A seven-week (June 12, 2008 – July 26, 2008) mark-recapture study performed by volunteer Robert S. Hogg in conjunction with the Ashland Resource Area, Medford District Bureau of Land Management (BLM)
Abstract

The Western pond turtle *Clemmys marmorata* is currently listed as a species of concern by the U.S. Fish and Wildlife Service, and the species is classified as Bureau Sensitive by the Bureau of Land Management (BLM). The BLM manages the Cascade-Siskiyou National Monument and has identified habitat with confirmed populations residing within the Jenny Creek Watershed. Visual surveys and mark-recapture efforts were last conducted in 1998, and to assess the current status of the sensitive species, three historic sites were revisited during a seven-week study through the summer of 2008. The “Jenny Power” site revealed a robust population with a strongly biased 3F:1M sex ratio. A majority of the sampled population was estimated to have recently attained sexual maturity, with a few juveniles approaching maturity, and the oldest adults estimated to be in the prime of their reproductive capabilities. Turtles were sparingly observed at the other sites and trapping efforts produced no captures for continued mark-recapture monitoring. Low capture rates and the observed presence of the highly predacious invasive American bullfrog *Rana catesbeiana* present concerns for the continued success of the region’s only native turtle, and despite the vigorous demographic population structure at “Jenny Power,” continued monitoring remains warranted.

Introduction

The Western pond turtle *Clemmys marmorata* is the only native freshwater turtle occurring in northern Baja California, California, southern Oregon, and isolated patches near Reno, Nevada (Bury, 1986). The range of *C. marmorata* overlaps with the range of the painted turtle (*Chrysemys picta*) in western Oregon and Washington (Bury, 1986). Local extirpations in southern British Columbia and Washington have reduced the *C. marmorata* range (Cameron, 2002). The fossil record indicates that the present distribution of *C. marmorata* is only marginally smaller than its historic range, however it is generally agreed that populations are declining in 80% of their range (Wray, 1998). Studies cite loss, alteration, and fragmentation of habitat, introduction of exotic species, and pollution as the main factors known to negatively impact *C. marmorata* populations (Wray, 1998).
Although commonly referred to as pond turtles, *C. marmorata* are rarely pond dwellers (Bury, 1986). The preferred habitat of *C. marmorata* appears to be in and around streams, large rivers, slow-moving sloughs, and quiet waters (Bury, 1986). These observations are more consistent with the hydrological record of the western U.S. where there were relatively few ponds and lakes prior to the construction of reservoirs and farm ponds (Bury, 1986).

*C. marmorata* is a relatively small turtle with adults ranging from 4 inches (10cm) to 9 inches (23cm) in carapace (shell) length (St. John, 2002). These turtles are commonly called “mud” turtles” because of their drab dark brown, olive brown, or nearly black coloration of the plastron (St. John, 2002). The maximum life span has been estimated at 50 to 70 years with long-term mark-recapture studies providing documentation of pond turtles over 40 years old (Ashton, 1997). The reproductive biology of pond turtles is poorly understood, but preliminary data indicates that females begin laying eggs at carapace lengths greater than 4.3 inches (11cm), with age estimated between 6 and 7 years (Lovich, 1998). Females generally lay eggs every other year and clutch size ranges between 1 to 13 eggs, which is significantly correlated with body size (Holland, 1994).

Due to the long life span and delayed sexual maturity of *C. marmorata*, declining populations may remain unnoticed for many years (Spinks, 2003). Observed populations may appear robust even though senescent (non-reproductive) adults dominate the population demography (Klemens, 2000). This problem may be compounded by habitat loss or modification resulting with the inability of gravid (egg bearing) females to acquire suitable nesting sites or if nests experience predation from introduced species. *C. marmorata* remains potentially at risk of extinction largely due to low genetic diversity brought on by shifts in population structure (Zug, p355).

The historical range of the Western pond turtle includes regions within the Ashland Resource Area of the Bureau of Land Management (BLM) Medford District. The United States Fish and Wildlife Service (USFWS) currently lists *C. marmorata* as a species of concern, while the species has Bureau Sensitive status with the BLM. Documented population declines suggest a need for investigations to determine the age composition, size, susceptibility to predation from introduced species (primarily the
American bullfrog *Rana catesbeiana*), and effects from natural or human caused habitat modifications at known and newly documented locations in the Ashland Resource Area. An understanding of the structure of these local populations could aid the BLM in developing management strategies within their district domains.

**Materials and Methods**

The Ashland Resource Area BLM in conjunction with the Oregon Department of Fish and Wildlife (ODF&W) counted, captured, marked, and re-captured pond turtles at three specific locations during the mid 1990’s. These surveys were conducted within the constraints of the Western Pond Turtle Monitoring Plan drafted in 1994 and last updated in 1998 by Simon Wray (ODF&W). Wray’s Monitoring Plan was drafted to enable collaboration between biologists representing the Medford District BLM, Siskiyou and Rogue National Forests, ODF&W, and private industry landowners. The Monitoring Plan persuaded agencies to adopt one protocol with agreed variables. Wray’s ODF&W monitoring protocol was employed during this seven-week, early summer 2008, survey of the three historic Jenny Creek Watershed sites. All three sites were historically proven in previous studies to provide suitable pond turtle habitat with robust populations recorded.

The three sites are commonly referred to as “Fredenburg Log Pond”, “Lake T.I.D.”, and “Jenny Power” (Figure 1). “Fredenburg Log Pond” is a seasonal pond located approximately a quarter of a mile from the main stem of Jenny Creek. During the time of sampling, “Fredenburg” contained more water and available basking locations than any of the other sites with an estimated size of 100m by 30m of waist deep water complete with substantial aquatic vegetation, riparian buffers, and dispersed fallen logs within the interior (Figure 2).
Figure 1. Map of Jenny Creek Watershed with historic western pond turtle survey sites labeled.
Figure 2. Fredenburg Log Pond as photographed from road-side ridgeline, which provided opportunities for stealthy views of site for pond turtle activity.

“Lake T.I.D.” is located along the main stem of Jenny Creek and has reduced flow created from a partial dam created from a landslide suffered when a Talent Irrigation District (T.I.D.) diversion canal washed out in flood waters sending fallen trees into the creek (Figure 3). “Lake T.I.D.” has experienced an increase in flow since the last pond turtle survey was performed in 1998, but continues to provide exceptional habitat with relatively still water, substantial cover resulting from a build up of silt and aquatic vegetation in creek bed, and dispersed basking logs both on interior and edges of site (Figure 3).
Figure 3. “Lake T.I.D.” portion of main stem Jenny Creek. Photo includes lower half of 25m by 50m, waist deep, survey site focusing on dam created by logs from historic landslide.

The “Jenny Power” site is a 5-foot deep mineral pool located less than 100-yards west of main stem Jenny Creek. The site gets its name from its close proximity to electrical power lines that span across the Jenny Creek canyon. The mineral pool’s volume fluctuates seasonally but appears to acquire a portion of its water through intersection with a groundwater sulfur spring, which is evidenced by the pool’s strong sulfur odor. During the time of sampling, the still-water pool reduced from approximately 10m by 10m to 7m by 10m, and a temperature increase appeared to cause a cyanobacteria algal bloom, which was evidenced by the pool’s increasingly cloudy green coloration (Figure 4). The deeper west bank of the pool was flanked with numerous fallen log debris and the shallower portions of the pool were surrounded by grassy and gravelly banks (Figure 4).
Each of the three sites were typically approached quietly and observed from a distance with spotting scope as not to disturb turtle activity. Monitoring from distance was conducted for at least 40 minutes and on most occasions for 1 hour. The number of turtles and activity observed was recorded before approaching the site in attempting hand captures, anchoring baited traps, or checking previously anchored traps. Traps provided by the BLM were commercially marketed to the public as crab traps. Thirteen traps were purchased new from Memphis Net & Twine and the other three traps were remnant hoop traps left over from monitoring efforts conducted in the 1990s. All traps were baited with punctured cans of tuna or sardines packed in oil and anchored in such a manner as to allow trapped turtles the ability to remain comfortable with access to aquatic or terrestrial body positioning. Anchored traps were checked at no less than 18-hour intervals and collapsed for removal at the end of the typical three-day trapping effort.

Captured turtles were immediately processed by measuring carapace length and width in mm, body weight in grams, determining sex based on body characteristics.
(Figures 5 & 6), and determining age based on plastron scute-ring annuli (Figure 7). Each turtle was also marked with unique tagging code by notching 4-5 mm deep “v” in corresponding carapace marginals using a small triangular file (Figures 8 & 9). Each turtle was processed in less than 15 minutes and immediately released near spot of capture.

**Figure 5.** Key to sexual dimorphic characteristics in the western pond turtle:

**Adult Females** (a) smaller head, (b) shorter nose, (c) blunt snout, (d) mustache like markings on maxilla, (e) dark markings on chin and throat, (f) cloacal opening at or within margin of carapace, (g) thinner tail base, (h) flat or convex plastron, (i) deeply domed carapace

**Adult Males** (a) larger head, (b) longer nose, (c) pointier snout, (d) lightly or unmarked maxilla, (e) larger neck with yellow or whitish chin and throat, (f) cloacal opening beyond margin of carapace, (g) thick tail base, (h) concave plastron, (i) flatter carapace
Female
Snout: Distance from orbit to edge relatively small
Maxilla: Fine dark vertical lines or “mustache”
Throat: Flecked with numerous small dark markings

Male
Snout: Distance from orbit to edge relatively large
Maxilla & Throat: Unmarked or lightly marked

Figure 6. Facial characteristics used in sex determination of Western pond turtles.

Figure 7. Plastron of female turtle assigned coded marking of #1189, which had estimated age of 5 years based on count of scute-ring annuli.
“V” Notch Markings Located on Marginal Scutes With Carapace-Plastron Connectivity are Often More Distinguishable From Profile View

Figure 8. Unique “v” notch marking of carapace marginals demonstrated.

Juvenile Assigned Unique Marking #1188 Using “V” Notches of Marginal Scutes

Value = 80

Value: 400 x 2 = 800

Marking: Assigned Value = 8

Assigned Value = 200

(Note: The 800 marginal could have been marked instead of marking the 400 marginal twice)

Figure 9. Juvenile turtle captured and assigned #1188 by “v” notching the corresponding coded marginal scutes of the carapace [400(2) + 200 + 100 + 80 + 8 = 1188].
Other pertinent data including ambient temperature, water temperature, cloud cover, other species present, habitat conditions, and total time spent observing or working at site were also recorded.

**Results**

**Fredenburg Log Pond**

BLM staff member Donna Fouts conducted a preliminary visual survey of the Fredenburg site on 13 May 2008 and observed five individual turtles basking on logs in the center of pond. The site was aggressively trapped beginning June 12-13 with all sixteen traps utilized. Turtles were neither observed nor captured during the initial trapping effort and a less aggressive trapping approach was utilized in subsequent efforts, freeing up traps for use at the other locations.

While anchoring baited traps during the initial trapping effort, hundreds, perhaps thousands of tadpoles were observed. One tadpole was captured and taken to lab to be keyed out as the Pacific tree frog *Pseudacris regilla* (Corkran, 2006). During the end of July, hundreds of *P. regilla* were observed emerging as juveniles. Stumps of Quaking Aspen trees were also observed near the perimeter of Fredenburg, indicating the recent presence of the American beaver *Castor cadensis* (Maser, 1998). The common garter snake *Thamnophis sirtalis* (St. John, 2002), red-winged blackbird *Agelaius phoeniceus* (Sibley, 2003), and Sora *Porzana carolina* (Sibley, 2003) were commonly observed during most trapping efforts, and the croaking song of adult bullfrogs *Rana catesbeiana* (Corkran, 2006) was heard during evening observation efforts. One adult bullfrog *R. catesbeiana* was observed on 26 June 2008 while anchoring traps.

Western pond turtles were not observed during subsequent visual surveys using spotting scopes and less aggressive trapping efforts were conducted with only four baited traps anchored during the June 20-21 effort, four traps anchored during the June 26-27 effort, seven traps anchored during the July 3-5 effort, five traps anchored during the July 10-12 effort, and four traps anchored during the July 24-26 effort.

No turtles were observed from the stealth, visual observation sites using spotting scopes after Donna Fouts’ preliminary observation, and no turtles were captured during any of the trapping efforts conducted at the Fredenburg Log Pond, leading to the absence
of mark-recapture data recorded from this site. In summary, only five turtles were observed with no captures netted at the Fredenburg site.

**Lake T.I.D.**

Initial visual observations from distant locations with spotting scopes were unsuccessful at producing pond turtle observations at the “Lake T.I.D.” site. Due to the lack of visual observations, Lake T.I.D. was the least aggressively trapped of the three sites. Five baited traps were anchored June 20-21, four traps were anchored June 26-27, a single trap was anchored July 4-5, and two traps were anchored July 11-12. During a routine 1-hour distant visual observation period with spotting scope conducted on the evening of July 12, a large adult turtle was observed swimming approximately 5m from a baited trap, and this observation prompted more aggressive trapping in subsequent efforts.

Eight baited traps were anchored during a four-day July 17-20 effort, and four traps were anchored for the final July 25-26 trapping effort. In summary, none of the trapping efforts at the Lake T.I.D. produced any captures and the lone turtle swimming near a trap on the evening of July 12 was the only observation recorded. However, the Lake T.I.D. site had the most diversity of organisms observed, with regular sightings of the common garter snake *T. sirtalis* (St. John, 2002), rough-skinned newt *Taricha granulose* (Corkran, 2006), western fence lizard *Sceloporus occidentalis* (St. John, 2002), western toad *Bufo boreas* (Corkran, 2006), Pacific treefrog *P. regilla* (Corkran, 2006), wood ducks *Aix sponsa* (Sibley, 2003), and snorkeling efforts revealed hundreds of individual rainbow trout *Oncorhynchus mykiss* of various life history stages as well as a couple of large (5-7 inch) unidentified red colored crayfish.

**Jenny Power**

BLM staff member Donna Fouts conducted a preliminary visual survey of the Jenny Power site on 13May2008 and observed fifteen individual turtles actively competing for basking spots on logs. She observed twelve adults and three juveniles over the course of a one-hour period, and the large number of observations prompted the most aggressive trapping efforts conducted across the three sites. With exception to the June
19-21 trapping efforts, in which seven baited traps were anchored, efforts at the Jenny Power site consisted of an eight-trap regimen. Turtles were observed on nineteen of twenty-one days in which the site was visited, and were captured on six of twenty-one days (Table 1). Turtles were observed and captured at the Jenny Power site under a variety of environmental conditions including ambient temperatures ranging from a low of 70°F to a high of 95°F, water temperatures ranging from a low of 60°F to a high of 83°F, on days ranging from clear skies to cloudy with rain, and mornings immediately following sunrise to evenings up until dusk (Table 1).

**Table 1.** Data collected from the “Jenny Power” site including number of turtles observed, number of turtles captured, ambient temperature, water temperature, cloud cover, and total time spent at site.

<table>
<thead>
<tr>
<th>Date</th>
<th>Total Observed</th>
<th>Total Captured</th>
<th>Ambient Temp (°F)</th>
<th>Water Temp (°F)</th>
<th>% Cloud Cover</th>
<th>Time of Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 13</td>
<td>15</td>
<td>0</td>
<td>70</td>
<td>-</td>
<td>20%</td>
<td>1315-1415</td>
</tr>
<tr>
<td>June 13</td>
<td>1</td>
<td>0</td>
<td>78</td>
<td>-</td>
<td>0%</td>
<td>1000-1040</td>
</tr>
<tr>
<td>June 19</td>
<td>0</td>
<td>0</td>
<td>89</td>
<td>-</td>
<td>0%</td>
<td>1215-1300</td>
</tr>
<tr>
<td>June 20</td>
<td>3</td>
<td>0</td>
<td>79</td>
<td>-</td>
<td>40%</td>
<td>1130-1400</td>
</tr>
<tr>
<td>June 21</td>
<td>3</td>
<td>0</td>
<td>78</td>
<td>60</td>
<td>80% (rain)</td>
<td>1020-1300</td>
</tr>
<tr>
<td>June 26</td>
<td>3</td>
<td>0</td>
<td>95</td>
<td>78</td>
<td>0%</td>
<td>1230-1415</td>
</tr>
<tr>
<td>June 27</td>
<td>4</td>
<td>1</td>
<td>88</td>
<td>62</td>
<td>0%</td>
<td>1015-1200</td>
</tr>
<tr>
<td>July 3</td>
<td>0</td>
<td>0</td>
<td>88</td>
<td>80</td>
<td>5% (smoky)</td>
<td>1400-1630</td>
</tr>
<tr>
<td>July 4</td>
<td>4</td>
<td>0</td>
<td>78</td>
<td>76</td>
<td>40% (breezy)</td>
<td>1120-1345</td>
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<tr>
<td>July 5</td>
<td>5</td>
<td>2</td>
<td>82</td>
<td>75</td>
<td>50%</td>
<td>1440-1730</td>
</tr>
<tr>
<td>July 10</td>
<td>3</td>
<td>0</td>
<td>94</td>
<td>83</td>
<td>0%</td>
<td>1400-1630</td>
</tr>
<tr>
<td>July 11</td>
<td>3</td>
<td>1</td>
<td>86</td>
<td>78</td>
<td>0%</td>
<td>1145-1430</td>
</tr>
<tr>
<td>July 12</td>
<td>6</td>
<td>2</td>
<td>95</td>
<td>79</td>
<td>0%</td>
<td>1330-1630</td>
</tr>
<tr>
<td>July 13</td>
<td>3</td>
<td>0</td>
<td>75</td>
<td>66</td>
<td>0%</td>
<td>0830-1005</td>
</tr>
<tr>
<td>July 17</td>
<td>4</td>
<td>0</td>
<td>85</td>
<td>80</td>
<td>10% (smoky)</td>
<td>1230-1500</td>
</tr>
<tr>
<td>July 18</td>
<td>4</td>
<td>0</td>
<td>84</td>
<td>76</td>
<td>0%</td>
<td>1230-1430</td>
</tr>
<tr>
<td>July 19</td>
<td>6</td>
<td>1</td>
<td>84</td>
<td>78</td>
<td>0%</td>
<td>1045-1530</td>
</tr>
<tr>
<td>July 20</td>
<td>3</td>
<td>0</td>
<td>90</td>
<td>80</td>
<td>0%</td>
<td>1300-1500</td>
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<td>July 24</td>
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<td>0</td>
<td>-</td>
<td>-</td>
<td>0%</td>
<td>1700-1845</td>
</tr>
<tr>
<td>July 25</td>
<td>7</td>
<td>5</td>
<td>84</td>
<td>82</td>
<td>0%</td>
<td>1330-1630</td>
</tr>
<tr>
<td>July 26</td>
<td>2</td>
<td>0</td>
<td>80</td>
<td>74</td>
<td>0%</td>
<td>1215-1345</td>
</tr>
</tbody>
</table>

Captured turtles were carefully inspected for “v” notch identification markings, and when no markings were found, individuals were assigned and marked with a unique code beginning with number 1188 and ending with number 1195. Of these eight captured turtles, two (#1191 and #1194) were recaptured in subsequent trapping efforts (Table 2). Additionally, two of the captured turtles were found with “v” notch codes intact from previous monitoring efforts. These two previously marked turtles were coded
with the numbers 1183 and 5780 (Table 2). In summary, twelve total captures were made at the Jenny Power site, with two individuals marked in previous surveys, and two individuals recaptured during the course of the 2008 survey, accounting for ten of fifteen turtles initially observed on May 13, 2008.

Eight of the turtles had physical characteristics that suggested female gender, but five of these individuals had carapace lengths less than 125mm, which is the suggested minimum length for accurate sex determination (Ashton, 1997). Plastron scute-ring analyses revealed a range in estimated age from two to fifteen years (Table 2). The youngest turtle, #1188, was the smallest, weighing 40 grams while measuring 62mm and 46mm in carapace length and width respectively, and the oldest turtle, #1192, was the largest, weighing 470 grams while measuring 163mm and 131mm in carapace length and width respectively (Table 2).

Table 2. Captured turtles assigned and marked with unique identification code accompanied with individual size measurements and sex determination (* indicates recapture during 2008 survey, ** indicates coded marking from previous survey).

<table>
<thead>
<tr>
<th>ID #</th>
<th>Weight (g)</th>
<th>Carapace Length (mm)</th>
<th>Width (mm)</th>
<th>Sex</th>
<th>Scute rings (age)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1188</td>
<td>40</td>
<td>62</td>
<td>46</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>1189</td>
<td>210</td>
<td>120</td>
<td>86</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td>1190</td>
<td>230</td>
<td>122</td>
<td>92</td>
<td>F</td>
<td>6</td>
</tr>
<tr>
<td>1191*</td>
<td>60</td>
<td>75</td>
<td>63</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>1192</td>
<td>470</td>
<td>163</td>
<td>131</td>
<td>M</td>
<td>15</td>
</tr>
<tr>
<td>1193</td>
<td>330</td>
<td>139</td>
<td>106</td>
<td>M</td>
<td>9</td>
</tr>
<tr>
<td>1194*</td>
<td>210</td>
<td>114</td>
<td>89</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td>1195</td>
<td>305</td>
<td>127</td>
<td>98</td>
<td>F</td>
<td>8</td>
</tr>
<tr>
<td>5780**</td>
<td>400</td>
<td>139</td>
<td>111</td>
<td>F</td>
<td>15</td>
</tr>
<tr>
<td>1183**</td>
<td>370</td>
<td>137</td>
<td>107</td>
<td>F</td>
<td>10</td>
</tr>
</tbody>
</table>

Regression analysis revealed that approximately 93.8% of the variation in individual turtle weight could be explained through the length of the carapace (Figure 10). These results suggest a strong linear relationship between length and weight of captured individuals.
Regression analysis revealed that approximately 97.8% of the variation in length of carapace could be explained through the width of the carapace (Figure 11). These results suggest a strong linear relationship between carapace length and width of captured individuals.

Following the establishment of strong linear relationships between the size variables of weight, carapace length, and carapace width, these variables were used in analyzing the relationship between size and plastron scute-ring annuli in making accurate age estimates. Regression analysis revealed that approximately 89.6% of the variation in the count of scute-ring annuli could be explained through the weight of the individual.
(Figure 12). These results suggest a strong linear relationship between weight and estimated age based on count of plastron scute-ring annuli.

![Graph showing the relationship between weight and estimated age.](image)

**Figure 12.** Estimated age based on count of plastron scute-ring annuli plotted against weight of turtles captured during 2008 survey of the Jenny Power site with sample size of ten individuals.

Regression analysis revealed that approximately 81.8% of the variation in the count of scute-ring annuli could be explained through the carapace width of the individual (Figure 13). These results suggest a strong linear relationship between carapace width and estimated age based on count of plastron scute-ring annuli.

![Graph showing the relationship between carapace width and estimated age.](image)

**Figure 13.** Estimated age based on count of plastron scute-ring annuli plotted against carapace width of turtles captured during 2008 survey of the Jenny Power site with sample size of ten individuals.
Regression analysis revealed that approximately 74.5% of the variation in the count of scute-ring annuli could be explained through the carapace length of the individual (Figure 14). These results suggest a strong linear relationship between carapace length and estimated age based on count of plastron scute-ring annuli.

![Figure 14](image.png)

**Figure 14.** Estimated age based on count of plastron scute-ring annuli plotted against carapace length of turtles captured during 2008 survey of the Jenny Power site with sample size of ten individuals.

The invasive American bullfrog *R. catesbeiana* has been documented as highly predacious upon hatchling pond turtles, and was targeted for removal if captured from the Jenny Power site (Ashton, 1997). One large adult bullfrog was sighted on June 19 but escaped capture; however three juvenile bullfrogs were captured and removed from the system during the course of the survey. One juvenile bullfrog measuring 58mm snout-to-vent length (SVL) was captured on July 4, another measuring 64mm SVL was captured on July 11, and another measuring 76mm SVL was captured on July 13. All three captured bullfrogs were quickly killed, frozen, and later dissected to identify stomach contents. Stomach contents revealed a diet of insects only.

Other species commonly observed at the Jenny Power site included the black-tailed deer *Odocoileus hemionus* (Maser, 1998), the common garter snake *T. sirtalis* (St. John, 2002), the western fence lizard *S. occidentalis* (St. John, 2002), and a plethora of flying insects most notably dragonflies of the family Libellulidae, generally referred to as common skimmers (Borror, 1970).
Discussion

Fredenburg Log Pond

The Fredenburg site was initially targeted with the most aggressive trapping efforts because it was the largest of the three sites and had confirmed visual sightings of basking turtles during the initial springtime survey in May. The site provided excellent habitat for juvenile turtles with warm, lentic waters, which presumably allow for more effective maneuverability in foraging and seeking refugia (Ashton, 1997). Water temperatures consistently ranged between 68°F and 74°F, with abundant aquatic vegetation for cover, and a variety of interior, emergent logs that provide basking locations away from terrestrial predators while allowing quick escape routes through relatively deep waters (Reese 1998). The decrease in water depth of the seasonal pond through the summer months (chest deep water in mid June decreased to upper thigh deep water towards end of July) offers a possible explanation for the lack of observed or captured turtles at the site. A noticeable retreat of water of up to five feet or more was noted along the pond’s banks during the seven-week study, and these conditions may have proven sub-optimal in providing protection from predation, leading turtles to disperse to more optimal locations.

The increase in height of grasses and peripheral vegetation coupled with the decreased water level offers an alternative explanation towards the lack of observed turtle activity. Basking sites became increasingly more difficult to view from distant locations and activity may have gone unnoticed, leading to sub-optimal placement of baited traps.

Lake T.I.D.

The Lake T.I.D. site proved to be the most difficult to approach and view from a distance, which may have accounted for the lack of visual observations. Initially, the site was the least aggressively trapped due to the lack of visual observations, but following the July 12 sighting of a large adult swimming less than 5m from a trap, efforts were increased considerably. The lotic conditions with lower water temperatures ranging from 56°F to 68°F were presumably less suitable for juvenile turtles, but habitat conditions remained hospitable for adults with relatively deep waters containing cover created by
silty build up and dense aquatic vegetation. These conditions, which are conducive to the increased mobility of adults may explain the lack of observed turtle activity.

Lake T.I.D.’s east bank is steep with large conifer trees blocking incoming morning solar radiation and the west bank, although not as steep and with fewer trees, is in proximity to western mountains that block afternoon solar radiation. The Lake T.I.D. portion of Jenny Creek has the shortest window for basking, with direct, incoming solar radiation limited to the hours of 1030h to 1600h. Water temperature was considerably lower at Lake T.I.D. when compared to the other sites (on average 10°F lower), and due to these conditions, it was expected that basking activity would be necessarily highest during the shortened five and a half hour window of direct solar radiation. Distant spotting scope observation attempts were strategically planned for times within the shortened window, but were met without success. The difficulty in approaching the distant sites without disturbance may account for the lack of observations, leading to sub-optimal placement of traps.

**Jenny Power**

Turtle activity at the Jenny Power site remained consistently high throughout daylight hours and under a variety of weather conditions. Both juvenile and adult turtles were observed on all but two visits to the site, leading to the conclusion of a robust, reproducing population. Trapping was the only effective means of capture due to the extremely cloudy green water conditions in the pool, and efforts were not as productive as anticipated until bait was changed from sardines to tuna. Relative to the number of observations, turtle captures did not provide enough data to apply mark-recapture methodology in estimating population size and structure. The maximum number of turtles observed during a single visit was fifteen, and a total of ten individuals were marked and described over the course of the study, leading a conservative population estimate of only fifteen.

Age estimations through non-lethal scute-ring methodology revealed a well-balanced age structure in addressing the concern that senescent post-reproductive adults may dominate the population structure. Scute-ring age estimations appeared valid after comparisons with size data revealed significant correlations. Juvenile turtles exhibit
female characteristics and sexual dimorphism generally becomes apparent in western pond turtles after juveniles reach a carapace length of 110-120 mm (Bury, 2008).

Utilizing this carapace length as the standard for determining sex and adulthood, the two juvenile turtles with carapace lengths of 62mm and 75mm were assigned as females based on physical characteristics, but this determination remains unfounded without confidence. Four of the remaining eight turtles had carapace lengths ranging between 114 mm and 127 mm, all of which exhibited female characteristics with age estimations ranging from 5-8 years placing a level of moderate confidence in their sex determinations. Sex determination of the four largest turtles was made with a high level of confidence, rendering two reproductive females with ages of 10 and 15 years, and two reproductive males with the ages of 9 and 15 years.

The largest turtle measured 163mm, which remains considerably smaller than the maximum length of 241mm for adult males over 20 years of age (Bury, 2008). This observation brings credibility to the claim of 15 years in estimated age for this individual. Females are generally smaller than males in most populations (Bury, 2008), and the observation of a 15-year-old female measuring 139mm brings credibility to this claim.

In summary, the sex ratio of the Jenny Power population was estimated at 1:3, M:F, with half of the captured individuals having recently approached sexual maturity within the last year, and all the adults deemed capable of continued sexual reproduction. Egg development in temperatures above 80°F often translates into a higher proportion of female hatchlings (Bury, 2008), which may explain the female skewed sex ratio at the Jenny Power site where temperatures often exceed 80°F. Additionally, the two captured juveniles testify to the population’s recent reproductive success, and these generalizations are supported through the demographic data gathered from this study.

Introduced American bullfrogs are opportunistic predators that are capable of feeding on any prey that can fit into their mouths (Corkran, 2006). Pond turtle hatchlings less than 40mm in carapace length remain vulnerable to bullfrog predation, and the presence of bullfrogs threatens continued reproductive success (Bury, 2008). Although the two species have been observed to co-exist, continued monitoring is suggested and removal of the introduced frogs may be useful in preserving declining pond turtle populations. The capture of three juvenile bullfrogs at Jenny Power is somewhat
alarming, because their presence indicates a reproductively successful population with potential to displace native turtles.

**Literature Cited**


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