

State of Utah

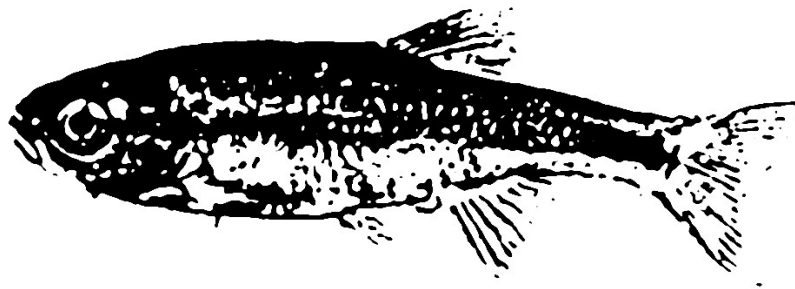
DEPARTMENT OF NATURAL RESOURCES

Division of Wildlife Resources - Native Aquatic Species

LEAST CHUB
(Iotichthys phlegethontis)

MONITORING SUMMARY

Snake Valley, 2004



Publication Number 04-33
Utah Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, Utah
Miles Moretti, Director

LEAST CHUB
(*Iotichthys phlegethontis*)

MONITORING SUMMARY

Snake Valley, 2004

Final Report
December 2004

Prepared by:

Kevin K. Wheeler
Richard A. Fridell
Jennifer A. Bryant

Publication Number 04-33
Utah Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, Utah
Miles Moretti, Director

ACKNOWLEDGMENTS

We are grateful to Melinda R.M. Bennion, Debbie A. Erinstone, Janice A. Huebner, Mike D. Mills, Mark W.L. Morras, Megan K. Morvilius, Daniel V. Nonne, Charity J. Schena, Martin A. Schijf, Kristine W. Wilson, and Lisa M. Wilson of the Utah Division of Wildlife Resources. This project was funded by the Utah Division of Wildlife Resources.

The Utah Department of Natural Resources receives federal aid and prohibits discrimination on the basis of race, color, sex, national origin, or handicap. For information or complaints regarding discrimination, contact Executive Director, Utah Department of Natural Resources, 1636 West North Temple #316, Salt Lake City, Utah 84116-3193, or the Equal Opportunity Commission, 1801 L Street NW, Washington D.C. 20507.

TABLE OF CONTENTS

| | |
|------------------------|----|
| INTRODUCTION | 1 |
| METHODS | 3 |
| RESULTS | 3 |
| SUMMARY | 6 |
| LITERATURE CITED | 23 |

LIST OF TABLES

| | |
|---|----|
| Table 1. Number and percentage of springs where least chub were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004 | 7 |
| Table 2. Number and percentage of springs where Utah chub were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004 | 7 |
| Table 3. Number and percentage of springs where speckled dace were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004 | 8 |
| Table 4. Species and number of fish captured by spring (n=12) at Leland Harris springs, Snake Valley, Utah from 1999 to 2004..... | 8 |
| Table 5. Species of fish captured by spring (n = 12) at Leland Harris, Snake Valley, Utah from 1993 to 2004. | 9 |
| Table 6. Species and number of fish captured by spring (n = 52) in the Gandy Marsh, Snake Valley, Utah from 1999 to 2004..... | 10 |
| Table 7. Species of fish species captured by spring (n=52) at Gandy Marsh, Snake Valley, Utah from 1993 to 2004 | 12 |
| Table 8. Species and number of fish captured by spring (n = 13) in Bishop Springs, Snake Valley, Utah from 1999 to 2004 | 14 |
| Table 9. Species of fish captured by spring (n=13) at Bishop Springs, Snake Valley, Utah from 1993 to 2004 | 15 |

LIST OF FIGURES

Figure 1. Location of Leland Harris least chub monitoring site 17

Figure 2. Location of Gandy Marsh complex least chub monitoring site..... 18

Figure 3. Location of Bishop Springs least chub monitoring site..... 19

Figure 4. Length frequency distribution of least chub (n = 242) captured at Leland Harris monitoring sites, Snake Valley, Utah, August 2004..... 20

Figure 5. Length frequency distribution of least chub (n = 120) captured at Gandy Marsh monitoring sites, Snake Valley, Utah, August 2004..... 20

Figure 6. Length frequency distribution of least chub (n = 16) captured at Bishop Springs monitoring sites, Snake Valley, Utah, August 2004..... 21

Figure 7. Percentage of sampling sites containing least chub during annual monitoring at Leland Harris, Snake Valley, Utah, from 1993 to 2004. 21

Figure 8. Percentage of sampling sites containing least chub during annual monitoring at Gandy Marsh, Snake Valley, Utah, from 1993 to 2004. 22

Figure 9. Percentage of sampling sites containing least chub during annual monitoring at Bishop Springs, Snake Valley, Utah, from 1993 to 2004. 22

INTRODUCTION

Least chub (*Iotichthys phlegethontis*) historically occupied a variety of habitats including rivers, clear streams, springs, ponds, and marshes (Sigler and Miller 1963). However, all known populations are currently restricted to isolated springs and associated marshes. Least chub habitat typically consists of small springs or ponds with cool stable temperatures, relatively low, stable dissolved oxygen values, and low conductivities (Perkins et al. 1998). Least chub are typically found in habitats consisting of moderate to dense emergent, floating, and submergent vegetation. Wetland vegetation most commonly associated with least chub habitat include: olney threesquare (*Scirpus americanus*), common threesquare (*S. pungens*), softstem bulrush (*S. validus*), wiregrass (*Juncus balticus*), clustered field sedge (*Carex praegracilis*), common cattail (*Typha domingensis*), common spikerush (*Eleocharis palustris*), duckweed (*Lemna sp.*), cutleaf water parsnip (*Berula erecta*), and waterfern (*Azolla mexicana*).

Least chub, which are endemic to the Bonneville Basin of Utah, have been declining since the 1940s (Holden et al. 1974), and studies over the last 20 years indicate a continued decline in their distribution and abundance (Perkins et al. 1998). Collections within the Bonneville Basin indicate that the approximate range of least chub once included Big Cottonwood Creek, the Provo River, Utah Lake, Beaver River, Parowan Creek, and Snake Valley (Sigler and Miller 1963, Crist 1990). However, Workman et al. (1979) surveyed historically occupied areas in Millard, Juab, Weber, Salt Lake, and Tooele counties, and concluded that least chub had been extirpated from a majority of their original range. Specifically, Workman and his colleagues showed that least chub distribution is limited to areas within Snake Valley, including the Gandy Marsh complex, Twin Springs (Bishop Springs), Leland Harris Spring complex, Callao Spring complex, and Redden Springs. Surveys conducted by Utah Division of Wildlife Resources in the mid 1990s found two previously undocumented populations of least chub in Juab County: one in the Sevier River drainage within Mills Valley, and another near the town of Mona in Juab Valley (Perkins et al. 1998). Additional inventories in 2003 led to the discovery of another previously undocumented population of least chub at Clear Lake

Waterfowl Management Area in Millard County (Fridell et al. 2003).

The first recorded collection of least chub in Snake Valley was by C. L. Hubbs in 1942 at the Gandy Marsh complex in Millard County (Sigler and Miller 1963). In 1970, R. R. Miller collected least chub from the Leland Harris spring complex in Juab County (Sigler and Sigler 1996). These findings prompted the West Desert survey conducted by Workman et al. (1979), which revealed the distribution of least chub was limited to Snake Valley. Osmundson (1985) found that least chub were most abundant in the Gandy Marsh spring complex and Leland Harris spring complex within Snake Valley. He noted that least chub were least abundant in Miller Springs (near Leland) and Bishop Springs (Twin and Central Springs). Further research has indicated that least chub have been extirpated from the Callao and Redden Spring complexes (Crist 1990). Thus, within Snake Valley, least chub are limited to the Gandy Marsh, Leland Harris spring, and Bishop Springs (Perkins et al. 1998).

Due to their declining distribution and abundance, least chub are currently classified as a conservation species by the State of Utah (Perkins et al. 1998). In 1998, the Conservation Agreement and Strategy for Least Chub (*Iotichthys phlegethontis*) in the State of Utah (Perkins et al. 1998) was developed in an effort to expand least chub populations and enhance their habitat. Conservation actions identified in the Conservation Agreement include: wetland re-vegetation, water quality improvements, grazing enclosure construction, surveys of suitable least chub habitat, control of non-native species, genetic analysis, and monitoring of least chub populations. Long-term population monitoring is necessary to determine least chub status and their response to implementation of conservation actions.

In August 2004, the Utah Division of Wildlife Resources conducted the twelfth consecutive year of least chub monitoring in Snake Valley, Utah. The objective of this ongoing effort is to monitor least chub populations and their habitat trends in Snake Valley within the West Desert Geographic Management Unit. The areas sampled and methodology used is consistent with monitoring conducted in previous years (Fridell et al. 1999, Fridell and Marr 2000, Fridell and Malecki 2001, Fridell et al. 2002, Fridell et al. 2003).

METHODS

In Snake Valley, least chub were sampled at three spring complexes: Leland Harris, Gandy Marsh, and Bishop Springs (Figures 1-3). A total of 77 sites were visited within these complexes (Leland Harris = 12, Gandy = 52, Bishop Springs = 13). Each of the 77 sites has been designated as an annual monitoring site and has been individually marked with permanent stakes. To determine the presence/absence of least chub, a minimum of one wire minnow trap (44.5 cm long, 22.9 cm diameter, 0.66 cm mesh) was placed at each site where water depth was sufficient to submerge the trap openings. All traps were set at a minimum depth of 13 cm (5") and were left for two to four hours before being removed. Trap locations, trap depths, and total trapping times were recorded at each site. All captured fish were positively identified and respective lengths were measured and recorded. Least chub size distribution was examined for each spring complex by plotting length frequency histograms in millimeter increments. In addition, mean length for least chub was calculated for each spring complex.

Habitat inventories were conducted at all springs to assess physical parameters of the site and to determine species occurrence and abundance of aquatic flora. Pool size, maximum water depth, substrate depth, bank condition, livestock damage, and similar habitat indices were recorded on standardized data sheets. Limited water quality parameters, including pH, dissolved oxygen, and temperatures were also recorded at each location.

RESULTS

From August 23, 2004 to August 26, 2004, field crews surveyed 77 pre-established sites within the Leland Harris, Gandy Marsh, and Bishop Springs complexes. Least chub comprised 37.0% (least chub = 378; Utah chub = 611; speckled dace = 32) of all fish captured in Snake Valley (Tables 4, 6, and 8). Of the 77 springs sampled, least chub were found in 24 (31.1%), Utah chub (*Gila atraria*) were in 23 (29.9%), and speckled dace (*Rhinichthys osculus*) were found in 13 (16.9%; Tables 1-3). A synopsis of 2004 results at

each spring complex follows.

Leland Harris (Sample # 04-001 - 04-012)

Least chub were captured in eight of 12 (66.7%) sites sampled at Leland Harris (Table 1). Species present in this complex included least chub and Utah chub (Table 5). Least chub comprised 38.5% (least chub = 242, Utah chub = 386) of all fish captured (Table 4). Most springs were classified as having low ungulate damage consisting of minimal bank disturbance. Springs 9, 10, and 2-B were classified as having moderate ungulate damage with a minimal amount of bank disturbance. Among sites containing least chub, average water depth ranged from 0.02 to greater than 8 m and surface water temperature ranged from 13.0° to 17.4° C (\bar{x} = 14.89° C). Dissolved oxygen ranged from 0.75 to 5.53 mg/L (\bar{x} = 2.45 mg/L), and pH ranged from 7.9 to 8.3 (\bar{x} = 8.11). Substrates at all sites in Leland Harris were primarily organic and silt.

Length frequency distributions of least chub at Leland Harris (Figure 4) show that the greatest number of fish caught were between the lengths of 41 and 48 mm. Mean length of least chub captured at Leland Harris was 42.9 ± 4.8 mm. Trend data of least chub captured at Leland Harris between 1993 and 2004 is shown in Figure 7. Least chub populations at Leland Harris have remained relatively stable since annual monitoring began in 1993 (Figure 7).

Gandy Marsh (Sample # 04-013 - 04-064)

Least chub were captured in nine of 52 (17.3%) sites sampled at Gandy Marsh complex (Table 1). Species present in this complex included least chub, Utah chub, and speckled dace (Table 7). Least chub comprised 63.5% (least chub = 120; Utah chub = 41; speckled dace = 28) of all fish captured (Table 6). Livestock damage was concentrated at sites outside of exclosures and was mostly low except for a few moderate sites. Among sites containing least chub, average water depth ranged from 0.4 to 3.5 m and surface water temperatures ranged from 12.0° to 19.8° C (\bar{x} = 14.9° C). Dissolved oxygen ranged from 1.64 to 5.54 mg/L (\bar{x} = 3.81 mg/L), and pH ranged from 7.9 to 8.3 (\bar{x} = 8.1). Substrate of the majority of sites in the Gandy Marsh complex was organic with an occurrence of silt to a lesser extent. The ongoing drought

continues to affect water levels at the Gandy Marsh complex. Although the water levels were higher in 2004 than previous years, most of the water was still confined to spring heads.

Length frequency distributions of least chub at Gandy Marsh (Figure 5) show that the majority of fish collected were between 38 and 52 mm in length. Mean length of least chub captured at Gandy Marsh was 43.7 ± 7.6 mm. The percentage of sampling sites containing least chub have gradually declined in the last 12 years (Figure 8).

Bishop Springs (Sample # 04-065 - 04-077)

Least chub were captured in seven of 13 (53.8%) sites sampled at Bishop Springs (Table 1). Species present in this complex included least chub, Utah chub, and speckled dace (Table 9). Least chub comprised 7.8% (least chub = 16; Utah chub = 184; speckled dace = 4) of all trapped fish (Table 8). Black spot cysts appeared on many least chub and Utah chub captured throughout Bishop Springs. Ungulate damage was low at all sites, however, at Twin Springs South, livestock have severely impacted banks, resulting in shallower water, and increased surface area and sedimentation of the spring. Among sites containing least chub, average water depth ranged from 0.3 to >2.0 m, with surface water temperatures ranging from 15.2° to 21.0°C ($\bar{x} = 18.19^\circ\text{C}$). Dissolved oxygen ranged from 4.83 to 8.05 mg/L ($\bar{x} = 6.82$ mg/L), and pH ranged from 7.9 to 8.3 ($\bar{x} = 8.17$). Organic material and clay constituted the major substrates at all Bishop Springs sites.

Least chub length frequency distributions for Bishop Springs show that most fish collected were between 41 and 48 mm in length (Figure 6). Mean length of least chub captured at Bishop Springs was 42 ± 4.2 mm. For the first time since 1996, water levels at Bishop were high enough to sample fish at all sites. Previously, northern and western portions of Bishop Springs dried annually due to dewatering at Foote Reservoir. Trend data of least chub captured at Bishop Springs between 1993 and 2004 is shown Figure 9. Although least chub populations have been highly variable, the population has remained relatively stable since annual monitoring began in 1993. The variability detected in the Bishop Springs least chub population is primarily due to periodic de-watering associated with the diversion of Foote Reservoir. Since 1996, this

area has annually dried and refilled, likely acting as an ongoing population sink for least chub produced in other portions of Bishop Springs (e.g. Twin Springs, Central Spring).

SUMMARY

Leland Harris

- Least chub were trapped in eight of 12 (66.7%) of the springs at Leland Harris (Table 1).
- Since annual monitoring began in 1993, Leland Harris has yielded the highest percentage of springs containing least chub nine of 11 years (Table 1).
- All Leland Harris sites have yielded least chub at least once since monitoring began in 1993.
- Least chub populations at Leland Harris have remained relatively stable (Figure 7).

Gandy Marsh

- Least chub were trapped in nine of 52 (17.3%) of the springs at Gandy Marsh (Table 1). This is the second lowest percentage of sites containing least chub recorded since monitoring began in 1993.
- Livestock damage at Gandy has been controlled by the construction of exclosures, and has been confined to areas outside of these exclosures.
- Least chub have been captured in a total of 29 different springs since 1993 (Table 7).
- There has been a gradual decline in the Gandy least chub population since 1993 (Figure 8).

Bishop Springs

- Least chub were trapped in seven of 13 (53.8%) of the springs at Bishop Springs (Table 1). This is an increase from 2003, and comparable to previous years (Figure 9).
- Although water levels were higher in 2004 than previous years, dewatering at Foote Reservoir continues to reduce habitat and threaten the long-term viability of least chub at Bishop Springs.

Table 1. Number and percentage of springs where least chub were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004.

| Year | Leland Harris | Gandy | Bishop Springs | Total |
|-------------|----------------------|------------------|-----------------------|------------------|
| 1993 | 07 of 11 (63.6%) | 22 of 50 (44.0%) | 11 of 13 (84.6%) | 40 of 74 (54.1%) |
| 1994 | 08 of 12 (66.7%) | 18 of 50 (36.0%) | 07 of 13 (53.8%) | 33 of 75 (44.0%) |
| 1995 | 10 of 12 (83.3%) | 15 of 50 (30.0%) | 05 of 11 (45.5%) | 30 of 73 (41.1%) |
| 1996 | 08 of 12 (66.7%) | 15 of 50 (30.0%) | 08 of 13 (61.5%) | 31 of 75 (41.3%) |
| 1997 | 10 of 12 (83.3%) | 13 of 50 (26.0%) | 05 of 13 (38.5%) | 28 of 75 (37.3%) |
| 1998 | 09 of 12 (75.0%) | 15 of 51 (29.4%) | 09 of 13 (69.2%) | 33 of 76 (43.4%) |
| 1999 | 10 of 12 (83.3%) | 15 of 51 (29.4%) | 07 of 13 (53.9%) | 32 of 76 (42.1%) |
| 2000 | 09 of 12 (75.0%) | 15 of 52 (28.9%) | 08 of 13 (61.5%) | 32 of 77 (41.6%) |
| 2001 | 07 of 12 (58.3%) | 11 of 52 (21.2%) | 08 of 13 (61.5%) | 26 of 77 (33.8%) |
| 2002 | 09 of 12 (75.0%) | 11 of 52 (21.2%) | 09 of 13 (69.2%) | 29 of 77 (37.7%) |
| 2003 | 08 of 12 (66.7%) | 08 of 52 (15.4%) | 05 of 13 (38.5%) | 21 of 77 (27.3%) |
| 2004 | 08 of 12 (66.7%) | 09 of 52 (17.3%) | 07 of 13 (53.8%) | 24 of 77 (31.1%) |

Table 2. Number and percentage of springs where Utah chub were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004.

| Year | Leland Harris | Gandy | Bishop Springs | Total |
|-------------|----------------------|------------------|-----------------------|------------------|
| 1993 | 09 of 11 (81.8%) | 07 of 50 (14.0%) | 10 of 13 (76.9%) | 26 of 74 (35.1%) |
| 1994 | 07 of 12 (58.3%) | 08 of 50 (16.0%) | 08 of 13 (61.5%) | 23 of 75 (30.7%) |
| 1995 | 08 of 12 (66.7%) | 14 of 50 (28.0%) | 09 of 11 (81.8%) | 31 of 73 (42.5%) |
| 1996 | 08 of 12 (66.7%) | 10 of 50 (20.0%) | 09 of 13 (69.2%) | 27 of 75 (36.0%) |
| 1997 | 10 of 12 (83.3%) | 05 of 50 (10.0%) | 06 of 13 (46.2%) | 21 of 75 (28.0%) |
| 1998 | 08 of 12 (66.7%) | 09 of 51 (17.7%) | 09 of 13 (69.2%) | 26 of 76 (34.2%) |
| 1999 | 09 of 12 (75.0%) | 04 of 51 (07.8%) | 07 of 13 (53.9%) | 20 of 76 (26.3%) |
| 2000 | 08 of 12 (66.7%) | 04 of 52 (07.7%) | 09 of 13 (69.2%) | 21 of 77 (27.3%) |
| 2001 | 10 of 12 (83.3%) | 04 of 52 (07.7%) | 10 of 13 (76.9%) | 24 of 77 (31.2%) |
| 2002 | 07 of 12 (58.3%) | 04 of 52 (07.7%) | 12 of 13 (92.3%) | 23 of 77 (29.9%) |
| 2003 | 08 of 12 (66.7%) | 03 of 52 (5.8%) | 08 of 13 (61.5%) | 19 of 77 (24.7%) |
| 2004 | 09 of 12 (75.0%) | 03 of 52 (5.8%) | 11 of 13 (84.6%) | 23 of 77 (29.9%) |

Table 3. Number and percentage of springs where speckled dace were captured at Leland Harris, Gandy Marsh, and Bishop Springs from 1993 to 2004.

| Year | Leland Harris | Gandy | Bishop Springs | Total |
|------|-----------------|------------------|------------------|------------------|
| 1993 | 0 of 11 (00.0%) | 27 of 50 (54.0%) | 05 of 13 (38.5%) | 32 of 74 (43.2%) |
| 1994 | 0 of 12 (00.0%) | 13 of 50 (26.0%) | 02 of 13 (15.4%) | 15 of 75 (20.0%) |
| 1995 | 0 of 12 (00.0%) | 15 of 50 (30.0%) | 03 of 11 (27.3%) | 18 of 73 (24.7%) |
| 1996 | 0 of 12 (00.0%) | 21 of 50 (42.0%) | 00 of 13 (00.0%) | 21 of 75 (28.0%) |
| 1997 | 0 of 12 (00.0%) | 14 of 50 (28.0%) | 00 of 13 (00.0%) | 14 of 75 (18.7%) |
| 1998 | 0 of 12 (00.0%) | 07 of 51 (13.7%) | 02 of 13 (15.4%) | 09 of 76 (11.8%) |
| 1999 | 0 of 12 (00.0%) | 03 of 51 (05.9%) | 02 of 13 (15.4%) | 05 of 76 (06.6%) |
| 2000 | 0 of 12 (00.0%) | 10 of 52 (19.2%) | 02 of 13 (15.4%) | 12 of 77 (15.6%) |
| 2001 | 0 of 12 (00.0%) | 07 of 52 (13.5%) | 04 of 13 (30.8%) | 11 of 77 (14.3%) |
| 2002 | 0 of 12 (00.0%) | 10 of 52 (19.2%) | 02 of 13 (15.4%) | 12 of 77 (15.6%) |
| 2003 | 0 of 12 (00.0%) | 05 of 52 (09.6%) | 03 of 13 (23.1%) | 08 of 77 (10.4%) |
| 2004 | 0 of 12 (00.0%) | 11 of 52 (21.2%) | 02 of 13 (15.4%) | 13 of 77 (16.9%) |

Table 4. Species and number of fish captured by spring (n=12) at Leland Harris springs, Snake Valley, Utah from 1999 to 2004.

| Spring | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 1 | LC=19,UC=31 | UC=5 | UC=4 | - | LC=2,UC=25 | LC=1,UC=11 |
| 2a | LC=81,UC=28 | LC=32,UC=15 | LC=34,UC=123 | LC=3,UC=121 | UC=43 | LC=1,UC=125 |
| 2b | LC=84,UC=36 | LC=16,UC=16 | LC=4,UC=84 | LC=53,UC=121 | LC=38,UC=244 | LC=22,UC=115 |
| 3 | LC=120,UC=2 | LC=32 | LC=19,UC=52 | LC=8,UC=3 | LC=6,UC=1 | LC=2,UC=4 |
| 4 | LC=15 | LC=12 | LC=21 | LC=16 | LC=11 | - |
| 5 | LC=210 | LC=14 | LC=7,UC=3 | LC=6 | - | LC=2 |
| 6 | LC=2 | LC=4 | UC=12 | LC=9,UC=5 | LC=2 | LC=11,UC=5 |
| 7 | LC=42,UC=165 | LC=8,UC=99 | LC=32,UC=185 | LC=138,UC=43 | LC=11,UC=101 | LC=185,UC=10 |
| 8 | LC=6,UC=17 | UC=4 | - | - | UC=1 | - |
| 9 | UC=182 | UC=5 | UC=138 | LC=1,UC=45 | UC=12 | UC=15 |
| 10 | UC=34 | LC=1,UC=1 | UC=46 | - | LC=2,UC=6 | UC=1 |
| 11 | LC=16,UC=123 | LC=213,UC=30 | LC=93,UC=2 | LC=9,UC=9 | LC=9 | LC=18,UC=7 |
| Total | LC=595,UC=61 | LC=332,UC=17 | LC=210,UC=64 | LC=243,UC=34 | LC=81,UC=433 | LC=242,UC=38 |

Fish trapped: LC = least chub, UC = Utah chub

Table 5. Species of fish captured by spring (n=12) at Leland Harris, Snake Valley, Utah from 1993 to 2004.

| Spring | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | LC, UC | LC, UC | LC, UC | LC, UC | UC | LC, UC | LC, UC | UC | UC | - | LC, UC | LC, UC |
| 2a | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | UC | LC, UC |
| 2b | - | LC, UC | LC, UC | LC, UC | LC, UC | LC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC |
| 3 | LC | LC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC | LC, UC | LC, UC | LC, UC | LC,UC |
| 4 | LC | LC | LC | LC | LC | LC | LC | LC | LC | LC | LC | |
| 5 | UC | - | LC | - | LC | LC | LC | LC | LC, UC | LC | - | LC |
| 6 | LC, UC | LC, UC | LC, UC | LC | LC, UC | UC | LC | LC | UC | LC, UC | LC | LC, UC |
| 7 | UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC |
| 8 | LC, UC | - | LC | - | LC, UC | LC | LC, UC | UC | - | - | UC | |
| 9 | UC | - | UC | UC | UC | UC | UC | UC | UC | LC, UC | UC | UC |
| 10 | UC | - | - | UC | LC, UC | UC | UC | LC, UC | UC | - | LC, UC | UC |
| 11 | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC | LC, UC |

Fish trapped: LC = least chub, UC = Utah chub

Table 6. Species and number of fish captured by spring (n = 52) in the Gandy Marsh, Snake Valley, Utah from 1999 to 2004.

| Spring No. | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|------------|------------------------|-------------------|-------------------------|--------------------------|-------------------------|-------------------|
| 1 | - | - | - | - | Water Depth < 5cm | - |
| 2 | - | - | - | - | - | - |
| 3 | - | - | - | - | Water Depth < 5cm | - |
| 4 | SD = 1 | - | - | - | - | - |
| 5 | LC = 19 | LC = 9, SD = 1 | LC = 22, SD = 4 | LC = 3, SD = 8 | - | SD=1 |
| 6 | LC = 1 | LC = 7, SD = 2 | - | LC = 5, SD = 2 | - | - |
| 7 | Water Depth < 5cm | Water Depth < 5cm | Water Depth < 5cm | Water Depth < 5cm | - | - |
| 8 | LC = 11 | LC = 33 | LC = 115, SD = 13 | LC = 240, SD = 29 | LC = 1, SD = 1 | LC=58, SD=3 |
| 9 | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - |
| 11 | - | - | - | Water Depth < 5cm | - | - |
| 12 | - | LC = 1 | - | Water Depth < 5cm | Water Depth < 5cm | - |
| 13 | - | - | - | - | - | - |
| 14 | LC = 164, UC = 1 | LC = 25, UC = 4 | LC = 51, UC = 2 | LC = 41, SD = 13 | - | SD=1 |
| 15 | LC = 3 | - | Water Depth < 5cm | Water Depth < 5cm | - | - |
| 16 | LC = 1, UC = 1 | LC = 1 | LC = 4, UC = 7 | - | LC = 13, UC = 15 | LC=7, UC=38, SD=2 |
| 17 | LC = 13 | LC = 21 | LC = 72, UC = 2, SD = 1 | LC = 12, UC = 19, SD = 1 | LC = 8, UC = 35, SD = 2 | LC=5, UC=2, SD=3 |
| 18 | - | Water Depth < 5cm | - | Water Depth < 5cm | - | - |
| 19 | - | - | - | Water Depth < 5cm | - | - |
| 20 | LC = 5 | LC = 4, UC = 2 | LC = 14 | LC = 7, UC = 13 | LC = 11, UC = 1 | - |
| 21 | - | - | - | - | - | - |
| 22 | - | - | - | Water Depth < 5cm | - | - |
| 23 | - | - | - | - | - | - |
| 24 | - | - | - | Water Depth < 5cm | - | - |
| 25 | Water Depth < 5cm | - | Water Depth < 5cm | Water Depth < 5cm | - | - |
| 26 | LC = 2, UC = 4, SD = 1 | SD = 1 | UC = 1 | UC = 2 | - | - |
| 27 | - | - | - | - | - | - |

Table 6. (continued).

| Spring No. | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|--------------|---------------------------------|-----------------------------------|-----------------------------------|------------------------------------|-----------------------------------|-----------------------------|
| 28 | LC = 335 | LC = 56, SD = 8 | LC = 16, SD = 8 | LC = 50, SD = 23 | LC = 2, UC = 6 | LC=2, SD=2 |
| 29-37 | LC = 18 | LC = 40, SD = 5 | - | SD = 1 | - | SD=4 |
| 38 | LC = 134 | LC = 219 | LC = 378, SD = 273 | LC = 112, SD = 18 | LC = 100, SD = 2 | LC=1 |
| 39 | SD = 1 | LC = 9, SD = 3 | LC = 54, SD = 273 | LC = 7, SD = 7 | - | LC=1, UC=4 |
| 40 | - | SD = 1 | SD = 4 | - | SD = 2 | - |
| 41 | - | - | - | - | - | - |
| 42 | - | - | - | - | LC = 1 | LC=2 |
| 43 | - | - | - | - | - | - |
| 44 | LC = 5, UC = 2 | LC = 117 | LC = 5 | LC = 29, UC = 4 | - | LC=36, UC=1, SD=2 |
| 45 | - | SD = 1 | - | - | - | - |
| 46 | LC = 21 | LC = 29 | LC = 24 | - | - | - |
| 47 | - | - | - | - | - | SD=1 |
| 48 | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - |
| 50 | - | Water Depth < 5cm | Water Depth < 5cm | Water Depth < 5cm | Water Depth < 5cm | - |
| 51 | - | - | - | - | - | - |
| 52 | - | Water Depth < 5cm | - | - | - | - |
| 53 | - | LC = 12, SD = 16 | Water Depth < 5cm | LC = 13, SD = 5 | LC = 1 | LC=8, SD=5 |
| 54 | - | UC = 16, SD = 1 | - | - | - | - |
| 55 | - | UC = 2 | - | - | - | - |
| 56 | - | - | - | - | - | - |
| 57 | LC = 1 | Water Depth < 5cm | Water Depth < 5cm | Water Depth < 5cm | - | - |
| 58 | - | - | - | - | - | - |
| 59 | Not Sampled | - | - | - | - | - |
| 60 | - | - | - | - | - | - |
| Total | LC = 732, UC = 8, SD = 3 | LC = 583, UC = 24, SD = 39 | LC = 755, UC = 12, SD = 30 | LC = 519, UC = 38, SD = 107 | LC = 137, UC = 51, SD = 13 | LC=120, UC=41, SD=28 |

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

Table 7. Species of fish captured by spring (n=52) at Gandy Marsh, Snake Valley, Utah from 1993 to 2004.

| Spring | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|--------|--------|------------|------------|------------|------------|--------|------------|--------|------------|------------|------------|------------|
| 1 | - | - | - | - | - | - | - | - | - | - | * | - |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | * | - |
| 4 | SD | - | - | - | - | SD | SD | - | - | - | - | - |
| 5 | SD | LC | - | LC, SD | - | - | LC | LC, SD | LC, SD | LC, SD | - | SD |
| 6 | LC | LC | LC | LC, SD | SD | LC | LC | LC, SD | - | LC, SD | - | - |
| 7 | - | * | * | * | * | * | * | * | * | * | - | - |
| 8 | LC, SD | LC | LC, SD | LC | LC | LC | LC | LC | LC, SD | LC, SD | LC, SD | LC, SD |
| 9 | - | SD | - | LC, UC, SD | LC | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | LC, SD | UC | - | - | - | - | - | - | - | * | - | - |
| 12 | LC, SD | LC | LC | LC | - | LC, UC | - | LC | - | * | * | - |
| 13 | - | - | - | - | SD | - | - | - | - | - | - | - |
| 14 | LC, SD | LC, SD | LC, UC, SD | LC, UC, SD | LC, SD | LC | LC, UC | LC, UC | LC, UC | LC, SD | - | SD |
| 15 | LC, SD | - | - | - | * | * | LC | - | * | * | - | - |
| 16 | LC, UC | LC, UC | UC | UC, SD | UC, SD | UC | LC, UC | LC | LC, UC | - | LC, UC | LC, UC, SD |
| 17 | LC, UC | LC, UC, SD | LC, UC, SD | LC, UC, SD | LC, UC, SD | LC | LC | LC | LC, UC, SD | LC, UC, SD | LC, UC, SD | LC, UC, SD |
| 18 | - | - | - | - | - | - | - | * | - | * | - | - |
| 19 | - | - | - | - | - | - | - | - | - | * | - | - |
| 20 | SD | SD | UC | UC | - | LC, UC | LC | LC, UC | LC | LC, UC | LC, UC | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | SD | - | UC | - | - | - | - | - | - | * | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | LC | - | UC | SD | - | - | - | - | - | * | - | - |
| 25 | - | - | * | * | * | - | * | - | * | * | - | - |
| 26 | LC, SD | UC | LC, UC | - | UC | UC | LC, UC, SD | Sd | UC | UC | - | - |
| 27 | SD | - | - | SD | - | - | - | - | - | - | - | - |

Table 7. (continued)

| Spring | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|--------|---------|------------|------------|------------|--------|--------|--------|--------|--------|--------|--------|------------|
| 28 | LC | LC | UC | LC, SD | LC | LC, SD | LC | LC, SD | LC, SD | LC, SD | LC, UC | LC, SD |
| 29-37 | LC, SD | - | LC, SD | LC, SD | LC, SD | LC, SD | LC | LC, SD | - | SD | - | SD |
| 38 | LC, SD | LC, SD | LC, SD | LC | LC | LC | LC | LC | LC, SD | LC, SD | LC, SD | LC |
| 39 | LC, SD | LC, SD | UC, SD | SD | LC, SD | LC, SD | SD | LC, SD | LC, SD | LC, SD | - | LC, UC |
| 40 | SD | - | SD | SD | LC, SD | - | - | SD | SD | - | SD | - |
| 41 | - | - | - | - | - | - | - | - | - | - | - | - |
| 42 | LC, UC, | LC | LC, UC, SD | SD | - | - | - | - | - | - | LC | LC |
| 43 | LC, SD | LC, UC, SD | LC, SD | LC, SD | - | - | - | - | - | - | - | - |
| 44 | LC, UC, | LC, UC | LC, UC, SD | LC, UC, SD | LC | LC, UC | LC, UC | LC | LC | LC, UC | - | LC, UC, SD |
| 45 | LC, UC, | LC, UC, SD | SD | LC, UC, SD | - | LC, UC | - | SD | - | - | - | - |
| 46 | LC, SD | LC, SD | LC, UC, SD | LC, UC, SD | LC, UC | LC | LC | LC | LC | - | - | - |
| 47 | SD | SD | SD | - | - | - | - | - | - | - | - | SD |
| 48 | SD | - | SD | - | SD | - | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - |
| 50 | - | - | - | - | * | * | - | * | * | * | * | - |
| 51 | - | - | - | - | - | LC, UC | - | - | - | - | - | - |
| 52 | - | - | - | SD | SD | - | - | * | - | - | - | - |
| 53 | LC, SD | - | - | SD | LC, SD | LC, SD | - | LC, SD | * | LC, SD | LC | LC, SD |
| 54 | - | LC, SD | - | UC | - | UC, SD | - | UC, SD | - | - | - | - |
| 55 | UC, SD | LC, UC, SD | LC, UC | LC, UC | UC, SD | UC | - | UC | - | - | - | - |
| 56 | LC, SD | LC, SD | LC, SD | SD | LC, SD | SD | - | - | - | - | - | - |
| 57 | LC, UC, | - | LC | SD | LC | - | LC | * | * | * | - | - |
| 58 | SD | - | - | - | SD | - | - | - | - | - | - | - |
| 59 | # | # | # | # | # | # | # | - | - | - | - | - |
| 60 | # | # | # | # | # | - | - | - | - | - | - | - |

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

* = Contained < 5cm of Water

= Site Not Sampled

Table 8. Species and number of fish captured by spring (n = 13) in Bishop Springs, Snake Valley, Utah from 1999 to 2004.

| Spring No. | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|-------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|--------------------------------|
| South Twin | - | ‡ | UC = 1 | UC = 1, † | LC = 2, UC = 18, † | UC=4 |
| North Twin | - | UC = 7 | UC = 30 | UC = 8 | UC = 45 | LC=1, UC=51 |
| 1 | * | * | - | LC = 5, UC = 3, SD = 1 | * | LC=3, UC=14 |
| 2 | * | * | LC = 4 | LC = 2, UC = 2 | * | - |
| 3 | LC = 4 | LC = 8, UC = 5 | LC = 1, UC = 3 | LC = 3, UC = 11 | * | LC=5, UC=1 |
| 4 | - | LC = 12, UC = 12 | LC = 8, UC = 62 | LC = 15, UC = 46 | * | LC=6, UC=29 |
| 5 | LC = 11, UC = 21, SD = 1 | LC = 7, UC = 14, SD = 1 | UC = 19 | LC = 4, UC = 19 | * | UC=2 |
| 6 | LC = 4 | LC = 6, UC = 1 | LC = 7, UC = 5, SD = 3 | LC = 4, UC = 2, SD = 3 | LC = 7, UC = 7, SD = 4 | UC=2 |
| 7 | LC = 5, UC = 91 | LC = 6, UC = 22 | LC = 9, UC = 60, SD = 1 | LC = 4, UC = 38, † | LC = 12, UC = 167 | LC=2, UC=5 |
| 8 | LC = 2, UC = 16 | LC = 6, UC = 38, SD = 1 | LC = 1, UC = 4, SD = 1 | LC = 13, UC = 17 | UC = 12, SD = 3 | LC=1, UC=14, SD=2 |
| 9 | LC = 7, UC = 13 | LC = 1, UC = 39 | UC = 15, SD = 1 | - | LC = 1, UC = 30 | UC=51 |
| 10 | UC = 17, SD = 3 | UC = 52 | LC = 6, UC = 41 | UC = 16 | UC = 22, SD = 4 | SD=2 |
| 11 | LC = 6, UC = 1 | LC = 2 | LC = 17, UC = 8 | LC = 4, UC = 2 | LC = 14, UC = 10 | LC=1, UC=11 |
| Total | LC = 39, UC = 159, SD = 4 | LC = 48, UC = 190, SD = 2 | LC = 53, UC = 248, SD = 6 | LC = 54, UC = 165, SD = 4 | LC = 36, UC = 311, SD = 11 | LC=16, UC=184, SD=4 |

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

† Largemouth bass observed

‡ Largemouth bass and goldfish observed

* = Area de-watered due to diversion of Foote Reservoir

Table 9. Species of fish captured by spring (n=13) at Bishop Springs, Snake Valley, Utah from 1993 to 2004.

| Spring | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---------------|------------|------------|-------------|--------|--------|------------|------------|----------------|------------|------------|------------|-----------|
| S Twin | LC, UC | UC, ‡ | UC, ‡ | UC, ‡ | UC, ‡ | ‡ | - | ‡ | UC | UC, † | LC, UC, † | UC |
| N Twin | UC, ‡ | UC | UC | UC, ‡ | UC, ‡ | UC | - | UC | UC | UC | UC | LC, UC |
| 1 | LC | * | Not Sampled | LC, UC | * | * | * | * | - | LC, UC, SD | * | LC, UC |
| 2 | LC, SD | - | Not Sampled | LC | * | * | * | * | LC, UC | LC, UC | * | - |
| 3 | LC, UC | LC | * | LC, UC | * | LC, UC, SD | LC | LC, UC | LC, UC | LC, UC | * | LC, UC |
| 4 | LC, UC | LC, UC, SD | * | LC, UC | * | LC, UC, LB | - | LC, UC | LC, UC | LC, UC | * | LC, UC |
| 5 | LC, UC, SD | LC, UC | LC, UC, SD | LC, UC | * | LC, UC, SD | LC, UC, SD | LC, UC, SD, LB | UC | LC, UC | * | UC |
| 6 | LC, UC | LC | LC, UC, SD | - | LC | LC | LC | LC, UC | LC, UC, SD | LC, UC, SD | LC, UC, SD | UC |
| 7 | LC, UC, SD | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC, SD | LC, UC, † | LC, UC | LC, UC |
| 8 | UC, SD | LC | LC, UC, SD | LC, UC | LC, UC | LC, UC | LC, UC | LC, UC, SD | LC, UC, SD | LC, UC | UC, SD | LC, UC SD |
| 9 | LC, UC | UC | UC | UC | LC, UC | LC, UC | LC, UC | LC, UC | UC, SD | - | LC, UC | UC |
| 10 | LC, UC, SD | LC, UC | UC | - | UC | LC, UC | UC, SD | UC | LC, UC | UC | UC, SD | SD |
| 11 | LC | UC, SD | LC, UC | LC | LC | LC, UC | LC, UC | LC | LC, UC | LC, UC | LC, UC | LC, UC |

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace, LB = largemouth bass,

† Largemouth bass observed

‡ Largemouth bass and goldfish observed

* Area de-watered due to diversion of Foote Reservoir.

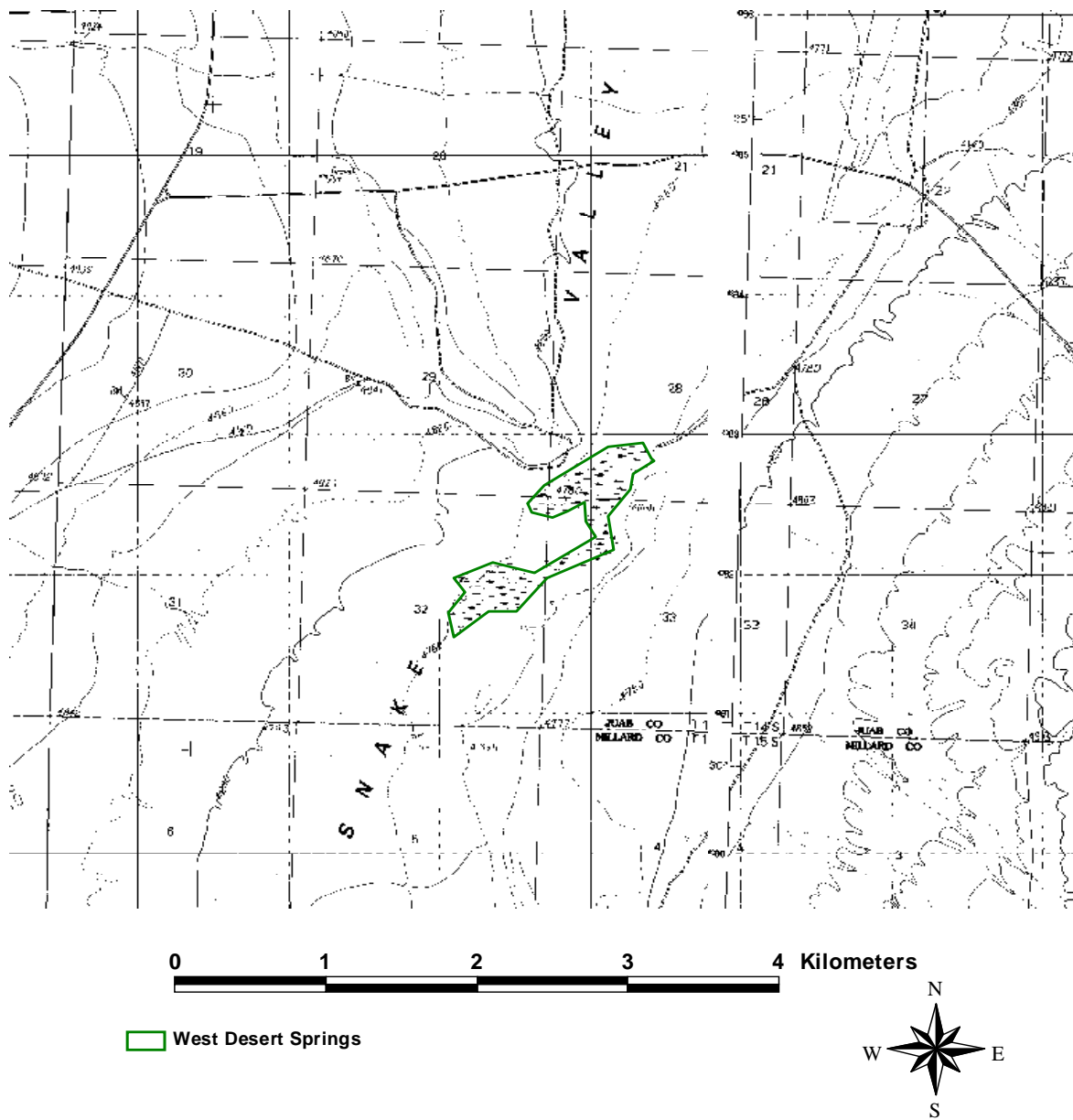


Figure 1. Location of Leland Harris least chub monitoring site. Gandy quadrangle, 7.5 minute series, 1:25,000 Scale, Juab Co., UT.

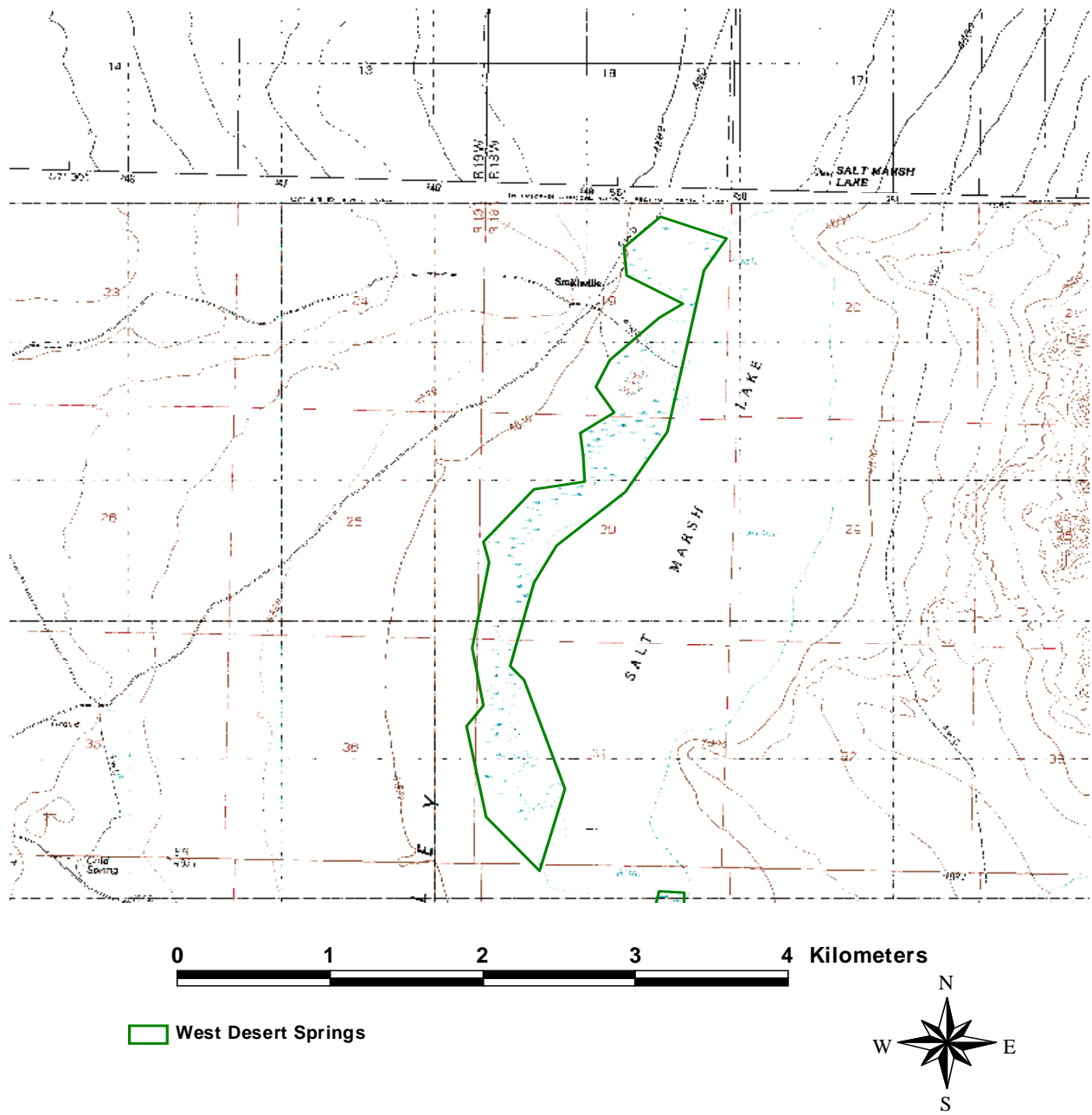


Figure 2. Location of Gandy Marsh least chub monitoring site. Gandy quadrangle, 7.5 minute series, 1:25,000 Scale, Juab Co., UT.

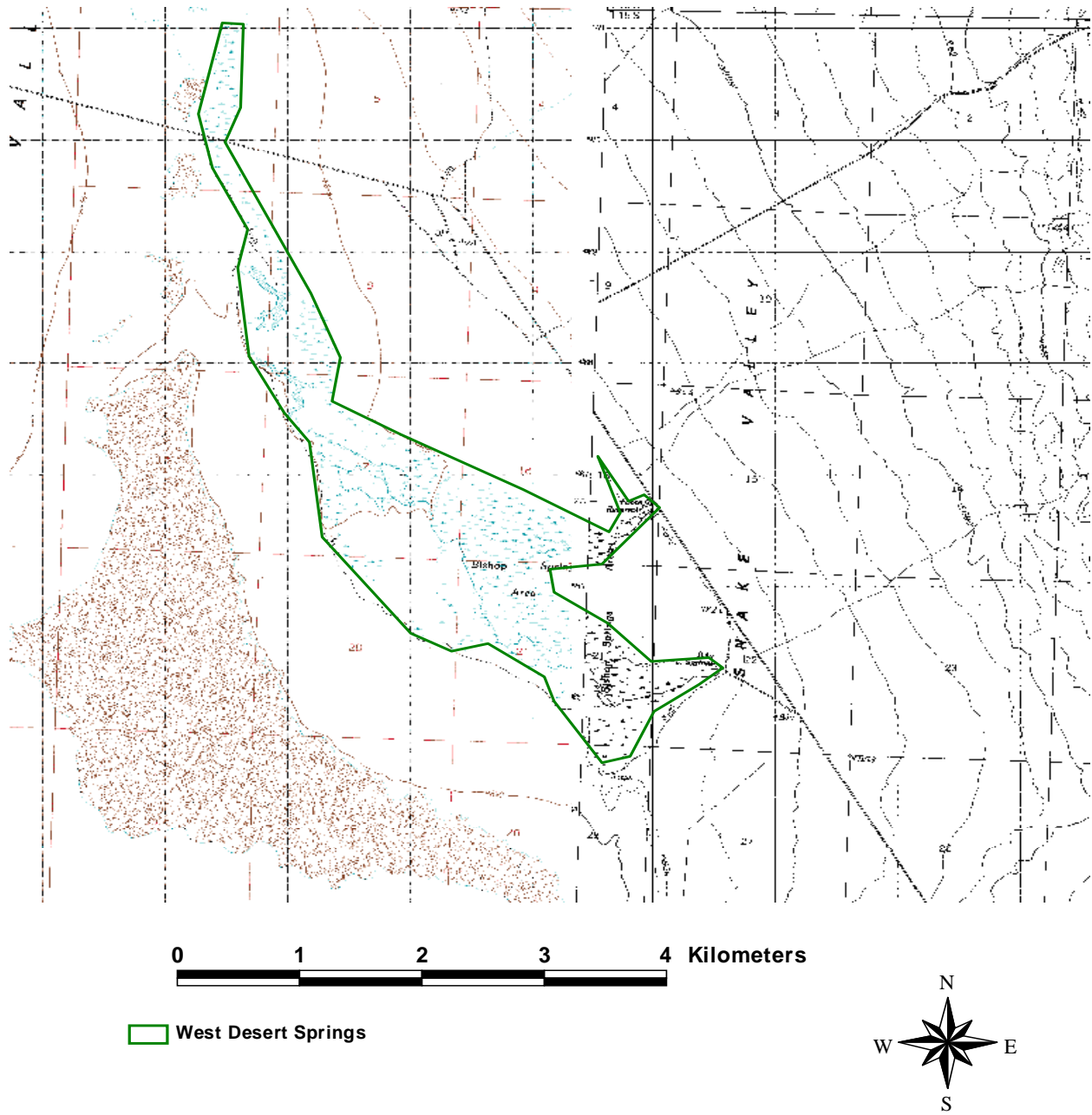


Figure 3. Location of Bishop Springs least chub monitoring site. Gandy quadrangle, 7.5 minute series, 1:25,000 Scale, Juab Co., UT.

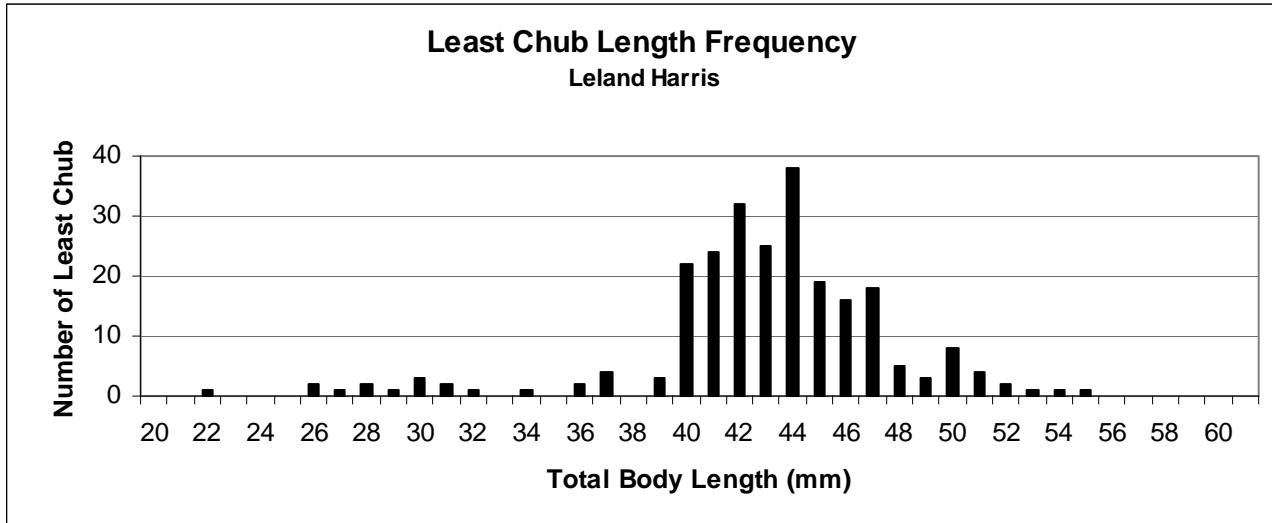


Figure 4. Length frequency distribution of least chub (n = 242) captured at Leland Harris monitoring sites, Snake Valley, Utah, August 2004.

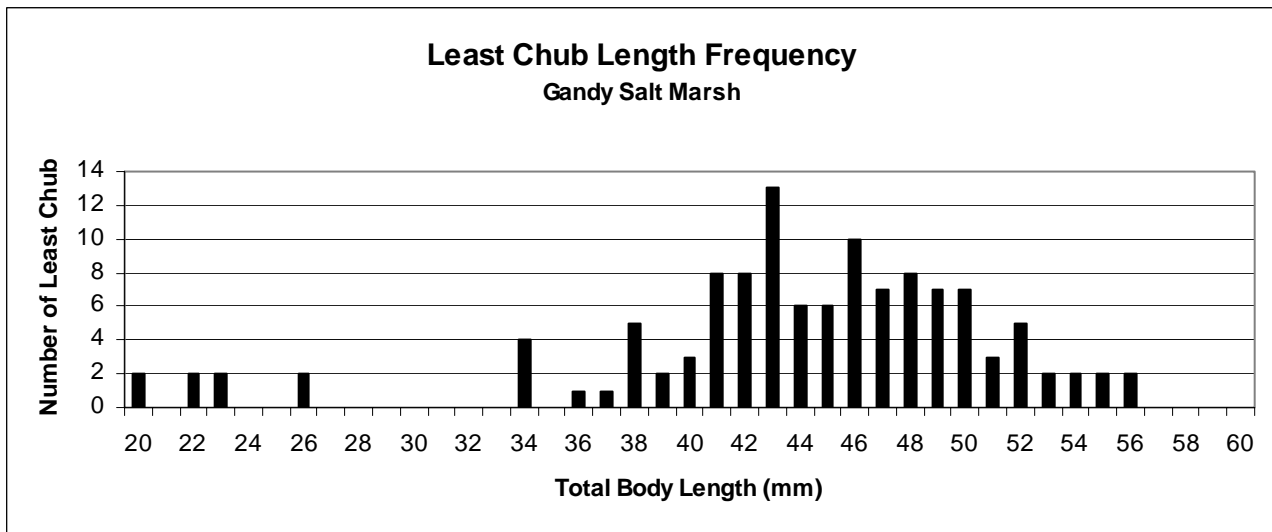


Figure 5. Length frequency distribution of least chub (n = 120) captured at Gandy Marsh monitoring sites, Snake Valley, Utah, August 2004.

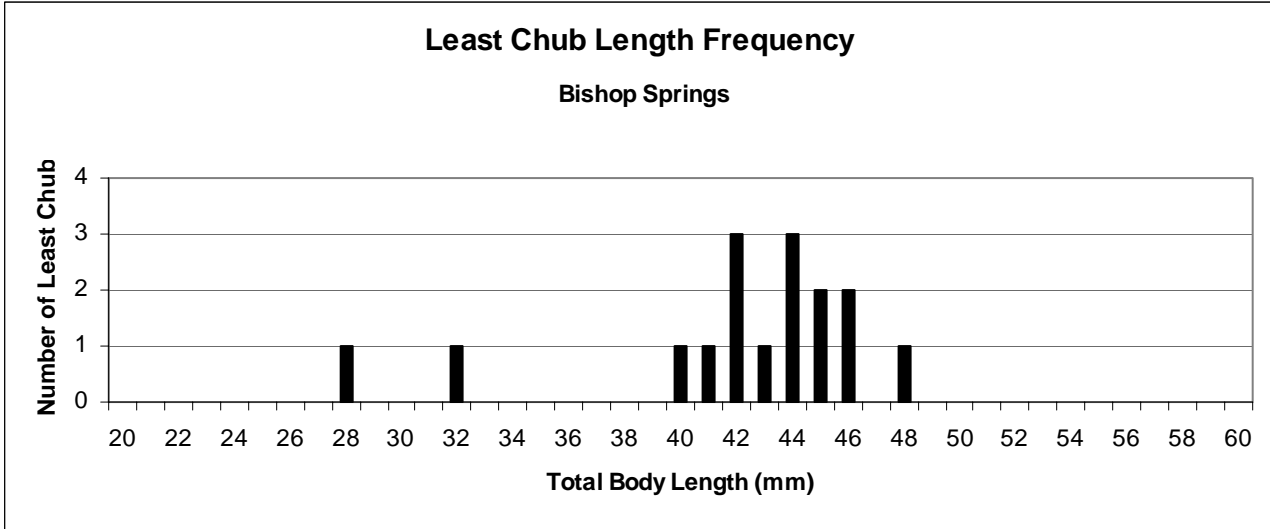


Figure 6. Length frequency distribution of least chub (n = 16) captured at Bishop Springs monitoring sites, Snake Valley, Utah, August 2004.

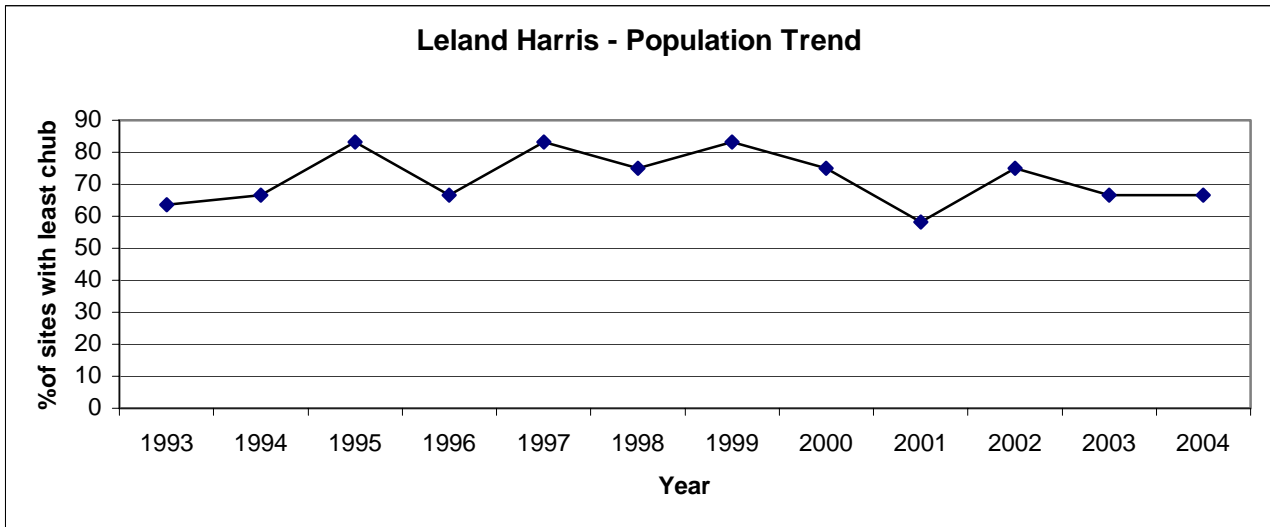


Figure 7. Percentage of sampling sites containing least chub during annual monitoring at Leland Harris, Snake Valley, Utah, from 1993 to 2004.

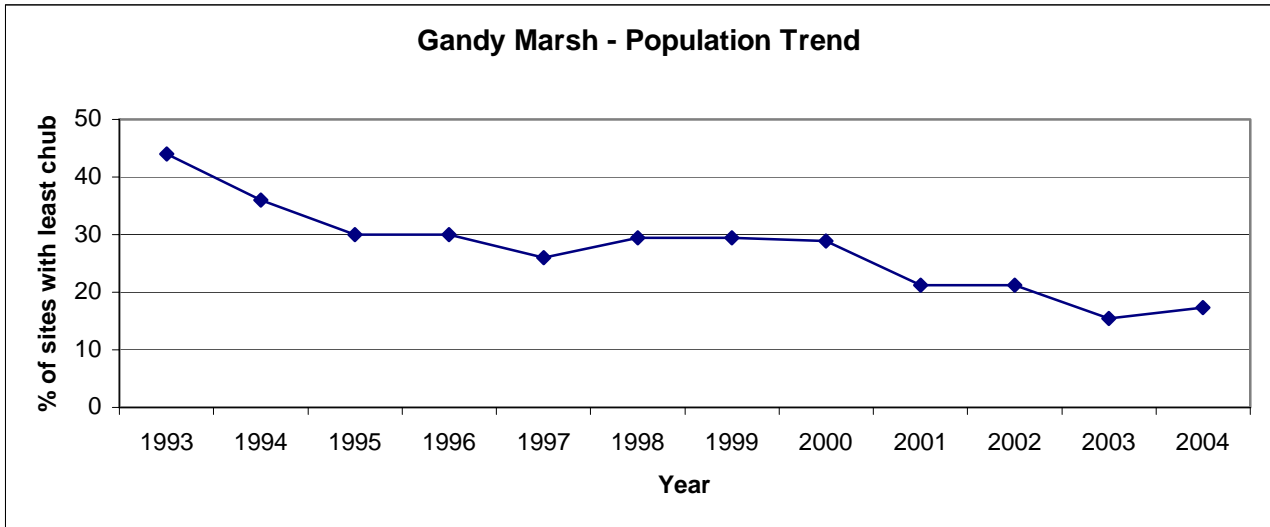


Figure 8. Percentage of sampling sites containing least chub during annual monitoring at Gandy Marsh, Snake Valley, Utah, from 1993 to 2004.

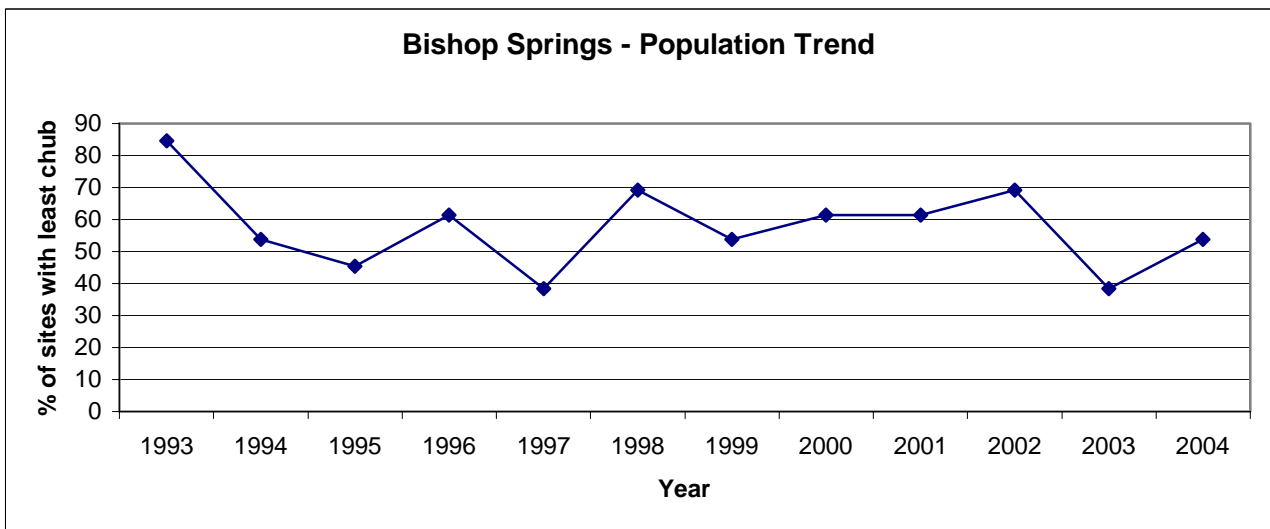


Figure 9. Percentage of sampling sites containing least chub during annual monitoring at Bishop Springs, Snake Valley, Utah, from 1993 to 2004.

LITERATURE CITED

- Crist, L. 1990. A study/monitoring plan for least chub (*Iotichthys phlegethontis*) in Snake Valley, Utah. Utah Division of Wildlife Resources, Salt Lake City, UT. 2 pp.
- Fridell, R.A., and J.W. Marr. 2000. Least Chub (*Iotichthys phlegethontis*) monitoring summary, Snake Valley, Utah. Utah Division of Wildlife Resources Publication Number 00-33. 21 pp.
- Fridell, R.A., and R.W. Malecki. 2001. Least Chub (*Iotichthys phlegethontis*) monitoring summary, Snake Valley, Utah. Utah Division of Wildlife Resources Publication Number 01-28. 20 pp.
- Fridell, R.A., A.M. McLuckie, K.K. Wheeler, M.K. Morvilius, M.A. Schijf, et al. 2003. Southern Region Native Aquatics FY03 field summary program report, July 2003. Utah Division of Wildlife Resources Publication.
- Fridell, R.A., K.L. Schroeder, C.K. Balcombe, T.C. Hogrefe, and K.W. Wilson. 1999. Least chub (*Iotichthys phlegethontis*) monitoring summary, Snake Valley, Utah. Utah Division of Wildlife Resources Publication Number 99-37. 21 pp.
- Fridell, R.A., M.A. Curtis, and K.K. Wheeler. 2003. Least Chub (*Iotichthys phlegethontis*) monitoring summary, Snake Valley, Utah. Utah Division of Wildlife Resources Publication Number 03-25 22 pp.
- Fridell, R.A., R.J. Curtis, S.E. Jones, M.A. Schijf, and K.K. Wheeler. 2002. Least Chub (*Iotichthys phlegethontis*) monitoring summary, Snake Valley, Utah. Utah Division of Wildlife Resources Publication Number 02-28. 20 pp.
- Holden, P., W. White, G. Somerville, D. Duff, R. Gervais, and S. Gloss. 1974. Threatened fishes of Utah. Utah Academy of Science, Arts, and Letters. 2 (2): 46-65.
- Osmundson, D.B. 1985. 1985 Status survey of least chub (*Iotichthys phlegethontis*) in desert springs of western Utah. Utah Division of Wildlife Resources. 18 pp.
- Perkins, M. J., L. D. Lentsch, and J. Mizzi. 1998. Conservation agreement and strategy for least chub (*Iotichthys phlegethontis*) in the State of Utah. Publication No. 98-25. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, UT.
- Sigler, W.F. and R.R. Miller. 1963. Fishes of Utah. Utah Fish and Game Department, Salt Lake City, UT. 203 pp.
- Sigler, W.F. and J.W. Sigler. 1996. Fishes of Utah. University of Utah Press. Salt Lake City, UT. 93 pp.
- Workman G.W., W. Workman, R. Valdez, W. Sigler, and J. Henderson. 1979. Studies on the least chub in geothermal active areas of western Utah. Contract No. YA-512-CT7-21, BLM, Utah State Office, Salt Lake City. 348 pp.