WASHINGTON NATURAL HERITAGE PROGRAM

# Summary Report on the Striped Whipsnake (*Masticophis taeniatus*) in Washington

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**Purpose**

This is a summary of work completed for a cooperative project initiated in 2005 between the Bureau of Land Management (BLM) Wenatchee Office, and the Washington Department of Natural Resources' Natural Heritage Program (WNHP) for purchase orders HWP050017 and HWP060025. The purpose was to describe habitat use and life history of a Striped Whipsnake (*Masticophis taeniatus taeniatus*) population in Grant County, Washington and evaluate the status of the species in Washington.

*M. taeniatus* reaches the northern limit of its geographic range in Washington State. Slater (1941) recorded the first published observation in Washington at Gingko State Park, Kittitas County in 1941. Wright and Wright (1952) considered this occurrence problematic. Johnson (1942) cited Slater with the comment that "the species may be a rare inhabitant of eastern Washington." Svihla (1955) confirmed the occurrence of *M. taeniatus* in Washington and extended the known range to both sides of the Columbia River with his observations of "striped racers," *Coluber taeniatus taeniatus*, from Grant County at 5 miles south of Vantage Ferry (1941) and Vantage Ferry (1954).

The Washington Department of Fish and Wildlife (WDFW) reptile and amphibian database contains 26 *M. taeniatus* records. These records were originally compiled for the Washington GAP project. Thirty-four museums were canvassed resulting in 15 *M. taeniatus* specimens collected in Washington. The remaining 11 records are sight records obtained from observation cards submitted to WDFW by biologists. These 26 records are clustered into 16 areas scattered around the central Columbia Basin (Fig. 1). The area encompassed by confirmed locations, either voucher specimens or multiple observations by different observers, is approximately 5,470 sq. km. Two observations from 1989 at Lake Lenore, Grant County and the "Bat Rock Ponds," Lincoln County, are unconfirmed by voucher specimens or additional observations. Inclusion of these records triples the estimate of the distribution range in Washington State to 15,296 sq. km.

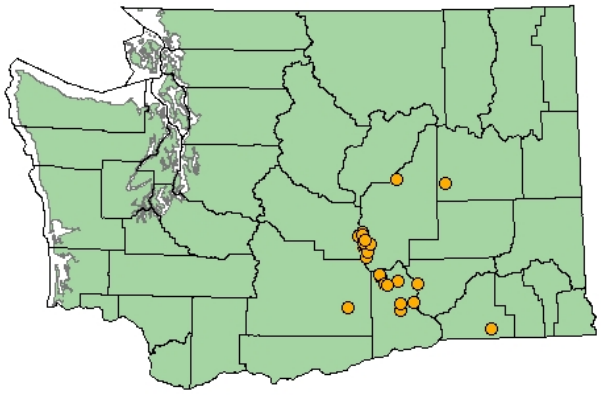

**Figure 1. *Masticophis taeniatus* distribution in Washington.**

Concern about the species' status in Washington was triggered by lack of observations during recent large scale herpetological inventories (Hallock 1998a, 1998b, 1999; ENSR Yakima Training Center herpetological inventory 1994-1995; S. Germaine [WDFW] habitat study in Columbia Basin; and Robert Weaver, CWU, Master's Thesis study) and surveys at historical *M. taeniatus* sites by the author over the interval 1998-2004. Moreover, WDFW received only three reports over the period 1990-2003.

A report of *M. taeniatus* near Wanapum Dam, Grant County, in October 2004 triggered surveys at the site by the author and biologists from BLM and WDFW. Two snakes and a shed skin were found. These mid-October observations were significant because the snakes were likely near a hibernaculum. A challenge-cost share

agreement was drafted between the DNR and BLM with the goal of locating the hibernaculum in 2005. Two hibernacula were found by fall 2005. A second contract was arranged to study the snakes emerging from the hibernacula spring 2006 and to examine the current distribution and status of the species in Washington. This report summarizes the results of both efforts.

## Part 1. Life History and Habitat Use by the Striped Whipsnake (*Masticophis taeniatus*) in Grant County, Washington.

### Introduction

*Masticophis taeniatus* is a long slender striped snake. They are alert, visual and fast-moving. Adults range in size from 76 to 183 cm total length (Stebbins 2003). The dorsal surface is dark brown with thin cream colored stripes on the sides of the body. The eyes are large and the pupil is round (Fig. 2) The scales are smooth with 15 rows at mid-body (Nussbaum et al. 1983). The underside is white grading into pink near the tail. Small dark spots are present on the underside of the neck in a pattern that varies by individual (Fig. 3). Hatchlings and juveniles lack or have only a small amount of pink coloration on the tail. Activity is diurnal.

**Figure 2. Adult female *M. taeniatus.***

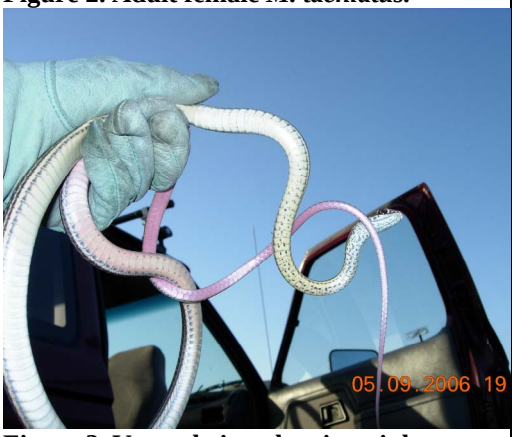


**Figure 3. Ventral view showing pink coloration.**

Published life history information comes primarily from studies conducted in Tooele County, Utah from late the 1960s to the 1980s (Bennion and Parker 1976; Brown and Parker 1982; Hirth 1966; Hirth and King 1968; Hirth et al. 1969, Parker 1974, 1976; and Parker and Brown 1972, 1973, 1980). Little information exists on Pacific Northwest populations (Nussbaum et al. 1983) and the species has received no scientific study in Washington despite its apparent rarity. In the Utah studies, *M. taeniatus* was found to overwinter communally with Racer (*Coluber constrictor),* Northern Pacific Rattlesnake (*Crotalus oreganus)* and Gopher Snake *(Pituophis catenifer)* and three other smaller snake species that were uncommon. Spring emergence started in mid-April and continued over a period of 30-45 days until late May (Brown and Parker 1982). Males emerged first and were highly active finding mates (Nussbaum et al. 1983). Maximum recorded dispersal distance from a den at Tooele Valley, Utah was 3.6 km (Hirth et al. 1969). Most whipsnakes returned to the hibernacula in mid-September where they remained active on the surface for an average of 17 days after arrival (Parker and Brown 1980). Overwintering mortality was low with a 4-year average of 4% at Tooele Valley (Parker 1974). First year juveniles typically did not use communal hibernacula (Parker 1976).

Oviposition information comes from a radio-telemetry study of two females (Parker and Brown 1972). Both laid eggs in mammal burrows, probably those of antelope ground squirrel (*Ammospermophilus leucurus*), in early July. Hatching emergence was in mid-August with a natural incubation period of 44-58 days. Clutch sizes ranged from 3-7 and have been reported to be as large as 8 (n = 17, $\bar{x}$ = 5.6, Camper and Dixon 2002). Clutch size is influenced by female body size (Brown and Parker 1972, 1980; Camper and Dixon 2002) with larger females producing more eggs. Lizards are the predominant prey with small mammals and snakes making up most of the balance of the diet (Brown and Parker 1982). Nussbaum et al. (1983) also lists young birds and insects as prey. Individuals may live as long as 20 years (Brown and Parker 1982).

The overarching goal of this study was to collect habitat and life history information that could be used to improve survey success and to inform management decisions. It was also important to determine if behavior and habitat use of *M. taeniatus* in Washington is similar to that observed in other parts of its range.

**Study Site**

The study site is located across an elevation range of 244 - 305 m in Grant County, Washington on the east side of the Columbia River near the Wanapum Dam. Most work was conducted on land managed by the Bureau of Reclamation (T16N R23E section 4) (Fig. 4).

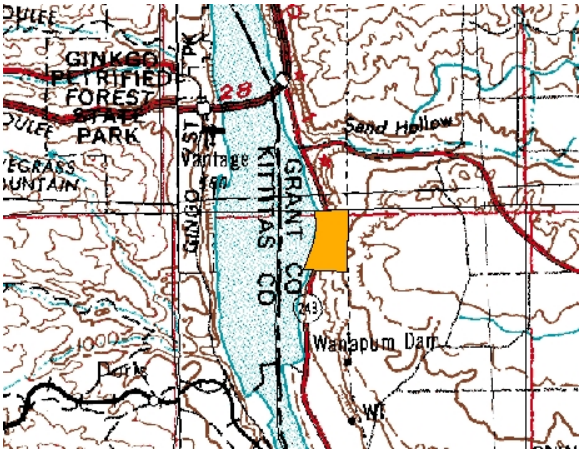


**Figure 4. Study site location.**

The geology is a result of Miocene basalt lava flows, Spokane Floods and Columbia River sand deposition (Alt and Hyndman 1984). The basalt was exposed by Spokane Floods that scoured the area. The resulting scablands are composed of basalt outcrops that range from tall columnar basalt walls to mound-like basalt formations that barely rise above the surrounding landscape (Fig 5). Frequent easterly winds with strong gusts move sand from the shore of the Columbia River uphill and have resulted in the formation of sand dunes to the north, middle and east of the site.

**Figure 5. Study site habitat. (Photo was taken facing north.**

The habitat was shrubland with grasses. Vegetation on the basalt outcrops was sparse and typically dominated by stiff sage (*Artemisia rigida)*, purple sage (*Salvia dorii)*, thyme-leaf buckwheat (*Eriogonum thymoides)* and round-headed buckwheat (*E. sphaerocephalum*). Native grasses were poa (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). Desert yellow daisy (*Erigeron linearis*) was common. Soils surrounding the basalt outcrops were sandy and supported big

sage (*A. tridentata*), bitterbrush (*Purshia tridentata*), snow buckwheat (*E. niveum)*, gray rabbit-brush (*Ericaneria nauseosa*), green rabbit-brush (*Chrysothamnus viscidiflorus)* and spiny hop sage (*Grayia spinosa)*. Some areas also had slender buckwheat (*E. microthecum*). Native grasses in the sandy areas were primarily needle-and-thread grass (*Hesperostipa comata)* and Indian rice grass (*Achnatherum hymenoides)*. Southeast of the site, a flat area of lithosols dominated by stiff sage and other lithosol-associated species, was present.

Cheatgrass (*Bromus tectorum*) and other exotic invasive weeds, such as Russian thistle (*Salsola kali)*, were present. *B. tectorum* cover was typically low on the basalt outcrops, shallow lithosols, and in sandy habitats that were exposed to wind. *B. tectorum* cover and density was greater in areas sheltered from the wind and in deeper finer soils. Irrigation water moved through the middle of the site and at locations to the north and south of the section. These areas were dominated by riparian species and weeds.

**Methods**

Cryptic coloration and elusive habits make snakes difficult to study. Snakes feed infrequently, have few risky social behaviors and avoid detection by predators if at all possible (Greene 1997). Surface activity is usually limited to basking, hunting and dispersing. Field methods for finding snakes vary depending on the species, season, habitat and information desired. Road cruising and drift fence arrays, for instance, result in captures only when the snakes are surface active and moving from one location to another. Rarely do these methods yield re-captures (Hirth et al. 1969) and determining the significance of the capture location is difficult. Hence, a variety of methods (Heyer et al. 1994) were used for this study. When a method failed to yield results, a new method was attempted.

Visual encounter surveys were conducted October 2004 (2 days), April -May 2005 (6 days) and September - October 2005 (7 days). Searchers walked slowly though the area looking for the snakes. Surveys took place when air temperature was greater than 18° C (65° F), cloud cover was low to moderate, and there was no precipitation. Start and end times were recorded.

Cover boards were placed at the north end of the site in April and removed in early May 2005. Twenty pairs of boards were scattered in an area where snakes had been seen the previous October. Half the cover boards in each pair had been modified into funnel traps.

Drift fence array – Two drift fence arrays were constructed at the north end of the site April 2006. The arrays were placed between the northern hibernaculum (located fall 2005 by radio-telemetry tracking, see information on “Radio-telemetry,” p. 7) and an area to the northeast where the majority of observations had occurred the previous fall. Each array had 4 funnel traps separated by 10 m of black visquene fencing supported by wood stakes. The visquene fencing was 60 cm tall. The top of the visquene was folded over and attached to a string suspended between each wood stake to block snakes from crawling up and over the fence.

A drift fence could not be constructed around the northern hibernaculum because of the rock configuration. It was also right next to Highway 243 and would have drawn attention to the site,

possibly to the detriment of the snakes. Plans to place a drift fence at the southern hibernaculum in early April were changed when the southern study snake emerged earlier than anticipated.

Shed skin surveys – In October 2005, radio-tracked snakes moved to multiple locations where freshly shed snake skins were present. The skins were identifiable as *M. taeniatus* based on a combination of traits including 1) length greater than 1 m; 2) large brilles [scales covering the eyes]; 3) the head scale arrangement with large parietal, frontal and superocular scales, an elongate bellshaped frontal and a small lower preocular wedged between the 3$^{rd}$ and 4$^{th}$ upper labials (Nussbaum et al. 1983); 4) smooth scales; 5) mid-body scale count of 15; 6) divided anal scale; and 7) visible lateral stripes. Shed skins of *C. constrictor* are similar in all traits except they lack the striped pattern.

An initial shed skin survey was initiated 18 October 2005. The southern, eastern and western sides of all basalt outcrops in the section on the east side of Highway 243 were searched. Survey start and end times were recorded. Shed skins located were identified to species and their locations were recorded. Shed *M. taeniatus* skins locations were marked with flagging that indicated the date. Sheds were left in place until after the snakes were within hibernacula for the winter.

A second survey was conducted 23 October 2006. The protocol was similar except the shed skins were collected the day they were found. Shed skins were placed individually in zip-lock bags marked with the date, time and UTM location and they were stored as a source of genetic material (Clark 1998, Fetzner 1999).

Road surveys- Highway 243, in the vicinity of the site, was checked during every visit for live snakes or road mortalities. Date, time and UTM location were recorded for each observation. Specimens were salvaged for vouchers and genetic material.

Radio-telemetry - An attempt to radio-track an adult to the hibernaculum in October 2004 using a small radio-transmitter attached externally (Hallock 2003) failed when the snake was able to remove the transmitter within hours of attachment. A radio-telemetry study was initiated to locate hibernacula. Concerns about population size, implantation methodology and the timing of implantation (within six weeks of hibernation) (Rudolph et al. 1998) were all taken into consideration and resulted in the decision to limit the number of snakes radio-tracked to only two individuals. The initial thought was that once the hibernaculum was located, snakes could be captured during spring egress to determine population size and other information.

*Study snakes*

Snakes were captured by hand on 14 September, 27 September, and 4 October. Upon capture each snake was placed in a snake bag and kept in a small Styrofoam cooler until surgery. SB-2 transmitters (Holohil Systems Ltd.), designed for intraperitoneal implantation in snakes, were used. The weight was 5 g, dimensions were 19 x 9.5 mm diameter, the nominal life was 10 months and lifespan range was 6-12 months.

Four additional adult snakes were implanted spring 2006. Smaller BD-2 transmitters (Holohil Systems Ltd.), designed for implantation, were used. The weight was 1.8g, the dimensions were 20 L x 8 W x 5 H mm and the nominal life was about three months.

When captured in May 06, Snake #303 had lost 30 g since her capture in October 05 and had a sore on her back at the transmitter location. After consultation with the veterinarian, the decision was made to replace the transmitter with a smaller one. This allowed the snake to remain in the study.

*Implantation*

An injected anesthetic, MS 222, was used to induce anesthesia for the first surgery. The snake never recovered and presumably the mortality resulted from an anesthetic overdose. Injected anesthetics have been used successfully by other researchers (Karlstrom and Cook 1955, Betz 1962, and Weatherhead and Anderka 1984 as cited in Blouin-Demers et al. 2000) including the biologist who performed this surgery. The main advantage is that MS 222 is readily available, inexpensive and does not require administration by a veterinarian. Disadvantages include unpredictable depth of anesthesia and adverse physiological effects.

As a result of the mortality, the rest of the surgeries were performed by a wildlife veterinarian who used vaporized isoflurane as the anesthetic. Inhalant anesthetics are superior to injected agents because the depth of anesthesia can be controlled and prolonged recovery times associated with injectable agents are avoided (Blouin-Demers et al. 2000). No additional anesthetic related mortalities occurred.

The snake was placed in a tight-fitting clear plastic tube. The isoflurane was pumped into the tube. Often the snake could barely right itself, actually spinning in the tube, and then would recover almost to the point of being alert. Additional anesthesia would result in the sudden loss of the snake's ability to right the body. At that point, the transmitter was implanted in the intraperitoneal cavity by the veterinarian. Details on the anesthetic and surgical procedure will be published by R. Hein, DVM, at a later time.

Due to logistical constraints, the snakes were held a total of 6 – 8 days in captivity before being released (Table 1). Snakes recovered quickly from the anesthesia and were alert and active within hours. Snakes were held a minimum of 24 hours post-surgery. Snakes were weighed, measured and photographed before release (Table 2). They were released at the exact location of capture. One month prior to predicted transmitter expiration, snakes were to be recaptured, examined and weighed.

**Table 1. Capture and release date for radio-telemetry study snakes.**

| Snake | Capture date | Surgery date | Release date | Days in captivity | Days post-surgery |
|---|---|---|---|---|---|
| S171 | 27 Sept 05 | 29 Sept 05 | 4 Oct 05 | 8 | 6 |
| S303 | 4 Oct 05 | 6 Oct 05 | 11 Oct 05 | 8 | 6 |
| S653 | 25 Apr 06 | 27 Apr 06 | 1 May 06 | 7 | 5 |
| S802 | 4 May 06 | 8 May 06 | 9 May 06 | 6 | 2 |
| S852 | 4 May 06 | 8 May 06 | 9 May 06 | 6 | 2 |
| S103 | 9 May 06 | 10 May 06 | 15 May 06 | 7 | 5 |
| S303 | 9 May 06 | 10 May 06 | 15 May 06 | 7 | 5 |

*Field equipment*
A Communication Specialist receiver with an aluminum Yagi antenna was used for the telemetry work. Tracking was scheduled twice a day for five days per week in October 05 and four days per week April to July 06. Signal reception varied tremendously because of the basalt outcrop topography. From high points on the site, some signals could be detected at 800 m. In other cases, the signals could not be detected over 100 m because of interfering rock formations.

Location information was collected in Universal Transverse Mercator (UTM) (datum NAD 83) units using a 12 XL 12 channel Garmin Handheld GPS unit. The location accuracy of the unit is within 20 m. In cases where the snakes were next to or within tall basalt walls, no readings were available or were less accurate. In these cases, readings were recorded away from the wall. The resulting mapped points were adjusted to better reflect the location using 2003 DNR color ortho photos projected into ArcView GIS 3.3.

*Data collection*
Standardized data sheets were used to collect information at each snake location (Appendix A). General categories for data collection included weather condition, snake location, activity, habitat type and feature, and microhabitat information. Air temperatures were recorded using a slow read thermometer held approximately 1.2 m off the ground in the shade. Lizard activity was noted. Photographs were taken of the habitat 1 m (microhabitat) and 5 m (macrohabitat) around each snake location. Each location was marked with flagging indicating date and time.

*Habitat and microhabitat*
Broad habitat categories were used including 1) basalt outcrop; 2) lithosols dominated by *A. rigida*; 3) sandy soils dominated by *A. tridentata, Pursha tridentata* and/or *G. spinosa*; and 4) loamy soils dominated by *A. tridentata*. A general description of the area and habitat were also included. For basalt outcrops, rock size and type were recorded using general categories of 1) columnar basalt, 2) fractured boulder, 3) fractured rock, and 4) consolidated rock. Aspect was recorded for the location of snakes found in basalt outcrops. Percent categories of 0, 1-5, 6-25, 26-50, 51-75, and >75 were used to categorize rock and aerial vegetation cover in 1 m and 5 m plots around each snake location. Plot area was estimated visually to prevent disturbance to the snakes. Vegetation classes were shrub, bunchgrass and cheatgrass. Perennials were uncommon in the plots and/or did not provide cover, and were therefore not included. Shrub and grass species were also recorded.

Snake location categories included 1) underground, 2) on surface, 3) under or in rock and 4) in shrub/vegetation. The category “under ground” was used when snakes were below the surface, usually in mammal burrows. The category “on surface” was used for snakes with greater than 50% of the body exposed. The category “under or in rock” was used for snakes that were sheltered in or had at least 50% of the body covered by rock. Snakes within branches or under shrubs were place in the category “in shrubs.”

*Data analysis*
To display snake movements patters, locations were mapped onto high-resolution orthographic photographs (WA DNR, 2003) using Arc View 3.1 (ESRI, 380 New York Street, Redlands, California 92373-8100, USA). The furthest distance each snake moved from the point of capture was calculated, as was the furthest distance from the hibernaculum. A major assumption for the later calculation was that each study snake would return to the hibernaculum closest to its spring capture location. The area occupied by the population during the study was determined by creating a polygon around all locations and calculating the area.

Total movement distance, maximum distance moved between tracking intervals, and maximum convex polygon area occupied were estimated for each study snake with the program extension ESRI Animal Movement Data Analysis (Hooge and Eichenlaub 1997). Nearest neighbor analysis test for complete spatial randomness was also calculated with this program.

Estimates for all calculations used straight-line connections between snake locations. Based on the observed distance moved versus the GPS unit locations, small movements were often overestimated. This error is associated with the precision of the GPS unit.

Descriptive statistics were used to examine macro– and microhabitat use information. The vegetation cover class and species variables were not compared statistically because the value for each was largely a factor of the habitat type and did not appear to reflect important information about *M. taeniatus* habitat use.

**Results**
All methods combined yielded 323 whipsnake locations (Fig. 6). The majority (260) of locations were from data collected on the six radio-telemetry study snakes. The remaining 63 locations were from shed skins (30), non-study snake observations (28) and road mortalities (5). Thirteen snakes, including the study snakes, were captured, weighed and measured (Table 2).

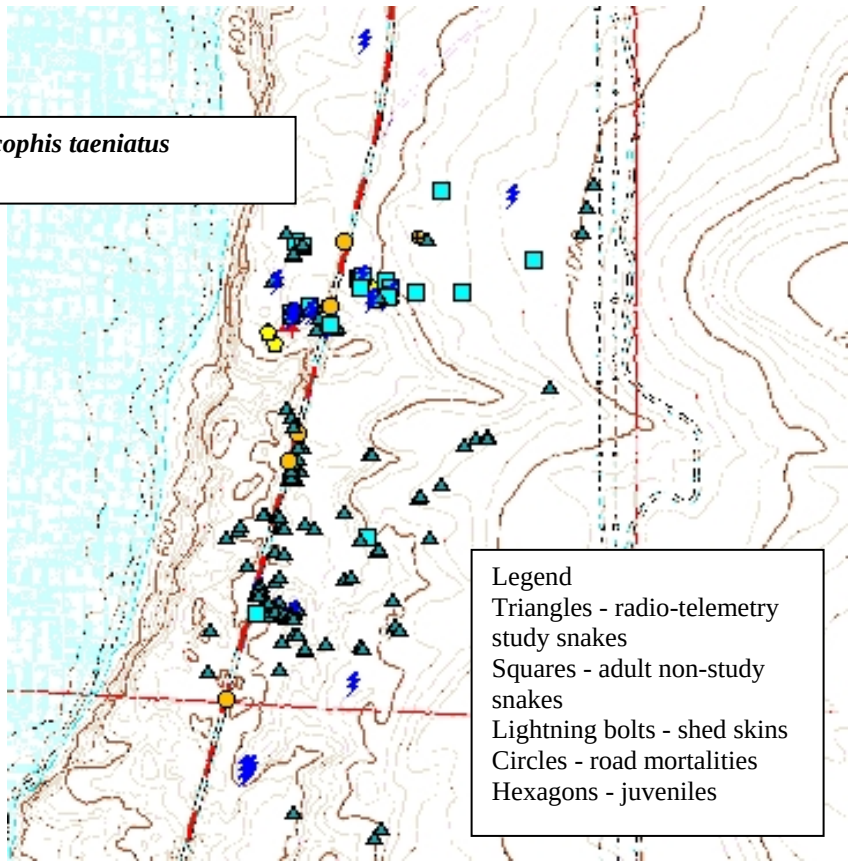


**Figure 6. *Masticophis taeniatus* locations.**

**Table 2. Length and weight of *M. taeniatus* captured 2004-2006.**

| DATE | INDIV | Life Stage | SVL (cm) | TAIL (cm) | TOTAL (cm) | WEIGHT (g) |
|---|---|---|---|---|---|---|
| 20041007 | | ADULT | 83.82 | | 116.84 | 140 |
| 20050426 | | ADULT | 83 | 37 | 120 | 95 |
| 20050426 | | ADULT | 88 | 37.2 | 125.2 | 96 |
| 20050427 | | ADULT | 86.2 | 35.7 | 121.9 | 119 |
| 20050914 | | ADULT | 90.5 | 38.7 | 129.2 | 150.2 |
| 20050926 | | ADULT | 75.25 | 30.5 | 105.73 | 87 |
| 20060524 | | ADULT | 87 | 38 | 125 | 116 |
| 20060706 | Snake 852 | ADULT MALE | | | | 82.5 |
| 20060516 | Snake 103 | ADULT MALE | 86.5 | 37.5 | 124.5 | 112 |
| 20050927 | Snake 871 | ADULT | 78.1 | 42.5 | 117.65 | 111 |
| 20051004 | Snake 776 | ADULT FEMALE | 81.9 | 34.3 | 116.2 | 117 |
| 20060504 | Snake 802 | ADULT FEMALE | 84.5 | 36.5 | 121 | 124 |
| 20060425 | Snake 653 | ADULT FEMALE | 93.98 | 40.64 | 134.62 | 168 |

Visual encounter surveys .- Twenty-one observations (Table 3-6) were recorded. Additional incidental observations were made while radio-tracking snakes. Finding snakes was time intensive with an average search time per snake of 10.5 hrs fall 04, 10.31 hrs spring 05, and 9.25 hrs. fall 06. The average detection time dropped spring 06 to 3.14 hrs/snake. The ability to locate snakes was increased by surveying areas where shed skins had been found the previous fall.

**Table 3. Results of fall 2004 visual encounter surveys.**

| DATE | AIR | CLOUD % | START | END | TEAM | TOTAL (HR) | Total search hrs | SNAKES All spp. | MATA | Snake species & life stage[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20041007 | 20 | 0 | 1100 | 1600 | 4 | 3 | 12 | 3 | 2 | MATA_J, MATA_A, CROR_S |
| 20041014 | 20 | 0 | 1130 | 1322 | 2 | 2 | 4 | 1 | 0 | CROR |
| 20041014 | 27 | 0 | 1400 | 1627 | 2 | 2.5 | 5 | 0 | 0 | |
| **Total** | | | | | | | **21** | 4 | **2** | **10.5 hrs per MATA, 5.25 hrs per snake** |

[1]*MATA – Masticophis taeniatus, CROR- Crotalus oreganus, PICA – Pituophis catenifer, COCO – Coluber constrictor, HYTO – Hypsiglena torquata, UTST – Uta stansburiana, _j- juvenile, _a- adult, _s-shed skin*

**Table 4. Results of spring 2005 visual encounter surveys.**

| DATE | AIR | CLOUD % | START | END | TEAM | TOTAL (HR) | Total search hrs | SNAKES All spp. | MATA | Snake species & life stage[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20050421 | | | 1230 | 1800 | 2 | 4.75 | 8.5 | 2 | 0 | 2 CROR_A_J |
| 20050425 | | | 900 | 1200 | 4 | 3 | 12 | | | |
| 20050426 | 17 | 0 | 945 | 1200 | 4 | 2.25 | 9 | 6 | 2 | 2 MATA, 4 CROR |
| 20050427 | 20 | | 930 | 1345 | 2 | 4.25 | 8.5 | 5 | 2 | 2 MATA, 2 CROR, 1 PICA |
| 20050503 | 22 | 25 | 1047 | 1248 | 1 | 2 | 2 | 1 | | CROR_J |
| 20050505 | 18 | 100 | 933 | 1052 | 1 | 1.25 | 1.25 | 0 | | |
| **Total** | | | | | | | **41.25** | 14 | **4** | **10.31 hrs per MATA, 2.95 hrs per snake** |

**Table 5. Results of fall 2005 visual encounter surveys.**

| DATE | AIR TEMP C | % CLOUD COVER | START TIME | END TIME | TEAM | HOURS | TOTAL SURVEY TIME | SNAKES All spp. | MATA FOUND | Snake species & life stage[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20050914 | 22 | 0 | 958 | 1215 | 2 | 2.25 | 4.5 | 2 | | 2 CROR |
| 20050914 | | | 1310 | 1620 | 2 | 3 | 6 | 1 | 1 | MATA |
| 20050926 | 21 | 0 | 1228 | 1440 | 2 | 2 | 4 | 0 | | |
| 20050926 | 26 | 75 | 1510 | 1725 | 2 | 2 | 4 | 2 | 1 | MATA, CROR_S |
| 20050927 | 18 | 0 | 940 | 1718 | 2 | 4 | 8 | 3 | 1 | MATA, CROR_A, CROR_J, (MATA) |
| 20050927 | | | 1515 | 1718 | 2 | 2 | 4 | 0 | | |
| 20050928 | 16 | 0 | 1006 | 1402 | 1 | 4 | 4 | 1 | 1 | MATA |
| 20050928 | 22 | 0 | 1521 | 1739 | 1 | 2 | 2 | 0 | | |
| 20051004 | | | 1223 | 1510 | 1 | 2.75 | 2.75 | 1 | 1 | MATA |
| 20051004 | | | 1630 | 1717 | 1 | 1.5 | 1.5 | 0 | | |
| 20051005 | 18 | 50 | 1248 | 1550 | 1 | 3 | 3 | 3 | | CROR_A, 2 CROR_S |
| 20051011 | 22 | 0 | 1450 | 1815 | 1 | 2.5 | 2.5 | 0 | | |
| | | | | | | **TOTALS** | **46.25** | **13** | **5** | **3.55 HRS PER SNAKES , 9.25 HRS PER MATA** |

[1]*MATA – Masticophis taeniatus, CROR- Crotalus oreganus, PICA – Pituophis catenifer, COCO – Coluber constrictor, HYTO – Hypsiglena torquata, UTST – Uta stansburiana, _j- juvenile, _a- adult, _s-shed skin*

**Table 6. Results of spring 2006 visual encounter surveys.**

| DATE | AIR | CLOUD % | START | END | TEAM | TOTAL (HR) | search hrs | SNAKES All spp. | MATA | Snake species & life stage[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20060425 | 26 | 100 | 1347 | 1725 | 1 | 3.5 | 3.5 | 4 | 3 | 2 MATA_A, MATA_J, PICA_A |
| 20060426 | 24 | 100 | 1520 | 1715 | 1 | 2 | 2 | 1 | 1 | MATA_A, |
| 20060427 | 15.5 | 0 | 1645 | 1721 | 2 | 0.68 | 1.36 | 0 | 0 | |
| 20060502 | 13 | 0 | 930 | 1200 | 2 | 2.5 | 5 | 0 | 0 | |
| 20060502 | 21 | 0 | 1433 | 1708 | 2 | 2.5 | 5 | 1 | 1 | MATA_J |
| 20060503 | 16 | 0 | 905 | 1236 | 2 | 3.5 | 7 | 1 | 1 | MATA_A, |
| 20060503 | 23 | 0 | 1428 | 1733 | 2 | 3 | 5.5 | 4 | 3 | MATA_SA, 2 MATA_A, PICA_A |
| 20060504 | 18 | 0 | 1105 | 1250 | 1 | 2 | 2 | 1 | 1 | 21MATA_A, PLUS INCIDENTAL DURING AM TELEMETRY (SAM), |
| | | | | | | | **31.36** | **12** | **10** | **3.14 HRS/MATA PLUS INCIDENTAL CAPTURE** |

Cover boards –were in place 25 April- 5 May 05 for a total of 11 days. Traps were checked twice a day from 25-28 April and 2-5 May. When not being checked, the traps were flipped over and functioned as cover boards. Twenty-one Side Blotched Lizards (*Uta stansburiana*) were observed under the boards. Three *U. stansburiana* and a small adult *P. cateniter* were captured in the traps. No *M. taeniatus* were captured.

Drift Fence Array – The drift fences were in place 6 April to 1 May 06. They were open 10 days for a total of 40 trap days. Twenty-one *U. stansburiana* were captured. Strong winds and gusts damaged the drift fence twice. Damage on April 10 was easily repaired. A particularly strong wind storm hit the site sometime between 28-1 May and destroyed the drift fence.

Shed skin surveys – Sixteen shed *M. taeniatus* skins were found during timed surveys (Table 7-8) and 13 additional shed skins were found incidentally while radio-tracking. Numbers of shed skins found during timed surveys in 2005 and 2006 were the same (8). However, an additional 10 shed skins were found incidentally during radio-tracking fall 2005. Average time to find a *M. taeniatus* shed skin during timed surveys in 2005 and 2006 was similar at 2.6 hrs and 2.68 hrs. Three additional shed skins, not shed in the fall, were found during 2006 telemetry work.

**Table 7. Results of fall 2005 shed skin surveys.**

| DATE | START | END | TEAM | TOTAL (HR) | Total search hrs | SNAKES All spp. | MATA | Species & life stage |
|---|---|---|---|---|---|---|---|---|
| 20051018 | 1511 | 1717 | 1 | 2 | 2 | 2 | 2 | MATA_S_J, MATA_S_A |
| 20051019 | 1059 | 1444 | 1 | 2.75 | 2.75 | 3 | 3 | 3 MATA_S_A |
| 20051019 | 1650 | 1731 | 1 | 0.75 | 0.75 | 0 | | |
| 20051020 | 1236 | 1529 | 1 | 3 | 3 | 0 | | |
| 20051025 | 1555 | 1736 | 1 | 1.5 | 1.5 | 0 | | |
| 20051026 | 947 | 1225 | 2 | 2.75 | 2.75 | 1 | 1 | 1 MATA_S OLD |
| 20051026 | 1307 | 1520 | 1 | 2 | 2 | 1 | | CROR_A |
| 20051103 | 1130 | 1420 | 2 | 3 | 6 | 3 | 2 | 2 MATA_S_A, 1 HYTO_S |
| | | | | | **20.75** | 13 | **8** | **1.6 hrs per snake, 2.6 hrs per MATA** |

[1]*MATA – Masticophis taeniatus, CROR- Crotalus oreganus, PICA – Pituophis catenifer, COCO – Coluber constrictor, HYTO – Hypsiglena torquata, UTST – Uta stansburiana, _j- juvenile, _a- adult, _s-shed skin*

**Table 8. Results of fall 2006 shed skin surveys.**

| DATE | START TIME | END TIME | TEAM | SURVEY TIME (HRS) | TOTAL SURVEY TIME (HRS) | SNAKES (ALL SPP.) | MATA* | MATA sheds | SPECIES AND LIFE STAGE |
|---|---|---|---|---|---|---|---|---|---|
| 20061023 | 917 | 1145 | 3 | 2.5 | 10 | 7 | 7 | 6 | 7 MATA_S |
| 20061023 | 1302 | 1616 | 5 | 3 | 11.5 | 6 | 4 | 2 | 2_MATA_S, 2 MATA_A, 1 PICA_J, 1 COCO_J |
| | | | | | **21.5** | 12 | 10 | **8** | **1.75 per snake, 2.68 per MATA** |

* Includes both snakes and shed skins.

Road surveys – Five *M. taeniatus* were found dead on Highway 243 (Fig. 6), all within the study site. One was a juvenile and the others were adults (one determined to be male). The dead snakes were too smashed to be salvageable.

Radio-telemetry - Six snakes were monitored from 4 October 05 to 12 July 06. Information was collected for 260 locations (Fig. 6). On average, snakes captured spring 06 were monitored for a period of 64 days (SE = 3.8, min. = 51, max. = 73). One snake, captured 4 October 05, was monitored 276 days. On average, snakes were located 45.5 times (min. = 32 days, max. = 78

days) (Table 9). On some days, snakes were located twice to collect information on activity periods and behavior. Snakes were observed 102/260 (39%) times located. The longest period between radio-tracking was 4 days with the exception of winter (4 Nov. 05 to 5 April 06) when the snakes were assumed to be inactive.

**Table 9. Monitoring duration and days tracked.**

| snake | capture | last local | days | days tracked |
|---|---|---|---|---|
| 852 | 4-May | 12-Jul | 70 | 43 |
| 103 | 9-May | 11-Jul | 64 | 35 |
| 871 | 27-Sep | 16-Nov | 51 | 30 |
| 653 | 25-Apr | 6-Jul | 73 | 45 |
| 776 | 4-Oct | 6-Jul | 276 | 78 |
| 802 | 4-May | 5-Jul | 63 | 38 |

Snakes tracked fall 2005 overwintered in different locations. Both locations were confirmed as communal hibernacula based on the observation of multiple shed *M. taeniatus* skins near the entrances. *C. oreganus* was heard October 05 within the southern hibernaculum and *P. catenifer* was seen April 06 at the northern hibernaculum, suggesting multiple snake species may use the hibernacula. Both snakes had settled into the hibernacula by 27 October 05. No change was found on 3 and 16 November. By that time, daytime temperatures were rarely exceeding 15° C.

On 10 February 06, the snake at the northern hibernaculum could not be located. The snake at the southern hibernaculum had not moved. By 17 March, this snake had moved 11 m downslope from the southern hibernaculum. Radio-tracking began in earnest 6 April. Plans to construct a drift fence array were cancelled because of the early egress of the study snake and the assumption that other snakes may also had emerged. The first surface active non-study *M. taeniatus* was observed the last week of April.

By July 13, none of the snakes could be located. Approximately 32 hours (4 days) were spent attempting to locate the snakes within the study area and adjacent parcels without success. The search area was about 12.62 hectares and extended 2.5 km north, 3.2 km northeast, 1.4 km east and 0.3 km southeast from the areas where *M. taeniatus* had been found. Lands in the southern half of T16N R23E Section 9 could not be surveyed because of trespass issues but attempts to pick up the transmitter signals were made from pull-offs along Highway 243 and from the Vantage substation road.

It seemed improbable that all the study snakes had suddenly moved so far. Just before arranging a flight over the site, the transmitter recovered from Snake #776 expired. It was one of the last to be implanted. At that point, it seemed more probable that the transmitters had expired early. Originally used for another project, the transmitters had been refurbished and stored before use for this study. When contacted, Holohil, Inc. determined that the loss of battery life for this transmitter model stored for eight months would be about 30%. This agreed strongly with the timing of the “disappearance” of each snake. Because of the early expiration time, only one snake had been weighed and examined to determine health.

Snake #852 was captured 7 July 06. His surgical scar was healed and the location of the transmitter was barely visible. His weight was 82.5 g, an 11% weight loss since capture.

Of the six study snakes, four (67 %) survived the entire study. Snake #774 disappeared between 16 November 05 and 10 February 06. Attempts were made to find it in March and April without success. Snake #303 was last seen basking 27 June 06. By that evening, the snake/transmitter was in a new location. The transmitter was recovered 6 July 06. The transmitter had only a small amount of dried mucus on it with no snake remains, no mammal bite marks and no bird or mammal scat.

*Movement patterns*

Movement varied between individuals (Table 10, Fig. 7). The mean total distance moved during the study was 2622 m (SE = 420.997) for the four snakes captured spring 2006. The first captured snake (#871) was not included because it was only tracked fall 2005. The second captured snake (#776) was also not included because it was tracked for much longer than the rest of the snakes (although it was relatively sedentary). Mean distance moved between tracking events was 48.9 m (SE = 13.56) for all snakes. These results, based on straight-line calculations, most likely underestimate the actual distance moved by the snakes. The mean maximum convex polygon area (ha) was 12.64 (SE = 4.53) for all snakes. The mean furthest location from original capture for all the snakes was 605 m (SE = 142. 56). The furthest any study snakes moved from one of the two identified communal hibernacula was 725 m.

**Table 10. Movement distances of study snakes.**

| ID | Days Monitored | Locations | Total distance (m) | Maximum distance traveled between observations (m) | Mean distance (m) | Maximum convex polygon area (h) | Furthest distance moved from original capture location (m) |
|---|---|---|---|---|---|---|---|
| 871 | 51 | 30 | 207 | 117 | 7.4 | 0.16 | 153 |
| 776 | 276 | 78 | 1041 | 387 | 14 | 4 | 623 |
| 103 | 64 | 35 | 1631 | 280 | 43 | 4.8 | 226 |
| 653 | 73 | 45 | 3366 | 473 | 80 | 26 | 718 |
| 802 | 63 | 38 | 2216 | 417 | 63 | 21 | 912 |
| 852 | 70 | 43 | 3275 | 884 | 86 | 7.41 | 998 |

*Area of occupancy*.- The six study snakes occupied an area of 65.92 ha during the study period (Fig. 6). This area expanded to 85.34 ha when the locations of shed skins and non-study *M. taeniatus* were included (Fig. 6).

*Nearest Neighbor Analysis Test for Complete Spatial Randomness*

All points were used (n=320). The null hypothesis was rejected; a tendency towards clumping exists with |z| = 17.1069 and R = 0.500119.

*Habitat*

*M. taeniatus* likely occupies a 519 ha area dominated by basalt formations (Fig. 8) based on habitat similarities, historical observations, and confirmation of presence by the owner of a parcel south of the study area. Habitat use may also extend beyond this area during the summer

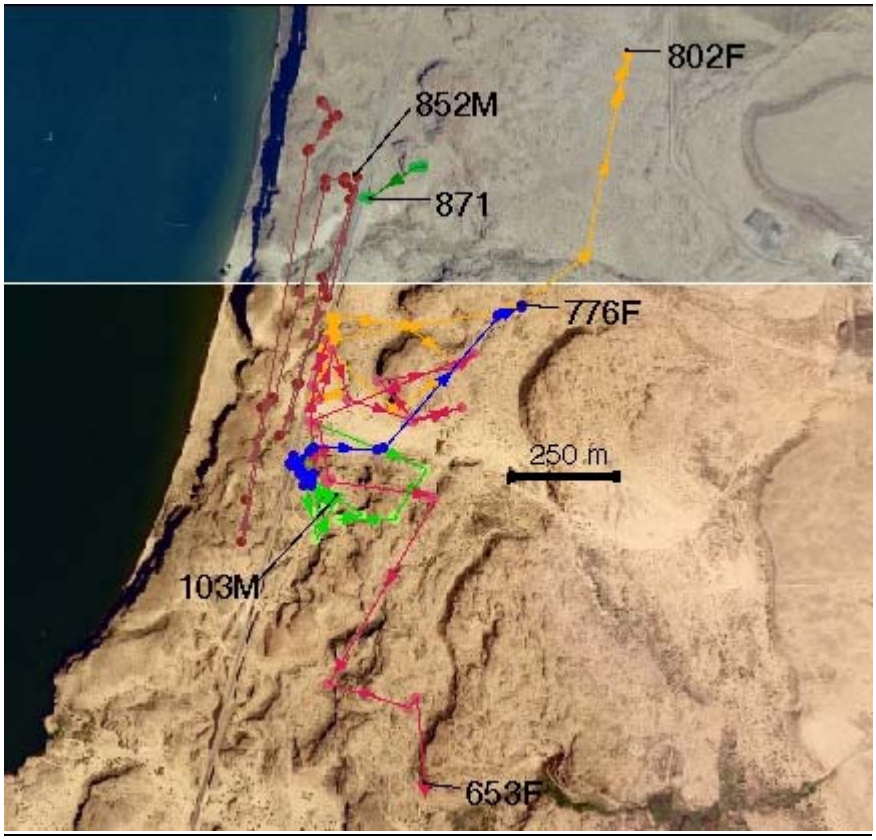


**Figure 7. Study snake movements.**
**Final locations are indicated by snake ID followed by sex (M- male, F- female).**

Habitat use was recorded at 143 locations. Locations were on or in basalt outcrops 89% of the time. The snakes were in areas with sandy soils and associated plant species 30% of locations. Two females moved to areas with loamy soils dominated by *A. tridentata* and were found in this type four times (.03). Talus was used once (< 1%). Snake 653 was located in sandy soil sites twice as many times as observed by the other study snakes.

Two communal hibernacula were identified. To the human eye, these sites had little in common other than both being south facing rock features (Fig. 9-10). Both types of rock features were common at the site. The northern hibernaculum is in a basalt outcrop composed of fractured rock. This outcrop extends to the west but was bisected when Highway 243 was constructed. Snakes (and shed skins) were present on both sides of the road in the fall and spring. The area shown in Fig. 9 looked like a pile of rocks but observations suggest there was a discrete opening used by the snakes. In addition to use by snake #871, three shed skins were found extending out of this opening; and two non-study *M. taeniatus* and an adult *P. catenifer* were observed at the opening spring 2006.

*Microhabitat*

Information on microhabitat was recorded 211 times. Snakes were observed active on the surface 14% of the times they were located. The rest of the time they were under some form

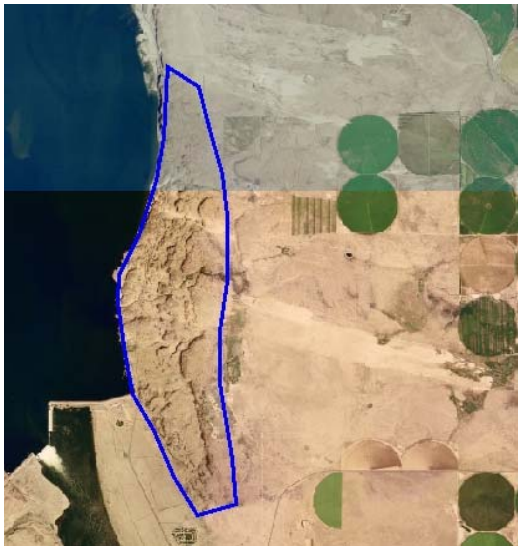

**Figure 8. Probable area occupied by *M. taeniatus.*** *Additional habitat may be used* in the summer.

of cover. At the majority (63%) of locations, snakes were under or within rocks. Snakes were in or under shrubs 14% and in holes underground 9% of the locations.

**Figure 9. Northern hibernaculum.**
**A shed skin is visible at the base of the purple sage.**

**Figure 10. Southern hibernaculum.**

## *Behavior and life history observations*

Ecdysis

*Fall and active season shedding behavior was observed for two study snakes. Both snakes sheltered in rocks previous to ecdysis with minimal surface activity. One snake remained within the same sheltering location from 11-17 October. On 19 October, the snake was observed attempting to remove a patch of unshed skin at the sutures by rubbing against rocks.*

*Another study snake moved little during the period from 12-20 June. On 14 June, this snake was approached closely without responding. The brilles were opaque. On 21 June, the shed skin, with sutures present, was found close to where the snake had sheltered.*

Predation on lizard

*One non-study snake was observed chasing, catching and consuming an adult male Uta stansburiana. The snake moved rapidly with the head up. The snake and lizard froze momentarily upon approaching me, then the snake captured the lizard and moved immediately under a large rabbitbrush where it rapidly consumed the lizard head first.*

Defensive behaviors

*The snakes were extremely alert to humans. I rarely approached an active snake that was not watching me. Usually most of the body was under some form of aerial cover, usually rock and sometimes shrub. Within dense shrubs, they were almost impossible to see unless they moved. The snakes typically remained immobile unless approached too closely, in which case they would flee. They would also flee if I averted my gaze to record data. The striped pattern combined with rapid movement, made it difficult to track the snake effectively and made capturing the snakes difficult. They usually fled into rock crevices. If captured, they used open-mouth displays and struck repeated. They did not calm when captured or held in captivity.*

Male mating behavior

*When Snake #776, a female, was located 9 May 06, an adult M. taeniatus was present within a meter of her. Upon my approach, the non-study snake moved away from her about 2 m south into the rocks. While I was photographing snake #776, the other M. taeniatus returned to her and then fled again. On its third return, it was captured. He was confirmed as a male, implanted with a transmitter and release at this location 15 May.*

*After release, he returned to the area of the hibernaculum. Although not actually observed in the hibernaculum, he passed the area twice. On 18 May, he was located in a small hole at the base of a columnar basalt wall. It was the exact hole where female #653 was captured on 25 April 06. The same day, he moved 131 m north (straight line distance) to a hole used by the same female 2 May 06. Not only was he using the exact same holes, he used them in the same order she did. Tracking did not start again until four days later 23 May. At that time, he had moved 240 m east and was 119 m south of her (Fig. 11). After that, he made his way back to the vicinity of the hibernaculum*

*again. Interestingly, later in June, these two snakes occupied the same area again. They were not found using the same sheltering locations but were within 10 m or less of each other.*

*The study snake on the west side of Highway 243 returned to the area of the northern hibernaculum (west side road) three times. Between two of those returns, he was found at locations 884 m and then 549 m south.*

*A non-study snake was captured at the northern hibernaculum on 24 May at 1802 hrs. The snake was repeatedly poking his snout into the dirt at the entrance. The snake was so focused that I was able to walk up and easily capture it. His snout was covered in a fine layer of dirt. The snake was weighed, measured and sexed. It was a male.*

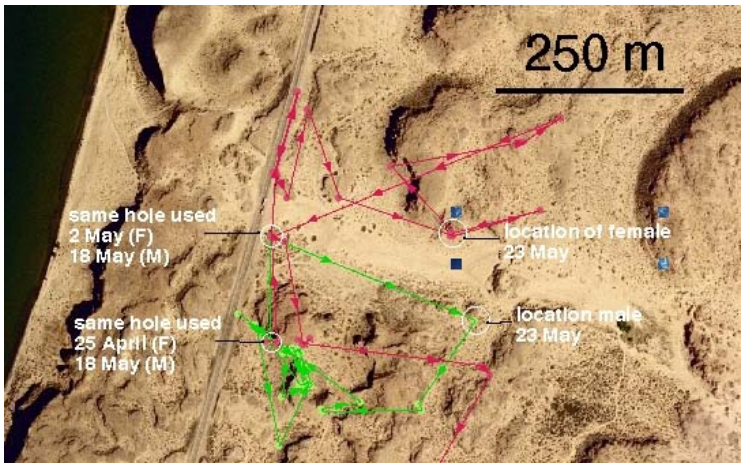


**Figure 11. Movements of male likely tracking female using chemical cues.**

Female movement to oviposition sites

*In late June and early July, the three females started making long moves. The transmitter from female #776 was recovered during this time. The other two snakes moved in opposite directions, one north and one south (Fig. 7, females 802 & 653). The snake moving south was in talus the last time she was located. This was the only observation during the study of M. taeniatus in talus. She was 718 m from her initial capture location (near the southern hibernaculum). The last time the other female was located, she was moving north. Her final location was in a mammal hole under a shrub. There was no basalt in the immediate area. Her movement was direct and rapid. She had been located the previous evening at twighlight under a shrub. By 1214 hrs, she had moved 350 m. Her movement was monitored over the next half hour. She moved 56 m by 1230 hrs and 55 m more by 1253 hrs (111m in 39 min., 2.85 m/min,). Monitoring ended when she moved underground into a mammal hole. At this last location, she was 912 m from her initial capture site.*

## Discussion

The main focus of this study was to collect life history and habitat use information that could be used to improve survey success. This information is also useful in understanding how to protect populations if management is required for their conservation. This is the first attempt to determine if the species habits and habitat use are similar to those described for populations in other parts of the range.

The results of this study assumed behavior and habitat use observed by the radio-tracked snakes was normal. Observations of non-study snakes and shed skins at many of the locations used by the study snakes, suggest habitat use was typical for the population. All study snakes moved to new locations right after their release. Once in the new location, half the study snakes remained relatively inactive for the first week and the other half were highly active moving to new locations and covering relatively large areas.

The initial two snakes implanted were the least active. The first snake was radio-tracked only in the fall. While tracked, it was inactive for a week prior to shedding. Hirth et al. (1969) also mentions that shedding individuals tended to remain in one place until exuviation was completed

Then it moved to the hibernaculum, a location 135 m from its capture. Once there, it moved little. The low activity level of the other snake was likely due to the first transmitter being too large.

Radio-tracking the two initial snakes in the fall yielded important information. First, both snakes moved to multiple locations with shed skins. Realizing the snakes shed prior to entering winter dormancy and that the shed skins were located near the hibernacula was one of the significant finding of this study. It provided a time efficient way to survey for the snakes that did not depend on ideal weather conditions. Parker and Brown 1980 commented that "…many entered hibernation after ecdysis nearby." Females also shed about 8 days before oviposition (Parker and Brown 1980). Therefore, shed skins should be present at occupied sites in both July and October.

This study attempted to define the pattern of habitat occupancy, the portion of the landscape used and the microhabitas most commonly used. The snakes were primarily associated with basalt outcrops. Holes and fractures in and under the rock outcrops were used by the snakes for cover more than any other microhabitat. In general, this habitat had sparse vegetation cover dominated by *A. rigida* with *P. secunda*, scattered *P. spicatum* and a low cover density of *B. tectorum*.

Studies that examine habitat selection by snakes are rare. Published studies suggest that individual snakes of some species do actively select preferred portions of their environment (Reinert 1993). The frequent use of basalt outcrops does seem to indicate this is the preferred habitat for snakes radio-tracked from September to early July. Non-study snakes observed during visual encounter surveys were also associated with rock outcrops, but these surveys were biased towards this habitat. A habitat study that examines selection would clarify if basalt outcrops are actually selected or if use is related to overall abundance of this habitat type.

Habitat and microhabitat use by the snakes was affected by the time of day they were located and weather conditions at that time. Snakes sheltered until temperatures were suitable for activity. Activity periods were relatively short. Attempts were made to locate the snakes during both active and inactive periods to examine both types of habitat use. Snakes were observed 39% of the times they were located indicating that the study did cover periods when the snakes were thermoregulating or surface-active. Habitat and microhabitat use during active periods (such as hunting) were likely underrepresented because of the short window when these activities took place. Because the snakes often returned to the same night retreat, locating the snakes only in the morning or evening could have resulted in underestimated activity levels and movements.

**Figure 12. *M. taeniatus* sheltering in rock.**

Aerial cover directly over the snakes was not originally recorded. As the study progressed, it became increasingly clear this might be significant. When searching for the snakes, the ability to find them was increased by searching from a position next to basalt outcrops where gaps between the rocks were visible (Fig. 12).

All of the study snakes used the same location more than once and all returned to one or more sheltering location after having moved to a new area. In at least four cases, study snakes used the exact same hole for shelter that had been used previously by another study snake. Non-study snakes also used some of these same retreats. Parker and Brown (1972) observed their two study snakes returning to the same sheltering locations multiple times and commented that this seemed to indicate selection of certain favorable sites for nocturnal retirement. Sheltering locations they describe included a rock-embedded man-made embankment and partially exposed cavities under boulders.

On a landscape level, the snake locations appear clustered (Fig. 6). The results of the nearest neighbor analysis test for complete spatial randomness support this observation. From a human perspective, it was not clear why these areas were favored.

Highway 243 bisects the study population. In the last decade, traffic has increase dramatically (personal observation), almost to the point of being constant. Opportunities for successful crossings, even for a fast and wary whipsnake, will most likely become rare in the near future.

The propensity for snakes to shelter in areas right next to the highway is of concern. Interestingly, none of the study snakes crossed the road even though all were observed within 5 m of the road at some point. The use of microhabitats that provide aerial cover may mean they avoid open expanses when possible. The snakes do sometimes attempt to cross the road as evidenced by the five road mortalities observed during this study. Additional road mortalities probably went undetected. Ravens search the highway regularly and most likely salvage the majority of animal carcasses. The remains found were completely flattened, most likely offering less appeal to a scavenger.

Two communal hibernacula were identified. No features distinguish the hibernacula from other rock features at the site and the two locations were different in appearance (Fig. 9-10). The rock outcrop that contained the northern hibernaculum was bisected when Highway 243 was constructed. Snakes and shed skins were found on both side of the road.

Shed skins were found two years in a row at a third location in section 9 at the base of a south-facing, columnar basalt wall. A shed skin was found coming out of the exact same hole two years in a row. No other information is known about this site. The three sites are separated (from north to south) by 630 m and 380 m.

Whipsnakes used only one den at Tooele Valley although several other apparently suitable dens occurred in the area (Parker and Brown 1973). At the Lone Rock site, 17 km west of the Tooele Valley they used at least three den sites (Parker 1976).

This study did not locate oviposition sites. Some oviparous snake species return to the same oviposition sites annually (Foley 1971). The two snakes tracked by Parker and Brown (1972) made relatively long movements to oviposition sites when compared to the rest of their movements. Movements they observed following oviposition suggested the oviposition site of one study snake was outside her normal home range. Parker and Brown (1972) indicated that

their observations suggested the snakes had favored sites for egg laying based on the presence of hatchlings of a second species, *C. constrictor,* at one oviposition site.

Observation of the three females at the Wanapum sites just before the transmitters expired, suggest they may have been moving to oviposition sites (Fig. 7). Timing is consistent with the oviposition dates of 4 and 5 July reported by Parker and Brown (1972). Determining areas used for oviposition, particularly if outside the normal areas used by the snakes, is critical information. Telemetry is the only way to locate this area. The need for this information, however, must be balanced by the risk of mortality to breeding females for a population that may be small.

In the Parker and Brown (1972) study, females were tracked to an abandoned farm in an old cultivated area that had sparse sagebrush, dense *B. tectorum* and where rodent burrow systems were common. The areas surrounding the farm had less-disturbed sagebrush communities but rodent burrow systems were rare or absent. Although this study is based on only two snakes, it suggests the females may move to more disturbed habitats to lay eggs if the habitat features, such as rodent burrows, are more readily available.

A growing body of experimentation and observation suggests snakes are not as solitary and asocial as once assumed (Reinert 1993). Observations and experiments have demonstrated the ability of snakes to actively follow conspecific scent trails (Ford and Burghardt 1993). In addition to use for selecting mates and locating the hibernacula, it may also function in the location of suitable habitat for other requirements such as food and shelter (Reinert 1993). Observations during this study suggest that males track females using chemical cues they pick up at the hibernaculum. More than one return to the hibernaculum by two study snakes was observed. This differs from Hirth et al. (1969) who reported that after dispersing, none of the snakes were recovered in or near the den before autumnal ingress began.

Observations of both study and non-study snakes repeatedly using the same sheltering spots, suggest snakes may be tracking each other. This also makes the snakes vulnerable to humans; the chances of capturing one are greatly increased by searching these favored locations.

Attempts to determine some information about population size were unsuccessful. The snakes were difficult to find and even more difficult to capture. Recaptures were unlikely. Attempts to capture snakes emerging from the hibernacula were not attempted during this study for reasons already mentioned. It may be possible to come up with a drift fence design or traps that could be used at some point. If the assumption about males returning to the hibernaculum to track female pheromone trails is correct, the use of a drift fence around these sites could interfere with mating.

The secretive and cryptic nature typical of snakes, makes it difficult to determine if low detection rates are because of small population size, improper search image, or simply difficulty of detection (i.e. lack of surface activity and/or snakes avoiding searchers). The use of radio-telemetry and searching for shed skins improved the ability to detect snakes. Observations made during this study, however, do not compare with those made by Utah researchers in 1970s and 1980s. For instance, Parker and Brown (1973) report captures of 185 *M. taeniatus* at a den with

1077 snakes of four species in 1950. The population at the Lone Rock site was estimated to be 425-543 (Parker 1976) in the mid-1970s.

Other evidence suggests the study site population (Wanapum Site) may be small. The small number of shed skins detected two years in a row is of concern. More information is needed on what percentage of the population sheds and if all shedding occurs as the snakes emerge from sheltering locations. In other words, what percentage is undetectable? Numbers of shed skins found during time surveys in October 2005 and 2006 were similar, but 10 additional sheds were found incidentally during radio-tracking in 2005. Too little is known at this time to determine if this is of concern. A small number of juveniles were observed indicating that there is recruitment.

The largest captured snake at the Wanapum Site was 134.62 cm (range 105.73-134.62, mean 121. 49 SD = 7.28). This is smaller than the 182 length given in Stebbins (2003) and Nussbaum et al. (1983). *C. oreganus, P. catenifer, C. constrictor* tend to be smaller on average than those observed in other parts of the range (personal observation). The smaller size has conservation implications. If growth is also slower, it may take longer for males and females to reach reproductive size (males, SVL 60 cm at 1 year; females, 71 cm at 2 years [Stebbins 2003]). Clutch size is related to female snout-vent length (Brown and Parker 1972, 1980; Camper and Dixon 2002) with larger females producing more eggs. Clutch sizes for this population are most likely at the lower end of the range (3-7 eggs) published in Camper and Dixon (2002). Thus, recruitment may be lower than observed in other areas of the species range.

Lizards are the primary prey species. *U. stansburiana* were the most common reptile encountered at the Wanapum site. They were abundant in most areas. *U. stansburiana* in some areas were recorded every 3-4 minutes while searching for *M. taeniatus*. They were confirmed as prey items twice during the study. Sagebrush Lizards (*Sceloporus graciosus*) occured on the sand dune habitats to the north and east of the site but were not detected in the study site (section 4).

The major prey at the Lone Rock site, Tooele County, Utah, Parker (1976) was *Sceloporus graciosus*. Parker (1976) estimated an individual *M. taeniatus* occupying about 5 ha might have an available food supply of 370 *S. graciosus*. *U. stansburiana* was the main prey species (64%) at another site in Utah (Parker 1976). Washington habitats without abundant populations of these lizard species may not be suitable for *M. taeniatus*.

The snakes are especially vulnerable to human-induced impacts when clustered together at hibernacula (Prior and Weatherhad 1996). Releasing these locations is problematic and was of concern for this report. Brown and Parker (1973) indicate that human predation on rattlesnakes (*Crotalus*) and whipsnakes (*Masticophis*) was the main cause for the disappearance of those two species from the den M population. In 1950, 1400 individuals of seven snake species, including 185 *M. taeniatus*, were captured. By 1972, only 40 *M. taeniatus* were captured.

During the active season, *M. taeniatus* at the Wanapum study site were difficult to find, wary of humans, and difficult to capture. For most humans at the site, encounters would be accidental. In general, whipsnakes and their kind (racers, coachwhips) make poor captives and most likely little

market exists for them in the pet trade. Collecting in Washington is most likely limited to a small number of amateur herpetologists. With the unknown but likely small population size at the site, collecting could harm the population and should be discouraged.

During this study, most activity observed from September to early July was within 1 km of the hibernaculum. To protect the snakes, habitat modification should not be made within this area. Hirth et al. (1969) recorded the greatest distance dispersed from the den to be 1.5, 3.2 and 3.6 km.

Lastly, there were ORV trails throughout the site. Vehicles were commonly driven up the climbing dune that bisects an area used by the study snakes. Target practice was common in this area also. A large amount of illegally dumped trash was present in an area used by two study snakes. Fire pits were located in at least three places. In one location, an attempt was made to remove a basalt column. Many of these activities were detrimental to the habitat and likely threaten whipsnakes. Management to prevent these activities at the site would likely benefit the snakes.

## Part 2. Status of the Striped Whipsnake (*Masticophis taeniatus*) in Washington.

### Introduction

This is the first attempt to conduct a systematic inventory to determine the status of the *Masticophis taeniatus* in Washington. The species has a long history of eluding Washington biologists. This inventory used information gained from the radio-telemetry study at the Wanapum site described in the first half of this report. The observation that adults shed prior to entering the hibernaculum for winter dormancy opened an entirely new way to search for the snakes that was less time consuming: approximately 3 hrs/shed skin vs. 9-10 hrs/snake. At the Wanapum Site, the first shed skins were observed in late September and the last was observed 2 November. The shed skins were clustered in areas, primarily hibernacula, or other significant habitat. The shed skins are fairly obvious even to the novice observer due to their length (> 1 m) and light color. The skins persist for weeks to months depending on how exposed they are to light, moisture and wind.

### Methods

*Data sources* – The primary source of location data for this project was the Washington Department of Fish and Wildlife reptile and amphibian database (WDFW herp database). The Washington State Gap Analysis Project provided the initial stimulus for the compilation of quality distributional data. Thirty-four museums were canvassed to provide Washington reptile and amphibian specimen records in 1994. Addition data comes from wildlife observation cards submitted by biologist to the Wildlife Resource Data System section of WDFW. All of the records were submitted by credible observers and biologists.

Three additional observations were included: 1) A published account of whipsnakes from 1941 at “5 miles south of Vantage Ferry” (Svihla 1955); and 2) two locations gleaned from field notebooks of Richard Fitzner, a Pacific Northwest National Laboratory (PNNL) biologist (deceased).

*Data accuracy*. - All documented *M. taeniatus* records in the WDFW herp database were examined for accuracy. Upon careful inspection, four records were found to be duplicate museum records added to the database more than once. The location uncertainty was greater than 1600 m. One record from each pair was chosen. This left 26 records documented from 1922-1999 (Table 11).

Seven of the 26 records were re-mapped as follows. Four observations, made from 1954-1956 at or near the town of Vantage, were mapped based on the present location of Vantage. In the early 1960s, Vantage was moved to a new higher location approximately 1 mile to the southwest of the original town. The original town site was inundated by Wanapum Lake in 1962. All four points were re-mapped based on the original town location. The mapped location of a 1993 record of a whipsnake found dead on Highway 243 at 2 miles south of Highway 26, was shifted slightly to more accurately reflect the 2 mile distance. Gary Lentz, a biologist with Washington State Parks, submitted three of the 26 whipsnake observations. Two of his observations: “individual occurrence near Beverly” from 1973 and “Gingko State Park” were re-mapped to better match the locations he described when contacted.

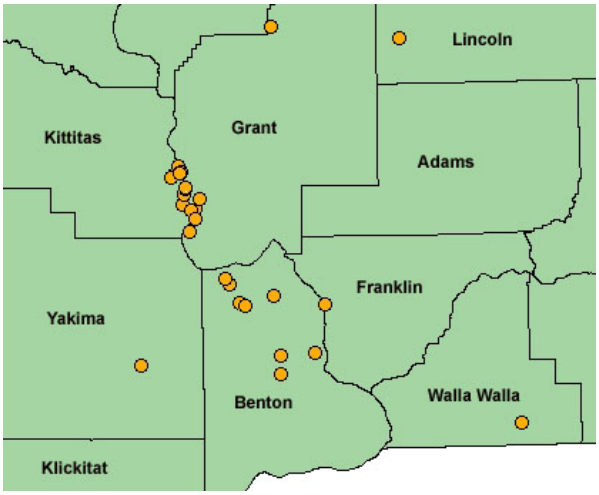


**Figure 13. Known locations of *M. taeniatus* in Washington**

*Historical locations*. – Locations (Table 11) were mapped on high resolution orthophotos in ArcView 3.3. Locations within 5 km of each other were considered to be the same occurrence (NatureServe 2006). Records with less precise location attributes were replaced when more precise records existed for the same area. The final result was 16 occurrences scattered in the Columbia Basin (Fig. 13). Nine occurrences are confirmed by the existence of museum vouchers, published accounts or multiple sightings by different observers. The remaining seven occurrences are considered valid but unconfirmed.

*Survey location selection* - Using orthophotos, each area with an occurrence was searched for habitat features similar to those at the Wanapum Site, primarily south or southwest facing basalt outcrops. Basalt outcrops with rubble fields were considered suitable but those with extensive talus fields were not included because the study snakes did not use this habitat. East facing outcrops were considered suitable but not ideal for finding shed skins in October. At the Wanapum site, the three shed whipsnake skins found in east facing outcrops were from ecdysis during the summer. In most cases, these summer shed skins would have deteriorated to the point of being unidentifiable by October. North facing outcrops are not typically used by snakes as hibernacula and, were therefore, not a focus of these surveys. Sixteen areas were identified for survey work (Table 12). In addition to these locations, the Wanapum study site was surveyed again. The purpose was to calculate how long it took on average to find a shed skin at an occupied site and also to compare results between fall 2005 and fall 2006. Results from surveys conducted in October 2005 from areas in Gingko State Park and Crab Creek Wildlife area are also included in the results.

Six occurrences were not included in the inventory because no suitable habitat could be identified on the orthophotos and/or there were problems gaining access to private land. These occurrences were 1) Walla Walla, Walla Walla County; 2) 9 mile southeast of Toppenish, Yakima County; 3) “Just north of Mattawa on Highway 243, Grant County, 4) Benton City, Benton County; 5) 5 mile N of Benton City, Benton County; and 6) 10 miles NE of Benton City, Benton County. In all three areas, most of the habitat in the vicinity of the original whipsnake observation had been converted to agriculture or developed for other uses. The only habitat that may be suitable near the Toppenish location is on the Yakama Reservation. Access was not granted for this survey period. Most of the area just north of Mattawa near Highway 243 had been converted to agriculture with the exception of a portion of section 35. This area has a north-south ridge of basalt that might have features suitable for hibernacula. Access could not be arranged for this survey. The location uncertainty was greater than 1 mile for the three records from the Benton City area. No suitable habitat was found while driving along Highway 225 between Highway 240 and Benton City. The occurrence “10 miles north of Benton City” was

most likely on Arid Lands Ecology Reserve (ALE) but rock outcrops or other features suitable for overwintering snakes were not identified.

*Survey protocol*. – These were timed visual encounter surveys. Each person was given an area in which they were to search. Microhabitats in the outcrops most likely to have shed skins were holes, horizontal fractures and rock "shelves." Special attention was also focused on the ground-rock interface at the base of the outcrops, shrubs on and next to the outcrops, and piles of rocks. Information collected for each shed skin included date, time and UTM location generated with a GPS unit. All shed skins were collected primarily for confirmation of identity. For whipsnake shed skins, additional microhabitat and habitat information was collected and each location was photographed.

*Shed skin identification*. – Shed whipsnake skins were identified using the same traits listed in the methods section of Part 1. All shed skins were identified twice, once in the field and then verified in the lab. Individual shed skins were placed in zip-lock bags and stored to prevent deterioration.

**Results**

Shed skins from *M. taeniatus* were found at two of the 17 areas surveyed (Table 12, Fig. 14, Appendix B). Eight shed skins were found at the Wanapum study site and one shed skin was found at the Crab Creek Wildlife Area, Grant County. There was also a brief observation, with fairly high confidence, of a juvenile whipsnake at the new site. The two sites are 7-8 km apart.

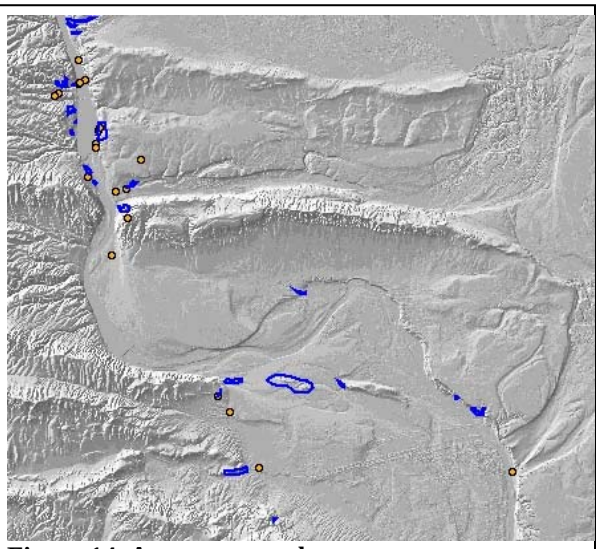

**Figure 14. Areas surveyed.**
**Orange circles are documented occurrences. Blue polygons are survey areas. Two additional sites were surveyed near Lenore Lake, Grant Co. and in western Lincoln Co.**

Over 100 hours were spent searching. Other snake species were detected at 13 of the 22 sites surveyed. *C. viridis* shed skins were the most common encountered (7/22 sites). These sheds are easily identified by the spotted pattern and strongly keeled overlapping scales. *C. coluber* shed skins were found at four of the sites. These shed skins look similar to *M. taeniatus* but lack the striped pattern. *C. coluber* shed skins were usually found in grass near but not in the rock outcrops. In most cases, air temperatures during these surveys were too cool for active snakes but some were observed.

**Table 11. Documented observation of *M. taeniatus* in Washington.**

| Element occurrence | County | Location | ID | Original source | Date (yyyy, mm, dd) | Type |
|---|---|---|---|---|---|---|
| 1 | Kittitas | Gingko State Park | 90 | Gary Lentz (State Parks) | 1979 | ob |
| 1 | Kittitas | Original town of Vantage (see comments). "3 collected at Vantage, Wagner found behind old resturant - 1955. Area now flooded." | 91 | Svihla, also Ernie Wagner | 1954 | ob |
| 1 | Kittitas | Gingko State Park | 3030 | Unknown | 19410525 | PSM 4028 |
| 2 | Kittitas | Huntzinger Road | 93 | Gary Lentz (State Parks) | 19770000 | ob |
| 3 | Grant | 1 collected 2 miles N of Vantage, E side Columbia River | 92 | Jones, W. | 19560513 | UWBM |
| 3 | Grant | Seen E side Columbia River near Vantage | 94 | Wagner, Ernie (Woodland Park Zoo) | 1955 | ob |
| 4 | Grant | East side of Columbia River, approximately .66 miles N of Wanapum Dam, west side of Highway 243 | 95 | Wilson, Byron (UW Zoo Dept.) | 1987 | ob |
| 4 | Grant | Just E of Boat Dock parking area above Wanapum Dam | 10744 | Dave Darda (CWU) | 1991 | Ob |
| 4 | Grant | T16N R23E section 9 | | Bill Fulerton ( see Byron Wilson also) | | Ob |
| 5 | Grant | Individual occurrence near Beverly | 96 | Gary Lentz (State Parks) | 1973 | ob |
| 5 | Grant | DOR, directly under powerline on Lower Crab Creek road, due E of Beverly | 98 | Hodge, Robert Parker | 19790429 | ob |
| 5 | Grant | Found in Saddle Mountains towards Beverly | 99 | Wagner, Ernie (Woodland Park Zoo) | 19790800 | ob |
| 5 | Grant | Dead on Beverly Burke Rd, ~ 3 mi NE of Beverly -t16n r23e sec 13 se1/4. adjacent to a large block of shrub-steppe habitat associated with the Columbia River cooridor. | 18181 | Friez, R. & D. Godsil | 1999 | UWBM |
| 6 | Grant | Dead on road just N of Mattawa on Highway 243 | 97 | Hodge, Robert Parker | 19740929 | DOR |
| 7 | Grant | Lenore Lake Canyon | 8190 | Keith Brady | 1989 | Ob |
| 8 | Franklin | 1 mile south of Ringold | 103 | # 8164 | 19590600 | PLU 2-1 |
| 9 | Yakima | 9 miles SE of Toppenish | 1199 | Bio Club | 19460504 | PSM #4337 |
| 10 | Benton | 1 collected at Benton City | 101 | PLU Collection | 19460504 | PLU R0165 |
| 11 | Benton | 5 miles N of Benton City | 1528 | Richard Fitzner | 19730600 | MSU 12458 |
| 12 | Benton | 10 miles NE of Benton City | 1550 | Bio Club | 19460504 | PSM 4338, 4339 |
| 13 | Walla Walla | 3 mi E Walla Walla | 5861 | L.R. Dice | 19220602 | UMMZ 56952 |
| 13 | Walla Walla | 3 mi E Walla Walla | 5862 | L.R. Dice | 19220606 | UMMZ 56953 |
| 14 | Lincoln | Bat Rock Pond (SW of Webley Lake) | 9798 | Lou Jurs, Todd Thompson (BLM) | 1989 | Ob |
| 15 | Benton | Highway 24, Yakima Barricade area, found near Yakima Barricade drift fence site operated to 1989 | 100 | Folliard & Larsen (WSU) | 19881000 | DOR |
| 15 | Benton | McGee Ranch, East 289126, N 5163748 NAD 83 | 18866 | Bret Tiller | 19960620 | Ob |
| 16 | Benton | Gate 118 road, then dirt rd to the south toward Benson Ranch about 1/2 mile, then walk east about 1/4 mile. Mammal trapping station, materials may still be present 10 x10 ft grid | 20965 | K. Gano, Battelle | 19750000 | Ob |
| 16 | Benton | Gate 119 | field notes | Richard Fitzner (PNL, Hanford) | 19740711 | Ob |
| 17 | Benton | B.C. Crib 200 Area | field notes | Richard Fitzner (PNL, Hanford) | 19720627 | Ob |

**Table 12. Survey areas for *M. taeniatus* inventory.**

| Survey Site area | EO | Township, Range, Section | Survey date | Searchers | Total survey time (hrs) | Masticophis taeniatus | Results |
|---|---|---|---|---|---|---|---|
| "Wanapum" Site | 4 | T16N R23E sec. 4 & 9 | 23-Oct-06 | 3, 5 | 21.5 | present | 9 MATA_s, 2 MATA _a, 1 PICA_j, 1 COCO_j |
| "Sunset highway" near Columbia River (W side) | 1 | T17N R23E sec.18 & 19 | 24-Oct-06 | 2, 4 | 3.25 | not detected | 1 CROR shed |
| Hell's Kitchen area, Gingko State Park | 1 | T17N R23E sec.13, 18, 19, 24 | 24-Oct-06 | 4 | 9 | not detected | |
| Huntzinger Road | 3 | T16N R23E sec. 20, 29 | 24-Oct-06 | | 4 | not detected | 1 PICA_j |
| Frenchman Coulee | 2 | T18N R23E sec. 19, 20, 30 | 25-Oct-06 | 4 | 12 | not detected | 3 CROR_s, 1 CROR_a, 1 CROR_j, 1 UTST |
| Saddle Mountain, west end | 4 | T15N R23E sec. 2, 11 | 26-Oct-06 | 3 | 4.5 | not detected | 0 |
| Crab Creek area | 5 | T16N R23E sec. 35, 36 | 26-Oct-06 | 3 | 2.25 | not detected | 1 CROR_s |
| Nunnally Lake, north side | 5 | T16N R23E sec. 25 | 26-Oct-06 | 3 | 3.75 | present | 1 MATA _s, 1 MATA_juv, 7 CROR_s, 3 CROR_a, 1 CROR_j, 3 UTST, 1_s?, 2 snake not identified, |
| SMNWR | | T14N R26E sec. 7 | 27-Oct-06 | 5 | 1.75 | not detected | no detections |
| ALE | 16 | T12N R25E sec. 20, 29, 30 | 27-Oct-06 | 5 | 5 | not detected | no detections |
| Ringold | 8 | T12, 13N R28E sec.30, 33 | 30-Oct-06 | 1 | 2.5 | not detected | 3 CROR_s, 1 shed no ID |
| Central Hanford, Borrow pit off Highway 24 | 15 | T13N R25E sec. 17, 18 | 31-Oct-06 | 2 | 3 | not detected | no detections |
| McGee Ranch | 15 | T13N R25E sec.24 | 31-Oct-06 | 2 | 1 | not detected | no detections |
| Gable Butte | | T13N R26E sec. 13, 14, 18, 19, 20, 24 | 1-Nov-06 | 2 | 3 | not detected | 1 COCO_s |
| Gable Butte | | T13N R26E sec. 13, 14, 18, 19, 20, 24 | 2-Nov-06 | 2 | 8.5 | not detected | 1 COCO_s, 1 CROR_remains |
| Gable Mountain | | T13N R26E sec. 15, 22 | 1-Nov-06 | 2 | 1 | not detected | no detections |
| Lenore Lake | 15 | T23N R26E sec. 24, 25 | 2-Nov-06 | 3 | 6.75 | not detected | 1 COCO_s |
| "Bat Rock" pond | 16 | T22N R31E sec. 1, 12 | 3-Nov-06 | 2 | 8.5 | not detected | 1 COCO_s, 3 CROR_s |
| Crab Creek Wildlife area | 5 | T 16N R24E sec. 19, 29, 30 | 13-Oct-05 | 1 | | not detected | 1 UTST_a, 1 CROR_j, 1 PICA_j |
| Gingko State Park | 1 | T17N R23E sec.30, 31 | 27-Oct-05 | 1 | | not detected | 1 CROR_s, 1 UTST |
| Gingko State Park | 1 | T17N R23E sec. 31 | 27-Oct-05 | 1 | | not detected | no detections |
| Gingko State Park | 1 | T16N R23E sec. 6 | 27-Oct-05 | 1 | | not detected | no detections |

[1]*MATA – Masticophis taeniatus, CROR- Crotalus oreganus, PICA – Pituophis catenifer, COCO – Coluber constrictor, HYTO – Hypsiglena torquata, UTST – Uta stansburiana, _j- juvenile, _a- adult, _s-shed skin*

Most areas surveyed had habitat that seemed suitable. This is not surprising because the survey sites were chosen based on the presence of outcrops similar to the Wanapum Site. The following are brief comments based on findings during the surveys.

*"Wanapum" Site*– This site was already known to be occupied. Eight shed skins were found. It took 2.68 hours per shed on average. This is similar to the results from 2005 where eight shed skins were found in 2.6 hours/per shed on average. Additional shed skins were found incidentally during radio-telemetry work in 2005 that were not included in these numbers.

The locations of the shed skins were all found in the same areas where shed skins were found in 2005. In a few cases, the exact same hole was used. The exception was the lack of shed skins found at the southern hibernaculum. In 2005 three shed skins were found at the opening and one was found in the vicinity. None were found in 2006 during these surveys or when this location was checked again 30 October 06. Two adult whipsnakes were observed.

*Gingko State Park and Huntzinger Road*- Six areas were surveyed. Many of these areas had dense cheatgrass. Some of habitat off Huntzinger Road looked particularly suitable, especially on the Yakima Training Center (YTC). YTC has no *M. taeniatus* records in their database and the species was not detected during a herpetological inventory conducted by ENSR and Associates in 1994. Access to the YTC could not be granted during this survey time period but surveys can be conducted in the future.

*Frenchman Coulee*- The historical occurrence near Frenchman Coulee was inundated by Wanapum Lake. The original observation was about 4.5 km south of the area surveyed. The survey area has rock outcrops that seem particularly suitable

*Saddle Mountain National Wildlife Refuge*- Whipsnakes are not known from this property and there is no basalt outcrops south of Highway 24. Rattlesnakes occur in only one area of the property and overwinter in the western most extent of the White Bluffs (pers. obs.). This feature is south facing and full of holes and crevices. If whipsnakes occurred in the area, they would most likely also overwinter at this location.

*Arid Lands Ecology Reserve* – Ken Gano, the Battelle biologist who saw the snake in 1974 was present during these surveys and took us to the location of the original observation. The snake had been captured in a mammal trap. It was only seen briefly. The closest rock to the capture site is 1.5 km west on the south facing slope of Yakima Ridge. The rock here is primarily in the form of talus. *U. stansburiana* were abundant in this area in 1995 (pers. obs.).

*Ringold* – Most of the land south of Ringold has been converted to agriculture most likely resulting in the extirpation of the historical occurrence. The Waluke Wildlife Area is the closest area with native habitat. There is no basalt. Features in the White Bluffs may provide habitat suitable for this species as it does for *C. oreganus*, a species also requiring communal hibernacula. It would take much more time than allotted to thoroughly survey this area. The main issue is the density of invasive exotic weeds. In many areas below the White Bluffs, it is difficult

to imagine a visual predator like the whipsnake being able to hunt in such dense vegetation. It is also doubtful lizards are present in these areas. The White Bluffs do provide habitat for the lizards, but may not provide enough cover for whipsnakes during the active season.

*McGee Ranch*- The location where the snake was observed in 1997 was visited. There is no rock in the vicinity. The closest rock features are in the area near the borrow pit off Highway 24.

*Central Hanford, Borrow pit off Highway 24*- The rock features on both sides of the road are similar to those at the Wanapum site but much of the rock is north facing.

*M. taeniatus* observations from the Hanford Site and ALE (EOs #15, 16, 17) were at locations > 2 km from rock features. Based on photo-interpretation, the 200 BC Crib area is sandy with no rock outcrops. The closest rock feature, Gable Mountain, is 7 km away. It would take at least two days to survey the entire south face of Gable Mountain and the rock features are different from those at the Wanapum Site. The closest rock feature to The McGee Ranch and Yakima Barricade observations is 2 km and 4 km respectively from the western extent of the Gable Butte ridge (= borrow pit off Highway 24). All south facing rock at Gable Butte and the associated east-west ridge that extends to Highway 24 was surveyed.

The snakes observed on ALE and Hanford were in habitats far from rock features. This is different from habitat use observed at the Wanapum Site where the snakes primarily sheltered in rocks. Occasionally, individuals sheltered underground in mammal burrows. Most likely, this is where the Hanford Site snakes would also shelter at sites with no rock features.

*Gable Butte*- This site has many areas of quality shrub-steppe habitat and a diversity of rock features. Some of the areas that seemed most suitable for a hibernaculum (south facing columnar basalt) had deep piles of tumble weeds at the base. This made seeing shed skins difficult if not impossible.

*Gable Mountain* – Only a small area of the southwest end of the mountain was surveyed. In some areas, it was difficult to search for shed skins because of the deep piles of tumble weeds. The rock features are different from the Wanapum site.

*Lake Lenore* – Rock features were plentiful, but south facing rock features were limited within the survey area. By afternoon, there was too much snow cover to continue the survey.

"*Bat Rock Ponds*" – Basalt outcrops are plentiful at this site, but most of the ones on the BLM property are north facing. From a distance, habitat to the north on private property looked more promising.

**Discussion**

The whipsnake are elusive and have proven difficult to find even where they are known to occur. Searching for shed skins eliminates many of the difficulties associated with finding an elusive species. At this time, it is the only method that seems effective both in terms of time spent searching and financial cost. Using this method, the Crab Creek occurrence was confirmed as

extant and the area of a hibernaculum, critical habitat for protection of the population, was likely located.

This method has limitations. The shed skins tend to be clustered in localized areas. To guarantee detection, surveys must cover all areas with the potential to provide overwintering habitat. In cases where records have high location uncertainty, it was difficult to determine the nearest habitat most suitable for hibernacula. Observations of the study snakes prior to ecdysis, found they shelter in rocks for about a week. It is unknown if the snakes always shed as they emerge or if some shed within the shelter (i.e. *C. constrictor*, Hirth et al. 1969). If the latter is true, a percentage of shed skins would go undetected. This could lower the chance of detection if a population is small. Lastly, information could not be found on the percentage of the population that shed before entering winter dormancy. This is critical information for understanding the significance of the number of shed skins found at each site.

*M. taeniatus* reaches the northern extent of its range in Washington. Evidence indicates the species was never common. The Washington occurrences are limited to the central area of the Columbia Basin that receives the least precipitation (0-20.3 cm annually) and tends to have shrub dominated communities rather than shrub-steppe. Lake Lenore and Bat Rock pond occurrences are exceptions (see discussion below). All Washington occurrences are below 460 m (1500 ft.) elevation. Nussbaum et al. (1983) suggest that the growing season for some of the egg-laying reptiles (specifically *Uta stansburiana*) that reach the extreme northern extent of their range in Washington, are too short above 460 m at high these high latitudes. The vast majority of lands at or below 460 m in the Columbia Basin, have been converted to agriculture or inundated by the reservoirs for the Columbia Basin Irrigation project.

Historical occurrences from Ringold (EO#8), Toppenish (EO#8), Benton City (EO#10) and Walla Walla (EO#13) are most likely extirpated based on extensive habitat conversion in those areas. Much of the habitat near the Mattawa occurrence (EO#6) has been converted with the exception of a north-south basalt outcrop and remnants of a sand dune. This area should be surveyed.

Kittitas county - Habitat on both sides of the river near the original Vantage town site was inundated in 1962 (EO #1). The snakes persisted on the west side of the river (Kittitas County) based on observations by Gary Lentz in 1979 at the Hell's Kitchen site, Gingko State Park and off Huntzinger Road in 1977 (EO#3). Surveys in 2005 and 2006 failed to detect any shed skins at rocky outcrops located near the boat launch off the old Vantage Highway, at Hell's Kitchen, or east and west of Wanapum Road. Habitat to the west of these sites increases in elevation. Sites above 460 m may not be suitable. The species was not detected during 1994 Herpetological Inventory conducted by ENSR at the Yakima Training Center and no additional observations have been documented since on this property. It is recommended that additional surveys be conduced at suitable habitat in the low lying areas between the Wanapum Dam and Beverly junction and also in the Doris area.

On 27 June 2000, an automobile accident on Highway 240 ignited a fire that burnt 191,000 acres of the Hanford site including most of ALE and portions of Central Hanford (including the 200

BC Crib area). Few shrubs remained. No studies have looked at the impact the fires had on the ALE reptile community. Most likely there was a dramatic decline in most populations due to mortality from the fire. A similar event occurred at one of the Utah sites (Brown and Parker 1982) when an extensive range fire completely razed a large area which included all the dens. They concluded that even if individuals survived the fire in underground retreats, they would have emerged to habitat lacking vegetation and prey items. By fall, wind blown sand had begun to fill the crevices between rocks at the den and by 1976 the den was buried by sand resulting in the local extirpation of the snakes.

The Hanford Site, including Central Hanford and the Hanford Reach National Monument (formerly SMNWR, ALE and Wahluke Wildlife Area) (EOs # 8, 15-17) is the largest expanse of intact shrub-steppe habitat remaining in Washington (560 sq. miles). Large areas have been impacted by severe fires and invasive weeds, but expanses of intact habitat persist in many areas. It is, therefore, difficult to imagine that whipsnakes are extirpated at the site. Failure to detect the snakes during extensive herpetological inventory work in 1995 and 1998 (Hallock 1998), during this inventory and the lack of observations by Battelle and TNC biologists and field crews in the 1980s and 1990s suggest the species is rare at the site. Observation of an individual in the McGee Ranch area in 1997 (an area unaffected by the 2000 fire) indicate the species may still be extant at the site.

This species moves to communal hibernacula for winter dormancy. Described hibernacula have been in rock. This clustering is important for surviving freezing winter temperatures and for locating mates in the spring. It is possible the snakes are present in low densities that make detection difficult or are overwintering in unusual spots such as a human-made structure. This species has high fidelity to hibernacula (Woodbury et al. 1951) and populations have been extirpated when a local hibernaculum was destroyed (Brown and Parker 1982). Identification of hibernacula used by this species is essential information for their conservation.

Individual observations at Lenore Lake, Grant County and Bat Rock Pond, Lincoln County were made in 1989 by a WDFW biologist and a BLM biologist. Neither snake was captured. These observations need verification and should be used cautiously when describing distribution and habitat. Their inclusion expands the known range and adds new habitat types. These locations receive more precipitation resulting in shrub-steppe habitat with a dominant bunchgrass understory. *M. teniatus'* main prey items, *S. graciosis* and/or *U. stansburiana*, have not been observed and are most likely absent (pers. obs.). Lizard species more likely to be present are Western Skink (*Eumeces skiltonianus*) and Short-horned Lizard (*Phrynosoma douglasii*); both seem unlikely prey items for a slim, visually oriented predator like *M. taeniatus*.

These surveys were all conducted in areas with documented occurrences. Populations may be present in undocumented areas. It seems probable, based on Oregon occurrences (Nussbaum et al. 1983), that populations occur(ed) in Benton County and southeastern Klickitat County near the Columbia River.

Washington populations may have geographic variation in habitat use. Basalt outcrops were the main habitat feature used at the Wanapum study site. No basalt rock outcrops or rock features

occur within 2 km of known *M. taeniatus* locations on the Hanford Site: McGee Ranch, 200 BC Crib area and ALE occurrences. Such variation may be a result of local adaptation. It is also possible that the bias to view habitats from a human perspective overlooks important structural cues (Reinert 1993) and basalt outcrops may have features in common with other habitats types that were not identified by this study.

While it is particularly difficult to ascertain the rarity of elusive snake species (Kery 2001), evidence is mounting that *M. taeniatus* have declined to the point of warranting conservation attention. No regulatory mechanisms currently exist for the protection of this species or its habitat.

Two occurrences are known to be extant. They are 7-8 km apart. A corridor of native habitat still remains between the two sites with habitats that have lizards (pers. obs.). A dead snake found on the Beverly-Burke Road in 1999 was about 3 km north of the Crab Creek site and 6 km south east of the Wanapum Site. Although the study snakes at the Wanapum site were not observed to move over 1 km from the hibernaculum during the study period, some exchange between the two populations probably occurs. Hirth et al. (1968) had snakes move 1.5, 3.2 and 3.6 km from the den and describes a male captured at one den site 17 April 1965 and re-captured at another den 16.8 km (straight air distance) away on 25 September 1965.

It is recommended that management at each site take into consideration the protection and conservation of this species. The Wanapum Site is managed by the Bureau of Reclamation and the Crab Creek Site is managed by WDFW. The hibernacula and surrounding habitat need to be protected. At the Wanapum site, almost all snake activity observed from September to July was within 1 km of hibernacula. Grazing and other activities that would result in changes to the shrub structure (i.e. removal of lower branches) and ground cover should not take place within this area. This could have impacts both on the snakes and the snakes' main prey species *U. stansburiana*. In Utah, *M. taeniatus* laid eggs in mammal burrows and some of the Wanapum site study snakes were also observed sheltering in burrows. Grazing and other activities that could crush mammal burrows should be prohibited within 1.5 kilometers of the hibernacula. All basalt mining activities should be prohibited. The native habitat corridor between the two sites should be preserved.

Additional surveys are needed at the Crab Creek site to determine the extent of the occurrence and other information about the population and habitat.

Conservation genetics could help determine if observations using traditional inventory methods are supported by genetic information. The shed skins can be used for genetic material (Clark 1998, Fetzner 1999) without harm to the population. With enough shed skins, it might be possible to determine the effective population size and to determine if these occurrences are genetically isolated from snakes in Oregon.

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# Appendices

Appendix A. Standardized Data Sheet

**MATA Radio-telemetry data sheet** **Date: _____** **Observer: _____**

**Individual:** **157.802 (m)** **156.103 (m)**
**156.303 (f)** **157.852 (m)**
**157.653 (f)**

**WEATHER: Air temp: _____ degrees C/F** **Cloud cover: 0 25 50 75 100 cirrus or cumulus**
**Wind:** calm, light, gusty, strong **Precipitation:** none, recent, light, heavy, intermittent

**Location time: _____** **Has snake moved?** Yes / No

**LOCATION : Zone 11 NAD 83 UTM: _____ _____ EPE: _____ft**

- ❑ Photo taken of microhabitat (approx. 1 m)
- ❑ Photo taken of general area (approx. 5 m or greater)
- ❑ Yellow Flagging (describe location if not actually placed at snake):

**Activity**

- ❑ Are lizards active? Yes/no
- ❑ Was snake observed? Yes/no
- ❑ If observed, what was behavior? Sheltering, basking, fleeing, hunting

**Habitat**

- ❑ What is the main habitat type/feature? ____basalt outcrop ___ shallow gravelly soil & stiff sage ____sandy soil & shrubs _____loamy soil & shrubs ____other: _____

Describe general area and habitat:

**Microhabitat**

- ❑ Snake is___ underground _____on surface _____under rock _____ in crack within rock
- ❑ If associated with basalt outcrop, describe 1) type 2) snake location in outcrop), and 3) aspect

- ❑ Percent aerial* cover around snake - percent categories 0, 1-5, 6-25, 26-50, 51-75, > 75

| Within 1 meter | General area within 5 meters: |
|---|---|
| _____% rock | _____% rock |
| _____% shrub**SB, RB, BB, HS, ____ | _____% shrubs: SB, RB, BB, HS, ____, ____ |
| _____% bunch grasses | _____% bunch grasses |
| _____% cheatgrass | _____% cheatgrass |

- ❑ Substrate: loam, sand, gravel, rock, ash
- ❑ Ground temp: _____ degrees C/F

*aerial cover – describe substrate and vegetation cover as if looking down on snake
** circle types of shrubs present in area: SB=sagebrush, RB=rabbitbrush, BB=bitterbrush, HS=hopsage, or SBW = Snow buckwheat, PS= purple sage, etc.

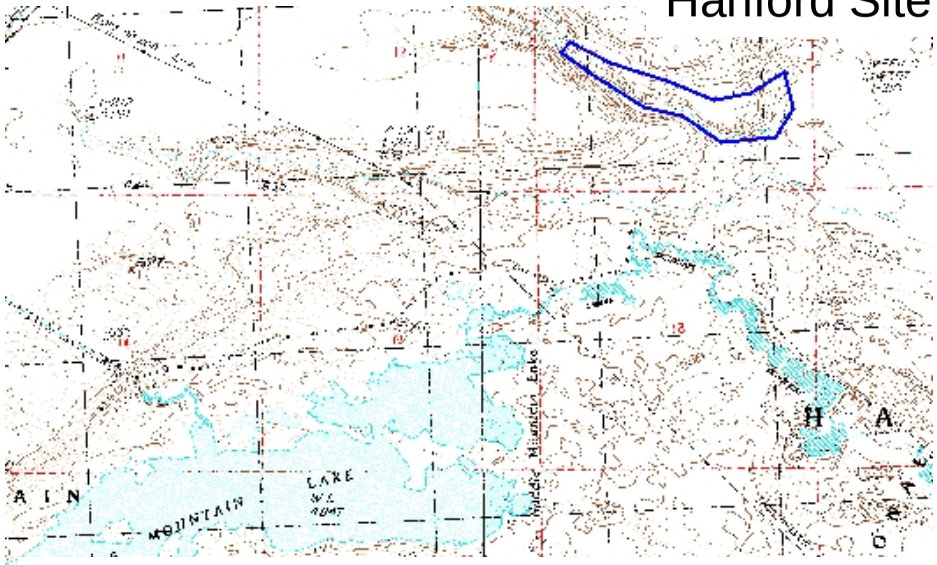
**SPECIES OTHER THAN *UTA* SEEN DURING SURVEY OR SHED SKINS**

Species: _____
Location: UTM _____
Life Stage: yoy, juv, adult

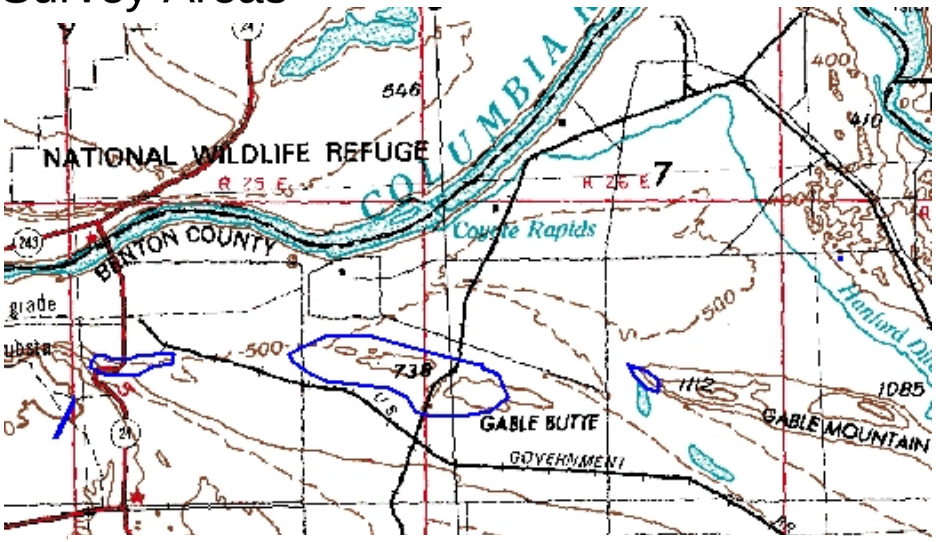
Species: _____
Location: UTM _____
Life Stage: yoy, juv, adult

Appendix B. Fall 2006 Shed Skin Survey Areas

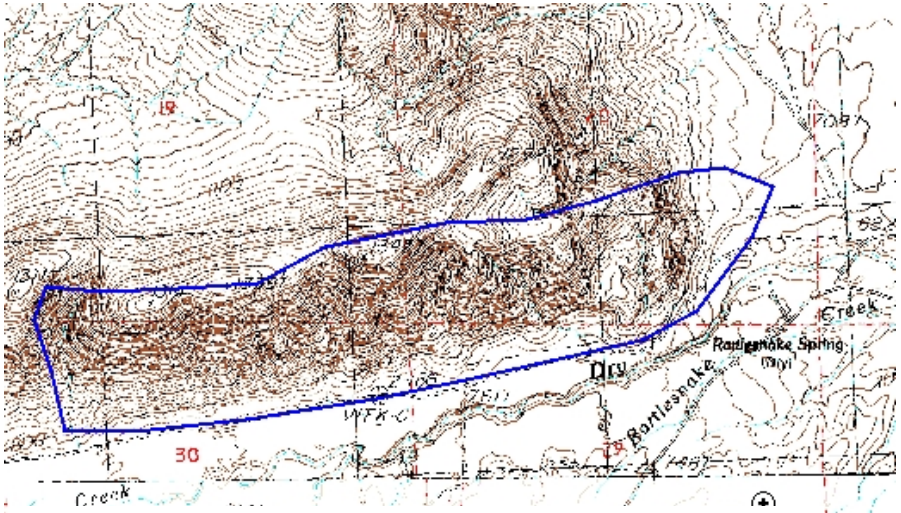
# Hanford Site Survey Areas



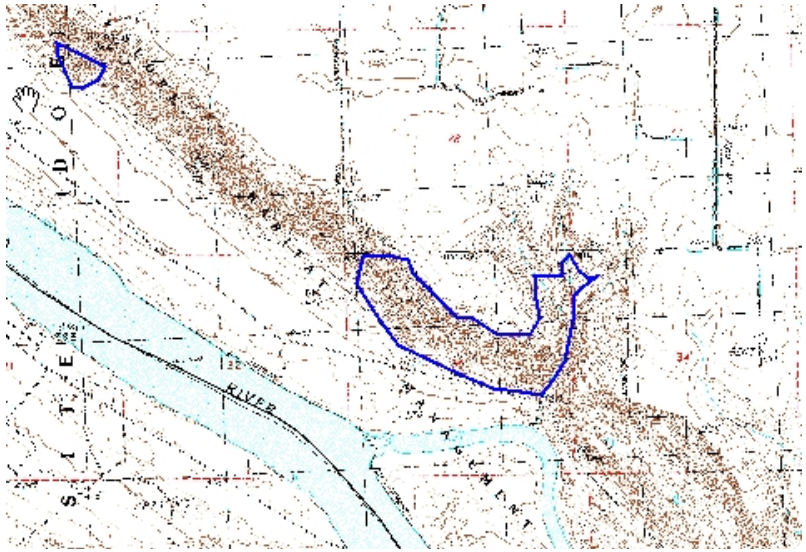

Survey area on Saddle Mountain National Wildlife Refuge, Grant County




Survey areas on Central Hanford, Grant County

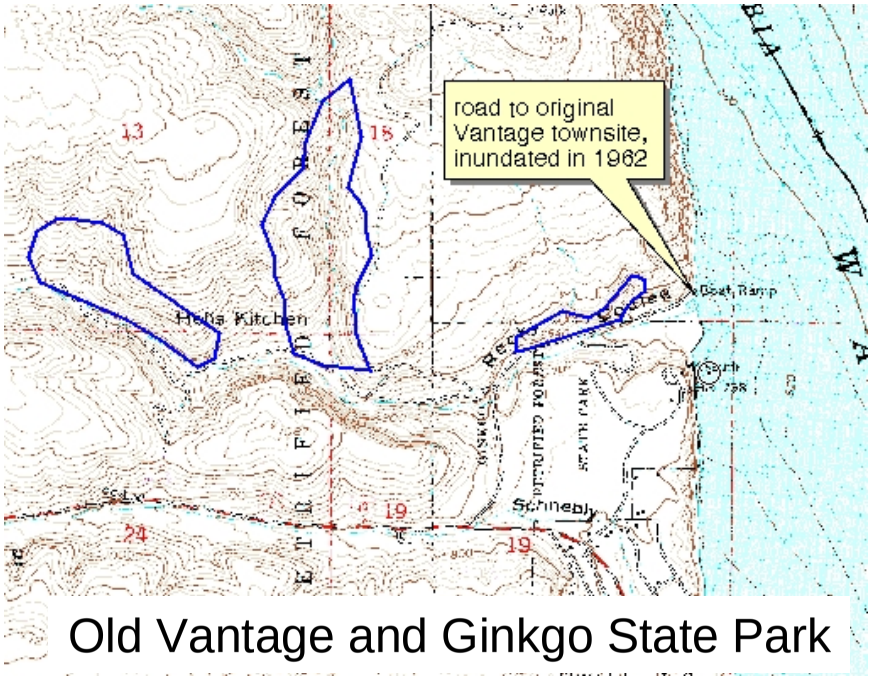



Survey area on Arid Lands Ecology Reserve, Benton County

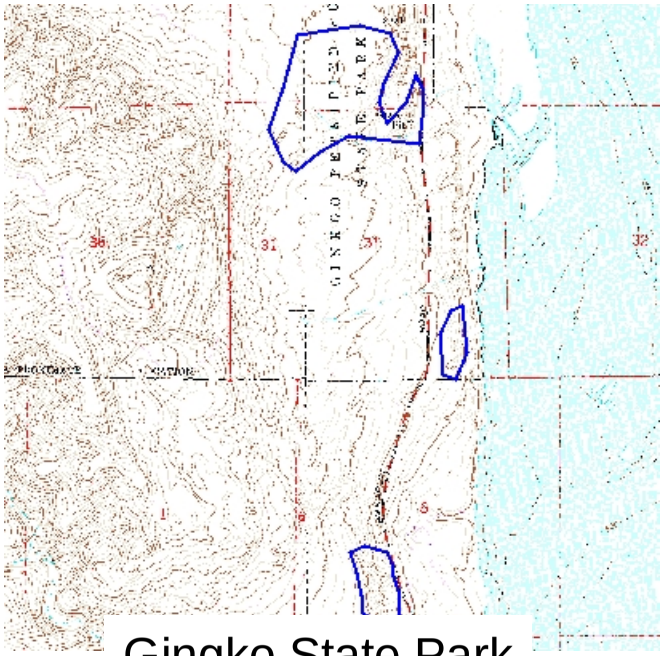



Survey area on Wahluke Wildlife Area, Franklin County

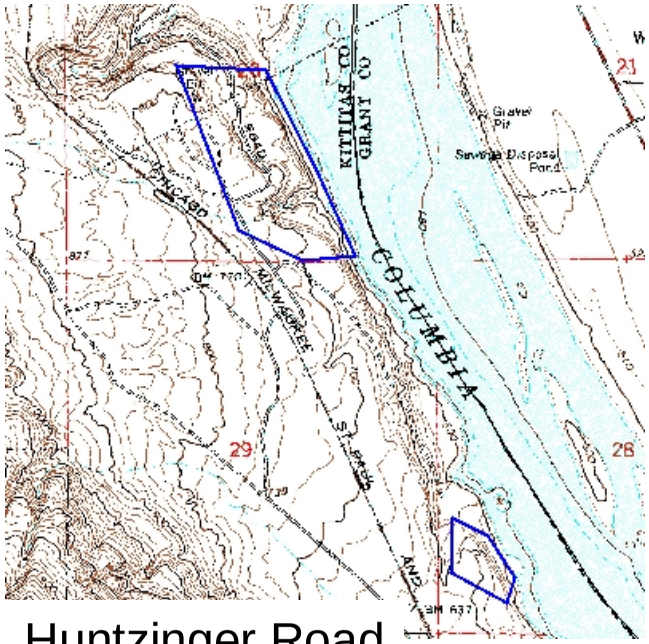
Kittitas County survey areas




Old Vantage and Ginkgo State Park

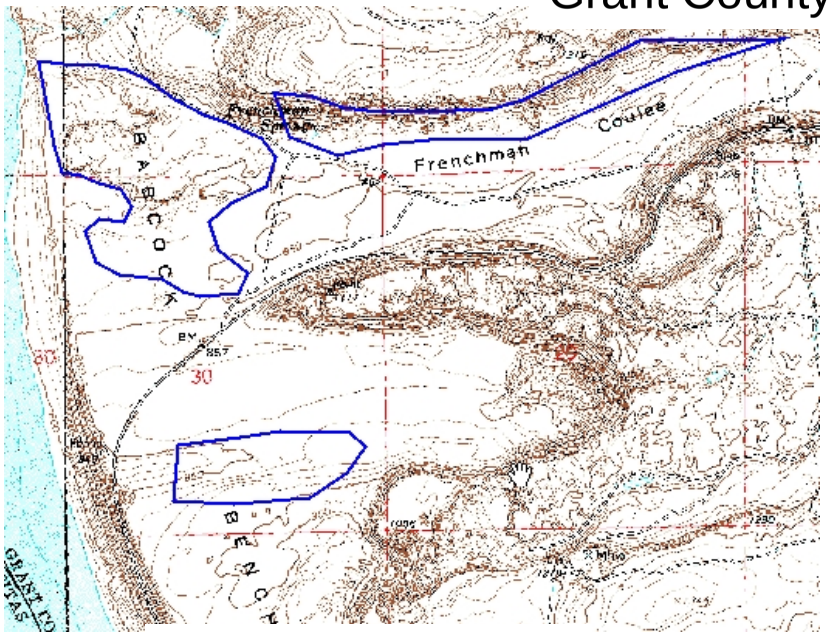


Gingko State Park

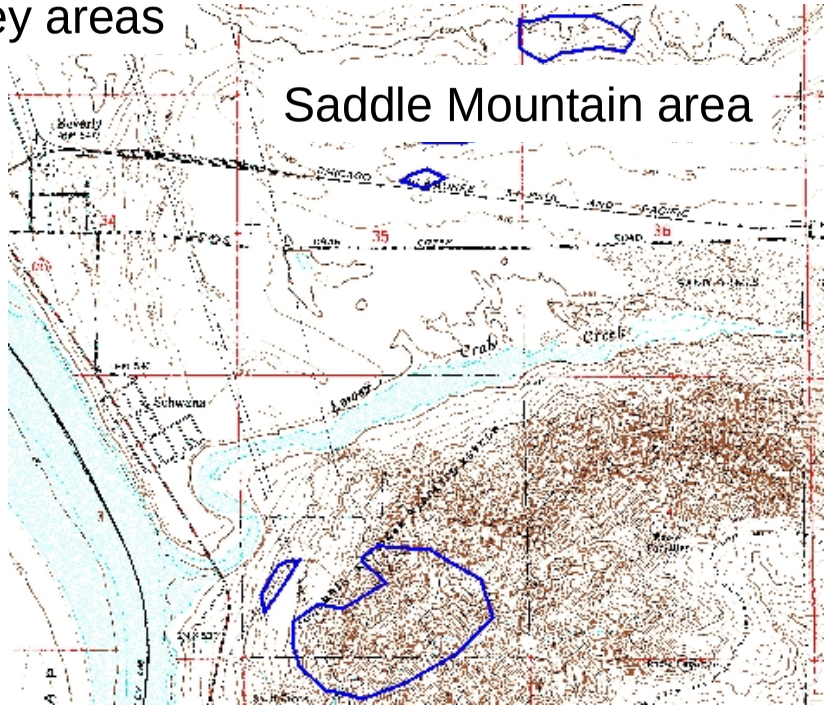


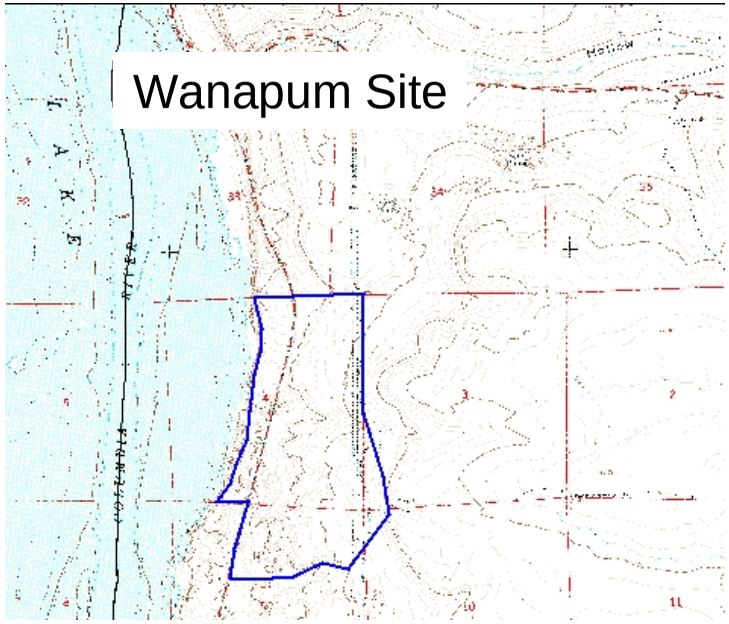

Huntzinger Road

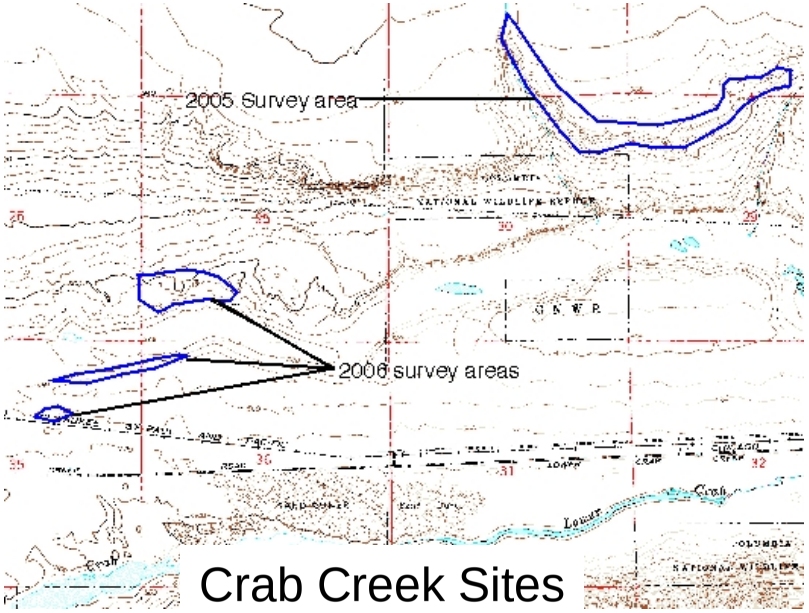
# Grant County survey areas



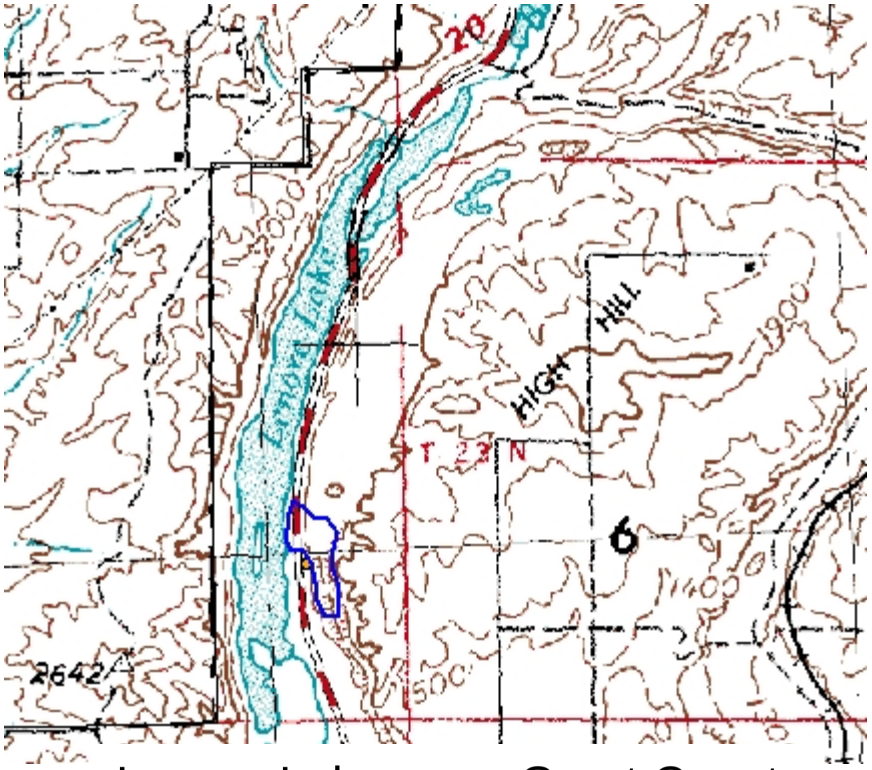

Frenchman Coulee



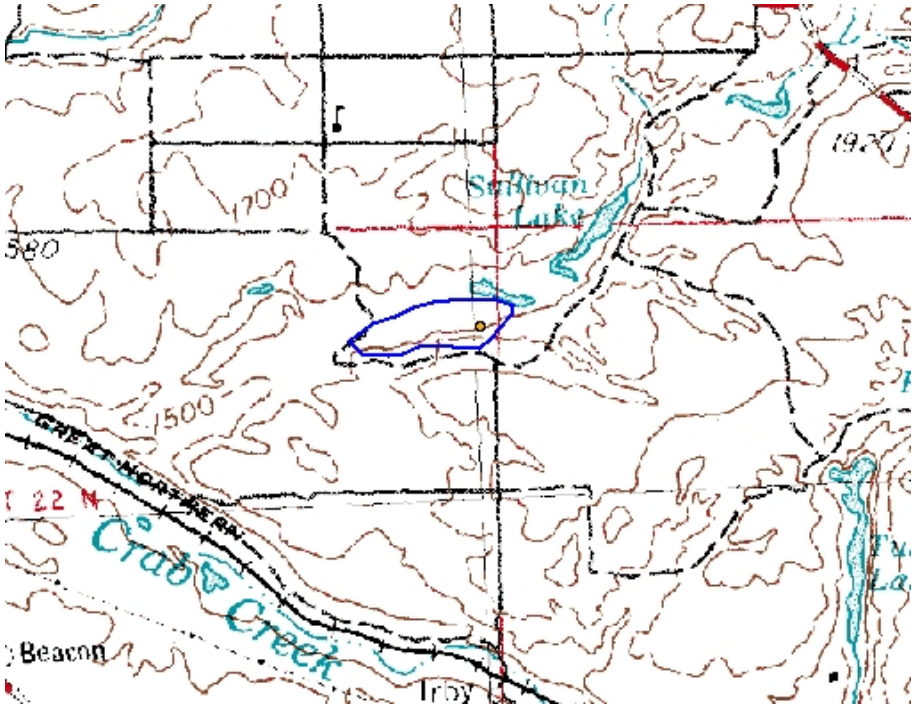




Crab Creek Sites




Lanore Lake area, Grant County




“Bat Rock Pond (BLM), Lincoln County