State of Utah
DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources - Native Aquatic Species

COLUMBIA SPOTTED FROG

(*Rana luteiventris*)

POPULATION MONITORING SUMMARY

Gandy, Bishop Springs, Tule Valley
2005

Publication Number 05-41
Utah Division of Wildlife Resources
1594 West North Temple
Salt Lake City, Utah
James F. Karpowitz, Director

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INTRODUCTION

The Columbia spotted frog (*Rana luteiventris*) is a medium sized, light to dark brown frog distinguished by its rough skin, dark dorsal spots, and yellow or salmon coloring on its underparts (Wright and Wright 1995). Spotted frogs are highly aquatic, inhabiting marshy edges of lakes, ponds, springs, and slow moving, cool streams with organic substrate. In the West Desert, the spotted frog inhabits wetland areas associated with springs and seeps characterized by bulrush *(Scirpus americanus*), salt grass (*Distichlis spicata*) and cattail (*Typha* sp.). Spotted frog breeding in the West Desert typically occurs during a six to seven week period in March and April (James et al. 1998, Fridell et al. 2001, Fridell et al. 2004).

The Columbia spotted frog is contiguously distributed from southeastern Alaska to Oregon and western Wyoming with isolated populations existing in Utah and Nevada. It is hypothesized that the spotted frog was common in Utah throughout the Lake Bonneville region more than 15,000 years ago (Hovingh 1993). A putative distribution decline following the recession of Lake Bonneville caused the isolation of several remaining populations (Hovingh 1993). Today, many of these populations are vulnerable, and some may now be extirpated (Ross et al. 1993).

The northern leopard frog (*Rana pipiens*) is sympatric with the spotted frog in Bishop Springs and Gandy Marsh within the West Desert. Although reproduction is usually temporally separated (Ross et al. 1994, Fridell et al. 2003), overlap in egg deposition has been observed in the West Desert (Wheeler et al. 2003a). Spotted frog egg masses have a loose circular shape, measure 7-10 cm in diameter, and consist of 500-600 eggs having 1-2 membranous envelopes. In contrast, leopard frog egg masses are deposited as a dense globular ball of as many as 6,500 eggs, each having 2-3 envelopes (Stebbins 1985). Additional morphological differences include direct attachment to vegetation and greater rigidity in gelatinous matrices in leopard frog egg masses

(Stebbins 1985), compared to unattached egg masses and a loose gelatinous matrix in spotted frog egg masses. Dumas (1966) reported that leopard frogs displace spotted frogs. Ross et al. (1994) suggested that leopard frogs are not native to the West Desert. However, we have observed both species in Bishop Springs and Gandy Marsh for more than 13 years (Ross et al. 1993), and have documented successful reproduction annually since 1994 (Fridell et al. 2004).

The Columbia spotted frog was proposed for listing in 1989 under the Endangered Species Act. In 1993, the U.S. Fish and Wildlife Service (USFWS) determined that federal listing of Utah spotted frog populations was warranted, although listing was precluded at that time (USFWS 1993). Reasons for the proposed listing included loss of habitat, introduction of non-native species, and the vulnerability of Utah's small, isolated populations (Perkins and Lentsch 1998). In response to regional declines and threats to spotted frog populations, the Utah Division of Wildlife Resources (UDWR) conducted spotted frog inventories in 1993 and began developing and implementing spotted frog conservation actions. These activities lead to the development of the Spotted Frog Conservation Agreement and Strategy (SFCAS; Perkins and Lentsch 1998), endorsed by the USFWS in February of 1998 (USFWS 1998). Based on protective actions and accomplishments in years following the implementation of the SFCAS, the USFWS removed the Utah populations as candidates for listing in 1999, and determined that listing was not warranted for the Wasatch Front populations in 2002 (USFWS 2002).

The goal of the SFCAS is to ensure the long-term viability of the spotted frog within its historical range through the collaboration of private landowners, local stakeholders, and natural resource agencies (Perkins and Lentsch 1998). This goal includes two primary objectives: 1) the reduction or elimination of threats to the spotted frog and its habitat to the extent that extinction of

Utah populations is unlikely; and 2) the long-term maintenance of spotted frog populations throughout its historical range in Utah. The SFCAS target population level is 1,000 breeding individuals per population (Perkins and Lentsch 1998). Recent declines of amphibians worldwide warrant the implementation of long-term monitoring and inventories (Stebbins and Cohen 1995, Houlahan et al. 2000). A vital component of the SFCAS is population monitoring in conjunction with habitat and population enhancement activities.

The SFCAS describes spotted frog Geographic Management Units (Sevier River, Wasatch Front, and West Desert; Perkins and Lentsch 1998) based on hydrologic subregions (United States Geological Survey 1974). Spotted frog monitoring locations in the West Desert include: Snake Valley, Tule Valley, and Ibapah Valley. This report summarizes monitoring efforts within Tule Valley and portions of Snake Valley (Bishop Springs and Gandy Marsh). The populations in Ibapah Valley, and Miller Spring and Leland Harris Springs in Snake Valley, are monitored by the Central Region of the UDWR, and are not discussed here. Bishop Springs, the largest of the areas, contains four springs which feed into confined, fast-flowing streams that spread into numerous channels and large, shallow, open water marshes (Figure 1). Gandy Marsh consists of numerous springheads and associated marshes along the western edge of the Gandy salt marsh lake (Figure 2). Tule Valley contains 13 individual springs that comprise four geographically isolated marsh complexes (Figure 3). The northern-most marsh complex in Tule Valley is Coyote Springs (Tule 7), whereas South Tule Spring (Tule 6) is the southern-most complex. The Willow Springs complex consists of Tule 1, Tule 2, and Tule 8, and the North Tule Spring complex contains Tule 3, Tule 4a, Tule 4b, Tule 4c, and Tule 5. Spotted frog reproduction in Tule Valley is monitored within each of these individual springs.

METHODS

Spotted frog surveys in spring 2005 were conducted at Bishop Springs, Gandy Marsh, and Tule Valley. Monitoring sites were selected based on historical records and previous annual population monitoring (James et al. 1998, Fridell et al. 2001, Fridell et al. 2003, Wheeler et al. 2003a, Wheeler et al. 2003b, Fridell et al. 2004). In addition, United States Geological Survey 7.5 minute topographic maps and Geographical Positioning System (GPS) units were used to locate habitat areas and plot UTM coordinates.

Visual encounter surveys were conducted at each site by walking transects along the banks and in shallow water searching for egg clusters, defined as egg masses located in close proximity (less than 0.3 m) to one another. The following assessments were made at each egg cluster: egg mass age class, number of masses, egg mass depth, egg mass distance to shore, water temperature, pH, conductivity, and dissolved oxygen. Water temperature, dissolved oxygen, and conductivity measurements were taken using model 85 YSI meters, and pH was measured with a pHTestr2. Snout vent length (SVL) was recorded for all amphibians captured. Physical habitat parameters taken at each site included elevation, percent of open water, substrate, bank type and condition, livestock damage, algal abundance, and aquatic flora present.

Sites were visited weekly (Week 1: 2-3 March, Week 2: 8-11 March, Week 3: 15-18 March, Week 4: 22-23 March, Week 5: 29-31 March) to locate new egg masses, track survival of previously encountered masses, and ensure that monitoring was conducted during the peak period of egg deposition. Masses were classified into five developmental age class categories: age class-1) mass below water surface and resting on substrate or vegetation, envelopes clear and ova small, dark, and circular; age class- 2) mass starting to float to surface, envelopes opaque and ova kidney-shaped or

elongated; age class- 3) mass at water surface with top layer of eggs crusty due to desiccation, embryos have tails and are close to hatching; age class-3+) mass starting to disarticulate and often yellow in color, half or more of the embryos have hatched and are feeding on the mass or swimming freely as tadpoles; and dead) embryos white, with disarticulation of both the embryos and the egg mass.

Egg mass counts were used to determine relative abundance and to estimate the number of breeding adults in the population. Breeding population size was calculated to facilitate comparison with geographic management subunit population goals in the SFCAS (Perkins and Lentsch 1998). If we assume an equal sex ratio, breeding females oviposit only one egg mass per year (Wells 1977), and each egg mass is the product of a single breeding pair, then doubling the number of egg masses detected during a single breeding season can provide an approximation of breeding population size ($\hat{N}$).

RESULTS

Spotted frog annual monitoring sites in the West Desert were surveyed between 2 March and 31 March 2005. The total number of egg masses detected within each area is presented in Table 1 (Bishop Springs, n = 325; Gandy Marsh, n =155; and Tule Valley, n =2,158). Table 2 contains the number of egg masses observed at each site annually since 1997. Adult spotted frogs were observed within all monitoring areas. Adult and juvenile leopard frogs were encountered in Snake Valley at Bishop Springs and Gandy Marsh. Age class breakdown of egg masses, water quality parameters, habitat conditions, and observations for Bishop Springs, Gandy Marsh, and Tule Valley follow.

Bishop Springs

Bishop Springs was visited on four occasions between 2 March and 31 March 2005. A total of 325 egg masses were observed (Table 1). Egg masses were first observed during week 1, with 94 masses, composed of age classes 1-3, although the majority was age class 1 (n = 90). Peak deposition was observed during week 2, when 115 additional masses were observed. A total of 116 egg masses were observed during the rest of the monitoring. Egg mass numbers observed at Bishop Springs are higher than 2004, but similar to previous years (Table 2, Figure 4).

Mean depth of egg masses observed in Bishop Springs was 4.94 cm (SE = 0.048) with a mean distance to shore of 5.25 meters (SE = 0.09). Mean water temperature was 10.9 ^{o}C (SE = 0.045), and mean pH was 8.3 (SE = 0.005). Mean conductivity was 730 μS (SE = 0.495) and mean dissolved oxygen measured 4.61 mg/L (SE = 0.09). Table 4 and Figures 5-10 contain spotted frog egg mass characteristics and water parameters recorded at Bishop Springs.

The majority of egg masses were located in still, shallow marsh areas. No egg masses were found in areas with fast moving water. Seven adult spotted frogs were observed at Bishop Springs and were heard calling during Week 1. Leopard frogs were observed throughout Bishop Springs during the survey period. Leopard frog and spotted frog egg mass deposition temporally overlapped in an area of Bishop Springs near Foote Reservoir. Moderate cattle damage was observed throughout Bishop Springs, and was characterized by cropped and trampled vegetation, damaged banks, and manure. South Twin Spring, on the eastern edge of Bishop Springs, has been severely impacted in recent years by livestock and wild horses trampling banks resulting in increased surface area and concurrent loss of depth.

Gandy Marsh

Gandy Marsh was visited on three occasions between 8 March and 31 March 2005. A total

of 155 egg masses were observed during the survey period (Table 1). Breeding had peaked when the site was first surveyed on 5 March. A total of 97 egg masses were observed during this first visit. An additional 53 masses were recorded during the remainder of the survey period. The total number of egg masses observed in Gandy Marsh is shown in Table 2 and Figure 17.

Mean water depth of egg masses at Gandy was 6.68 cm (SE = 0.079) and mean distance to shore was 14.3 meters (SE = 0.20). Mean water temperature near egg masses was 11.7 ^{o}C (SE = 0.083) and mean pH was 7.8 (SE = 0.007). Mean conductivity measured 910 μS (SE = 0.988) and mean dissolved oxygen was 2.02 mg/L (SE = 0.019). Spotted frog egg mass characteristics and water quality parameters recorded at Gandy Marsh are presented in Table 4 and Figures 11-17.

Only one adult spotted frog was observed during the monitoring period at Gandy, which was in amplexus with an adult leopard frog. Numerous leopard frogs were observed throughout the monitoring period. Additionally, leopard frog egg masses were observed near spotted frog egg masses, with temporally overlapping development. Slightly more egg masses were observed than the previous three years, however numbers remain drastically diminished from pre-2002 levels (Table 2).

Tule Valley

Tule Valley was visited on three occasions between 8 March and 23 March 2005. A total of 2,158 egg masses was observed (Table 1). The first egg masses were detected on 8 March in Tule 7 (Coyote Springs), and breeding had peaked when the site was first surveyed with a total of 1,298 egg masses observed. An additional 860 egg masses were observed in the remainder of the survey period. The majority of egg masses were observed at Tule 7 (Coyote Springs: 64%, n = 1376; Table 3). No egg masses were found at Tule 8, likely due to the succession of dense vegetation in the

spring. Only one mass was found in Tule 6 (South Tule). Most of this site contains dense vegetation and much of the marsh has dried in the past few years. The total number of egg masses observed in Tule Valley is shown in Table 2 and Figure 18.

Tule Valley egg masses were located at a mean depth of 4.52 cm (SE = 0.021) and a mean distance to shore of 3.81 meters (SE = 0.025). Mean water temperature at egg masses was 11.5 ^{o}C (SE = 0.032). Water pH averaged 7.9 (SE = 0.003). Mean conductivity near egg masses was 1630 μS (SE = 0.224), and dissolved oxygen averaged 3.81 mg/L (SE = 0.025). Spotted frog egg mass characteristics and water quality parameters measured in Tule Valley are presented in Tables 4 and 5 and Figures 19 through 24.

Many spotted frogs were observed or heard calling during the monitoring period in Tule Valley. Most activity was observed during the first visit (8-9 March) when frogs were heard calling at many sites. Nine adults were seen at Tule 4A and 13 pairs were observed in amplexus at Tule 5. Livestock damage was low to moderate throughout Tule Valley and was characterized by cropped and trampled vegetation, damaged banks and substrate, and manure.

SUMMARY AND CONCLUSIONS

Bishop Springs

- A total of 325 spotted frog egg masses was observed during spring 2005 monitoring (Table 2).
- The estimated spotted frog breeding population size ($\hat{N}$ = 650) at Bishop Springs is below the SFCAS target level of 1000.
- The number of spotted frog egg masses observed in 2005 is consistent with numbers observed in previous years (Table 2, Figure 4).
- The long-term viability of the Bishop Springs spotted frog population is threatened by de-watering due to diversion of the Foote Reservoir outflow. Habitat and water quality

degradation from livestock grazing is also a threat at Bishop Springs.

Gandy Marsh

- A total of 155 spotted frog egg masses was counted during spring 2005 monitoring (Table 2).

- The estimated spotted frog breeding population size ($\widehat{N}$ =310) at Gandy Marsh is well below the SFCAS target level of 1000.

- Numbers of egg masses observed at Gandy are comparable to numbers observed the previous three years, however significantly lower than pre 2002 levels (Table 2, Figure 11).

- There was overlap in spotted and leopard frog egg deposition at Gandy Marsh, and high numbers of juvenile and adult leopard frogs were observed. Adverse potential impacts of leopard frog / spotted frog interactions should be evaluated at Gandy Marsh.

Tule Valley

- A total of 2,158 spotted frog egg masses were documented during spring 2005 monitoring (Table 2).

- The estimated spotted frog breeding population size ($\widehat{N}$ = 4,316) in Tule Valley currently exceeds the SFCAS target of 1000.

- Other than a strong year in 2003, the spring 2005 total masses observed is similar to other years in Tule Valley (Table 2, Figure 18).

- Egg masses at Tule 7 (Coyote Springs) comprised 64% of all egg masses observed in Tule Valley (n = 1,376); no egg masses were observed in Tule 8 (Table 3).

- The Tule Valley spotted frog population is currently stable, however spotted frog breeding habitat could be vulnerable to succession of spring complexes and livestock grazing impacts.

Table 1. Total number of spotted frog egg masses observed by age class in Bishop Springs, Gandy Marsh, and Tule Valley, spring 2005.

Site	AC 1	AC 2	AC 3 & 3+	Dead	Total
Bishop	**275**	**4**	**46**	**0**	**325**
Gandy	**144**	**4**	**7**	**0**	**155**
Tule Valley	**1151**	**421**	**330**	**256**	**2158**

Table 2. Total number of spotted frog egg masses found in Bishop Springs, Gandy Marsh, and Tule Valley for the years 1997 - 2005.

Site	Bishop	Gandy	Tule Valley
1997	**not surveyed**	**406+**	**1451**
1998	**275**	**1545**	**441**
1999	**274**	**672**	**1220**
2000	**241**	**784**	**1631**
2001	**201**	**585**	**2072**
2002	**357**	**90**	**2203**
2003	**615**	**115**	**3870**
2004	**213**	**131**	**1326**
2005	**325**	**155**	**2158**

Table 3. Total number of spotted frog egg masses observed by age class (AC) at individual springs in Tule Valley, spring 2005.

Site	AC 1	AC 2	AC 3 & 3+	Dead	Total
Tule 1	**82**	**19**	**31**	**1**	**133**
Tule 2	**7**	**20**	**26**	**0**	**53**
Tule 3	**16**	**29**	**140**	**0**	**185**
Tule 4A	**89**	**29**	**19**	**0**	**137**
Tule 4B	**10**	**0**	**0**	**0**	**10**
Tule 4C	**2**	**0**	**0**	**0**	**2**
Tule 5	**213**	**37**	**10**	**1**	**261**
Tule 6	**1**	**0**	**0**	**0**	**1**
Tule 7	**731**	**287**	**104**	**254**	**1376**
Tule 8	*	*	*	*	*
Tule Valley	**1151**	**421**	**330**	**256**	**2158**

*** No egg masses were found at this site during spring 2005 monitoring.**

Table 4. Mean and standard error of spotted frog egg mass depth and distance to shore, water temperature, pH, conductivity, and dissolved oxygen (D.O.) measurements recorded during spotted frog monitoring at Bishop Springs, Gandy Marsh, and Tule Valley, spring 2005.

		Egg Mass Depth (cm)	Egg Mass Distance to Shore (m)	Temperature (^{o}C)	pH	Conductivity (μS)	D.O. (mg/L)
Bishop	avg=	**4.94**	**5.25**	**10.87**	**8.3**	**730**	**4.61**
	se=	**0.048**	**0.09**	**0.045**	**0.005**	**0.495**	**0.09**
	n=	**325**	**325**	**325**	**325**	**273**	**285**
Gandy	avg=	**6.68**	**14.3**	**11.73**	**7.8**	**910**	**2.02**
	se=	**0.079**	**0.20**	**0.083**	**0.007**	**0.988**	**0.019**
	n=	**155**	**155**	**155**	**155**	**149**	**149**
Tule Valley	avg=	**4.52**	**3.81**	**11.51**	**7.9**	**1630**	**3.44**
	se=	**0.021**	**0.025**	**0.032**	**0.003**	**0.224**	**0.025**
	n=	**2158**	**2158**	**2158**	**2158**	**2158**	**2158**

Table 5. Mean and standard error of spotted frog egg mass depth and distance to shore, water temperature, pH, conductivity and dissolved oxygen (D.O.) measurements recorded during spotted frog monitoring at individual springs in Tule Valley, spring 2005.

		Egg Mass Depth (cm)	Egg Mass Distance to Shore (m)	Temperature (^{o}C)	pH	Conductivity (µS)	D.O. (mg/L)
Tule 1	avg =	**3.28**	**3.23**	**15.65**	**7.7**	**1414**	**4.2**
	se=	**0.058**	**0.031**	**0.061**	**0.008**	**0.153**	**0.051**
	n=	**133**	**133**	**133**	**133**	**133**	**133**
Tule 2	avg =	**2.94**	**7.37**	**18.23**	**7.7**	**1474**	**3.46**
	se=	**0.088**	**0.064**	**0.068**	**0.015**	**0.184**	**0.064**
	n=	**53**	**53**	**53**	**53**	**53**	**53**
Tule 3	avg =	**4.84**	**4.53**	**7.51**	**8.0**	**1242**	**2.74**
	se=	**0.050**	**0.049**	**0.090**	**0.006**	**0.201**	**0.025**
	n=	**185**	**185**	**185**	**185**	**185**	**185**
Tule 4A	avg =	**4.99**	**2.81**	**13.85**	**8.4**	**1145**	**3.52**
	se=	**0.064**	**0.088**	**0.106**	**0.004**	**0.181**	**0.020**
	n=	**137**	**137**	**137**	**137**	**137**	**137**
Tule 4B	avg =	**3.5**	**6.04**	**12.52**	**8.0**	**1571**	**3.14**
	se=	**0.144**	**0.212**	**0.024**	**0.005**	**1.060**	**0.047**
	n=	**10**	**10**	**10**	**10**	**10**	**10**
Tule 4C	avg =	**2.0**	**9.00**	**3.5**	**8.1**	**1236**	**2.04**
	se=	**0**	**0**	**0**	**0**	**0**	**0**
	n=	**2**	**2**	**2**	**2**	**2**	**2**
Tule 5	avg =	**4.97**	**6.51**	**8.66**	**8.0**	**981**	**3.25**
	se=	**0.042**	**0.036**	**0.036**	**0.009**	**0.122**	**0.025**

	n=	**261**	**261**	**261**	**261**	**261**	**261**

Table 5. Continued.

		Egg Mass Depth (cm)	Egg Mass Distance to Shore (m)	Temperature (^{o}C)	pH	Conductivity (μS)	D.O. (mg/L
Tule 6	avg =	**2**	**4.2**	**9**	**8.1**	**1230**	**1.35**
	se=	**0**	**0**	**0**	**0**	**0**	**0**
	n=	**1**	**1**	**1**	**1**	**1**	**1**
Tule 7	avg =	**4.54**	**3.20**	**11.7**	**7.8**	**1880**	**6.72**
	se=	**0.030**	**0.033**	**0.042**	**0.003**	**0.184**	**0.719**
	n=	**1376**	**1376**	**1376**	**1376**	**1376**	**1376**
Tule 8	avg =	*	*	*	*	*	*
	se=	*	*	*	*	*	*
	n=	**0**	**0**	**0**	**0**	**0**	**0**
Tule Valley	avg =	**4.52**	**3.81**	**11.51**	**7.9**	**1631**	**3.44**
	se=	**0.021**	**0.025**	**0.032**	**0.003**	**0.224**	**0.016**
	n=	**2158**	**2158**	**2158**	**2158**	**2158**	**2158**

*__No egg masses were found at this site; habitat parameters were not taken__.

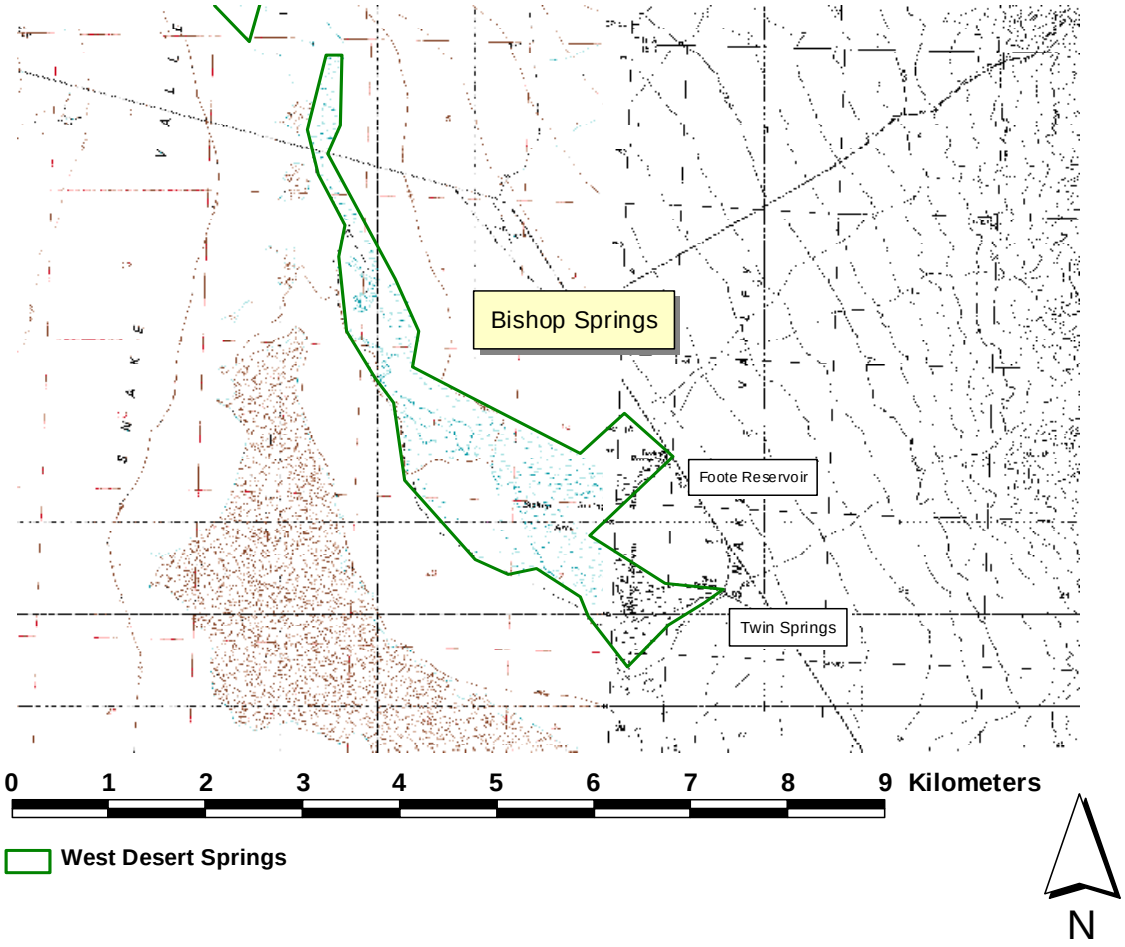

Figure 1. Location of Bishop Springs, Snake Valley, Utah (Gandy Quadrangle, 7.5 minute series, 1:25,000 Scale).

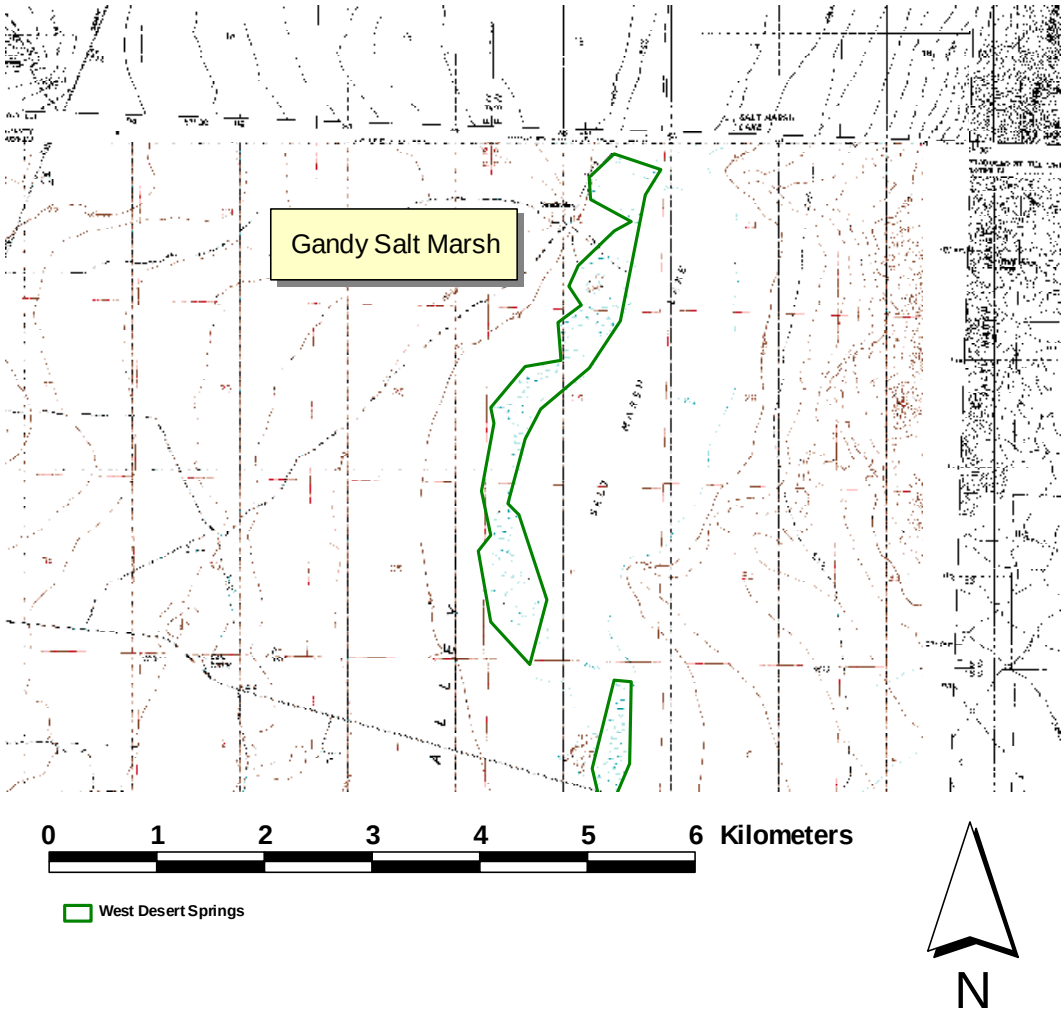

Figure 2. Location of Gandy Marsh, Snake Valley, Utah (Gandy Quadrangle, 7.5 minute series, 1:25,000 Scale).

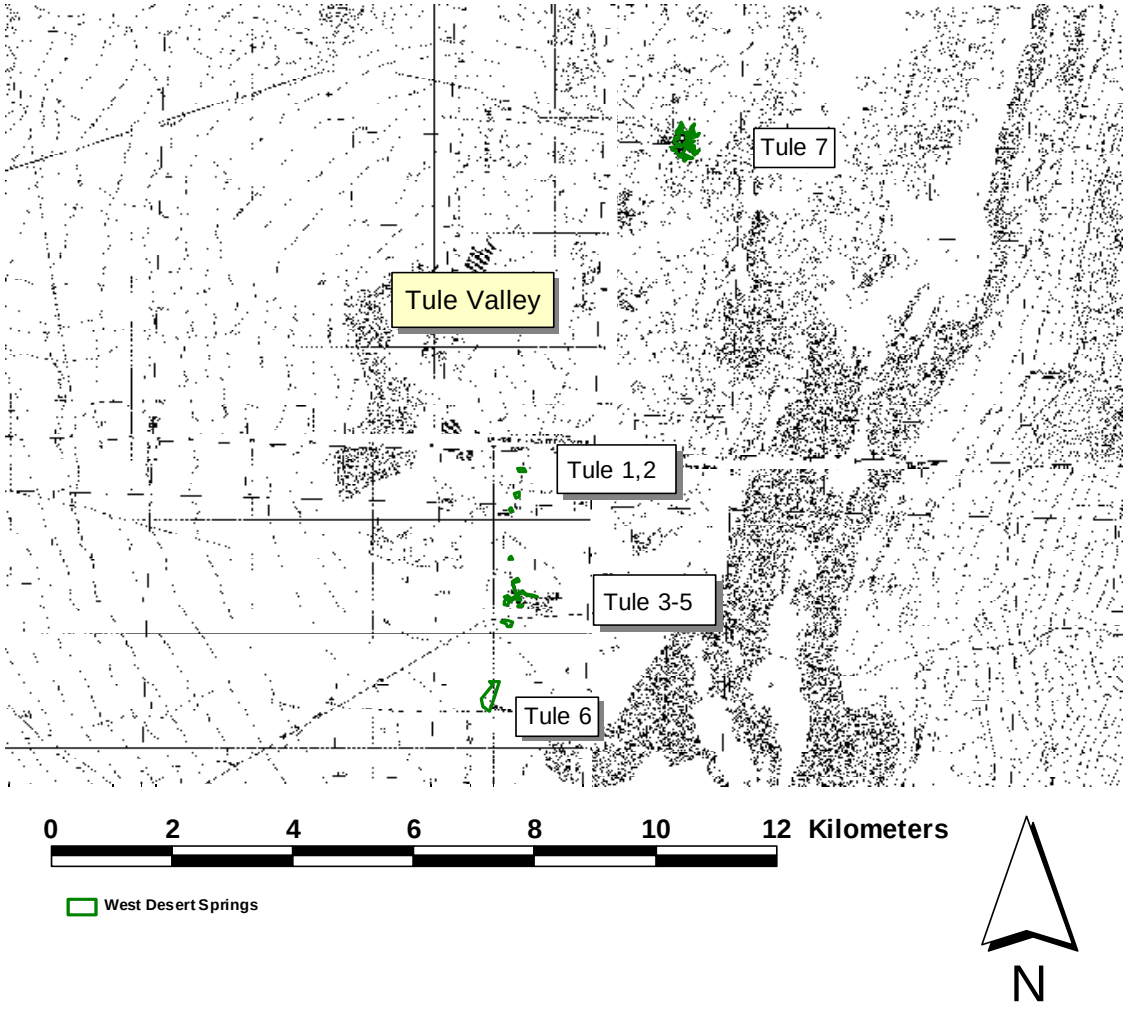

Figure 3. Location of spotted frog monitoring sites, Tule Valley, Utah (Chalk Knolls and Coyote Knolls Quadrangles, 7.5 minute series, 1:25,000 Scale).

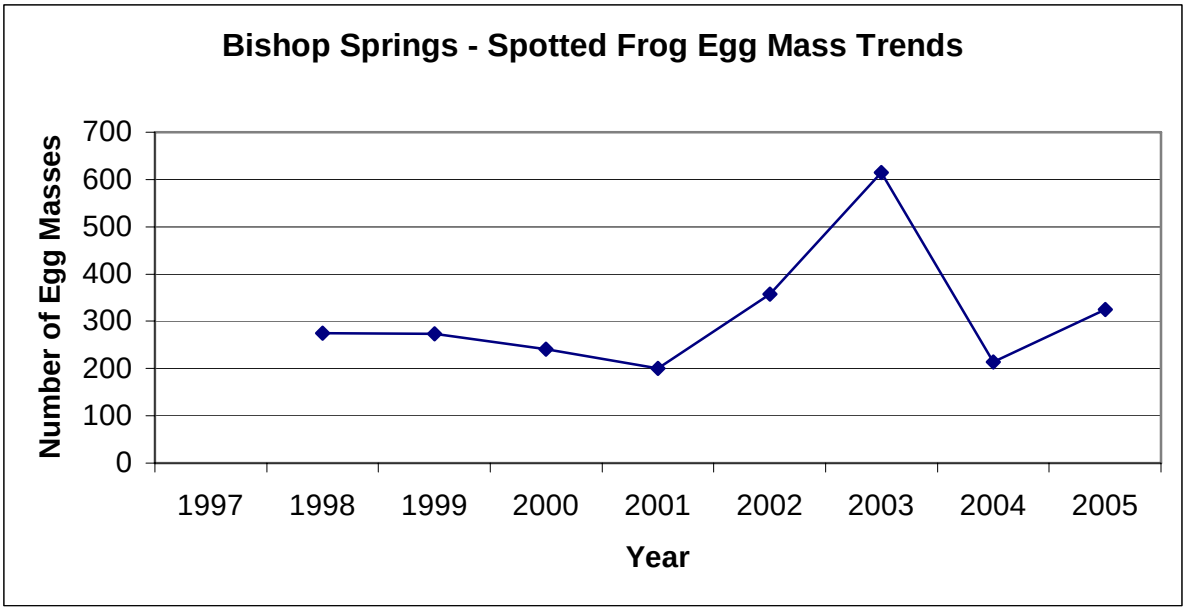

Figure 4. Number of spotted frog egg masses observed during annual monitoring from 1998 to 2005 at Bishop Springs, Utah.

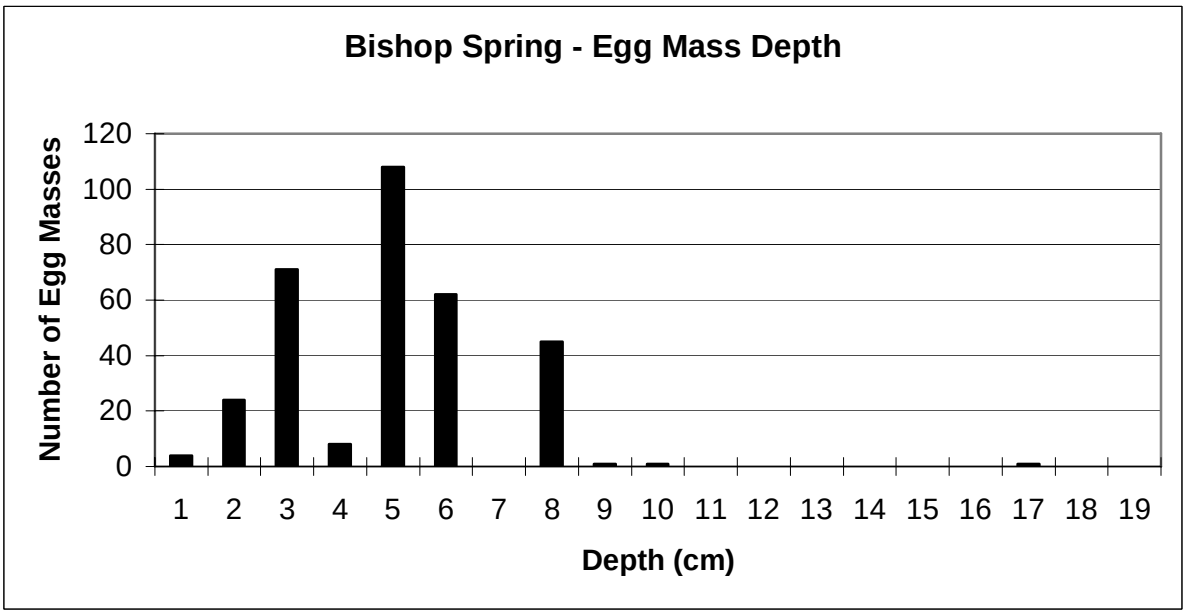

Figure 5. Depth (cm) of spotted frog egg masses measured during monitoring at Bishop Springs, Utah, spring 2005.

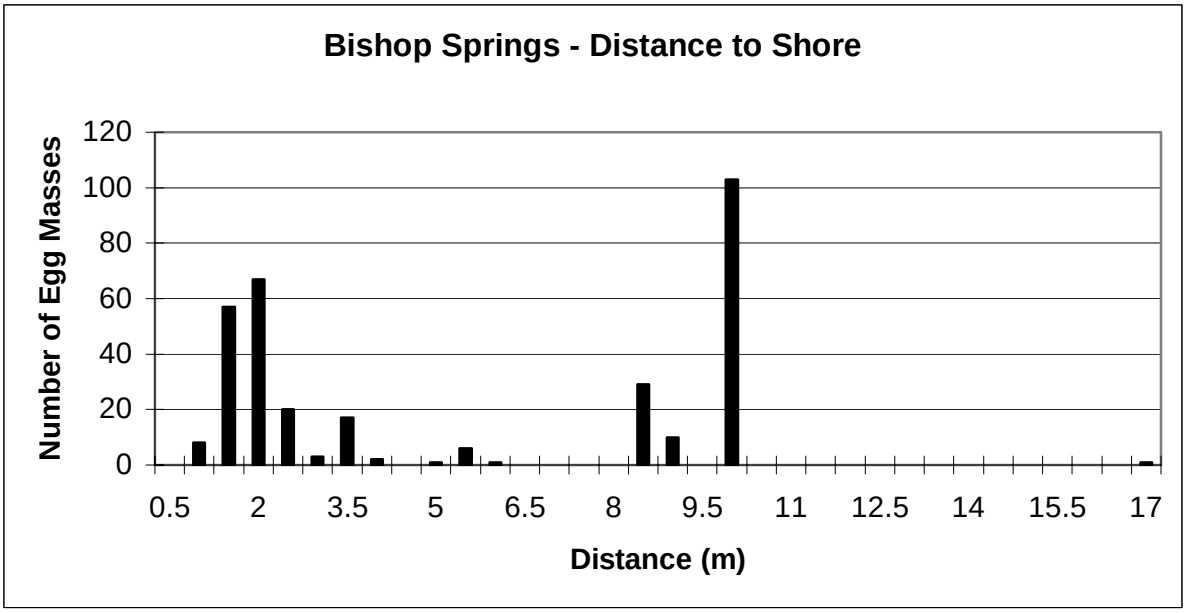

Figure 6. Distance to shore (m) of spotted frog egg masses observed during monitoring at Bishop Springs, Utah, spring 2005.

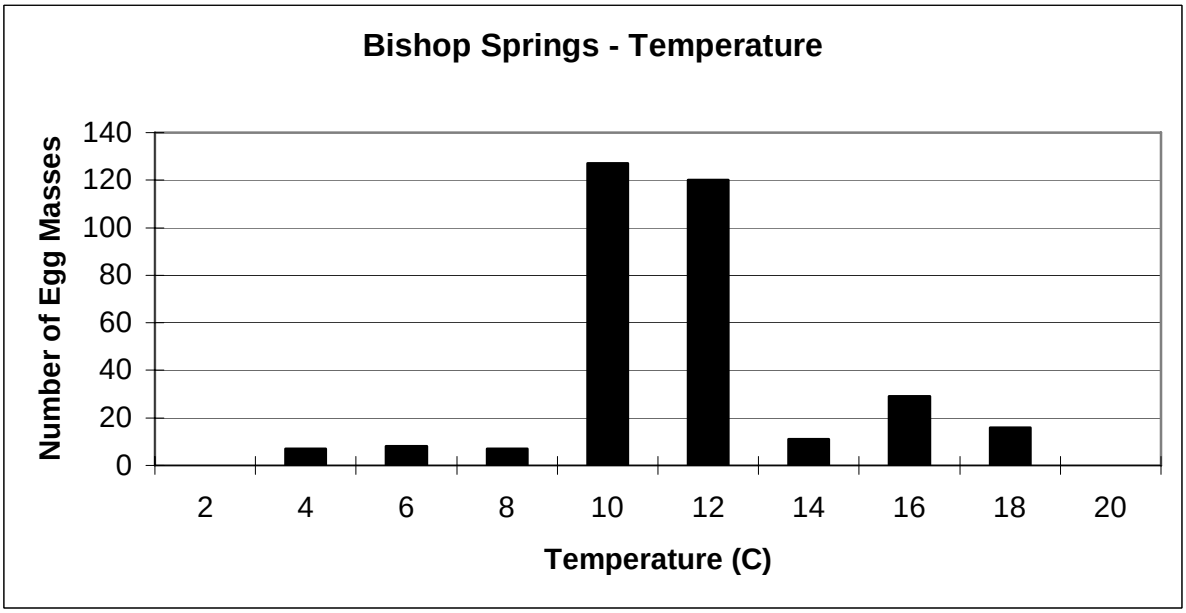

Figure 7. Temperature (^{o}C) measured at spotted frog egg masses during monitoring at Bishop Springs, Utah, spring 2005.

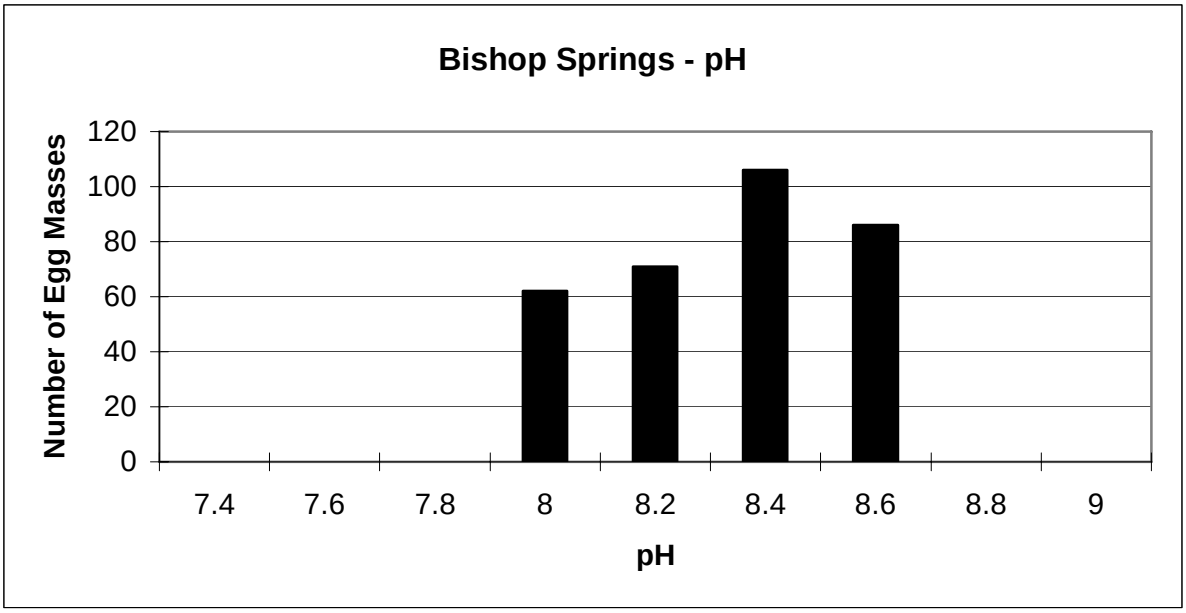

Figure 8. pH recorded at spotted frog egg mass clusters during monitoring at Bishop Springs, Utah, spring 2005.

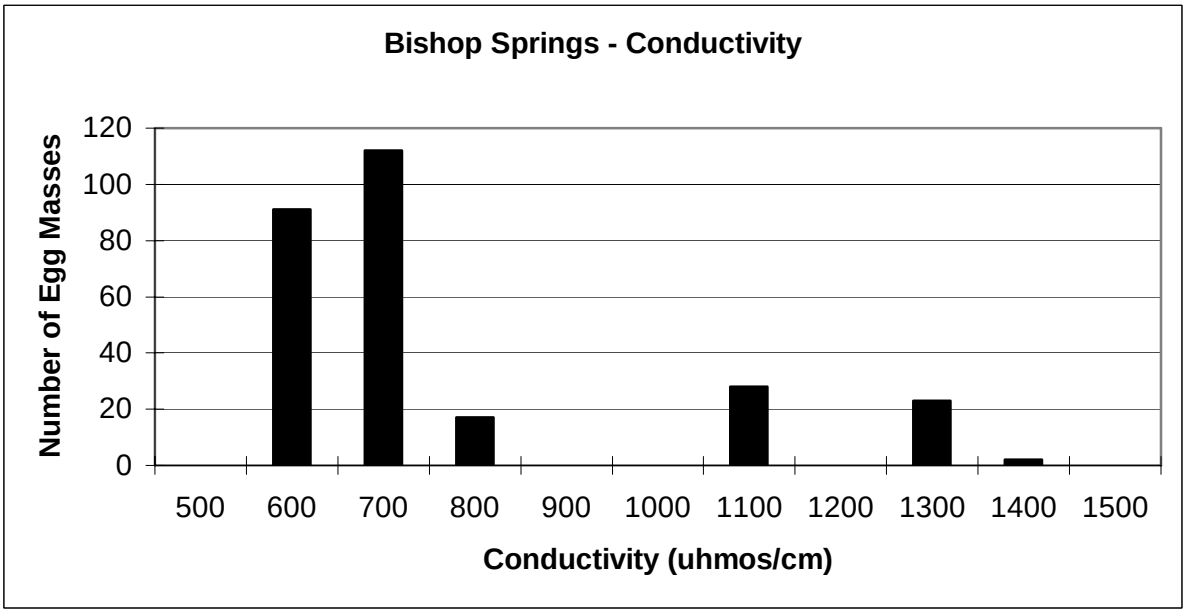

Figure 9. Conductivity (umhos/cm) measured at spotted frog egg masses during monitoring at Bishop Springs, Utah, spring 2005.

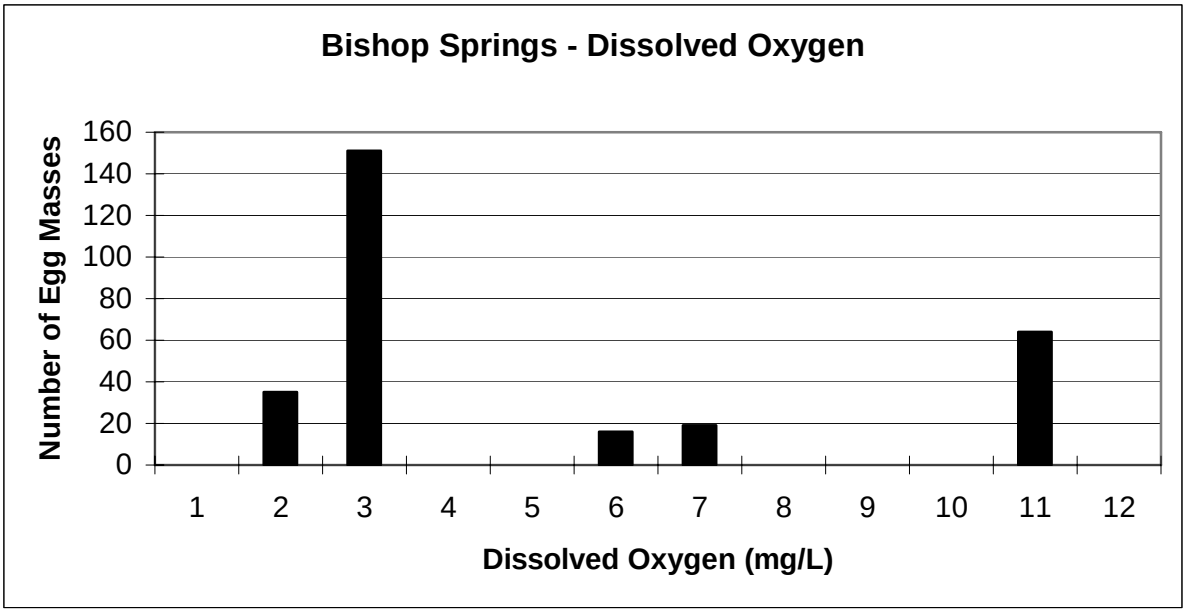

Figure 10. Dissolved oxygen (mg/L) measured at spotted frog egg masses during monitoring at Bishop Springs, Utah, spring 2005.

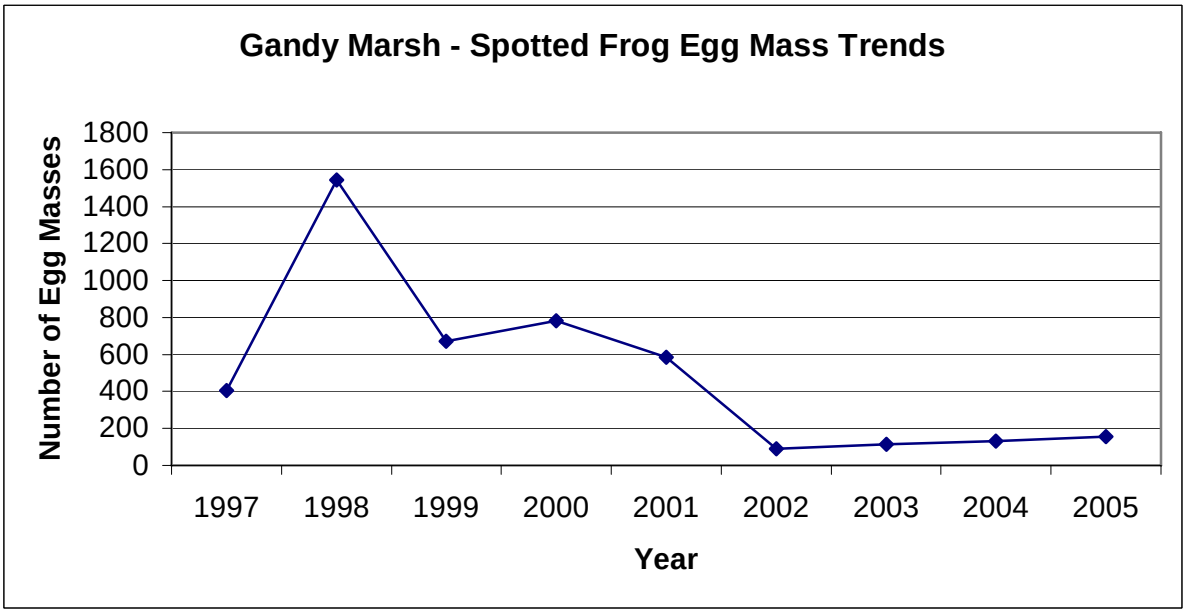

Figure 11. Number of spotted frog egg masses observed during annual monitoring from 1997 to 2005 at Gandy Marsh, Utah.

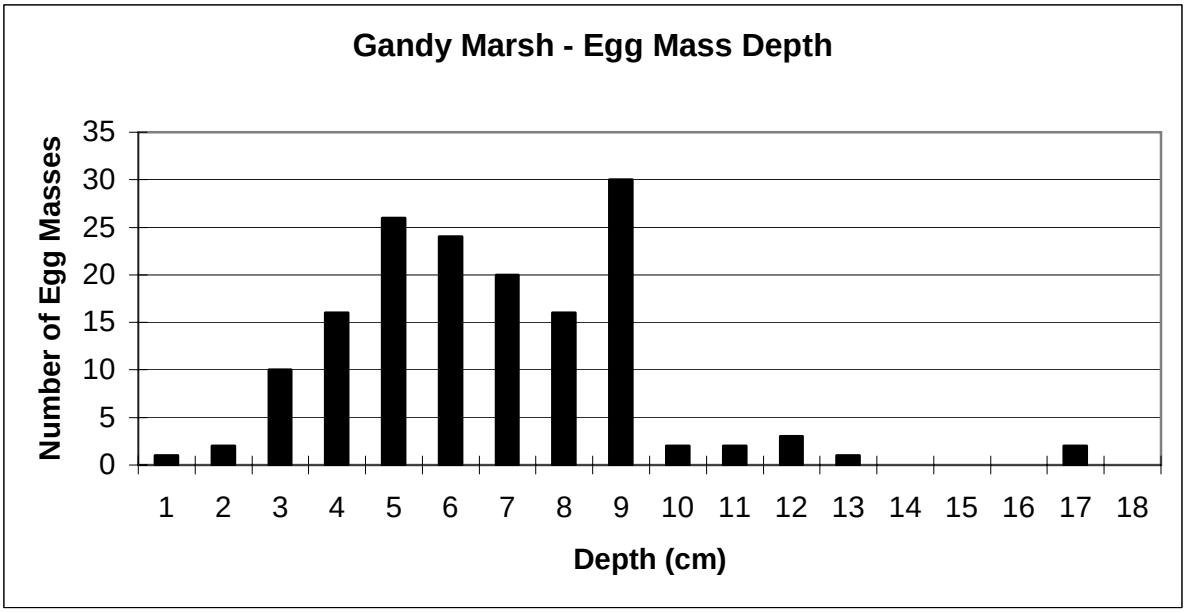

Figure 12. Depth (cm) of spotted frog egg masses observed during monitoring at Gandy Marsh, Utah, spring 2005.

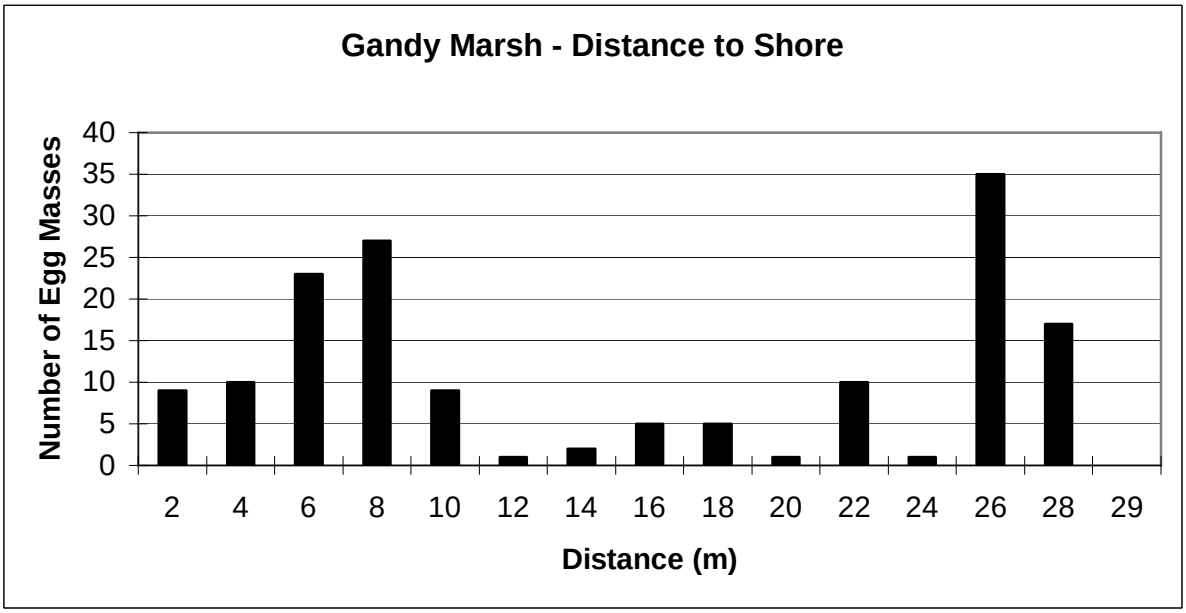

Figure 13. Distance to shore (m) of spotted frog egg masses observed during monitoring at Gandy Marsh, Utah, spring 2005.

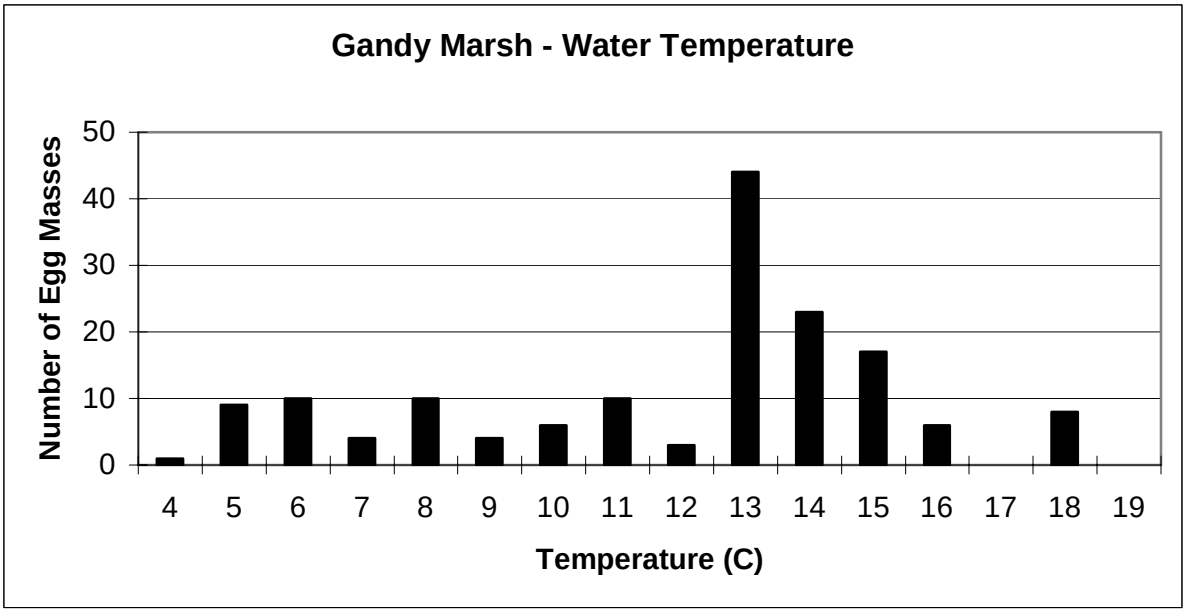

Figure 14. Temperature (^{o}C) measured at spotted frog egg masses during monitoring at Gandy Marsh, Utah, spring 2005.

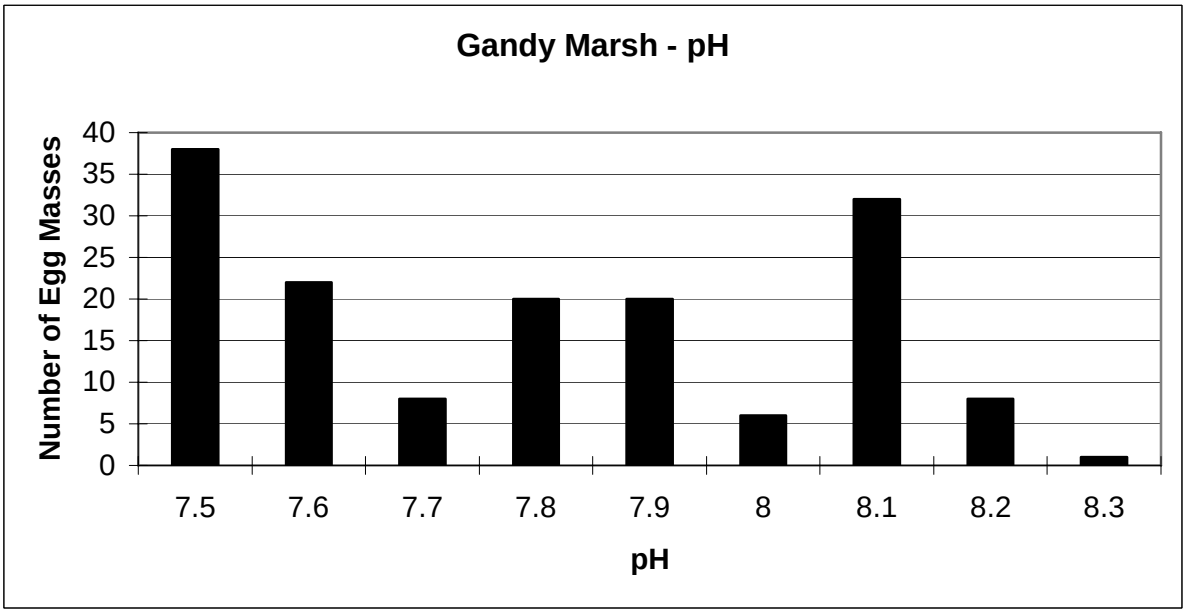

Figure 15. pH recorded at spotted frog egg masses during monitoring at Gandy Marsh, Utah, spring 2005.

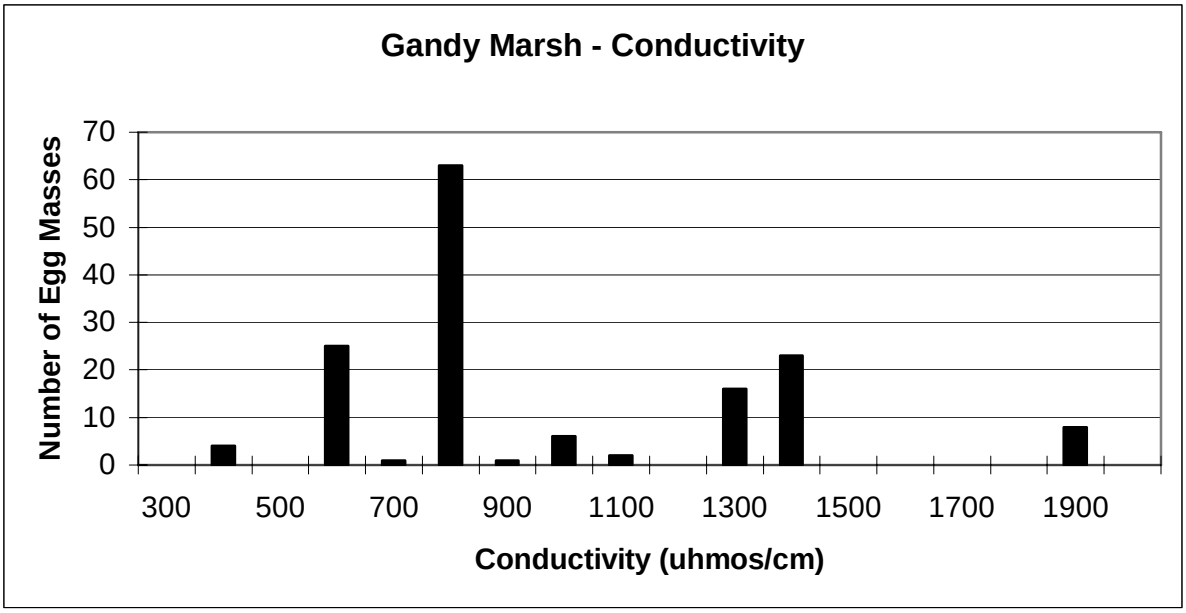

Figure 16. Conductivity (umhos/cm) measured at spotted frog egg masses during monitoring at Gandy Marsh, Utah, spring 2005.

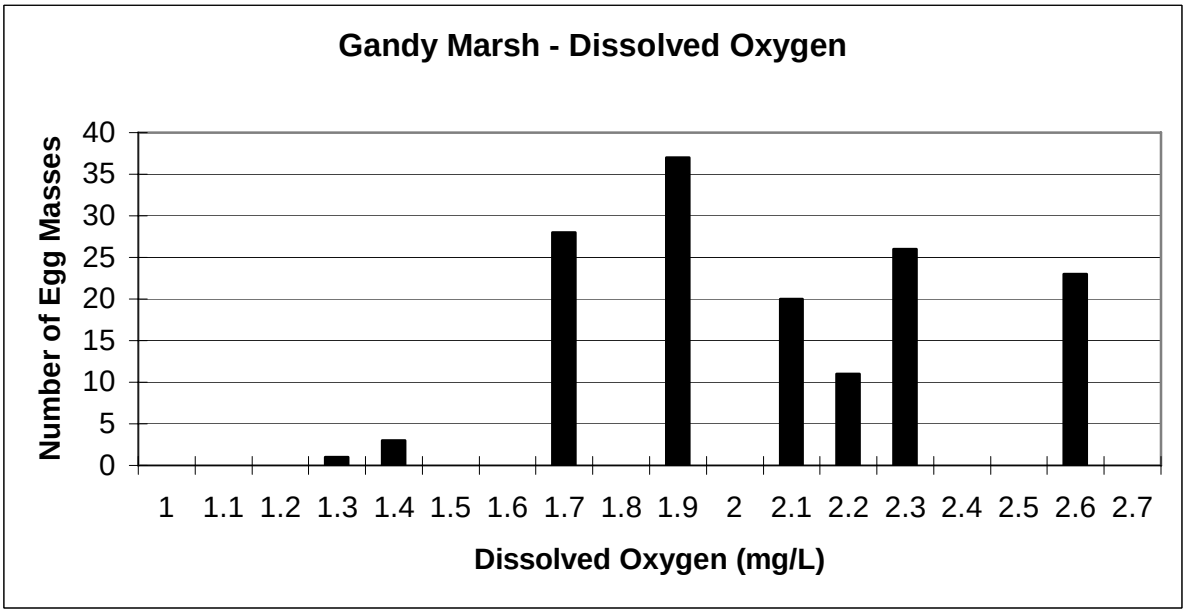

Figure 17. Dissolved oxygen (mg/L) measured at spotted frog egg masses during monitoring at Gandy Marsh, Utah, spring 2005.

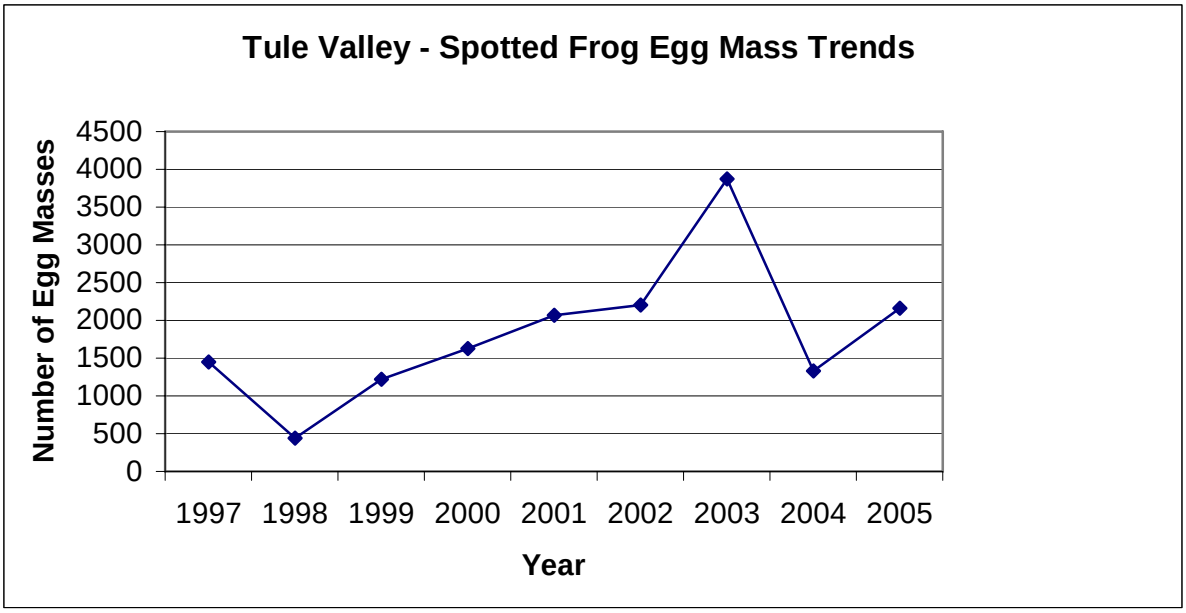

Figure 18. Number of spotted frog egg masses observed during annual monitoring from 1997 to 2005 at Tule Valley, Utah.

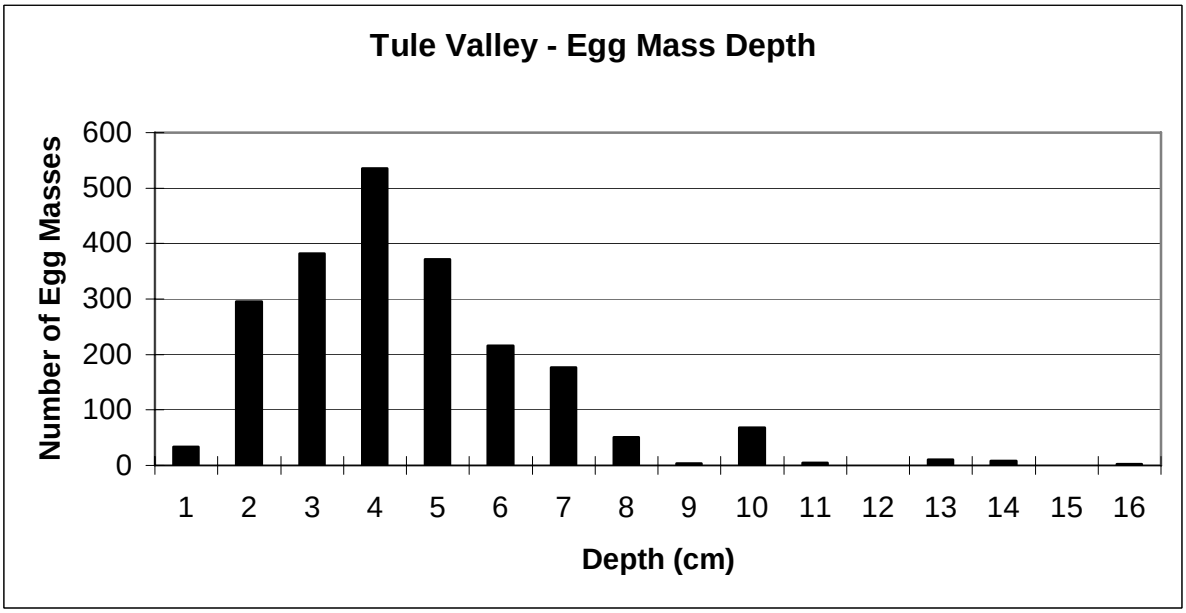

Figure 19. Depth (cm) of spotted frog egg masses observed during monitoring in Tule Valley, Utah, spring 2005.

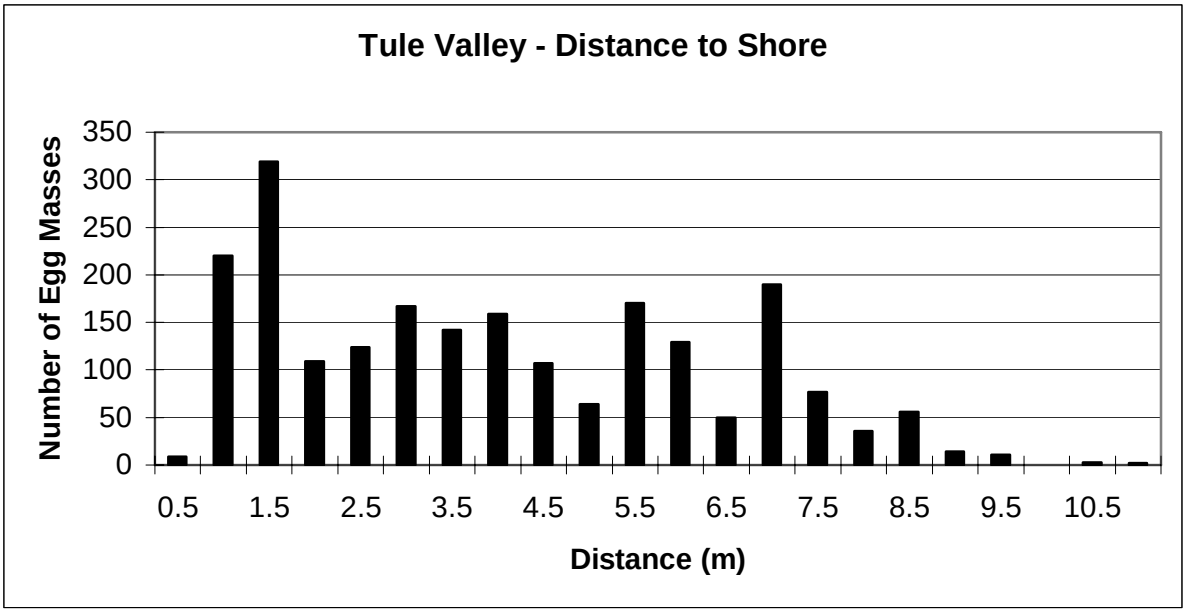

Figure 20. Distance to shore (m) of spotted frog egg masses observed during monitoring in Tule Valley, Utah, spring 2005.

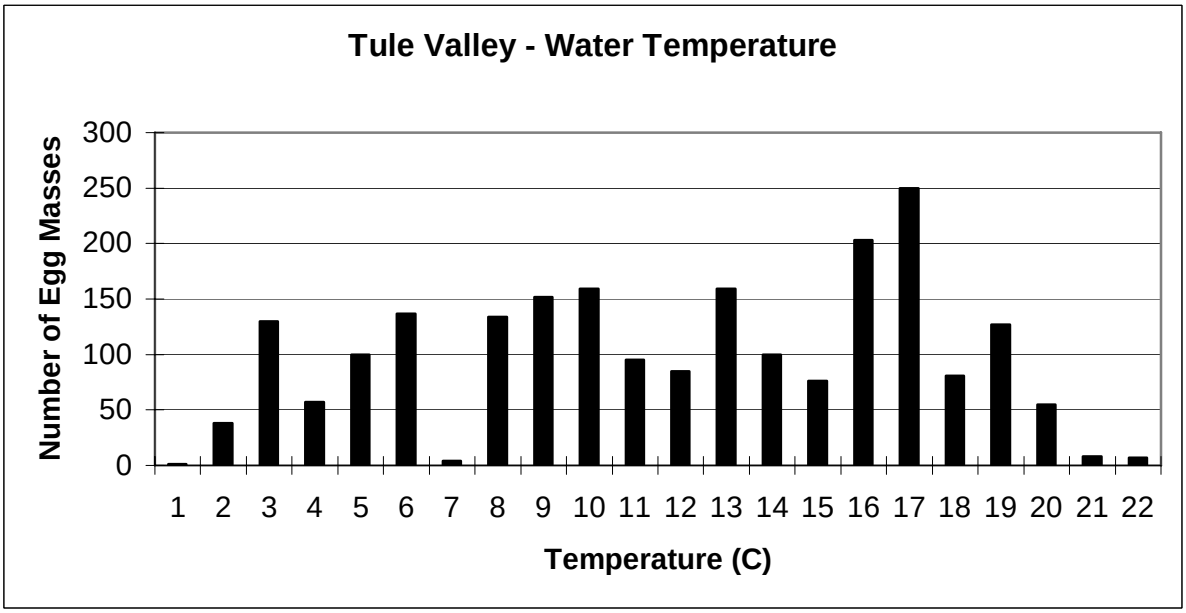

Figure 21. Temperature (^{o}C) measured at spotted frog egg mass clusters during monitoring in Tule Valley, Utah, spring 2005.

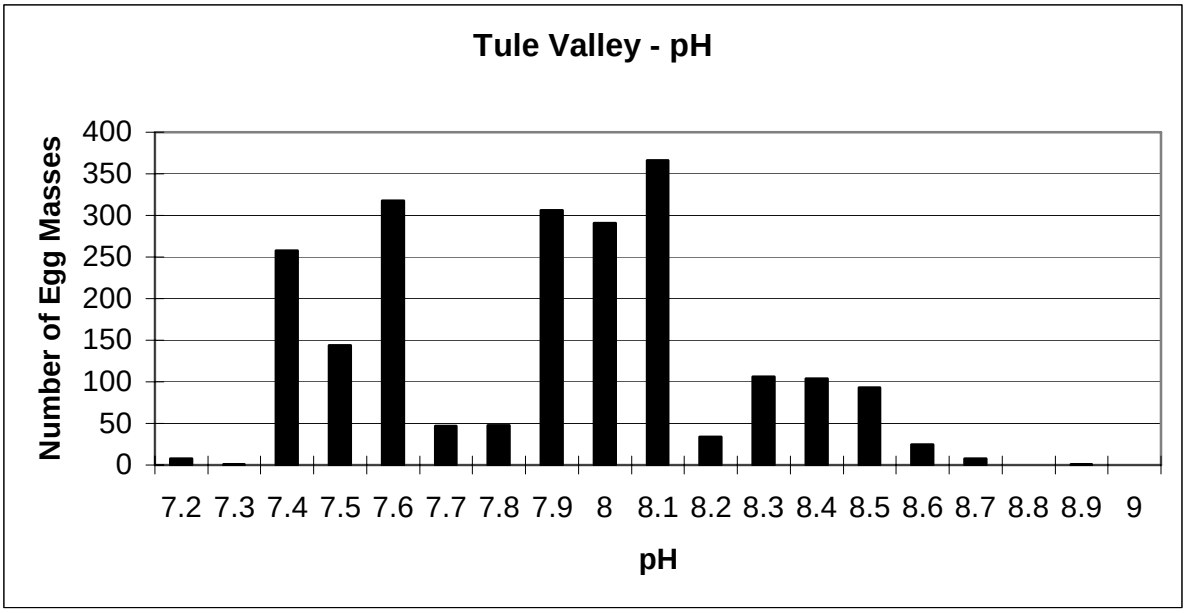

Figure 22. pH recorded at spotted frog egg masses during monitoring in Tule Valley, Utah, spring 2005.

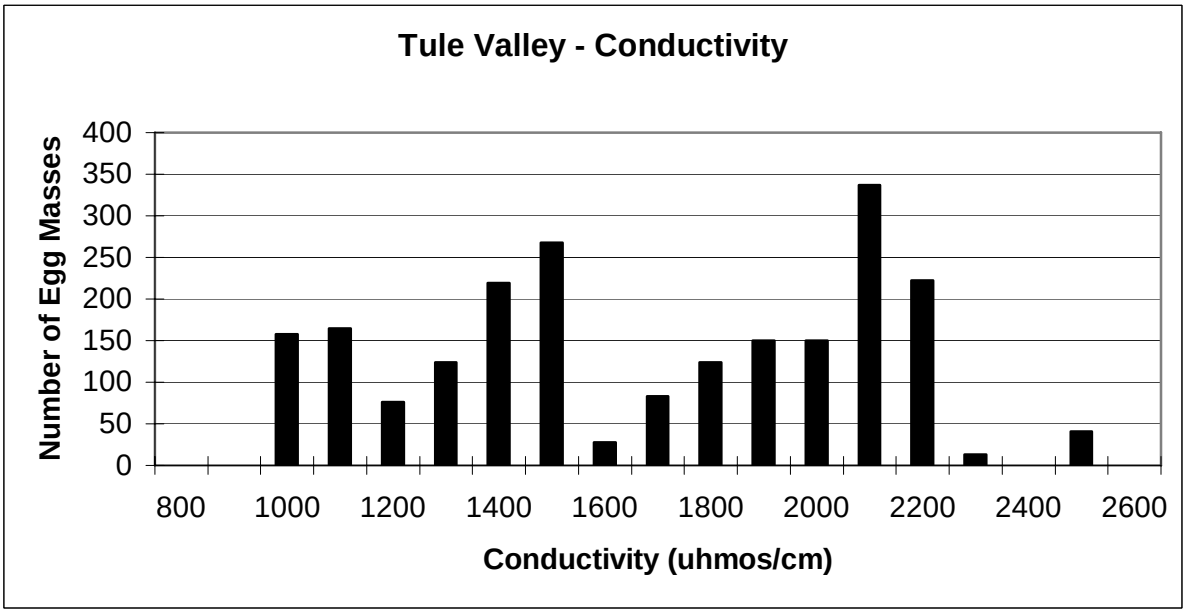

Figure 23. Conductivity (umhos/cm) measured at spotted frog egg masses during monitoring in Tule Valley, Utah, spring 2005.

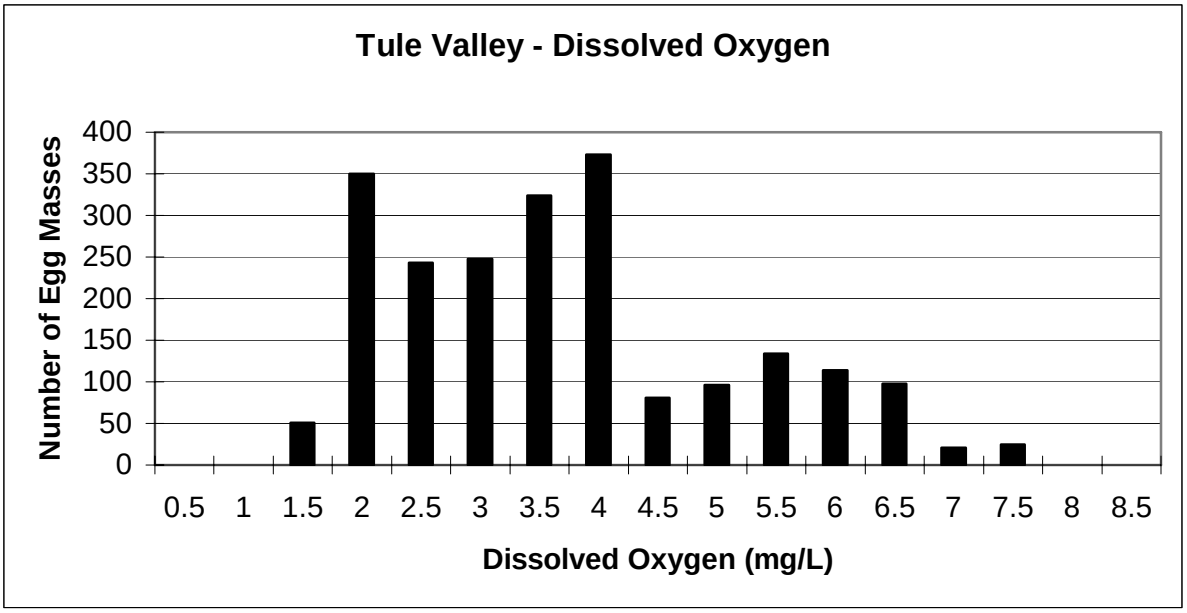

Figure 24. Dissolved oxygen (mg/L) measured at spotted frog egg masses during monitoring in Tule Valley, Utah, spring 2005.

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