

**French Fire**  
**Invasive Plant Control and Vegetation Monitoring**  
**Final Accomplishment Report**  
**Whiskeytown National Recreation Area**

**September 2005**



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## Introduction

The French Fire began on Saturday, August 14, 2004 along Trinity Mountain Road in Whiskeytown National Recreation Area (NRA) and burned 13,323 acres of NPS, BLM, and private land before it was contained on August 20<sup>th</sup>. Under recommendation from the U.S. Department of the Interior Burned Area Emergency Response Team, Whiskeytown NRA began emergency stabilization procedures to control non-native plant species and monitor vegetation response in the fall of 2004.

The French Fire Burned Area Emergency Stabilization (BAER) Plan (USDOI 2004) recommended procedures to control known non-native plant populations and prevent their expansion in the burned area. The plan also identified the following four objectives for monitoring treatment effectiveness and vegetation recovery on NPS land within the fire boundary:

1. Monitor success of noxious weed treatments.
2. Monitor for new occurrences of undesirable plant species within the burned area.
3. Monitor short-term shrub recovery.
4. Monitor overall vegetation response to fire.

Before the French Fire, Whiskeytown staff documented approximately 169 acres of non-native invasive plant species within the fire area, including populations of Himalayan blackberry (*Rubus discolor*), Scotch broom (*Cytisus scoparius*), yellow star thistle (*Centaurea solstitialis*), tree of heaven (*Ailanthus altissima*), bull thistle (*Cirsium vulgare*), and mullein (*Verbascum sp.*). Efforts to control these species and prevent their expansion were undertaken by park staff, and effectiveness monitoring was conducted to determine treatment success. In addition, surveys were conducted to identify and manage new infestations of non-native invasive species.

According to the French Fire BAER Plan (USDOI 2004), 70% of the area burned in Whiskeytown NRA experienced high to moderately high immediate post-fire vegetation mortality, predominantly in the mixed chaparral, knobcone pine, and oak vegetation types. Monitoring was conducted in these vegetation types to examine shrub and overall vegetation recovery and identify any future rehabilitation needs.

## Methods

### Invasive Plant Control and Monitoring

Proposed invasive plant control and monitoring activities were outlined in a plan developed by park staff soon after the fire (Commons 2005). In this plan, treatment priorities were established for known and potential infestations based on the species' ability to invade uninfested lands within the park and how difficult they are to control. Three priority levels were established with infestations of tree of heaven (*Ailanthus altissima*), Scotch broom (*Cytisus scoparius*), and common mullein (*Verbascum thapsus*) receiving the highest priority. Himalayan blackberry (*Rubus discolor*) infestations near drainages and in small isolated populations were the second priority (Figure 1), followed by blackberry infestations that were established before the fire, and those populations that are in close proximity to the fire

with the potential to invade the burned area. Because of its difficulty to control, yellow star thistle (*Centaurea solstitialis*) was identified as the lowest priority and management of the species focused on new infestations that threatened pristine and uninfested areas.

Treatment methods were defined for each species based on established procedures used in the park's integrative pest management program (Table 1). Treatments were targeted to coincide with the timing of phenology of specific species to maximize treatment success.

Table 1. Treatment methods used for invasive plant control.

| Species                    | Treatment Method                                                                                                                                                                                                                                                                        |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Ailanthus altissima</i> | Small plants: Foliar application of 1.44% active triclopyr (3 oz Garlon-4/gallon water).<br>Medium plants: Basal bark treatment with 12.3% active triclopyr (80% adjuvant oil, 20% Garlon-4)<br>Large plants: Cut to 8 inch stump and "painted" with Garlon-4 (61.6% active triclopyr). |
| <i>Cytisus scoparius</i>   | Hand pulled. Plants with flowers or seeds bagged and disposed.                                                                                                                                                                                                                          |
| <i>Rubus discolor</i>      | Foliar application of 1.44% active triclopyr (3 oz Garlon-4/gallon water).                                                                                                                                                                                                              |
| <i>Verbascum blattaria</i> | Hand pulled. Plants with flowers or seeds bagged and disposed.                                                                                                                                                                                                                          |
| <i>Verbascum thapsus</i>   | Hand pulled and raked. Plants with flowers or seeds bagged and disposed.                                                                                                                                                                                                                |



Figure 1. Biological Technician applying herbicide to a post-fire infestation of Himalayan blackberry.

Treatment areas were mapped using Trimble GeoExplorer GPS units and data was collected on the number, percent cover, phenology of invasive species and the extent of the area treated. Park staff also kept track of the types of herbicides or mechanical treatments were used, concentration, quantity, effort, and supporting metadata. The effectiveness of treatments was measured by revisiting each site and continuing to map and measure the degree and extent of infestation. Fourteen photopoints (App. A, Map. 1) were established to capture the effectiveness of mechanical and chemical treatments and to capture the native vegetation response to the treatments. Each photopoint was revisited three times during the field season and the time, date, and general observations recorded on each visit.

### Survey for New Occurrences of Invasive Plants

Surveys were conducted throughout the summer to identify and document new infestations of invasive plants within the burned area (Figure 2). Roadsides, stream corridors, and areas impacted by suppression were identified as survey priorities. However, due to the history of high severity and frequent fire in the area, surveys were expanded into the mid- and upper-slopes of the nearby hillsides. New infestations were documented with GPS units and the number of individuals present was recorded for each species encountered.



Figure 2. Biological Technician surveying for new infestations of non-native invasive plants.

### Monitoring of Short-Term Shrub Response

Park staff surveyed the fire area one month and three months post fire to assess the short-term response of shrubs. Overall, the plant communities on National Park Service lands within the fire can be lumped into the following broad categories: blue oak (*Quercus douglasii*) savannah, canyon live oak woodland (*Quercus chrysolepis*), interior live oak woodland (*Quercus wislizeni*), white leaf manzanita (*Arctostaphylos viscida*) chaparral, chamise (*Adenostoma fasciculatum*), riparian, and a mixture of knobcone pine (*Pinus attenuata*), ghost pine (*Pinus sabiniana*), and chaparral species. A qualitative approach was taken to assess the shrub recovery within these communities through field observations and photographs one month and three months post fire.

### Monitoring of Overall Vegetation Response

Prior to the fire, two different research studies collected vegetation data within the fire perimeter. Park staff saw this as an opportunity to use these protocols to compare the data before and after the fire to assess the overall vegetation response (App. A, Map 2). The recovery of shrubs and trees was measured using protocols and data provided by Humboldt State University for the Whiskeytown NRA Vegetation Mapping Project (Stuart et al 2003). To assess the response of herbaceous species and determine the ratio of native to non-native plant cover, protocols and pre-fire data provided by Jon Keeley (Merriam et al 2002) were used.

Post-fire tree and shrub recovery was measured in eighteen circular plots utilizing the relevé approach. In tree-dominated vegetation types sample plot size totaled 0.05 hectare (0.12 acre, 41.4-foot radius) and 0.02 hectare plots (0.05 acre, 26.2-foot radius) were sampled in shrub-dominated vegetation types. Within each plot, the percent cover of each tree and shrub species present was recorded along with the average height and cover of three strata representing vegetation height classes of <0.75 m, 0.75-5.0 m, and >5.0 m tall.

Post-fire herbaceous response was measured in four transects of seven plots each (twenty-eight total plots) along the Trinity Mountain dozer line. Belt transects perpendicular to the fuel break were sampled on both sides at 500 ft intervals from the origin nearest to a road corridor. Transects were 1 m in width and extended from the middle of the fuel break 40 m into surrounding vegetation. At 5 m intervals a 1 x 1 m quadrat was sampled by recording species composition and estimating cover of individual species in cover classes (Figure 3). Densiometer readings of canopy cover were taken at each sample quadrat, and slope, aspect, and inclination were recorded for each transect.



Figure 3. Biological Technician collecting herbaceous response data in the French Fire.

## Results

### Invasive Plant Control and Monitoring

Overall, 60.5 acres (approximately 10,120 plants) of high priority species were chemically treated and approximately 21.6 acres (approximately 54,275 plants) were hand-pulled from October 2004 to September 2005. This totals to 82.1 acres (approximately 64,395 plants) treated (Table 2). The treatment area was broken into nine major infestations (App. A, Maps 3 and 4) which were monitored and assessed for treatment effectiveness.

Table 2. Summary of treatments.

| Species             | Estimated # Plants | Treatment | Acres       | Hours      |
|---------------------|--------------------|-----------|-------------|------------|
| <i>R. discolor</i>  | n/a                | Herbicide | 30.6        | 274        |
| <i>A. altissima</i> | 10,120             | Herbicide | 29.9        | 197        |
| <i>V. thapsus</i>   | 54,000             | Hand-pull | 21.3        | 136        |
| <i>C. scoparius</i> | 275                | Hand-pull | 0.3         | 20         |
| <b>Total</b>        | <b>15,795</b>      |           | <b>82.1</b> | <b>627</b> |

Himalayan blackberry was treated by foliar application of herbicide (1.44% active triclopyr) resulting in a 99% reduction in blackberry cover over a one month period. However, due to late spring rains, herbicide treatment could not begin until later in the season and the blackberry was able to establish more cover than it would have with earlier treatment. This allowed the blackberry to establish thickets as tall as one meter in some areas, which has resulted in thick masses of dead canes after treatment. Overall, the treatment of Himalayan blackberry averaged 88.6% (Table 3).

Table 3. Himalayan blackberry treatment effectiveness.

| Infestation ID | Acres | Estimated %Cover |                        |                        | Effectiveness |
|----------------|-------|------------------|------------------------|------------------------|---------------|
|                |       | Pre-treatment    | 1 month Post-treatment | 2 month Post-treatment |               |
| Boundary       | 1.41  | 60               | 0                      | 5                      | 92%           |
| Bend           | 1.05  | 30               | 0                      | 5                      | 84%           |
| Creek*         | 6.2   | 65               | 0                      | 5                      | 92%           |
| Drainage       | 4.88  | 25               | 0                      | 5                      | 80%           |
| Orchard        | 1.23  | 100              | 0                      | 5                      | 95%           |

\*Multiple treatments

Tree of heaven was treated by size class using established park methods. Small plants were treated by foliar application of herbicide (1.44% active triclopyr), medium sized plants were treated with basal bark application of herbicide (12.3% active triclopyr), and large plants were cut to an 8 inch stump and painted with herbicide (61.6% active triclopyr). These treatments resulted in an average 97% reduction in live tree of heaven cover over a one month period. Overall, the effectiveness of treating tree of heaven averaged 80%.

Table 4. Tree of heaven treatment effectiveness.

| Infestation ID    | Acres | Estimated %Cover |                        |                        | Effectiveness |
|-------------------|-------|------------------|------------------------|------------------------|---------------|
|                   |       | Pre-treatment    | 1 month Post-treatment | 2 month Post-treatment |               |
| Boundary**        | 4.73  | 20               | 15                     | 18                     | 10%           |
| Trinity Mountain* | 1.8   | 10               | 0                      | 2                      | 80%           |
| Creek             | 1.245 | 65               | 0                      | 2                      | 97%           |
| Highway           | 8.9   | 35               | 0                      | 2                      | 94%           |
| Roadside*         | 3.3   | 25               | 0                      | 2                      | 92%           |
| Merry Mountain    | 0.95  | 70               | 5                      | 8                      | 89%           |
| Orchard           | 2.1   | 25               | 0                      | 2                      | 92%           |

\*Multiple treatments

\*\*Incomplete treatment



(a) June 23, 2005



(b) August 2, 2005



(c) October 12, 2005

Figure 4. Successive photopoints documenting the success of treating the Boundary infestation. Photo (a) shows the infestation prior to the treatment. Photo (b) shows a completed treatment of Himalayan blackberry and a recent treatment of tree of heaven. Photo (c) shows an increase in black mustard after the Himalayan blackberry and tree of heaven cover had been reduced by the treatments.

Scotch broom, common mullein, and moth mullein plants were pulled by hand and the seeds were bagged and disposed. This treatment resulted in a 98% reduction of these species in the treated areas (Table 5 and 6).

Table 5. Common mullein treatment effectiveness.

| Infestation ID | Acres | Estimated # plants |                        |                        | Effectiveness |
|----------------|-------|--------------------|------------------------|------------------------|---------------|
|                |       | Pre-treatment      | 1 month Post-treatment | 2 month Post-treatment |               |
| Boundary       | 1.51  | 350                | <10                    | <10                    | 97%           |
| Creek*         | 5.48  | 52750              | <200                   | <200                   | 99%           |
| Orchard        | 3.91  | 300                | <10                    | <10                    | 97%           |
| Highway        | 3.91  | 600                | <10                    | <10                    | 98%           |

\*Multiple treatments

Table 6. Scotch broom treatment effectiveness.

| Infestation ID | Acres | Estimated # plants |                        |                        | Effectiveness |
|----------------|-------|--------------------|------------------------|------------------------|---------------|
|                |       | Pre-treatment      | 1 month Post-treatment | 2 month Post-treatment |               |
| Creek          | 0.016 | 25                 | 0                      | 0                      | 100%          |
| Stone House    | 0.283 | 250                | <5                     | <5                     | 98%           |

While treatment of target species was highly successful during the emergency stabilization phase, new infestations of high priority species became established within the same areas immediately post treatment. Of greatest concern is degree and extent in which black mustard and common mullein became established after Himalayan blackberry was treated. The cover of black mustard in some treatment areas is approaching 95% and impeding the ability of native species to recover.

The largest area of Himalayan blackberry infestation is located between Trinity Mountain Road and Clear Creek. This area, identified as the “Creek” infestation, was deemed to be the highest priority blackberry infestation due to its proximity to Clear Creek and the likelihood that it would expand into nearby uninfested plant communities that sustained 100% overstory tree mortality during the fire. The Creek infestation encompasses 6.2 acres and was intensively treated during emergency stabilization work. Three blackberry treatments were completed in this area with 92% effectiveness. Immediately afterwards, common mullein and black mustard began to take over the site. Three treatments were initiated to control the mullein and one crew of California Conservation Corps pulled approximately 50,000 common mullein plants during the second mullein treatment. A single treatment of Scotch broom was completed by hand pulling 25 plants and in all, six full treatments were completed within the 6.2 acre Creek infestation (Figure 5).



(a) May 25, 2005



(b) June 24, 2005



(c) July 13, 2005

Figure 5. Successive photopoints documenting the success of treating the Creek infestations. Photo (a) shows the Himalayan blackberry in the foreground prior to treatment. Photo (b) shows a recent treatment of Himalayan blackberry taking partial effect. Photo (c) demonstrates the successful treatment of Himalayan blackberry and retention of native species in the center of the photo.

### Survey for New Occurrences of Invasive Plants

Himalayan blackberry, tree of heaven, black locust, common mullein, and black mustard responded prolifically to the French Fire. Overall, the newly discovered populations of Himalayan blackberry, tree of heaven, common mullein, black mustard, and black locust account for an additional 115.3 acres in the fire area (Table 7).

Table 7. Non-native invasive plant population expansion after the French Fire. Acres were mapped using GPS units and numbers of plants were estimated by field personnel.

| Species                | Pre-Fire Infestation |              | Expansion    |               | Post-Fire Infestation |               |
|------------------------|----------------------|--------------|--------------|---------------|-----------------------|---------------|
|                        | Acres                | #Plants      | Acres        | #Plants       | Acres                 | #Plants       |
| <i>R. discolor</i>     | 23.3                 | n/a          | 65.5         | n/a           | 88.8                  | n/a           |
| <i>A. altissima</i>    | 19.5                 | 920          | 33.2         | 11,680        | 52.7                  | 12,600        |
| <i>V. thapsus</i>      | 9.5                  | 495          | 7.1          | 49,855        | 16.6                  | 50,350        |
| <i>B. nigra</i>        | n/a                  | n/a          | 6.2          | >5000         | 6.2                   | >5000         |
| <i>C. scoparius</i>    | 0.3                  | 250          | 0.0          | -50           | 0.3                   | 200           |
| <i>R. pseudoacacia</i> | 0.3                  | 25           | 3.3          | 1,975         | 3.6                   | 2,000         |
| <b>Total</b>           | <b>52.9</b>          | <b>1,690</b> | <b>115.3</b> | <b>63,460</b> | <b>168.2</b>          | <b>65,150</b> |

The largest expansion of Himalayan blackberry and tree of heaven occurred in the “Drainage” infestation (Figure 6). This infestation extends from Trinity Mountain Road up towards the western ridgeline (App. A, Fig. 5) and along a drainage that was burned in both the 1999 Trinity and Tower fires and again in the French Fire. Himalayan blackberry cover is estimated to be 20% at the local and community level. Park staff are gravely concerned that the response of Himalayan blackberry will soon outcompete resprouting Blue Elderberry (*Sambucus mexicana*), which is federally protected as habitat for the federally listed valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (Figure 7).



Figure 6. View of the Drainage infestation from the top of the ridgeline. Tree of heaven and blackberry have increased dramatically in this area since the French Fire.



Figure 7. Himalayan blackberry in the foreground encroaching on the federally protected Blue Elderberry, at the middle and top of the photo, within the Drainage infestation.

The “Boundary” infestation is located on the north boundary of the park in an historic meander of Clear Creek (App., Map 5). This infestation is associated with old lumber mill ponds and tailing piles and since the French Fire, it has extended significantly upslope and is primarily composed of black locust and tree of heaven seedlings. Within the 9 acre Boundary infestation, tree of heaven experienced a dramatic increase in the number of plants. There were approximately 100 individuals prior to the fire, and the area is now estimated to contain up to 10,000 tree of heaven seedlings - a population increase of nearly 10,000% (Figure 9).



Figure 9. Tree of heaven seedling recruitment within the Boundary infestation.

Within the areas that underwent chemical treatment to control Himalayan blackberry and tree of heaven, annual non-native invasive plants have begun to invade. The decrease in native tree and shrub cover caused by the fire combined with the treatment of the woody invasive plants has removed the majority of the overstory cover in some of the treatment areas. This has created the ideal situation for common mullein and black mustard to invade the treated areas and establish new infestations.

#### Monitoring of Short-Term Shrub Response

Overall, the understory species within all of the plant communities surveyed responded favorably to fire. Field surveys and photographs of the vegetation response immediately post fire revealed that numerous species were resprouting robustly. Table 8 summarizes the overall response of resprouting shrubs within each plant community. The majority of the resprouting shrubs observed were native; however, several non-native, invasive species showed an immediate response as well. Within the riparian plant community, Himalayan blackberry and Tree of Heaven resprouted vigorously (Figure 10) within days of the fire and essentially had a “jump-start” over the native plant species where existing infestations were already established. In some areas, resprouting Himalayan blackberry was documented even before the fire was contained.

Table 8. A summary of the overall response of resprouting shrub species and management implications for plant communities in the French Fire.

| Plant Community                              | Observed Resprouting Shrub Species               | Shrub Response Immediately post fire                               | Shrub Response three months post fire | Management Implications                                                                                                                                                                                                                     |
|----------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| blue oak savannah                            | Red bud<br>poison oak<br>toyon                   | Minor response                                                     | Moderate response                     | Fire behavior was a backing fire and impacts were minimal.<br><br>Full recovery is expected within 1 year.                                                                                                                                  |
| canyon live oak woodland                     | Poison oak<br>toyon                              | Minor response                                                     | Moderate response                     | Fire behavior was a backing fire and impacts were minimal.<br><br>Full recovery is expected within 1-2 years.                                                                                                                               |
| interior live oak woodland                   | Poison oak<br>chamise                            | Minor response                                                     | Vigorous response                     | This plant community experienced a low severity backing fire and is expected to fully recover within 1-2 years.                                                                                                                             |
| interior live oak shrubland                  | Poison oak<br>Chamise<br>Interior live oak       | Minor response                                                     | Moderate response                     | This plant community has experienced several high severity fires within the past 20 years and is in danger of being type converted to a grassland.<br><br>Full recovery is expected within >40 years, in the absence of high severity fire. |
| white leaf manzanita chaparral               | Coffee berry<br>poison oak<br>chamise            | Minor response                                                     | Vigorous response                     | Full recovery is expected within 10-20 years.                                                                                                                                                                                               |
| chamise                                      | chamise                                          | Moderate response                                                  | Vigorous response                     | Full recovery is expected within 5 years.                                                                                                                                                                                                   |
| knobcone pine, ghost pine, and chaparral mix | Toyon<br>Poison oak<br>redbud                    | Minor response                                                     | Moderate response                     | Full recovery is expected in 10-20 years.                                                                                                                                                                                                   |
| Riparian                                     | Willow<br>Tree of Heaven<br>Himalayan blackberry | Vigorous response by<br>Tree of Heaven and<br>Himalayan blackberry | Vigorous response of all species      | Full recovery of native species is expected in 5-10 years.<br><br>Non-native species may dominate by responding quickly and more vigorously than the native species.                                                                        |



Figure 10. Himalayan blackberry sprouts one month post fire along Clear Creek.

Native species had a delayed response and began to resprout in early fall. For the most part, plant communities that responded quickly are those that are comprised of mostly resprouting species, such as chamise. These communities occupy the steepest slopes within the fire area and it is thought that they were primarily responsible for stabilizing the slopes that experienced high fire severity. The fire behavior in the canyon live oak woodlands and blue oak savannahs was primarily a backing fire. Fortunately for park staff, the response of such understory species as poison oak occurred fairly quickly in early fall. The chamise plant community had perhaps the most robust response on the steepest of hillsides (Figure 11). Species within whiteleaf manzanita and in the mixed communities responded similarly. Resprouting species such as toyon (*Heteromeles arbutifolia*), poison oak (*Toxicodendron diversiloba*), and silk tassel bush (*Garrya fremontii*) dominated this community's response.



Figure 11. Chamise resprouting in early fall.

The response of interior live oaks along Trinity Mountain Road was minimal when compared to interior live oaks in other locations. This area has experienced several high severity fires within the last twenty years, which have left the oaks in a suppressed shrub form. Before the French Fire, Humboldt State University classified this community as an “Interior Live Oak Shrubland” for their vegetation mapping project. It is expected to take greater than forty years for this plant community to demonstrate signs of recovery and for the interior live oaks to develop into trees. In the event of continued frequent fire, this area will most likely be converted to grassland. Planting of interior live oaks and other species has been proposed, but will only be successful if fires are successfully suppressed, and this cannot be guaranteed. On the other hand, the Interior Live Oak Woodland experienced a backing fire during the French Fire and understory resprouting species have responded well. It is expected that this woodland community will recover within 1-2 years (Figure 12).



Figure 12. Vegetation map plots indicating the Interior Live Oak plant communities. On the left is an area that has experienced several high severity fires and is at risk of being type converted to grassland. Shrub-like resprouting interior live oaks can be seen in the foreground. On the right is an area that has experienced fewer fires of lesser severity and oak individuals are represented by large trees.

#### Monitoring of Overall Vegetation Response

The response of herbaceous species, shrubs, and trees was determined using ocular estimates and by comparing pre- and post-fire vegetation data. The understory response of herbaceous species varied depending on the plant community. Within the blue oak woodland and sections of interior live oak woodland, where the fire was a low severity backing fire, the understory herbaceous species flourished. However, in other plant communities, such as chamise, canyon live oak woodland, and some interior live oak woodland a head fire caused much greater fire severity and therefore a slower herbaceous response.

To more accurately capture the vegetation response, quantitative data was collected. Tree and shrub recovery was measured in five plant associations identified by the Humboldt State University vegetation mapping project. This project collected data before the French Fire in what has been now classified as the following vegetation associations: canyon live oak/poison oak; chamise; interior live oak/poison oak/yellow star thistle; interior live oak/poison oak shrubland; interior live oak/poison oak woodland. By comparing data collected in 2002 to post-fire measurements, park staff calculated the percent change in tree and shrub cover by species in these five vegetation associations as well as the change in cover of three strata representing vegetation height classes of <0.75 m, 0.75-5.0 m, and >5.0m.

The average value of tree and shrub cover in the chamise association decreased by 46% post fire, while the canyon live oak/poison oak association experienced a decrease of 25% and the interior live oak associations showed little (<7%) decrease in tree and shrub cover. This minimal change could be explained by the fact that the interior live oak woodland associations experienced a backing, low severity fire and the interior live oak shrubland had very little shrub and tree cover prior to the fire. Thus, the percent change in shrub and tree cover reflects the fire behavior that was observed. Overall, the fire decreased canopy cover and shifted vegetation cover to shorter height classes, and hence successional stages, within all five plant associations (Chart 1).

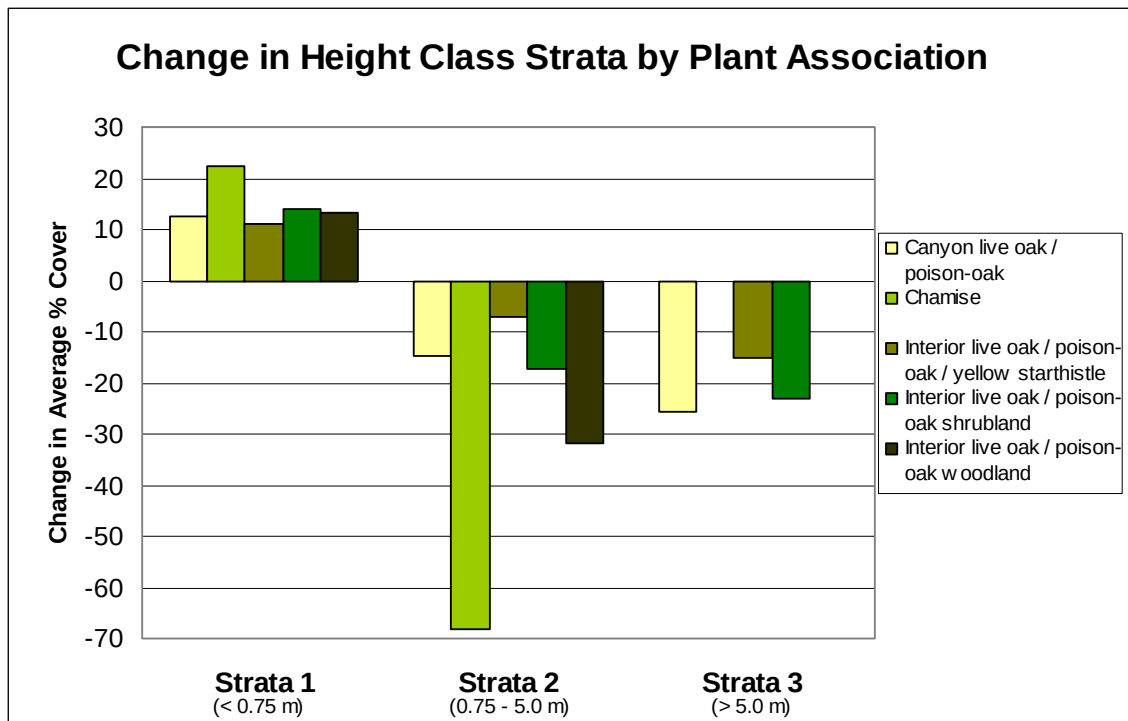


Chart 1. The percent change in species cover demonstrates a shift from the taller (strata 2 & 3) height classes to the shorter (strata 1) class.

The decrease in tree and shrub cover and shift to the shorter height class indicate that herbaceous species increased in abundance and cover post fire. Data from the Keeley

fuelbreak study (Merriam 2002) was used to assess the overall response of native and non-native herbaceous species and shrubs along the old Tower Fire fuelbreak which was bulldozed in 1999. Before the French Fire, Keeley's researchers found that the percent cover of non-native herbaceous species was greater on fuelbreaks than in the surrounding wildlands in study areas throughout California. Using this pre-fire information, park staff examined the post-fire change in vegetation cover both on the old Tower Fire fuelbreak and into the surrounding wildland.

After the French Fire, the data demonstrated a marked decrease in shrub cover and increase in herbaceous cover both on the fuelbreak and in the surrounding wildland (Chart 2). Before the fire, the fuelbreak area was dominated by herbaceous species due to the mechanical removal of shrubs, but the unaltered wildland areas were dominated by shrubs with little herbaceous cover in the understory. After the French Fire, herbaceous species dominated cover both on the fuelbreak and in the surrounding wildland and the total shrub cover in each area decreased.

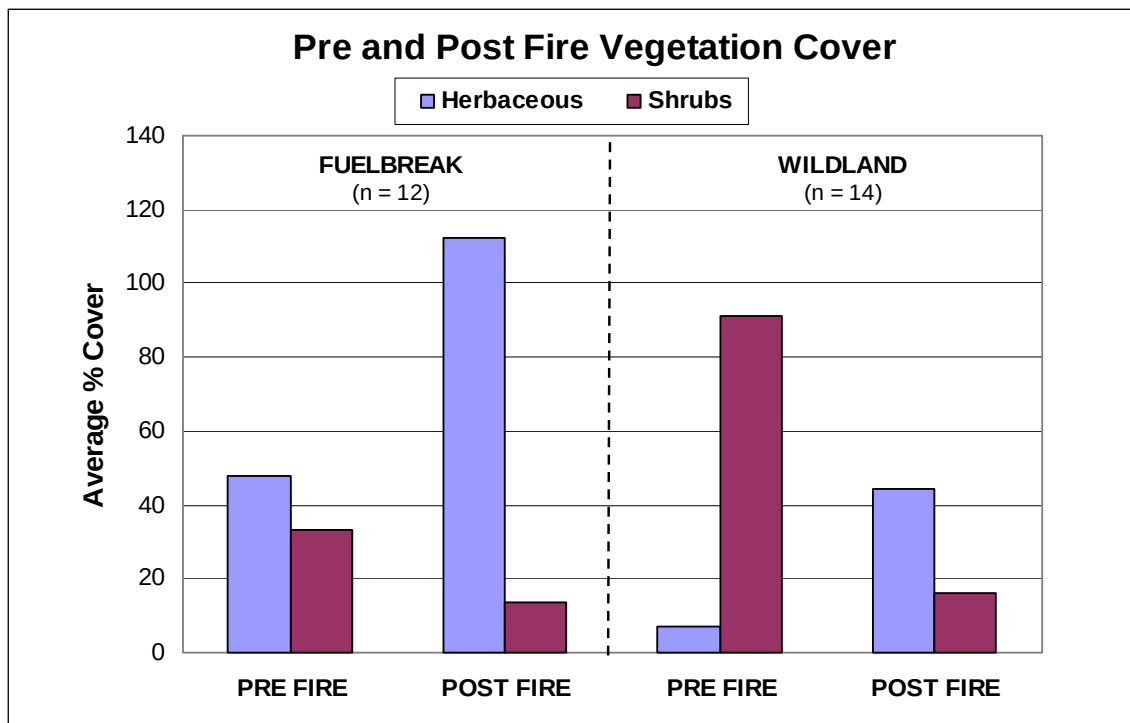


Chart 2. Pre and post fire herbaceous and shrub cover on the Tower fuelbreak and in the surrounding wildlands.

Tree and such shrub species as chamise, toyon, whiteleaf manzanita, interior live oak, yerba santa (*Eriodictyon californicum*), and poison oak dominated the wildland areas before the fire (Table 9). However, after the fire, herbaceous and grass species such as small flowered lotus (*Lotus micranthus*), fescue (*Vulpia sp.*), and blazing star (*Mentzelia sp.*) showed a greater initial response.

Table 9. Species with the greatest average % cover before and after the fire on the fuelbreak and in the surrounding wildlands.

| 10 Most Common Species in Each Area (Pre- and Post-Fire) |          |           |             |                                 |          |           |             |
|----------------------------------------------------------|----------|-----------|-------------|---------------------------------|----------|-----------|-------------|
| Fuelbreak (Pre-Fire)                                     |          |           |             | Fuelbreak (Post-Fire)           |          |           |             |
| Species                                                  | Nativity | Life form | Avg % Cover | Species                         | Nativity | Life form | Avg % Cover |
| <i>Adenostoma fasciculatum</i>                           | native   | shrub     | 18.3        | <i>Lotus micranthus</i>         | native   | herb      | 43.4        |
| <i>Centaurea solstitialis</i>                            | non      | herb      | 12.1        | <i>Vulpia bromoides</i>         | non      | graminoid | 21.8        |
| <i>Eriodictyon californicum</i>                          | native   | shrub     | 11.4        | <i>Hypochaeris radicata</i>     | non      | herb      | 14.1        |
| <i>Bromus madritensis</i>                                | non      | graminoid | 8.0         | <i>Bromus madritensis</i>       | non      | graminoid | 6.1         |
| <i>Vulpia myuros</i>                                     | non      | graminoid | 7.3         | <i>Eriodictyon californicum</i> | native   | shrub     | 5.7         |
| <i>Bromus hordeaceus</i>                                 | non      | graminoid | 5.8         | <i>Adenostoma fasciculatum</i>  | native   | shrub     | 5.1         |
| <i>Galium parisiense</i>                                 | non      | herb      | 4.8         | <i>Vulpia myuros</i>            | non      | graminoid | 5.0         |
| <i>Toxicodendron diversilobum</i>                        | native   | shrub     | 3.4         | <i>Galium sp.</i>               | native   | herb      | 2.8         |
| <i>Vulpia bromoides</i>                                  | non      | graminoid | 2.7         | <i>Micropus californicus</i>    | native   | herb      | 2.3         |
| <i>Vulpia microstachys</i>                               | native   | graminoid | 1.6         | <i>Bromus diandrus</i>          | non      | graminoid | 1.8         |
| Wildland (Pre-Fire)                                      |          |           |             | Wildland (Post-Fire)            |          |           |             |
| Species                                                  | Nativity | Life form | Avg % Cover | Species                         | Nativity | Life form | Avg % Cover |
| <i>Adenostoma fasciculatum</i>                           | native   | shrub     | 64.2        | <i>Lotus micranthus</i>         | native   | herb      | 21.8        |
| <i>Heteromeles arbutifolia</i>                           | native   | shrub     | 13.3        | <i>Adenostoma fasciculatum</i>  | native   | shrub     | 12.0        |
| <i>Arctostaphylos viscida</i>                            | native   | shrub     | 7.6         | <i>Vulpia bromoides</i>         | non      | graminoid | 6.1         |
| <i>Quercus wislizeni</i>                                 | native   | tree      | 5.8         | <i>Mentzelia sp.</i>            | native   | herb      | 4.3         |
| <i>Eriodictyon californicum</i>                          | native   | shrub     | 3.2         | <i>Vulpia myuros</i>            | non      | graminoid | 3.1         |
| <i>Toxicodendron diversilobum</i>                        | native   | shrub     | 3.0         | <i>Arctostaphylos viscida</i>   | native   | shrub     | 1.9         |
| <i>Aira carophyllea</i>                                  | non      | graminoid | 2.1         | <i>Eriodictyon californicum</i> | native   | shrub     | 1.9         |
| <i>Vulpia myuros</i>                                     | non      | graminoid | 1.4         | <i>Bromus madritensis</i>       | non      | graminoid | 1.3         |
| <i>Vulpia bromoides</i>                                  | non      | graminoid | 1.4         | <i>Aira carophyllea</i>         | non      | graminoid | 1.1         |
| <i>Bromus madritensis</i>                                | non      | graminoid | 1.3         | <i>Trifolium microcephalum</i>  | native   | herb      | 1.1         |

This increase in herbaceous species cover was comprised of a mixture of both native and non-native herb and grass species. Both on the fuelbreak and in the surrounding wildland, native species increased dramatically, while smaller increases were seen in non-native species cover (Chart 3). However, this effect could be attributed to a sampling constraint in which the pre and post data were collected at different phenological stages. The pre-data was collected in late spring and early summer when such non-native and invasive plant species would be in flower, and the post data was collected in mid-spring, when most would just be at the cotyledon or rosette stage. The rationale for this inconsistency in sampling schedule was that park staff would rather focus their efforts on the removal or application of herbicide to such non-native and invasive species during such a critical phenological time within the entire area of the French Fire.

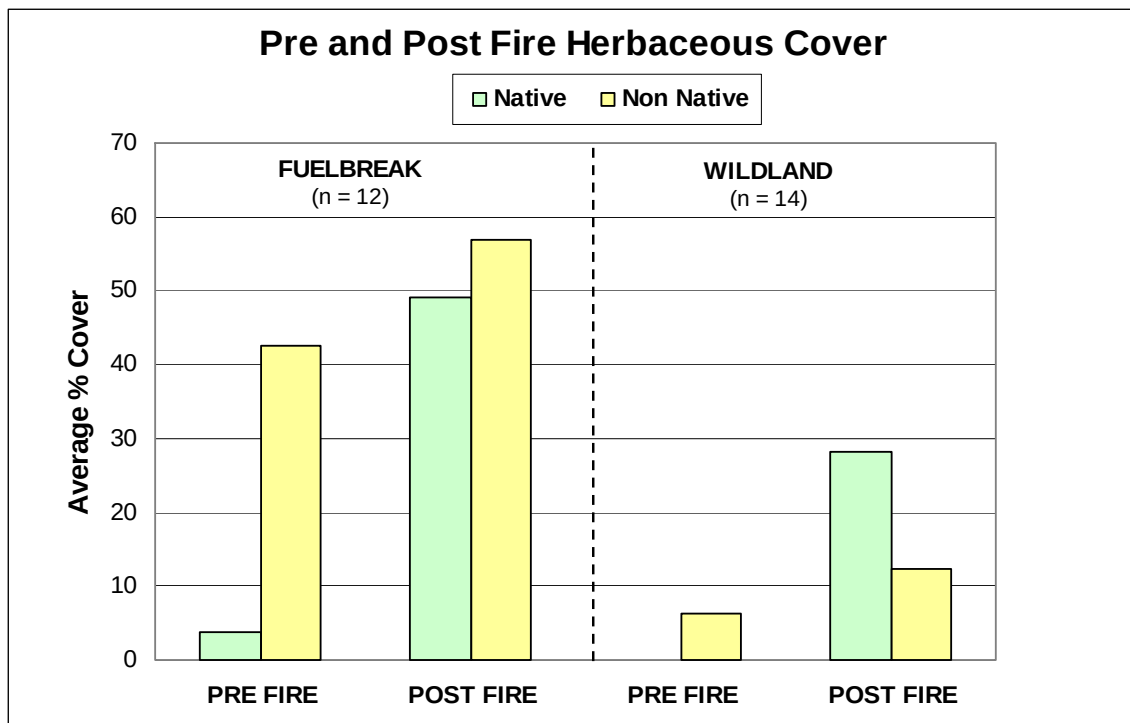


Chart 3. Pre and post fire cover of native and non-native herbaceous species on the Tower fuelbreak and in the surrounding wildland.

## Discussion

### Invasive Plants

Over 42 treatments totaling 82 acres were treated in FY05, which includes the management of tree of heaven, Himalaya blackberry, Scotch broom, common mullein, and moth mullein. Despite this success, park staff are gravely concerned over the new infestations that have become established as a result of the fire and which total over 115 acres in what was once considered fairly pristine habitat. Additionally, new invasive species have infested the areas that were treated during 2005. The two most prevalent species are black mustard and mullein, which are estimated to be over 50,000 plants and 90% cover.

Preventing invasive plant species establishment and expansion is the most important priority for park staff within the French Fire. The work completed this year to control known infestations and map new occurrences of invasive species is considered an initial action in the long-term management activities that will be required in the fire area. The French Fire burned along the northernmost boundary of the park and along Clear Creek, which is a gateway for non-native invasive species to spread further into the park. The French Fire has also opened fairly pristine areas to invasion by new invasive species. As is the case with any invasive plant treatment program, a multi-year effort will be required to successfully control the expansion of these populations within the fire and prevent introductions into undisturbed sites downstream within the interior of the park.

### Vegetation Response

The vegetation response to the French Fire is consistent with management objectives in all plant communities except the interior live oak shrublands and the riparian zone along Trinity Mountain Road. The interior live oak shrublands in this area have experienced several high severity fires in the past twenty years and are in danger of type conversion to a grassland community if this trend continues. Unfortunately, the history of fire in this area leaves little management opportunity for restoration activities. While planting of interior live oaks and other species may be a viable way to speed the natural recovery of this community, it is likely that another high severity fire will ignite on these steep slopes and negate the effects of any management actions taken. On the other hand, there may be an opportunity for successful restoration activities in the riparian zone between Clear Creek and Trinity Mountain Road. Non-native shrubs such as Himalayan blackberry and tree-of-heaven have dominated the post-fire response in this riparian community. While treatment activities are underway to control these highly invasive species, revegetation with native species may be needed to ensure the long-term recovery of this riparian community.

### Literature Cited

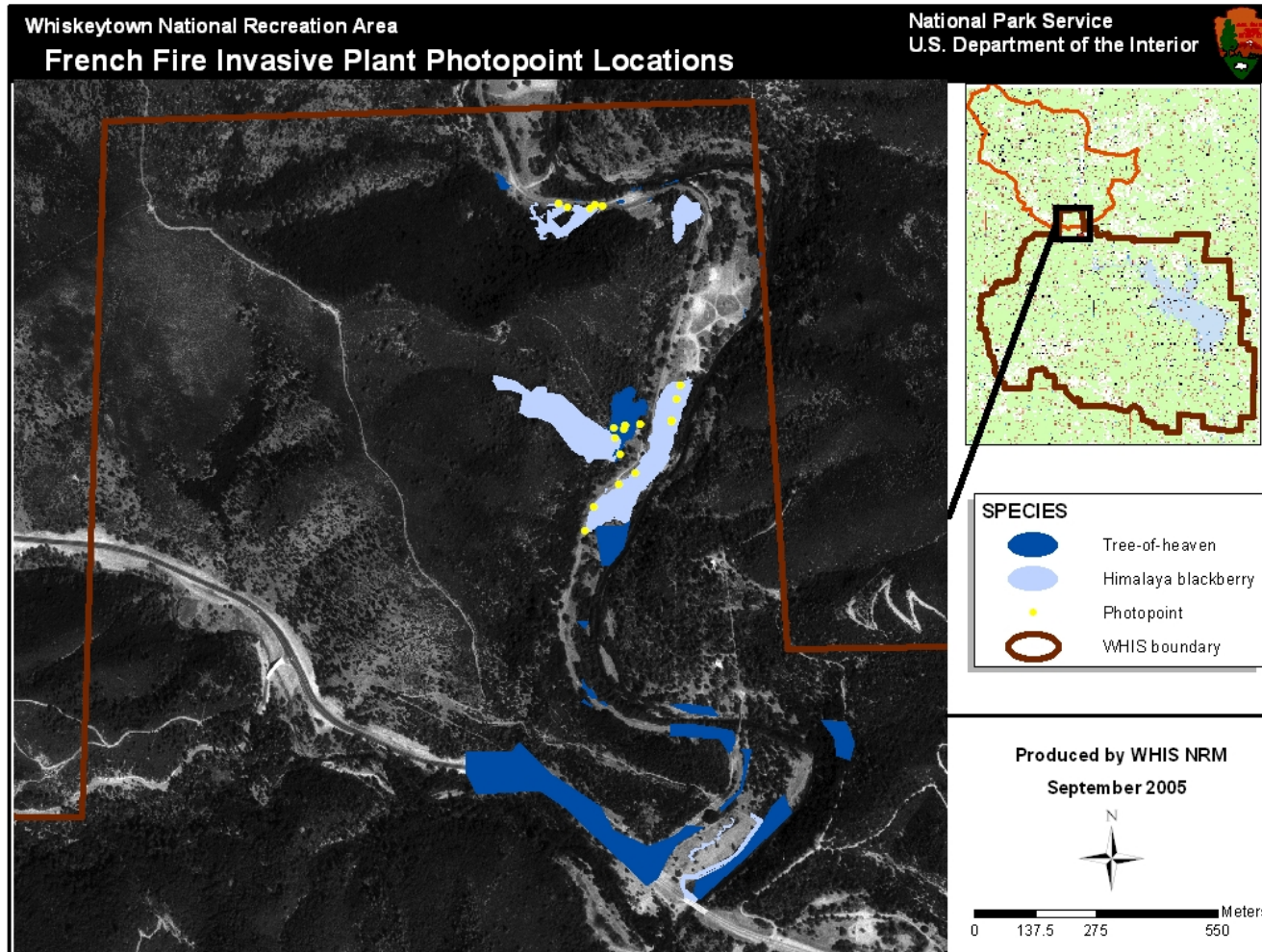
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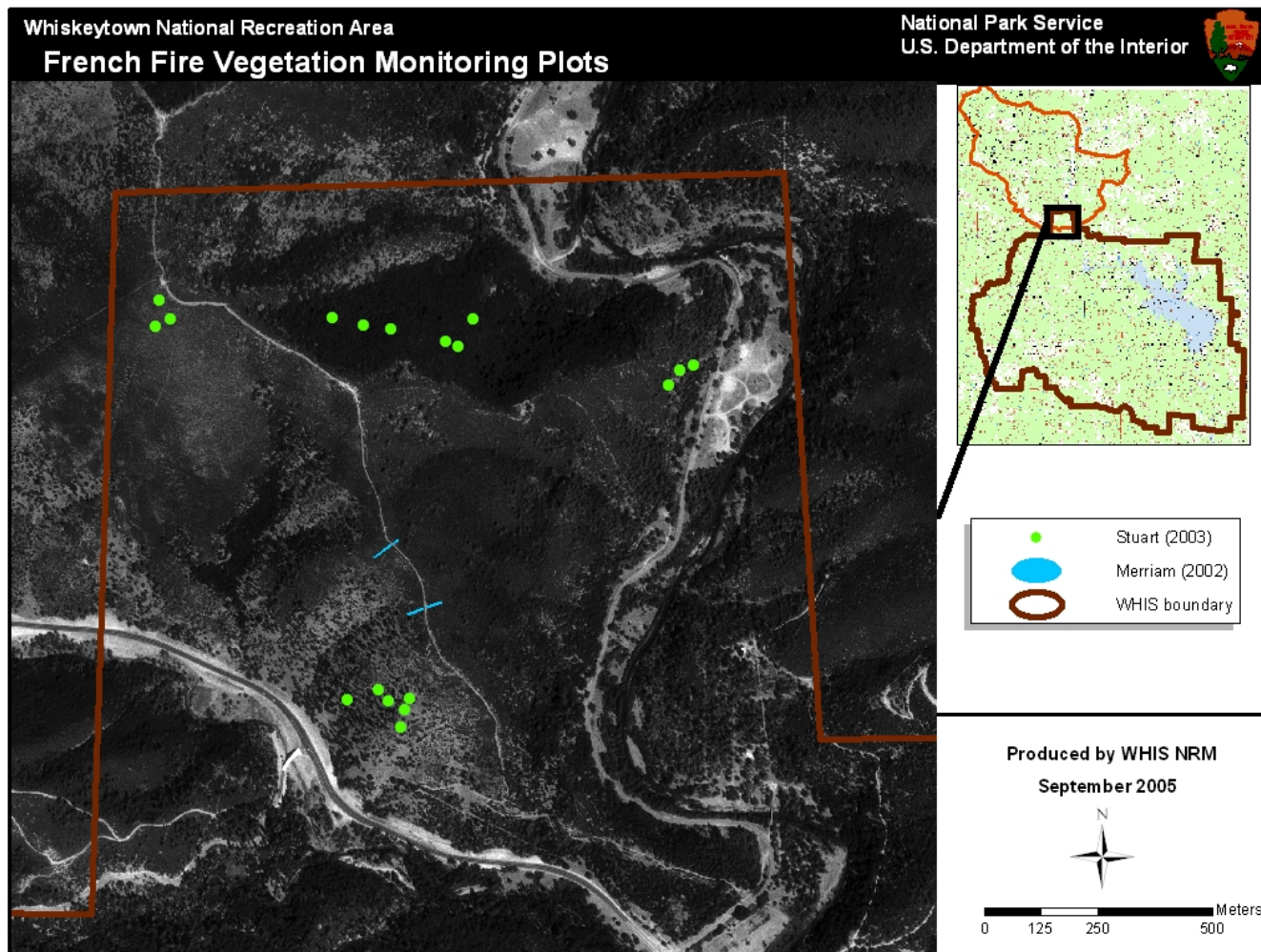
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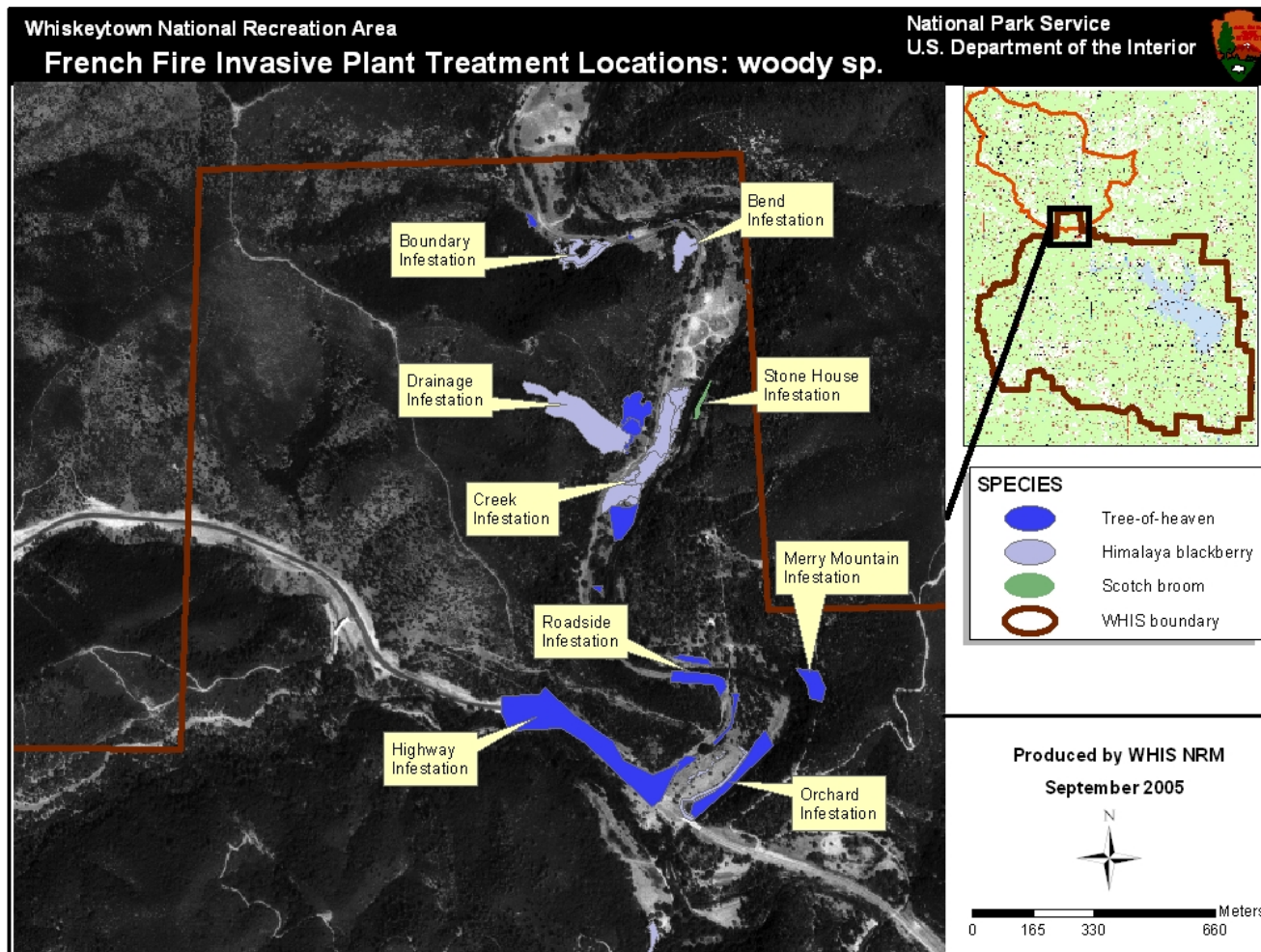
## Appendix A: Maps of Infestation Treatments and Monitoring Activities within the French Fire



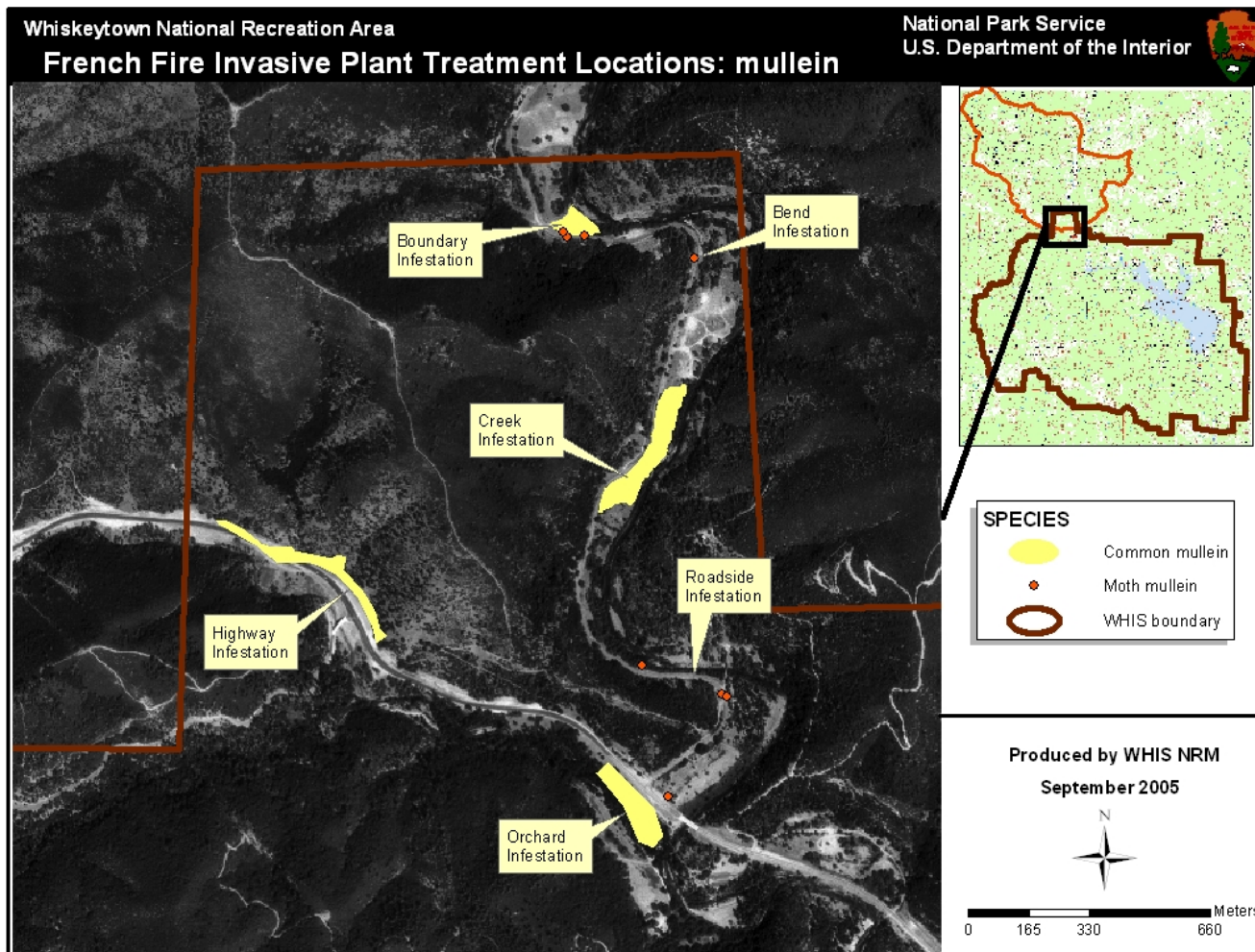
Map 1. Post-fire non native plant monitoring photopoint locations



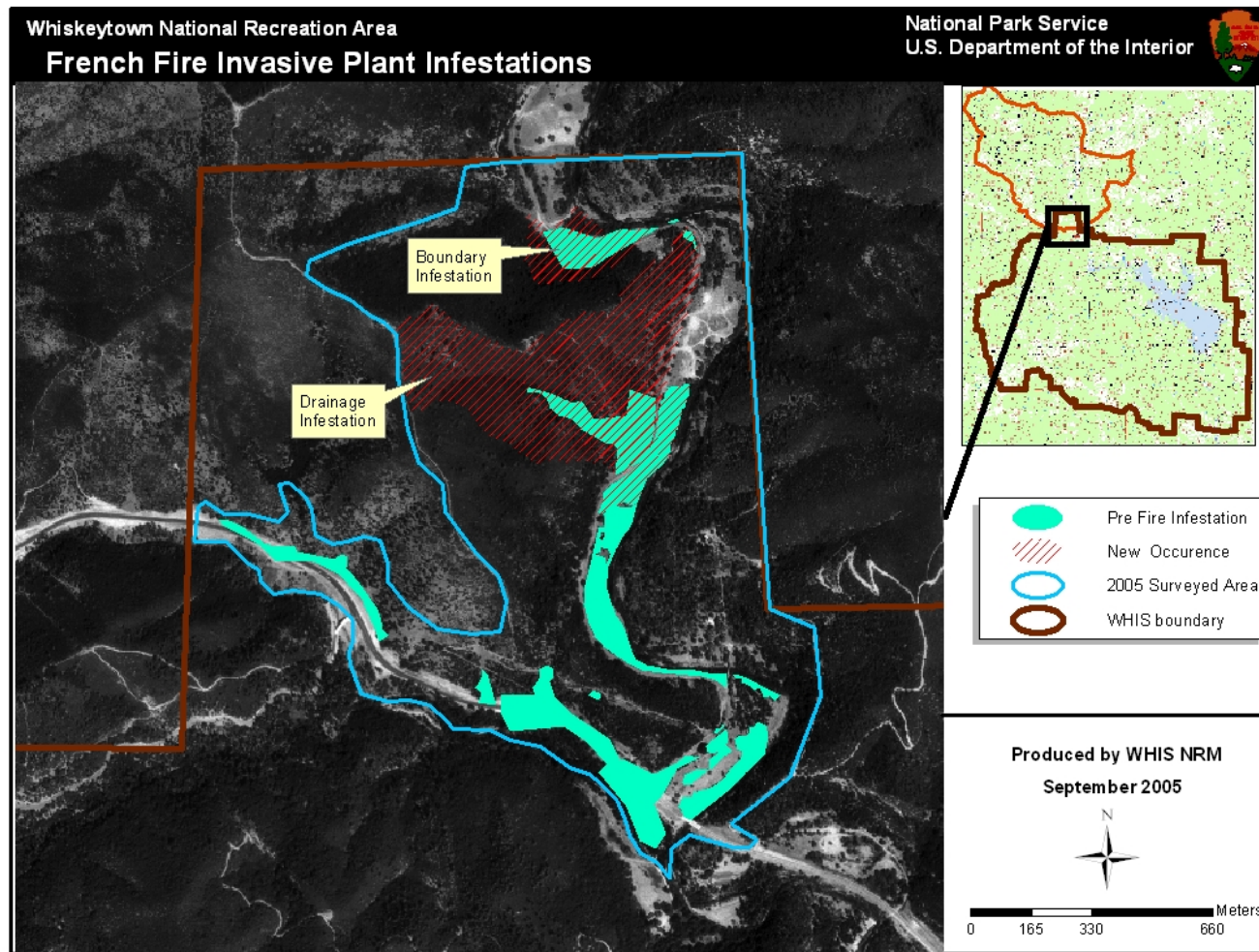
Map 2.. Post-fire vegetation response monitoring plot locations.



Map 3. Post fire infestations locations of Tree of Heaven (approximately 29.9 acres), Himalayan blackberry (approximately 30.6 acres) and Scotch broom (approximately 0.3 acres).



Map 4. Post-fire infestations of common mullein (approximately 21.3 acres) and moth mullein (approximately 0.2 acres).



Map 5. Pre-fire non native plant infestation and new non native occurrences discovered after the fire.