will be the same at all topographic positions within a site. Data from 2003 and 2004 demonstrate that, in general, survivorship varies with microhabitat. Tahoe yellow cress performance, as measured by survivorship, was significantly better in the moist shoreline than the low or high beach microhabitats at both Upper Truckee East and Nevada Beach. Reproduction followed a similar pattern. At Upper Truckee East, significantly more plants reproduced in the berm and moist shoreline than in the low or high beach. At Nevada Beach, reproduction was significantly better in the moist shoreline than in the low or high beach.

The main ecosystem factor being tested in the experiment was the depth to the water table of a microhabitat. Microhabitats were categorized according to elevation, based on the assumption that

the water table is at the elevation of Lake Tahoe and therefore the height of a plot above the lake is equivalent to the depth to the water. The water potential monitoring component attempted to quantify plant response to microhabitat by measuring plant water status. Since plant water status reflects the ambient soil and atmospheric moisture conditions, it affords an opportunity to directly assess differences in the water availability among various Tahoe yellow cress microhabitats.

A regression analysis indicated that mean mid-day water potentials explained up to 30 percent of the variation in founder survivorship at all sites in September. Although the relationship is not strong, the overall pattern that mean survivorship decreases as water potentials decrease (and therefore water stress increases) is to be expected because many plants thrive when water is readily available. The fact that Tahoe yellow cress is likely well-adapted to drought may minimize differences in plant performance related to water stress among the microhabitats and indicates that other factors beside water availability are also influencing survivorship.

Given the results to date, the answer to this KMQ is that all microhabitats at a given sandy site are not equivalent with respect to providing adequate conditions for TYC populations. Microhabitats that provide a shallow depth to the water table that are protected from lake level and human disturbance are more likely to allow high survivorship and reproductive output of TYC. Managers cannot, therefore, assume microhabitat equivalency when issuing permits or prescribing mitigation measures that affect the species.

**KMQ 3) Can Tahoe yellow cress populations be created or restored in order to enhance the self-sustaining metapopulation dynamic?**

This KMQ addresses those factors that might influence the success of outplanting and therefore determine whether new populations could be created or enhancement of existing populations is feasible. The question of improving the metapopulation dynamic must be addressed at the landscape level and requires a long-term data set and spatially explicit mapping of colonization and extirpation events around the lake.

In 2003, a preliminary evaluation of the site factors and plant factors that might influence restoration success was conducted. Site factors were broadly described as different "habitat types" that mainly reflected plant position on the beach (i.e., moist shoreline occurred within 7 ft [2 m] of the lake and high beach included everything else). Plant factors were related to either greenhouse condition (initial founder vigor at the time of planting) or the genetic stock of the founder. Observations included the following: 1) Site factors influenced Tahoe yellow cress performance at all sites; 2) the initial vigor of the founding plant influenced Tahoe yellow cress performance at three of four sites; and 3) the genetic stock of the founder did not appear to influence Tahoe yellow cress performance.

In 2004, the site factor of microhabitat strongly influenced plant performance at all sites, while the plant factors of initial vigor and genetic parent did not influence plant performance. Given the low genetic diversity detected in multiple studies (DeWoody and Hipkins 2004, Saich and Hipkins 2000), the importance of site factors in creating or enlarging populations is not surprising. Nearly 90 percent of the 2003 founders that survived to the end of the first season returned in the second season and survived to September. This represents a return rate of 54 percent on the initial investment of founders in 2003. Such a high rate of return may indicate that the population at Sand Harbor was

successfully created and existing populations at Avalanche, Zephyr Cove, and Taylor Creek were successfully enhanced. However, habitat availability increased in 2004 when the lake elevation decreased from 6,224 ft to 6,223 ft. If the lake level had risen, rate of return on our investment would be expected to diminish because Tahoe yellow cress persistence has been shown to be inversely related to lake level (Pavlik *et al*. 2002).

The importance of site factors in restoration success is therefore related to the probability of inundation and erosion of habitat by the lake. It may follow from the principle of founder-cost averaging that it is a good strategy to plant as many individuals as possible in a low water year, but the year to year uncertainty of lake elevation means that on average it is best to distribute restoration efforts through time and space.

Given the results to date, the answer to this KMQ is that reintroduction to certain microhabitats at a given sandy site appears to be a practical and effective tool for creating and enhancing TYC populations. Age structuring and founder-cost averaging appear to be beneficial approaches for promoting better demographic performance and population persistence. Managers can, therefore, prescribe carefully designed, executed and monitored reintroduction for purposes of conservation, restoration and mitigation.

**KMQ 4) Can any Tahoe yellow cress genotype or gene pool perform equally well at any site?**

This KMQ addresses the importance of using multiple seed lots in restoration efforts. The null hypothesis is that Tahoe yellow cress from all seed lots perform equally well. Data from 2003 suggested that seed lot did not influence Tahoe yellow cress performance. Results from the replicated experiments at Nevada Beach and Upper Truckee East strongly suggests that founder genetics do not play a significant role in the survival of transplanted seedlings and therefore restoration designs do not need to incorporate this factor. Mean percent survivorship in September of founders from different seed lots was not significantly different within any of the microhabitats present at either site. In order to retain any unique alleles, it would be ideal to mix seed from many locations for propagation purposes, but the maternal parent of the propagated individuals does not need to be tracked for restoration efforts.

Given the results to date, the answer to this KMQ is that any TYC genotype or gene pool (source population) appears to perform equally well at any site and in any optimal microhabitat. Therefore, managers do not have to insist upon certain design features to compensate for genetic factors when reintroduction is for conservation, restoration or mitigation purposes.

**KMQ 5) Can Tahoe yellow cress habitats be found or created that are less likely to be adversely disturbed despite high visitor use or intense shoreline activity?**

This KMQ focuses on whether we can mitigate adverse impacts from recreational use. The null hypothesis is that given equal levels of recreational use, the presence or absence of fencing does not affect Tahoe yellow cress performance. The only way to test this statistically is to set up an experiment at a single site with a set of replicated plots with fences and a second set without fences.

This scenario is unrealistic from a management perspective and we are forced to infer from observational monitoring data over 2 years that fencing is largely effective despite the fact that fencing at three of the enclosures (Taylor Creek, Upper Truckee East, and Zephyr Cove) was vandalized during the course of the project. Monitoring data was compromised at Taylor Creek when the August data had to be omitted due to vandalism. No plants were harmed at any of the sites but signs of dogs and footprints were evident in the plot during every monitoring period at Upper Truckee East.

Given the results to date, the answer to this KMQ is that humans and their animals gravitate to the locations of restoration activities and, therefore, there will always be a probability of disturbance. Even remote, hard to access locations (e.g. Avalanche) can be subjected to recreational impacts. Therefore, managers will need to maintaining fencing during all conservation, restoration, and mitigation projects, especially those requiring the collection of monitoring data.

### 3.4.4 CONCLUSIONS

Nursery propagation

- 3,300 founders from 8 seed sources were available for outplanting in May 2004.
- 50% were classified as Low vigor and 50% were classified as High vigor (only 14% classified as Low vigor in 2003).

2004 Experimental Outplanting and Pilot Replication

- 1,424 founders were outplanted at 4 sites in 2003.
- 2,814 founders were outplanted at 4 sites in 2004.
- Total of 4,238 founders were outplanted at 6 sites over 2 years.

Demography of 2004 Experimental Populations

At Nevada Beach

- 75% of founders survived to September.
- Founders in the moist shoreline and low beach had significantly greater survivorship, were larger in size, and produced more seed than founders in the high beach.
- Regardless of assigned habitat, founders on the North side of Burke Creek (at a lower elevation) were significantly more likely to survive to September than founders of the South side of the creek.
- Reproduction was significantly greater in the moist shoreline.

At Upper Truckee East

- 73% of one year old founders survived to September, but only 51% of two year olds.
- Founders in the berm and moist shoreline were significantly more likely to survive to September than those in the low or high beach.
- Outplanting late in the growing season (late July) decreased survivorship and reproductive output, especially in the high beach habitat.
- Founders in the low beach were less likely to survive than those in the high beach (likely due to the high cover by native lupine).

- Founders in the berm were larger and produced significantly more seed than all other microhabitats (although the mean seed out put per plant of founders in the low beach that survived was not significantly different).

Effects of initial founder vigor

- Unlike 2003, low vigor founders did not have decreased survivorship or reproductive output at any of the sites. Rather, the higher lake elevation may have increased water availability sufficiently to erase the differences between low and high vigor plants, particularly in the drier habitat.s. This may have also eliminated the "stress-induced hardiness" witnessed in 2003 where low vigor plants were actually more likely to reproduce than high vigor plants, especially in drier habitats.

Effect of founder population source

- Experimental data demonstrate that founder genotype did not play a significant role in the survival of outplanted seedlings at any of the sites. Therefore, until data to the contrary become available, restoration designs need not incorporate seed source as a variable.

Effect of the water status of founders

- Data results indicate that founders in the moist shoreline experience less stress than the low beach or the high beach, possibly due to differences in soil moisture availability. Lower water stress levels of founders in the low beach compared to the high beach are likely due to other factors than soil moisture (i.e. humidity or air temperature).

Effects of human disturbance

- Fencing helped to reduce impacts from recreational activities among the sites, but three of the enclosures were vandalized during the season. Maintaining fencing throughout subsequent experimental plantings will be important for data collection continuity. Positive identification of individual plants is required for detecting trends in founder survival and reproduction.

Demography of 2003 and 2004 Pilot Populations

- Nearly 90% of the 2003 founders that survived to the end of the first growing season (September 2003) were alive at the end of the second (September 2004).
- 750 established second year-olds survived at four sites from the 2003 pilot project.
- First year survivorship at Taylor and Sand Harbor was greater in the 2004 cohort than the 2003 cohort.
- At most sites, founders in low beach and moist shoreline from both cohorts were larger, produced more seed, and had greater vegetative reproduction than founders in the high beach.
- Two-year old founders had greater survivorship to reproduction than one year olds in the same habitat.

### 3.5 FRIENDS OF TAHOE YELLOW CRESS STEWARDSHIP PROGRAM

To implement the "Friends of Tahoe Yellow Cress" stewardship idea, subcommittee members met with TRPA on issues regarding fencing and signage to determine types that would be allowed under current regulations and whether new regulations would be needed.

A "Voluntary Conservation Agreement" was drafted following a brainstorming session with the subcommittee. While covering all issues intended, it was deemed overly formal and will be revised to provide a list for landowners of reasons to conserve Tahoe yellow cress and options to do so. There will be several forms of this information, depending on each individual circumstance.

Several site visits were held at lakefront landowner's properties to show them Tahoe yellow cress and discuss conservation options. In addition, several landowners were contacted by the Tahoe Lakefront Owners' Association to gain access for the annual survey.

Members of the TAG again attended the Tahoe Lakefront Owners' Association annual education meeting with a poster and handouts, including a small poster to post in rental homes that has photos of Tahoe yellow cress and identification information, as well as a handout on invasive species to remove from Tahoe yellow cress habitat areas.

## 4. 2004 ACTIVITIES BY AGENCY

The CS requires a brief summary of annual agency staff time and expenditures on conservation and management activities specific to Tahoe yellow cress. Table 8 provides agency hourly breakdown for years 2001, 2002, 2003, and 2004. In collaboration with the TAG, CTC developed an Agency Activity Report form. The form assists management agencies in describing the following: Site-specific conservation activities for each Tahoe yellow cress location undertaken during the previous growing season; general Tahoe yellow cress conservation activities (i.e., public outreach, consultation, TAG participation, etc.); significant disturbances to the species or its habitat and subsequent response; planned Tahoe yellow cress conservation activities anticipated for the upcoming year; and all shorezone projects undertaken within potentially suitable Tahoe yellow cress habitat. Agency Activity Report forms submitted in the year 2004 are supplied in Appendix H.

**Table 8. Summary of agency hours spent on Tahoe yellow cress related activities during 2001, 2002, 2003, and 2004**

| Agency/Year | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|
| TRPA | No report | No report | 150 | 326.5 |
| USFWS | 700 | 500 | 400 | 390 |
| USFS | 658 | 1,250 | 1,168 | 516.5 |
| NDSP | No report | No report | 132 | 189 |
| NDF | No report | No report | 304 | 144 |
| NNHP | 130 | 98 | 160 | 95 |
| CDFG | 240 | 232 | 272 | 325 |
| CDPR | 160 | 155 | 403 | 218 |
| CTC | 1,580 | 1,634 | 1,024 | 140 |
| CSLC | 575 | 565 | 400 | 224 |
| TLOA | No report | No report | 100 | 48 |
| **Total** | **4,043** | **4,434** | **4,109** | **2,616** |

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# Appendix A: Example 2004 Annual Field Survey Form

## TAHOE YELLOW CRESS *(Rorippa subumbellata)* FIELD SURVEY FORM

Survey date[1]: _____

Surveyor[2]: _____ Affiliation[2]: _____

Email[2]: _____ Telephone[2]: _____

**LOCATION[3](attach copy of quad map showing boundaries and pictures taken)**

**Site name:** _____

USGS quad: S. Lake Tahoe Emerald Bay Meeks Bay Homewood Tahoe City Kings Beach Marlette Lake Glenbrook

County: El Dorado Placer Washoe Carson Douglas **Site ownership:** Private State Federal City/Local

**Legal access:** _____

**TYC Present[4]? Yes No Actual Number of Plants[5]: _____ or Estimated Plants: _____**

Amount of person minutes spent in search[6]?

Previous plant occurrence[7]? Yes No Date Plant last observed[8]: _____

**Cluster[9] 1(individual clusters are equal to TYC that is within 13 m radius):** (record additional clusters on back or on additional data sheets)

GPS Coordinates taken[10]: (UTM NAD 27, Zone 11) – be specific about where the coordinates are from (centroid, endpoints, etc.)

Easting: _____ Northing: _____ Location:_____

Easting: _____ Northing: _____ Location: _____

Easting: _____ Northing: _____ Location: _____

Easting: _____ Northing: _____ Location: _____

[11]Number of plants within cluster_____ Actual Number or Estimated Percentage in each phenological stage (circle one)

Juvenile: _____ Senescent: _____ Flowering: _____ Fruiting (may also be flowering): _____

Min. Rosette Diameter (cm): _____ Max. Rosette Diameter (cm): _____

### *PHYSICAL ATTRIBUTES*

Elevation[12]: _____

Lake level on day of survey (USGS Station 10337000)[12]:_____

Distance to lake water line (meters)[13]: Shortest _____ Longest _____

Other waterbodies closer than lake[13]?_____ How far_____

Sketch beach profile (use back paper additional space)[14]:

substrate / soils (relative cover w/in 0.3 meter)[15]:

_____ % sand (<2 mm)

_____ % fine gravel (>2-5 mm)

_____ % medium gravel (>5-20 mm)

_____ % coarse gravel (>20-75 mm)

_____ % cobbles (>75-250 mm)

_____ % stones (>250-600 mm)

_____ % boulders (>600 mm)

_____ % other (silt, wrack, litter)

### *BIOLOGICAL ATTRIBUTES*

Total Vegetation % cover[16]: _____

Associated vegetation[17]:

| *% Cover* | *Name* | *% Cover* | *Name* |
|---|---|---|---|
| ___ | TYC (*R. subumbellata)* | ___ | _____ |
| ___ | _____ | ___ | _____ |
| ___ | _____ | ___ | _____ |
| ___ | _____ | ___ | _____ |
| ___ | _____ | ___ | _____ |
| ___ | _____ | ___ | _____ |

Common associates:

| *% Cover* | | *% Cover* |
|---|---|---|
| __ | Spike-rush (*Eleocharis* spp.) | ___ Willow (*Salix* spp.) |
| __ | Sweet clover (*Melilotus alba*)* | ___ Alder (*Alnus incana*) |
| __ | Clover (*Lotus purshianus*) | ___ *Epilobium* spp. |
| __ | Mullein (*Verbascum thapsus*)* | ___ Sedge (*Carex* spp.) |
| __ | Monkey flower (*Mimulus primuloides*) | ___ Rush (*Juncus* spp.) |
| __ | W. yellow cress (*Rorippa curvisiliqua*) | ___ Dock (*Rumex* spp.) |

Non-native species in vicinity of TYC population[18]? Yes No (If YES, add to above species list and % cover and identify w/ an *)

### *LAND USES and IMPACTS19*

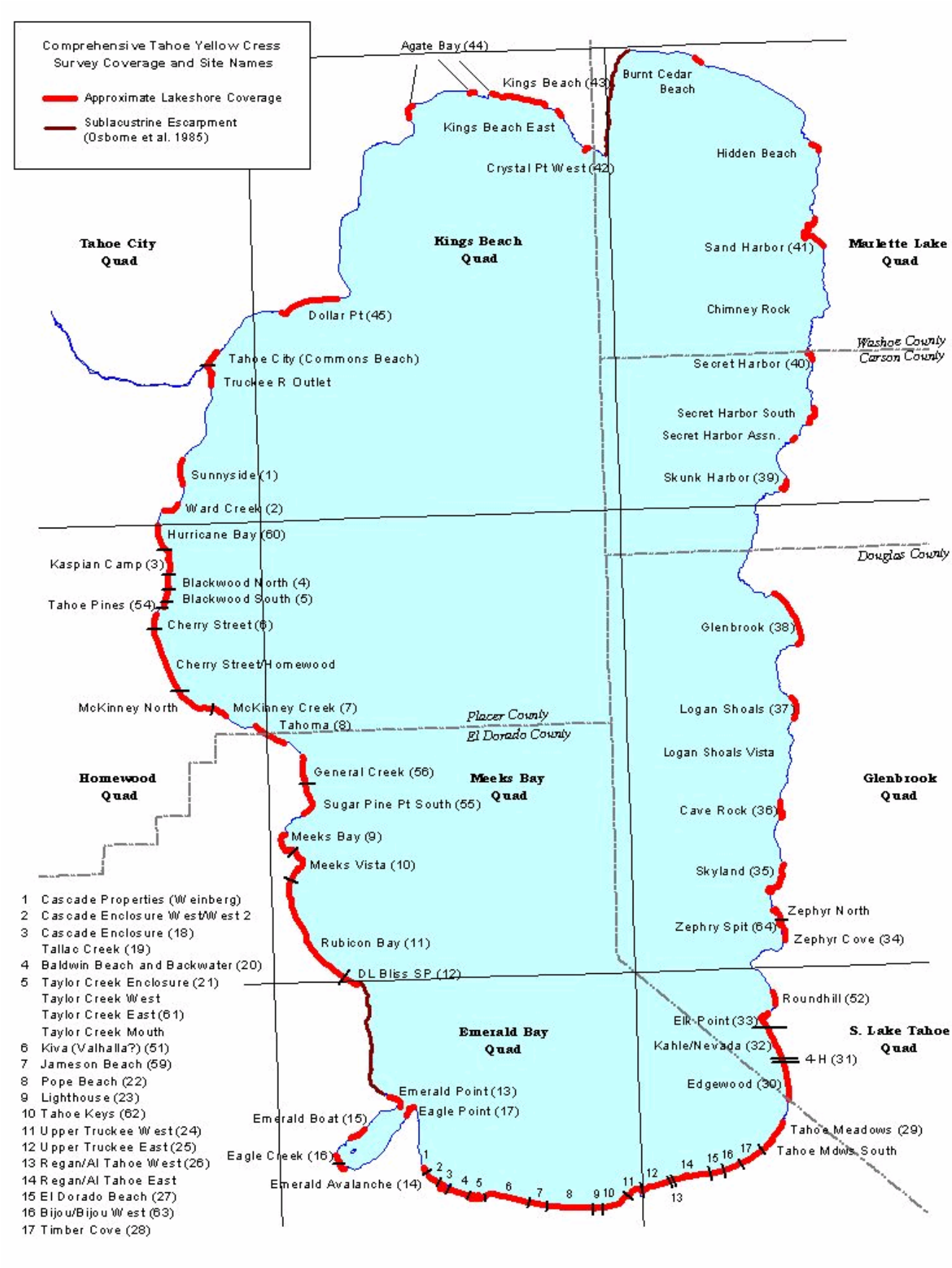
Cover of footprints within patch[20]: <5% 5-25% 26-50% 51-75% >75%

Note vegetation removal, trash, recreational impacts, vandalism and/or other impacts[20]: _____

_____

Enclosure effectiveness[21]: good fair poor Comment: _____

Possible management actions and other notes[22]: _____


Comprehensive Tahoe Yellow Cress Survey Coverage and Site Names
Approximate Lakeshore Coverage
Sublacustrine Escarpment (Osborne et al. 1985)
Agate Bay (44)
Kings Beach (43)
Burnt Cedar Beach
Kings Beach East
Crystal Pt West (42)
Hidden Beach
Tahoe City Quad
Kings Beach Quad
Sand Harbor (41)
Marlette Lake Quad
Chimney Rock
Dollar Pt (45)
Washoe County
Carson County
Tahoe City (Commons Beach)
Truckee R Outlet
Secret Harbor (40)
Secret Harbor South
Secret Harbor Assn.
Sunnyside (1)
Skunk Harbor (39)
Ward Creek (2)
Hurricane Bay (60)
Douglas County
Kaspian Camp (3)
Blackwood North (4)
Blackwood South (5)
Tahoe Pines (54)
Cherry Street (6)
Glenbrook (38)
Cherry Street/Homewood
McKinney North
McKinney Creek (7)
Tahoma (8)
Placer County
El Dorado County
Logan Shoals (37)
Logan Shoals Vista
Homewood Quad
General Creek (56)
Meeks Bay Quad
Glenbrook Quad
Sugar Pine Pt South (55)
Cave Rock (36)
Meeks Bay (9)
Meeks Vista (10)
Skyland (35)
Zephyr North
Zephyr Spit (64)
Zephyr Cove (34)
Rubicon Bay (11)
DL Bliss SP (12)
Roundhill (52)
Elk Point (33)
S. Lake Tahoe Quad
Emerald Bay Quad
Kahle/Nevada (32)
4-H (31)
Edgewood (30)
Emerald Point (13)
Eagle Point (17)
Emerald Boat (15)
Tahoe Meadows (29)
Eagle Creek (16)
Tahoe Mdws South
Emerald Avalanche (14)
1 Cascade Properties (Weinberg)
2 Cascade Enclosure West/West 2
3 Cascade Enclosure (18)
Tallac Creek (19)
4 Baldwin Beach and Backwater (20)
5 Taylor Creek Enclosure (21)
Taylor Creek West
Taylor Creek East (61)
Taylor Creek Mouth
6 Kiva (Valhalla?) (51)
7 Jameson Beach (59)
8 Pope Beach (22)
9 Lighthouse (23)
10 Tahoe Keys (62)
11 Upper Truckee West (24)
12 Upper Truckee East (25)
13 Regan/Al Tahoe West (26)
14 Regan/Al Tahoe East
15 El Dorado Beach (27)
16 Bijou/Bijou West (63)
17 Timber Cove (28)

Appendix A

**Appendix B: 2004 Survey Protocols for Tahoe Yellow Cress Annual Surveys**

**1-Survey Date:** Date of on the ground survey work

**2-Surveyor/E-mail/Affiliation/Telephone:** At least list survey leader with their contact information (normally person who has conducted surveys in past); ideally list all participants and contact info. Contact information is very important to include in case questions arise about the survey data.

**3-Location:** This information will be filled out prior to survey for all known sites. When a new site is found fill out the information for Site name, Site ownership and Legal access.

**4-Tahoe yellow cress Present:** Circle appropriate response after surveying site.

**5-Actual number of plants, or estimated plants:** After surveying the site this should be a total (or estimate when there are too many plants to count) of all the clusters found at each site. A plant is considered an individual when it is at least 6" from another stem/plant.

**6-Amount of person minutes spent in search:** Total the time spent on each site, by each individual.

**7-Previous plant occurrence:** On site with a previous occurrence this will be filled out prior to the survey using the information from past surveys that is stored at NV natural heritage.

**8-Date plant last observed:** On site with a previous occurrence this will be filled out prior to the survey using the information from past surveys that is stored at NV natural heritage program (NNHP).

**9-Cluster:** If two clusters are separated by less than 13 m, consider them one cluster. For Tahoe yellow cress clusters separated by a distance greater than 13 m, they should be treated as two separate clusters. Use exact measurement, if you can pace it off this is okay just be sure you and your team members are correct in pacing. Refer to 10-GPS coordinates below for additional information about working with and about the logic behind the cluster definition. Page one has space for the first cluster only. Space for clusters two and three can be found on page two, any additional clusters can be found on the additional cluster page; please fill in the cluster number in the blank after cluster.

**10-GPS Coordinates:** The preferred reading should be in Nad 27, zone 11, if you do not take a reading in this zone or datum make sure you indicate where it was taken. Because the site boundaries have been established, surveyors are only responsible for GPSing Tahoe yellow cress clusters/individuals. Most of the GPS units we will be using are only accurate to within 3 to 9 meters (m) and for NNHP Biotics an error within about 6.5 m is acceptable. Therefore, for example, if you find a cluster that is less than 6.5 m in diameter, simply take a central point. For one cluster with a diameter larger than 6.5 m, endpoint or corner coordinates can be taken. If two clusters are separated by less than 13 m, consider them one cluster and either take one point on each of the outer

edges or one central point. For Tahoe yellow cress clusters separated by a distance greater than 13 m, they should be treated as two separate clusters, and GPS coordinates should be obtained for each cluster (either end points or central points). NNHP will keep track of these clusters, but they will be subsets of the overall population at that site. **It is critical to indicate what and where particular coordinates are from and if they are central points or endpoints in order to ensure proper data interpretation!** Drawing pictures is helpful as well. Additionally, if you take multiple points for clusters and outlying individuals within a site, document what data you have taken and how it should be interpreted by NNHP.

**11- Number of plants in cluster__ Actual Number or Estimated Percentage in each phenological stage (circle one). Juvenile: _____ Senescent: _____ Flowering: _____ Fruiting (may also be flowering): _____ Min. Rosette Diameter (cm): _____ Max. Rosette Diameter (cm):**

Record the actual or estimated number of plants within the cluster then circle actual number if you count each individual plant within the cluster or estimated percent if you estimate the phenology of the cluster. Then recorded the number/percent in each of the phenological stages.

The last thing in the box is the min. and max. rosette size within the cluster. **An individual plant is considered to be the number of stems within 6" of each other. When stems become further then 6" it is considered that there is more than one individual.**

**12-Elevation/Lake Level:** This information will be filled in by NNHP after the survey. If you know the information you can fill it in.

**13-Distance to lake water line (meters):** Measure meters to Lake Tahoe for each cluster. If there is another body of water closer note this also.

**14-Sketch beach profile:** Sketch the beach profile and any dominate markers that help to identify the site. Either draw in space provided or use back site of map. If have time, it is nice to also include a map of the locations of each cluster.

**15-Substrate/soils:** The size for each type of substrate is based on USDA's *Comparison of size particle classes* from the Field Book for Describing Sampling Soils version 2.0. Give a percentage to each category of substrate (make sure this adds up to 100%) for the area within the cluster to 0.3 meters outside of it. If you are unsure use a ruler to measure the substrate until you get a feel for it. It is also a good idea to do the first percentage estimate with the group to try to calibrate everyone into the percentage estimates.

**16-Total Vegetation % cover:** This is a measurement of how much % cover of vegetation is within each cluster to 0.3 m away from cluster.

**17-Associated vegetation:** Include any vegetation found within the cluster, include species when possible. Then include the percent cover of each of the species within the cluster; this should add up to 100%. Don't forget to include Tahoe yellow cress.

**18-Non-native species:** Circle yes or no if there are any non-native species found within the cluster. Identify the non-native species with an * next to their names.

**19-Land use and impacts:** This data is for the whole site, not individual clusters.

**20-Cover of footprints/Impacts to site:** Record everything that you see within the site, especially if found within actual clusters.

**21-Management actions/other notes:** Use this for any suggestions or notes about abnormalities, for example, if a cluster of Tahoe yellow cress is growing on a 50% slope recorded that information here.

## Appendix C:  Presence (X) and Absence (0) of Tahoe Yellow Cress (1978-2004)

**Appendix D: 2004 Annual Survey Data by Ranking Priority**
**Survey dates: September 2004; Lake level: approx. 6223 ft**

| SITE | RANK | #STEMS 2004 | EFFORT (MIN) 2004 |
|---|---|---|---|
| Blackwood North | Core | 54 | 140 |
| Blackwood South | Core | 163 | 270 |
| Edgewood | Core | 106 | 240 |
| Lighthouse | Core | 18 | 45 |
| Tahoe Meadows | Core | 17 | 70 |
| Tallac Enclosure | Core | 14 | 60 |
| Tallac Creek (outside enclosure) | Core | 0 | 120 |
| Taylor Creek Enclosure | Core | 521 | 120 |
| Upper Truckee East | Core | 5000 | 2300 |
| Upper Truckee West | Core | 1289 | 540 |
| **TOTAL CORE SITES** | | **7182** | **3905** |
| | | | |
| Eagle Creek/Avalanche | High | 493 | 417 |
| Cascade | High | 125 | 240 |
| Kahle/Nevada | High | 1 | 135 |
| Meeks Bay | High | 0 | 290 |
| Ward Creek | High | 66 | 200 |
| Zephyr Cove | High | 59 | 540 |
| **TOTAL HIGH SITES** | | **743** | **1822** |
| | | | |
| 4-H | Medium | 33 | 45 |
| Baldwin Beach | Medium | 54 | 360 |
| Cave Rock | Medium | 0 | 25 |
| D.L. Bliss SP Enclosure | Medium | 1 | 20 |
| Eagle Point | Medium | 15 | 225 |
| Emerald Boat Camp | Medium | 24 | 132 |

| SITE | RANK | #STEMS 2004 | EFFORT (MIN) 2004 |
|---|---|---|---|
| Emerald Point | Medium | 157 | 611 |
| Glenbrook | Medium | 164 | 180 |
| Logan Shoals | Medium | 1135 | 580 |
| Rubicon Bay | Medium | 698 | 960 |
| Secret Harbor | Medium | 0 | 220 |
| Tahoe Keys | Medium | 1010 | 240 |
| Timber Cove | Medium | 2 | 40 |
| **TOTAL MEDIUM SITES** | | **3293** | **3638** |
| | | | |
| Cherry St./Tahoe Swiss Village | Low | 51 | 150 |
| Dollar Point | Low | 315 | 400 |
| El Dorado Beach | Low | 0 | 50 |
| Kiva/Valhalla | Low | 99 | 240 |
| McKinney Creek | Low | 2 | 40 |
| Pope Beach | Low | 7 | 180 |
| Regan/Al Tahoe | Low | 330 | 50 |
| Sand Harbor | Low | 29 | 360 |
| Tahoma | Low | 3 | 60 |
| **TOTAL LOW SITES** | | **836** | **1530** |
| | | | |
| Sunnyside | Unranked | 0 | 60 |
| Kaspian Camp | Unranked | 1 | 150 |
| Tahoe Pines (Fleur Du Lac) | Unranked | 18 | 110 |
| McKinney North/Shores | Unranked | 63 | 150 |
| Sugar Pine Point State Park | Unranked | 86 | 210 |
| Meeks Vista | Unranked | NS | 140 |
| Cascade Creek | Unranked | 125 | 120 |
| Baldwin Beach Parking Lot Enclosure | Unranked | 24 | 120 |
| Taylor Creek | Unranked | 1102 | 480 |

| SITE | RANK | #STEMS 2004 | EFFORT (MIN) 2004 |
|---|---|---|---|
| Bijou (Timber Cove Lodge) | Unranked | 25 | 30 |
| Elk Point | Unranked | NS | 0 |
| Roundhill | Unranked | 25 | 129 |
| Marla Bay | Unranked | 10 | 90 |
| Skyland | Unranked | 64 | 120 |
| Skunk Harbor | Unranked | 0 | 90 |
| Chimney Rock | Unranked | 0 | 120 |
| Hidden Beach | Unranked | 13 | 150 |
| Burnt Cedar Beach | Unranked | 0 | 150 |
| Crystal Point | Unranked | 0 | 60 |
| Kings Beach | Unranked | 0 | 165 |
| Hurricane Bay | Unranked | 0 | 60 |
| D.L. Bliss State Park | Unranked | 0 | 56 |
| Jameson | Unranked | 0 | 60 |
| Agate Bay | Unranked | 0 | 330 |
| **TOTAL UNRANKED SITES** | | **1556** | **3150** |

**Appendix E: Tahoe Yellow Cress Site-Specific Information Sheet Example: Dollar Point**

## Tahoe Yellow Cress Site-Specific Information: Dollar Point (934)

Prepared by: Eric Gillies, California State Lands Commission (CSLC), in collaboration with the Tahoe Yellow Cress Technical Advisory Group (TAG)

Date: May 10, 2005 (rev. _____)

County/State: Placer County, California

Location: Tahoe City Public Utility District (TCPUD) Recreation Area (public access point), Lake Forest, The Northshore, and Dollar Point private residential areas off North Lake Blvd (Highway 28) northeast of Tahoe City

Ownership/Management: Private (approx. 12 individual parcels) and TCPUD

Contact Information: Eric Gillies, CSLC, (916) 574-1897, gilliee@slc.ca.gov

Meets Ranking Criteria: Yes, surveyed 14 consecutive years with 2 NS events (Table 1)

Viability Index and Rank: unranked (2000); -8, Medium Priority Restoration Site (2004)

Lake Elevation Persistence: Low only

TRPA Threshold Site: No. The site should count toward maintaining a minimum number of populated sites (26 sites); however, if conducting a threshold attainment evaluation during a high water year (>6224 ft LTD), the population would not be persistent due to inundation.

### Site Description

The Dollar Point site has several scattered Tahoe yellow cress populations located along the approximate 1.6-kilometer shoreline reach. The shoreline reach is from TCPUD Recreation Area on the west to approximately 500 meters west of Dollar Point on the east (see attached map). Because of the great distant between the eastern and western clusters and each having different habitat characteristics, this site may warrant splitting into two. The historic population is the eastern clusters and the western clusters were first observed in 2002.

### Survey History

Table 1 provides a summary of the survey history and results for the Dollar Point site. This Tahoe yellow cress site was first observed in 1991 and was observed in 1993 and 1994, which was within a low water period. Plants were not observed from 1995 to 2001, which, except for 2001, was a high water period. The site was not surveyed in 1992 and 1999. Plants have been observed in 2002, 2003, and 2004. Surveys have occurred over one full high/low lake elevation cycle. Currently, its persistence is at 50% (6 out of 12 years).

### Table 1. Tahoe Yellow Cress Annual Survey Summary – Dollar Point

| Year | Lake Elev. (ft. LTD) | Survey Data | Stem Count | Comment |
|---|---|---|---|---|
| 1991 | 6222 | X | n/a | 1st year of site record |
| 1992 | 6223 | NS | - | |
| 1993 | 6223 | X | 191 | 1993 Shorezone Survey data |
| 1994 | 6222 | X | n/a | |
| 1995 | 6227 | 0 | - | |
| 1996 | 6227 | 0 | - | |
| 1997 | 6228 | 0 | - | 6 year high lake elevation period |
| 1998 | 6228 | 0 | - | |
| 1999 | 6228 | NS | - | |
| 2000 | 6228 | 0 | - | |
| 2001 | 6225 | 0 | - | Lake elevation transition year (high to low) |
| 2002 | 6224 | X | 10 | Western cluster near TCPUD Recreation Area 1st observed |
| 2003 | 6224 | X | 83 | |
| 2004 | 6223 | X | 315 | |

X = present; 0 = absent; NS = not surveyed

## Population and Ecological Characteristics

During the comprehensive 1993 Shorezone Survey, 191 stems were observed. The population in 2002 had only 10 stems, which was a year following a period of high water years, 1995 to 2000, and a transition year, 2001 (Table 1). In 2004, with lake elevation falling below 6223 ft Lake Tahoe Datum (LTD), 315 stems where observed in several clusters. Presently, this site appears to persist when lake elevation is at or below 6224 ft LTD and has greater abundance when lake elevation is 6223 ft LTD and below.

The population on the west end near the TCPUD Recreation Area is typically very small with few plants (<10). The substrate has little sand (<10%) and is mostly fine to medium gravel (>85 %) on a relatively flat shoreline (1-2 % slope). Associated species include *Epilobium* spp., willow (*Salix* spp.), and *Trifolium* spp. with 20-50% total vegetative cover. The cluster's distance to the lake in 2004 (lake elevation 6223 ft LTD) was 25 to 35 meters.

The population clusters at the east end are more extensive and in different habitat. The substrate is mostly sandy and fine gravel (>85%) with larger gravels to large cobbles making up the rest of the beach substrate. Associated species include pigweed (*Chenopodium* spp.), mullein (*Verbascum thapsus*), sweet clover (*Melilotus alba*) and some willow saplings. The beach has overall low vegetation cover (10-15%) in strips paralleling the shoreline. Tahoe yellow cress has been observed within the understory of large mullein and sweet clover plants. The sandy and fine gravel beach begins to narrow and become very limited with cobbles beginning to dominate the substrate with

denser weedy species such as clover (*Lotus purshianus*) as the shoreline begins to bend around the point. The cluster's distance to the lake in 2004 (lake elevation 6223 ft LTD) was typically about 5 meters.

There is approximately 800-meter stretch of shoreline between the west and east clusters, where plants are not observed. This stretch is a steep sloping beach with no vegetation and the substrate consists of 100% fine to medium gravel. Its characteristics are very dissimilar to locations where the plants are observed and described above.

## Potential Threats/Concerns (ranked in order of significance)

1. High lake elevation levels (>6224 ft LTD)
2. Recreation (beaching watercrafts and foot traffic/beach use)
3. Shoreline projects (private piers, revetment, and utility projects)

## Past Activities

No Tahoe yellow cress conservation actions have occurred in the area.

Present Activities

The area has been surveyed for shorezone projects including shoreline revetment projects. In 2003, TCPUD did some sewer line repair and revetment work adjacent to some of the populations. Plants were found growing against the silt fences during the 2003 survey. Construction activities did not appear to have a detrimental effect since nearly four times the number of plants were observed in the following year. There is a moderate amount of shoreline development that can occur in or around the clusters. Shoreline project approving agencies need to ensure pre-construction surveys for Tahoe yellow cress are conducted, which is required under CSLC lease agreements; however, not all shoreline projects require a lease form CSLC, e.g., revetment projects.

Recreational use is moderate to heavy during the summer months. Temporary fencing of the clusters similarly designed at Sugar Pine Point or signage during low water years and when the plants are present may be a strategy for the area. The TAG Stewardship Subcommittee needs to strategize on how to outreach to the private landowners and have them consider entering into Voluntary Conservation Agreements.

Recommendations:

- Site will continue to be part of the annual surveys, although surveys probably do not need to occur when lake elevation is above 6225 ft LTD. This should be confirmed early into the next high water or transition period.
- Initiate outreaching efforts to the private landowners and have them consider entering into Voluntary Conservation Agreements.
- Although the site is a medium priority for restoration efforts, the site is highly susceptible to high lake levels and there would need to be support from the many private landowners.

## Appendix F: Site-Specific Information Sheet assignments for 2005

| Agency | # of Sites Assigned |
|---|---|
| California State Lands Commission (CSLC) | 17 |
| United States Forest Service (USFS) | 15 |
| California Dept of Parks and Recreation (CDPR) | 9 |
| California Tahoe Conservancy (CTC) | 7 |
| Nevada Division of State Parks (NDSP) | 5 |
| Tahoe Regional Planning Agency (TRPA) | 4 |

| SITE NAME | NNHP EO NUMBER | OWNERSHIP/YEAR ELEVATION | SITE-SPECIFIC INFORMATION ASSIGNMENTS |
|---|---|---|---|
| Sunnyside | 929 | Private/Placer Co | CSLC |
| Ward Creek | 921 | Private | CSLC (in prep) |
| Hurricane Bay | | Private | negative data |
| Kaspian Campground | 901 | USFS | USFS |
| Blackwood North | | Private | CSLC |
| Blackwood South | 919 | Private/Placer Co | CSLC |
| Tahoe Pines (Fleur Du Lac) | | Private | CSLC |
| Cherry Street/Tahoe Swiss Village | 937 | Private | CSLC |
| McKinney North/ Shores | | Private | CSLC (in prep) |
| McKinney Creek | 928 | Private | CSLC (in prep) |
| Tahoma | 918 | Private | CSLC |
| Sugar Pine Point State Park | | CA State Parks | CDPR (in prep) |
| Meeks Bay | 917 | USFS | USFS |
| Meeks Bay Vista | 910 | Private | CDPR |
| Rubicon Bay | 936 | Private | CDPR |
| DL Bliss State Park & Enclosure | 916 | CA State Parks | CDPR |
| Emerald Point | 924 | CA State Parks | CDPR |
| Emerald Bay Boat Camp | 914 | CA State Parks | CDPR |
| Eagle Creek/Avalanche | 915 | CA State Parks | CDPR |
| SE Emerald Bay | | CA State Parks | CDPR |
| Eagle Point | 927 | CA State Parks | CDPR |
| CTC Cascade Creek | | CTC | CTC |
| Cascade | 925 | Private | CTC |
| Tallac Enclosure & Tallac Creek | 912 | USFS | USFS |
| Baldwin Beach | 931 | USFS | USFS |
| Taylor Creek & Enclosure | 911 | USFS | USFS |
| Kiva Beach/Valhalla | 913 | USFS | USFS |
| Jameson | | Private | negative data |
| Pope Beach | 909 | USFS | USFS |
| Lighthouse | 938 | Private | CTC |
| Tahoe Keys | 926 | Private | CTC |
| Upper Truckee West | 908 | CTC | CTC |
| Upper Truckee East | 907 | CTC | CTC |
| Regan/Al Tahoe | 905 | Private/City SLT | CTC |
| El Dorado Beach | 906 | City SLT | CSLC |

| SITE NAME | NNHP EO | OWNERSHIP/YEAR | SITE-SPECIFIC INFORMATION |
|---|---|---|---|
| Bijou (Timber Cove Lodge) | 903 | Public | CSLC |
| Timber Cove | 904 | Private | CSLC |
| Tahoe Meadows | 902 | Private | CSLC |
| Edgewood | 2 | Private | USFS |
| 4-H Camp/City Pump House | 1 | UNR/City | USFS |
| Kahle/Nevada & Enclosure | 8 | USFS | USFS |
| Elk Point | 14 | Private | TRPA |
| Roundhill | 9 | USFS | USFS |
| Marla Bay | | Private | TRPA |
| Zephyr Cove | 11 | Private/USFS | USFS |
| Skyland | 5 | Private | NDSP |
| Cave Rock | 17 | NV State Parks | NDSP |
| Logan Shoals | 10 & 6 | Private | TRPA |
| Glenbrook | 4 | Private | TRPA |
| Skunk Harbor | 16 | USFS | USFS |
| Secret Harbor | 12 | NV State Parks | NDSP |
| Chimney Rock | 13 | USFS | USFS |
| Sand Harbor | 3 | NV State Parks | NDSP |
| Hidden Beach | | NV State Parks | NDSP |
| Burnt Cedar Beach | | IVGID | USFS |
| Crystal Point | 933 | Private/Placer Co | CSLC |
| Kings Beach | 932 | Private/Public | CSLC |
| Agate Bay | 920 | Private | CSLC |
| Dollar Point | 934 | Private | CSLC (completed) |

**Appendix G: Agency Management Activity Report Forms for 2004**

**US Forest Service (USFS)**
**US Fish and Wildlife Service (USFWS)**
**Tahoe Regional Planning Agency (TRPA)**
**California State Lands Commission (CSLC)**
**California Department of Fish and Game (CDFG)**
**California Department of Parks and Recreation (CDPR)**
**California Tahoe Conservancy (CTC)**
**Nevada Natural Heritage Program (NNHP)**
**Nevada Division of State Parks (NDSP)**
**Nevada Division of Forestry (NDF)**

**USFS Annual Report**

## Tahoe Yellow Cress Conservation Activities

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | LTBMU-USFS |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 2/25/05 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Taylor Creek | Monitored 03 outplanted plants, planted additional 600 plants and monitored them | 75 | 5475 |
| Baldwin Beach/Lagoon | Built Fence protect existing TYC plants by bathroom | 25 | 5200 |
| Nevada Beach | Outplanted 600 plants, monitored them | 75 | 5475 |
| Zephyr Cove | Monitored 03 plants | 50 | 3650 |
| Meeks Bay | Built fence to protect existing TYC plants | 25 | 5200 |
| Interagency survey on FS land | Interagency survey | 144 | 4925 |
| | | | |
| | | | |
| | | | |
| | Site Specific Conservation Activities Totals | 250 | 29925 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| TAG meetings | 88 | 3000 |
| Executive meetings | 24 | 1500 |
| Assisted with 2004 annual report | 10 | 2350 |
| | | |
| General Conservation Activities Totals | 112 | 6850 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| none | | | |
| | | | |
| | | | |
| | | | |
| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| Outplanting at additional sites |
|---|

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
| Built wildlife fence at Baldwin Beach | |
| | |
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**USFWS Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | USFWS |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | May 17, 2005 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| NA | | | |
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| | | | |
| | Site Specific Conservation Activities Totals | | |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| Attended TAG meetings; drafted minutes | 95 | 4940 |
| Attended Executive Committee meeting | 30 | 1560 |
| Drafted 2003 annual report | 100 | 5200 |
| Organized and participated in 2004 interagency annual survey | 90 | 4680 |
| Updated Candidate Notice of Review; prepared briefing statements | 35 | 1820 |
| Participated in stewardship program development; attend TLOA meeting | 40 | 2080 |
| | | |
| | | |
| | | |
| General Conservation Activities Totals | 390 | 20280 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| NA | | | |
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| | | | |
| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| |
|---|
| Participation in technical and executive committee meetings; participation in annual survey; fulfill any requirements for the agency's annual reporting exercises; update Candidate Notice of Review for FY 2005 |

List and describe in the table below all shorezone projects within the agency’s jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
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**TRPA Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | TRPA |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 3/30/2005 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| N/A | | | |
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| | Site Specific Conservation Activities Totals | | |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| Conservation Strategy Participation (MV) | 36.5 | $1,122 |
| Conservation Strategy Participation (Jenny Leach) | 140 | $2,405 |
| Contract Administration (MV) | 110 | $3,382 |
| Annual Survey (Jenny Leach) | 40 | $687 |
| | | |
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| General Conservation Activities Totals | 326.5 | |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| N/A | | | |
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| | | | |
| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| Continued TYC Con Strat participation and contract management |
|---|

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
| Karen Vanhoorhis | navigational devices (shoreline protective devices) apn 083-172-09 |
| Richard and Lee Dixon | single family dwelling (addition/expansion) apn 130-331-05 |
| Lowell and Terry Lash | single family dwelling rebuild apn 094-160-12 |
| Jason and Sarah Dilullo | single family dwelling rebuild apn 094-160-21 |
| John Hodge & Stacey Keare | shorezone - minor QE apn 115-020-02 |
| Al Huber (Shorezone stair replacement) | shorezone - minor QE apn 016-142-08 |
| Robert S. Basso | beach recreation (piers) apn 085-344-05 |
| | |
| | |

## CSLC Annual Report
## Agency Tahoe Yellow Cress Conservation Activities

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | California State Lands Commission |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 3/28/05 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
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| | Site Specific Conservation Activities Totals | | |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| TYC TAG | 24 | 3,948 |
| Stewardship Subcommittee/Brochure | 40 | 2,359 |
| Site-Specific Plan template | 40 | 4,347 |
| New site ranking review | 30 | 2,854 |
| Annual Shorezone Survey | 40 | 3,995 |
| Environmental Review (TRPA Shorezone EIS) | 14 | 1,398 |
| Environmental Review (BOR/DWR TROA EIS/EIR) | 12 | 1,340 |
| CSLC project application reviews | 8 | 800 |
| TYC Executive meeting | 16 | 2,000 |
| General Conservation Activities Totals | 224 | 23,041 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
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| | | | |
| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| |
|---|
| |

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
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**CDFG Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | California Department of Fish and Game |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | March 4, 2005 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Zephyr Cove | field review and meeting with pvt landowner | 12 | 650 |
| | | | |
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| | Site Specific Conservation Activities Totals | 12 | 650 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| TAG participation | 96 | 4850 |
| Annual survey | 60 | 3000 |
| Stewardship activities | 65 | 3400 |
| Permit coordination and review | 34 | 1200 |
| Section 6 funds coordination | 18 | 900 |
| Executive Committee | 40 | 2400 |
| | | |
| | | |
| General Conservation Activities Totals | 313 | 15750 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
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| | | | |
| | Totals | 0 | 0 |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| |
|---|
| |

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
| none | |
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**CDPR Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | California Department of Parks and Recreation |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 4/7/05 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Lester Beach Enclosure | Fence maintenance | 8 | 247.00 |
| General Creek | Monitoring status and impacts | 5 | 173.00 |
| Sugar Pine South | Monitoring status and impacts | 5 | 173.00 |
| Avalanche | Monitoring status and impacts | 5 | 173.00 |
| | | | |
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| | Site Specific Conservation Activities Totals | 23 | 766.00 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| USFS Nevada Beach TYC outplanting | 16 | 311.00 |
| TAG and subcommittee meeting participation | 31 | 1677.00 |
| Executive Committee meeting participation | 12 | 1698.00 |
| Annual Report preparation | 6 | 198.00 |
| TYC Annual Survey Participation | 93 | 2757.00 |
| Miscellaneous-review documents, mtg note preparation, communications, etc. | 42 | 1538.00 |
| | | |
| | | |
| General Conservation Activities Totals | 158 | 8179.00 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| General Creek | trampling; CEQA & install temp. fencing | 12 | 350.00 |
| Sugar Pine South | trampling; CEQA & install temp. fencing | 25 | 700.00 |
| | | | |
| | | | |
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| | Totals | 37 | 1050.00 |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

Avalanche, Lester Beach, Sugar Pine South, and General Creek TYC status and impact monitoring
Install temporary fences at General Creek & Sugar Pine South if TYC vulnerable to trampling
Rebuild Lester Beach enclosure and outplant TYC for education purposes
Participate in TAG/subcommittee and Executive Committee meetings
Participate in TYC annual lake-wide survey

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
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**CTC Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | California Tahoe Conservancy |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | June 10, 2005 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Upper Truckee River East and | Fence and sign maintenance | 100 | 1500.00 |
| Upper Truckee River West | High Sierra Patrol | | 400.00 |
| | | | |
| | | | |
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| | | | |
| | Site Specific Conservation Activities Totals | 100 | 1900.00 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| TAG participation | 40 | 1200.00 |
| Funding of Land Steward for Upper Truckee Marsh | | 5950.00 |
| | | |
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| | | |
| General Conservation Activities Totals | | 7150.00 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| None | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

| Planting and fence and sign maintenance |
|---|

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
| None | |
| | |
| | |
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**NNHP Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | Nevada Natural Heritage Program |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 1 March 2005 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
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| | Site Specific Conservation Activities Totals | | |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| Update and Maintenance of Occurrence Database | 40 | 1320 |
| Attendance of TYC TAG Meetings | 30 | 990 |
| Revision and update of yearly suvery forms | 25 | 825 |
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| General Conservation Activities Totals | | |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
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| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

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| Update and maintenance of database, attendance of TYC TAG meetings, update of annual survey forms, help with annual survey. |

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
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**NDSP Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to field:

| | |
|---|---|
| Enter name of reporting agency: | Nevada Division of State Parks |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 02/17/05 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Cave Rock (unranked) | None | None | None |
| Hidden Beach (unranked) | None | None | None |
| Sand Harbor (low) | None | None | None |
| experimental enclosure | -Removal of 2003 enclosure fence;<br>- Redesign, layout, and installation of new experimental enclosure;<br>-Planting and monitoring of 353 plant (some stems were still alive and in place from the 2003 Pilot Study). | 84 | 2,012 |
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| | Site Specific Conservation Activities Totals | 84 | 2,012 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| Staff was involved with the basin-wide planning efforts associated with the implementation of the TYC Conservation Strategy and with research priorities and projects within the boundaries of the LTNSP. TAG coordination and Executive Committee meetings were regularly attended. | 45 | 1,125 |
| Staff assistance (x2) was given during this year's annual survey to include the use of the park's patrol boat (2 days). This involved a total of 3 days to | 48 | 2,000 |

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|---|---|---|
| include upper Truckee sites and others along the east and north shore. | | |
| Plant survey markers were purchased to be used basin-wide for the experimental outplanting. | | 1,000 |
| Experimental outplanting assistance (x2) at Taylor Creek | 10 | 250 |
| $20,000 was expended from a $50,000 Tahoe License Plate grant commitment to support basin-wide activities for Conservation Strategy implementation. This expenditure covers 2004 activities. | | 20,000 |
| Planning for a TYC display at the Sand Harbor Visitors Center. | 2 | 50 |
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| General Conservation Activities Totals | 105 | 24,425 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Cave Rock | Average site recreation pressure. | | |
| Sand Harbor | Average site recreation pressure. | | |
| Hidden Beach | Average site recreation pressure. | | |
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| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

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| Continued participation with basin-wide Conservation Strategy implementation and TAG participation. It is also anticipated that Sand Harbor will continue to be a site for experimetal outplantings. The display at the visitor's center should be completed. Staff will also be involved with the 2005 TYC annual survey. |

List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
|---|---|
| Sand Harbor Visitor Center - Phase Two Utilities | A park-wide (Sand Harbor) utility upgrade involving power, phone, water, and fire suppression improvements to accomadate the Sand Harbor Visitors Center. The project involved a 50,000 gallon (storage) fire suppression system with an intake line in Lake Tahoe. There was no TYC present at the site of shorezone disturbance. |
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**NDF Annual Report**
**Tahoe Yellow Cress Conservation Activities**

As agreed to in the Tahoe Yellow Cress (TYC) Conservation Agreement, by January 1 of each year, the TYC Technical Advisory Committee (TAC) shall prepare an annual report describing the status of TYC. A component of the annual report is a reporting by each of the participating agencies on TYC conservation activities undertaken or planned for the future

This form provides a standardize format to assist management agencies in submitting their annual report to the TAG. This report should be completed by each management agency and submitted to the TYC TAG no later than **November 1** of each year.

Please complete the following fields. Press the tab key to scroll from field to filed:

| | |
|---|---|
| Enter name of reporting agency: | Nevada Division of Forestry |
| Reporting period: | January 1 2004 through December 31, 2004 |
| Enter date report submitted to TAG: | 3/22/05 |

Describe in the table below site-specific conservation activities for each TYC site within the agency's jurisdiction undertaken during the previous growing season. Please use site names as listed in the TYC Conservation Strategy:

| List TYC site name: | Describe site specific activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|---|
| Sand Harbor | Outplanting | 24 | $740 |
| Upper /Lower Truckee | Annual Survey | 24 | $740 |
| North End Lake Tahoe | Annual Survey | 16 | $420 |
| East Side lake Tahoe | Annual Survey | 8 | $220 |
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| | Site Specific Conservation Activities Totals | 72 | $2,120 |

Describe in the field below general TYC conservation activities undertaken by the agency during the reporting period (i.e. public outreach, consultation, TAG participation, etc.):

| Describe general conservation activities: | Staff hours involved | Cost (include staff time and other costs) |
|---|---|---|
| Nursery | 16 | $400 |
| TAG Participation | 56 | $1540 |
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| General Conservation Activities Totals | 72 | $1,940 |

Please describe in the field below any significant disturbances to the species or its habitat on land within agencies jurisdiction and subsequent response:

| List TYC site name: | Describe disturbance and response: | Staff hours involved | Cost (include staff time and other costs) |
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| | Totals | | |

Please describe in the field below planned TYC conservation activities anticipated for the upcoming year:

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List and describe in the table below all shorezone projects within the agency's jurisdiction undertaken within potentially suitable TYC habitat:

| Project Name (list below): | Project Description including location: |
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