



State of Utah

DEPARTMENT OF NATURAL RESOURCES

Division of Wildlife Resources - Native Aquatic Species

LEAST CHUB
(Iotichthys phlegethontis)

MONITORING SUMMARY

Snake Valley, 2000

Publication Number 00-33
Utah Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, Utah
John F. Kimball, Director

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Snake Valley, 2000

Final Report
October 2000

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INTRODUCTION

Least chub historically occupied a variety of habitats including rivers, clear streams, springs, ponds, and marshes (Sigler and Miller 1963). However, large 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 1940's (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 have 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 Salt Marsh complex, Leland Harris Spring complex, Callao Spring complex, Twin Springs (Bishop Springs), and Redden Springs. Surveys conducted by Utah Division of Wildlife Resources in the mid 1990's found two previously unknown 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).

The first recorded collection of least chub in Snake Valley was by C.L. Hubbs in 1942 at the Gandy Salt 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 Salt Marsh 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. Thus, within Snake Valley, least chub are limited to the Gandy Salt Marsh complex, Leland Harris spring complex, and Bishop Springs complex (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 (*Lotichthys phlegethontis*) in the State of Utah (Perkins et al. 1998) was implemented in an effort to expand least chub populations and enhance their habitat. Conservation actions identified in the Conservation Agreement include: Wetland revegetation, water quality improvements, grazing enclosure construction, surveys of suitable least chub habitat, control of nonnatives, genetic analysis, and monitoring of least chub populations. Long-term population monitoring is necessary to determine least chub trends and their response to implementation of conservation actions.

In August 2000, the Utah Division of Wildlife Resources conducted the eighth 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 (Perkins et al. 1998). The areas sampled and methodology used are consistent with monitoring conducted in previous years (Fridell et al. 1999).

METHODS

In Snake Valley, least chub were sampled at three spring complexes: Leland Harris, Gandy Salt Marsh, and Bishop Springs (Figures 1-3). A total of 77 sites were sampled within these complexes (Leland Harris = 12, Gandy = 52, Bishop Springs = 13). Each of the 77 sites have been designated as an annual monitoring site and have 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. All traps were set at a minimum depth of 5" and were left for 2 to 4 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 1 mm 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 temperature were also recorded at each station.

RESULTS

From August 21, 2000 to August 30, 2000, a field crew totaling 7 individuals surveyed 77 pre-established sites within the Leland Harris, Gandy Salt Marsh, and Bishop Springs complexes. Least chub comprised 69.1% (least chub = 963; Utah chub = 389; speckled dace = 41) of all fish captured in Snake Valley (Tables 4, 6, and 8). Of the 77 springs sampled, least chub occurred in 32 (41.6%), Utah chub (*Gila atraria*) in 21 (27.3%), and speckled dace (*Rhinichthys osculus*) in 12 (15.6%) (Tables 1 - 3). A brief synopsis of the spring complexes follows.

Leland Harris (Sample # 00-001 - 00-012)

Least chub were captured in nine of 12 (75.0%) sites sampled at Leland Harris (Table 1). Species present in this complex included least chub and Utah chub (Table 5). Least chub comprised 65.5% (least chub = 332, Utah chub = 175) of all fish captured (Table 4). Most springs were classified as having low livestock damage consisting of minimal bank disturbance. Springs 2a, 2b, and 10 were classified as having moderate livestock damage consisting of cropped vegetation around spring heads and unstable banks resulting from trampling. Among sites containing least chub, average water depth ranged from 0.09 to 0.55 m and surface water temperature ranged from 14° to 17° C (\bar{x} = 15.1° C). Dissolved oxygen ranged from 1.3 to 17.3 mg/L (\bar{x} = 3.8 mg/L), and pH ranged from 6.4 to 7.8 (\bar{x} = 7.0). Substrate at all sites in Leland Harris was either organic or silt.

Length frequency distributions of least chub at Leland Harris Spring Complex (Figure 4) show that the greatest number of fish caught were between the lengths of 39 and 41 mm. Mean length of least chub captured at Leland Harris was 41 mm.

Gandy Salt Marsh (Sample # 00-013 - 00-064)

Least chub were captured in 15 of 52 (28.9%) sites sampled at Gandy Salt Marsh (Table 1). Species present in this complex included least chub, Utah chub, and speckled dace (Table 7). Least chub comprised 90.2% (least chub = 583; Utah chub = 24; speckled dace = 39) of all fish captured (Table 6). Livestock damage was concentrated at sites outside of exclosures. Among sites containing least chub, average water depth ranged from 0.03 to 1.76 m and surface water temperatures ranged from 14° to 24° C (\bar{x} = 17.3° C). Dissolved oxygen ranged from 1.1 to 10.6 mg/L (\bar{x} = 4.4 mg/L), and pH ranged from 7.0 to 7.8 (\bar{x} = 7.5). Substrate at all sites in the Gandy Salt Marsh complex was either organic or silt. Purple loosestrife (*Lythrum salicaria*) was observed and removed at sites 45 and 46. Water levels at Gandy were the lowest since annual monitoring began in 1993, with most water being confined to spring heads.

Length frequency distribution of least chub at Gandy Salt Marsh (Figure 5) showed that the majority of fish collected were between 41 and 43 mm in length. Mean length of least chub captured at Gandy Salt Marsh was 44 mm.

Bishop Springs (Sample # 00-065 - 00-077)

Least chub were captured in eight of 13 (61.5%) 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 20.0% (least chub = 48; Utah chub = 190; speckled dace = 2) of all trapped fish (Table 8). Black spot cysts (*Uvulifer ambloplitis*) appeared on many least chub and Utah chub captured throughout Bishop Springs. Sites 1 and 2 were dry due to the diversion of flows from Foote Reservoir, so no traps were set. Livestock damage was low at all sites, with the exception of South Twin where damage was high. Among sites containing least chub, water depth ranged from 0.10 to >8.30 m, with surface water temperatures ranging from 19° to 23°C (\bar{x} = 20.6°C). Dissolved oxygen ranged from 3.7 to 8.7 mg/L (\bar{x} = 5.5 mg/L), and pH ranged from 6.8 to 8.0 (\bar{x} = 7.7). Substrate at all sites at Bishop Springs was either organic or silt.

Least chub length frequency distribution for Bishop Springs show that most fish collected were between 42 and 44 mm in length (Figure 6). Mean length of least chub captured at Bishop Springs was 44 mm.

SUMMARY

Leland Harris

- Least chub were trapped in 75.0% of springs at Leland Harris (Table 1).
- Since annual monitoring began in 1993, Leland Harris has continued to yield a high percentage of springs containing least chub (Table 1).
- Site 9 has not yielded least chub since annual monitoring began in 1993 (Table 5).

Gandy Salt Marsh

- Least chub were trapped in 28.9% of springs at Gandy Salt Marsh (Table 1).
- Water levels at Gandy were the lowest since annual monitoring began in 1993. Springs 52 and 57 were completely dry for the first time since monitoring began.
- Livestock damage 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).

Bishop Springs

- Least chub were trapped in 61.5% of springs at Bishop Springs (Table 1).
- Largemouth bass and goldfish have been observed consistently at North Twin and South Twin.
- Sites 1 and 2 have been dry or had less than 5.08 cm (2 inches) of water since 1997, due mainly to the diversion of Foote Reservoir (Table 9).
- Diversions at Foote Reservoir continue to de-water habitat and threaten 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 Salt Marsh, and Bishop Springs spring complexes from 1993 to 2000.

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%)

Table 2. Number and percentage of springs where Utah chub were captured at Leland Harris, Gandy Salt Marsh, and Bishop Springs spring complexes from 1993 to 2000.

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%)

Table 3. Number and percentage of springs where speckled dace were captured at Leland Harris, Gandy Salt Marsh, and Bishop Springs spring complexes from 1993 to 2000.

Year	Leland Harris	Gandy	Bishop Springs	Total
1993	00 of 11 (00.0%)	27 of 50 (54.0%)	05 of 13 (38.5%)	32 of 74 (43.2%)
1994	00 of 12 (00.0%)	13 of 50 (26.0%)	02 of 13 (15.4%)	15 of 75 (20.0%)
1995	00 of 12 (00.0%)	15 of 50 (30.0%)	03 of 11 (27.3%)	18 of 73 (24.7%)
1996	00 of 12 (00.0%)	21 of 50 (42.0%)	00 of 13 (00.0%)	21 of 75 (28.0%)
1997	00 of 12 (00.0%)	14 of 50 (28.0%)	00 of 13 (00.0%)	14 of 75 (18.7%)
1998	00 of 12 (00.0%)	07 of 51 (13.7%)	02 of 13 (15.4%)	09 of 76 (11.8%)
1999	00 of 12 (00.0%)	03 of 51 (05.9%)	02 of 13 (15.4%)	05 of 76 (06.6%)
2000	00 of 12 (00.0%)	10 of 52 (19.2%)	02 of 13 (15.4%)	12 of 77 (15.6%)

Table 4. Species and number of fish captured at springs (n = 12) of the Leland Harris spring complex, Snake Valley, Utah in 1999 and 2000.

Spring No.	Species/Numbers 1999	Species/Numbers 2000
1	LC = 19, UC = 31	UC = 5
2a	LC = 81, UC = 28	LC = 32, UC = 15
2b	LC = 84, UC = 36	LC = 16, UC = 16
3	LC = 120, UC = 2	LC = 32
4	LC = 15	LC = 12
5	LC = 210	LC = 14
6	LC = 2	LC = 4
7	LC = 42, UC = 165	LC = 8, UC = 99
8	LC = 6, UC = 17	UC = 4
9	UC = 182	UC = 5
10	UC = 34	LC = 1, UC = 1
11	LC = 16, UC = 123	LC = 213, UC = 30
Total	LC = 595, UC = 618	LC = 332, UC = 175

LC = Least Chub, UC = Utah Chub

Table 5. Fish species captured at Leland Harris, Snake Valley, Utah from 1993 to 2000.

Spring	1993	1994	1995	1996	1997	1998	1999	2000
1	LC, UC	LC, UC	LC, UC	LC, UC	UC	LC, UC	LC, UC	UC
2a	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC
2b	not sampled	LC, UC	LC, UC	LC, UC	LC, UC	LC	LC, UC	LC, UC
3	LC	LC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC
4	LC	LC	LC	LC	LC	LC	LC	LC
5	UC	-	LC	-	LC	LC	LC	LC
6	LC, UC	LC, UC	LC, UC	LC	LC, UC	UC	LC	LC
7	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
9	UC	UC	UC	UC	UC	UC	UC	UC
10	UC	-	-	UC	LC, UC	UC	UC	LC, UC
11	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC

LC = Least Chub, UC = Utah Chub

Table 6. Species and number of fish captured at springs (n = 52) of the Gandy Salt Marsh spring complex, Snake Valley, Utah in 1999 and 2000.

Spring No.	Species/Numbers 1999	Species/Numbers 2000
1	-	-
2	-	-
3	-	-
4	SD = 1	-
5	LC = 19	LC = 9, SD = 1
6	LC = 1	LC = 7, SD = 2
7	water < 2"	water < 2"
8	LC = 11	LC = 33
9	-	-
10	-	-
11	-	-
12	-	LC = 1
13	-	-
14	LC = 164, UC = 1	LC = 25, UC = 4
15	LC = 3	-
16	LC = 1, UC = 1	LC = 1
17	LC = 13	LC = 21
18	-	water < 2"
19	-	-
20	LC = 5	LC = 4, UC = 2
21	-	-
22	-	-
23	-	-
24	-	-
25	water < 2"	-
26	LC = 2, UC = 4, SD = 1	SD = 1
27	-	-

Table 6. (continued)

Spring No.	Species/Numbers 1999	Species/Numbers 2000
28	LC = 335	LC = 56, SD = 8
29	LC = 18	LC = 40, SD = 5
38	LC = 134	LC = 219
39	SD = 1	LC = 9, SD = 3
40	-	SD = 1
41	-	-
42	-	-
43	-	-
44	LC = 5, UC = 2	LC = 117
45	-	SD = 1
46	LC = 21	LC = 29
47	-	-
48	-	-
49	-	-
50	-	water < 2"
51	-	-
52	-	Dry
53	-	LC = 12, SD = 16
54	-	UC = 16, SD = 1
55	-	UC = 2
56	-	-
57	LC = 1	Dry
58	-	-
59	not sampled	-
60	-	-
Total	LC = 732, UC = 8, SD = 3	LC = 583, UC = 24, SD = 39

LC = Least Chub, UC = Utah Chub, SD = Speckled Dace

Table 7. Fish species captured at Gandy Salt Marsh, Snake Valley, Utah from 1993 to 2000.

Spring	1993	1994	1995	1996	1997	1998	1999	2000
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	SD	-	-	-	-	SD	SD	-
5	SD	LC	-	LC, SD	-	-	LC	LC, SD
6	LC	LC	LC	LC, SD	SD	LC	LC	LC, SD
7	-	water < 2"	water < 2"	water < 2"	water < 2"	water < 2"	water < 2"	water < 2"
8	LC, SD	LC	LC, SD	LC	LC	LC	LC	LC
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
15	LC, SD	-	-	-	water < 2"	water < 2"	LC	-
16	LC, UC	LC, UC	UC	UC, SD	UC, SD	UC	LC, UC	LC
17	LC, UC	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC	LC	LC
18	-	-	-	-	-	-	-	water < 2"
19	-	-	-	-	-	-	-	-
20	SD	SD	UC	UC	-	LC, UC	LC	LC, UC
21	-	-	-	-	-	-	-	-
22	SD	-	UC	-	-	-	-	-
23	-	-	-	-	-	-	-	-
24	LC	-	UC	SD	-	-	-	-
25	-	-	water < 2"	water < 2"	water < 2"	-	water < 2"	-
26	LC, SD	UC	LC, UC	-	UC	UC	LC, UC, SD	SD
27	SD	-	-	SD	-	-	-	-

Table 7. (continued)

Spring	1993	1994	1995	1996	1997	1998	1999	2000
28	LC	LC	UC	LC, SD	LC	LC, SD	LC	LC, SD
29	LC, SD	-	LC, SD	LC, SD	LC, SD	LC, SD	LC	LC, SD
38	LC, SD	LC, SD	LC, SD	LC	LC	LC	LC	LC
39	LC, SD	LC, SD	UC, SD	SD	LC, SD	LC, SD	SD	LC, SD
40	SD	-	SD	SD	LC, SD	-	-	SD
41	-	-	-	-	-	-	-	-
42	LC, UC, SD	LC	LC, UC, SD	SD	-	-	-	-
43	LC, SD	LC, UC, SD	LC, SD	LC, SD	-	-	-	-
44	LC, UC, SD	LC, UC	LC, UC, SD	LC, UC, SD	LC	LC, UC	LC, UC	LC
45	LC, UC, SD	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
47	SD	SD	SD	-	-	-	-	-
48	SD	-	SD	-	SD	-	-	-
49	-	-	-	-	-	-	-	-
50	-	-	-	-	water < 2"	water < 2"	-	water < 2"
51	-	-	-	-	-	LC, UC	-	-
52	-	-	-	SD	SD	-	-	Dry
53	LC, SD	-	-	SD	LC, SD	LC, SD	-	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, SD	-	LC	SD	LC	-	LC	Dry
58	SD	-	-	-	SD	-	-	-
59	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled	-
60	not sampled	not sampled	not sampled	not sampled	not sampled	-	-	-

LC = Least Chub, UC = Utah Chub, SD = Speckled Dace

Table 8. Species and number of fish captured at springs (n = 13) of the Bishop Springs spring complex, Snake Valley, Utah in 1999 and 2000.

Spring No.	Species/Numbers 1999	Species/Numbers 2000
South Twin	-	†
North Twin	-	UC = 7
1	Dry*	Dry*
2	Dry*	Dry*
3	LC = 4	LC = 8, UC = 5
4	-	LC = 12, UC = 12
5	LC = 11, UC = 21, SD = 1	LC = 7, UC = 14, SD = 1
6	LC = 4	LC = 6, UC = 1
7	LC = 5, UC = 91	LC = 6, UC = 22
8	LC = 2, UC = 16	LC = 6, UC = 38, SD = 1
9	LC = 7, UC = 13	LC = 1, UC = 39
10	UC = 17, SD = 3	UC = 52
11	LC = 6, UC = 1	LC = 2
Total	LC = 39, UC = 159, SD = 4	LC = 48, UC = 190, SD = 2

LC = Least Chub, UC = Utah Chub, SD = Speckled Dace

† Largemouth bass and goldfish observed

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

Table 9. Fish species captured at Bishop Springs, Snake Valley, Utah from 1993 to 2000.

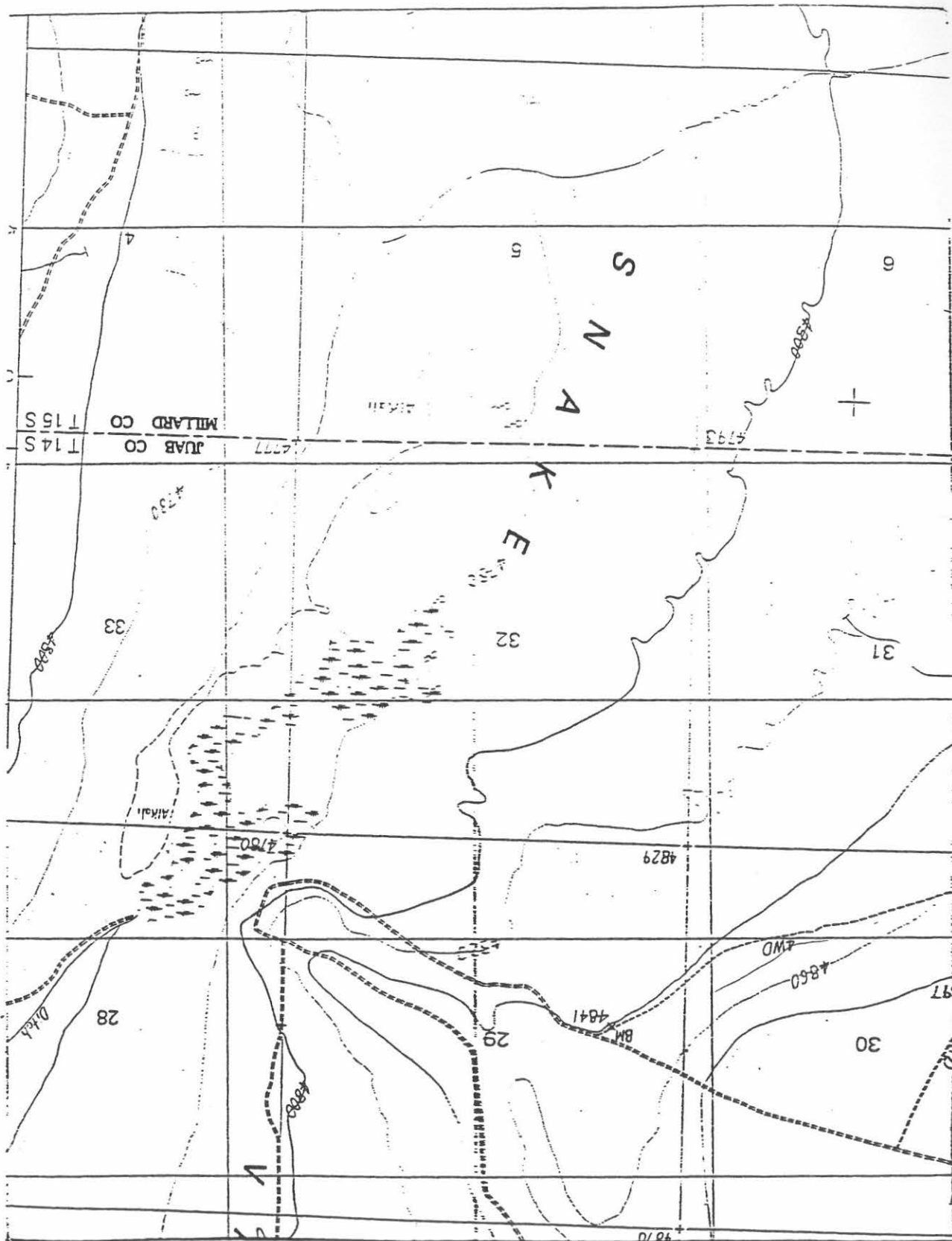
Spring	1993	1994	1995	1996	1997	1998	1999	2000
S Twin	LC, UC	UC, †	UC, †	UC, †	UC, †	-†	-	-†
N Twin	UC, †	UC	UC	UC, †	UC, †	UC	-	UC
1	LC	water < 2"	not sampled	LC, UC	Dry*	water < 2"	Dry*	Dry*
2	LC, SD	-	not sampled	LC	Dry*	water < 2"	Dry*	Dry*
3	LC, UC	LC	Dry*	LC, UC	Dry*	LC, UC, SD	LC	LC, UC
4	LC, UC	LC, UC, SD	Dry*	LC, UC	Dry*	LC, UC, LB	-	LC, UC
5	LC, UC, SD	LC, UC	LC, UC, SD	LC, UC	Dry*	LC, UC, SD	LC, UC, SD	LC, UC, SD, LB
6	LC, UC	LC	LC, UC, SD	-	LC	LC	LC	LC, UC
7	LC, UC, SD	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC
8	UC, SD	LC	LC, UC, SD	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC, SD
9	LC, UC	UC	UC	UC	LC, UC	LC, UC	LC, UC	LC, UC
10	LC, UC, SD	LC, UC	UC	-	UC	LC, UC	UC, SD	UC
11	LC	UC, SD	LC, UC	LC	LC	LC, UC	LC, UC	LC

LC = Least Chub, UC = Utah Chub, SD = Speckled Dace, LB = Largemouth Bass, GF = Goldfish

† Largemouth bass and goldfish were observed at North Twin and South Twin

* 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, Juab Co., UT.



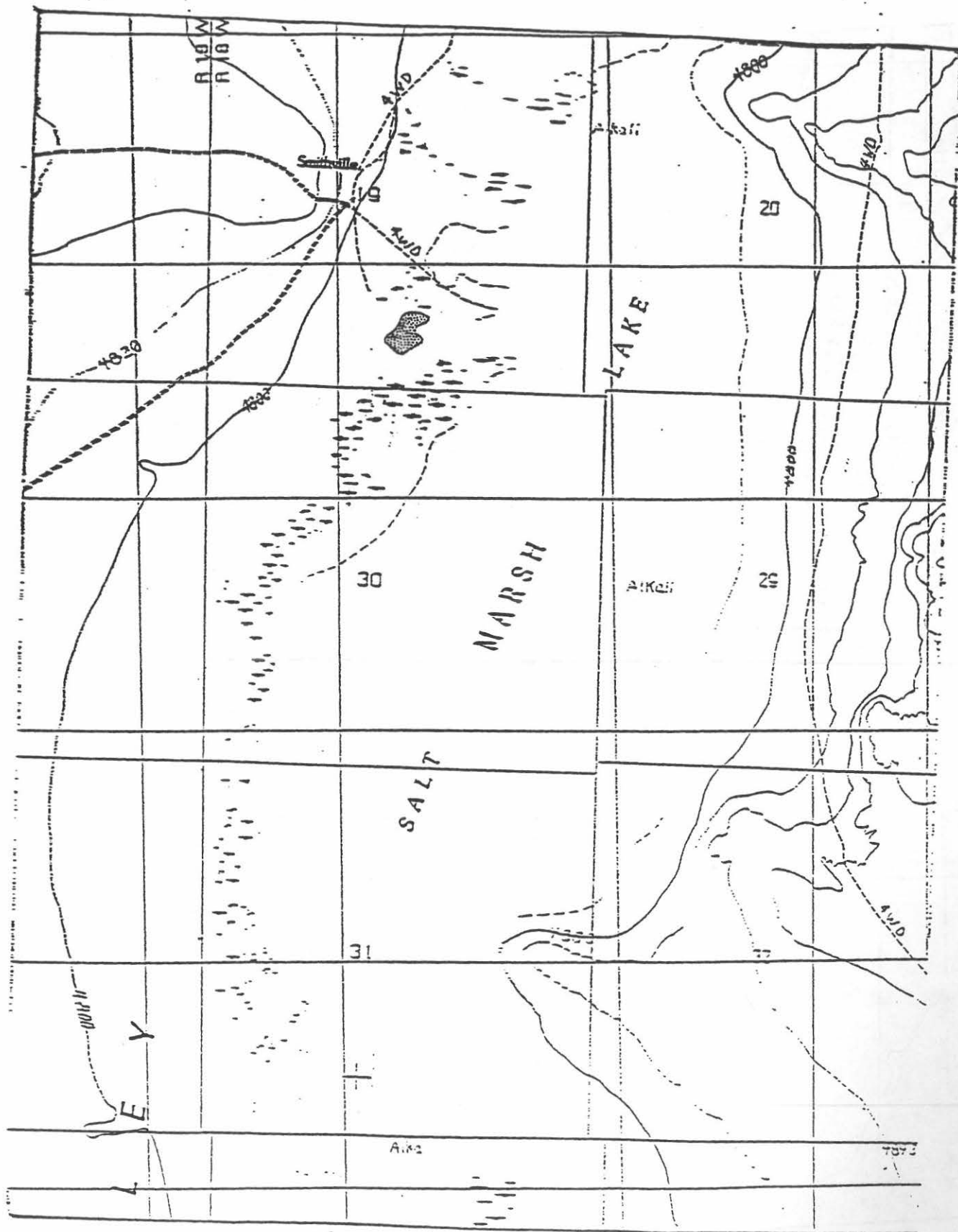


Figure 2. Location of Gandy Salt Marsh least chub monitoring site. Gandy quadrangle, 7.5 minute series, Juab Co., UT.

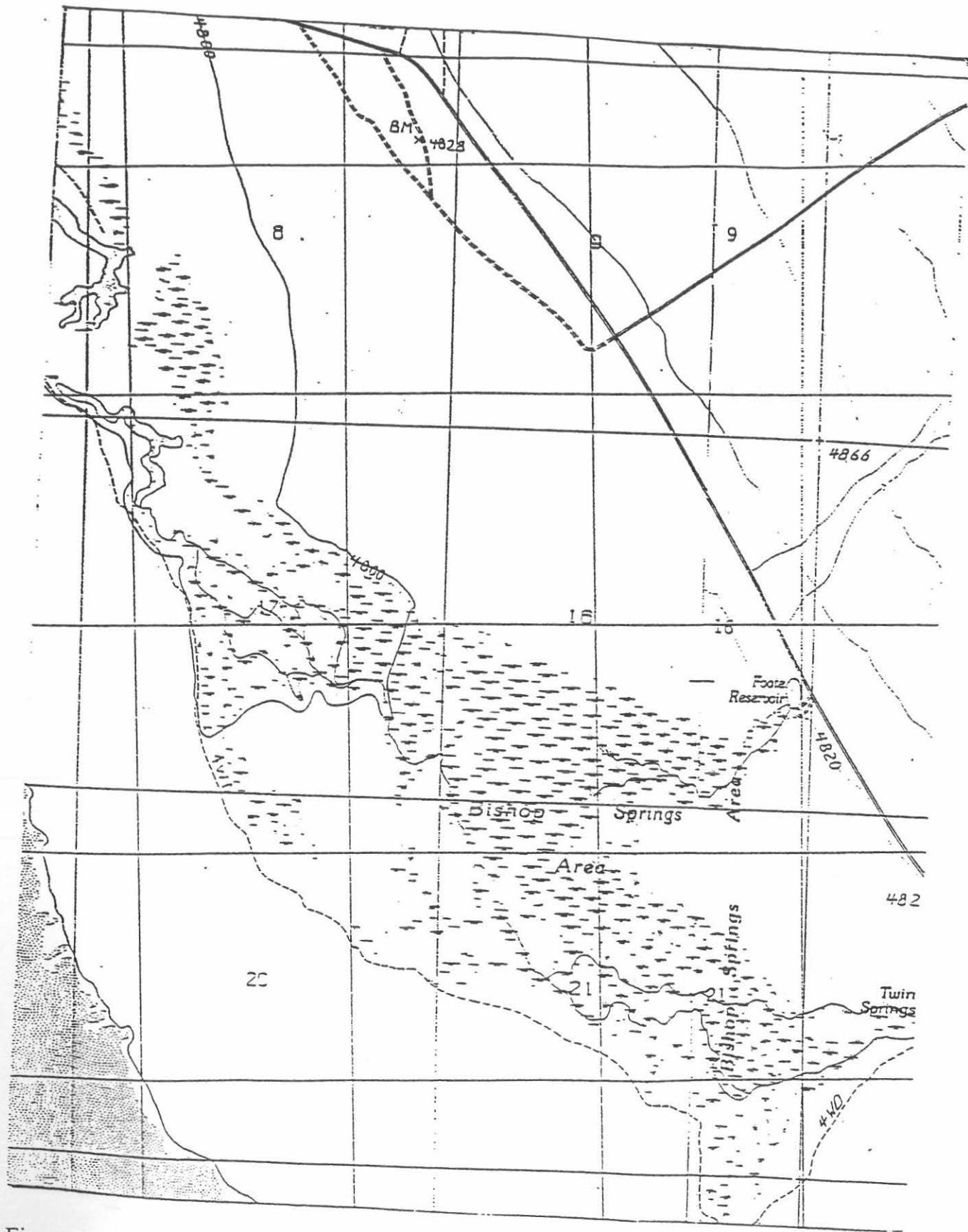


Figure 3. Location of Bishop Springs least chub monitoring site. Gandy quadrangle, 7.5 minute series, Juab Co., UT.

Least Chub Length Frequency

Leland Harris

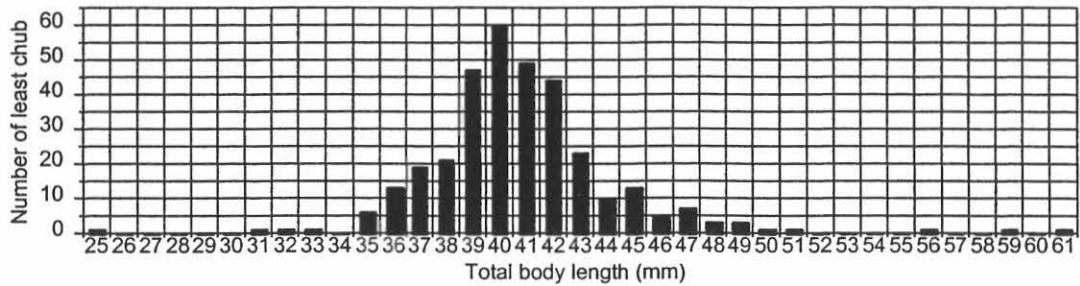


Figure 4. Length frequency distribution of least chub ($n = 332$) captured at Leland Harris monitoring sites, Snake Valley, Utah, August 2000.

Least Chub Length Frequency

Gandy Salt Marsh

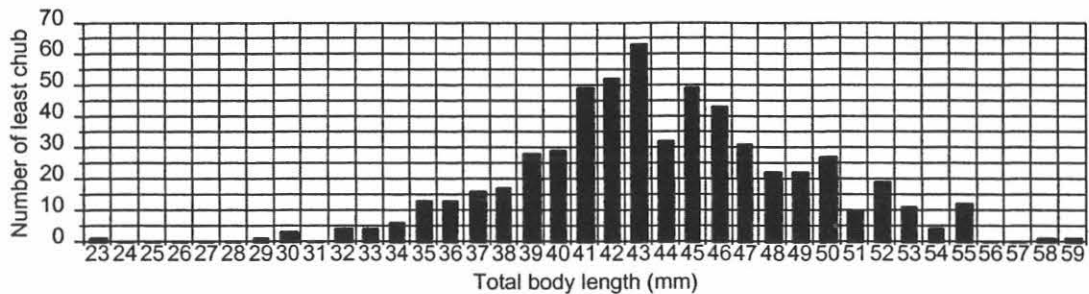


Figure 5. Length frequency distribution of least chub ($n = 583$) captured at Gandy Salt Marsh monitoring sites, Snake Valley, Utah, August 2000.

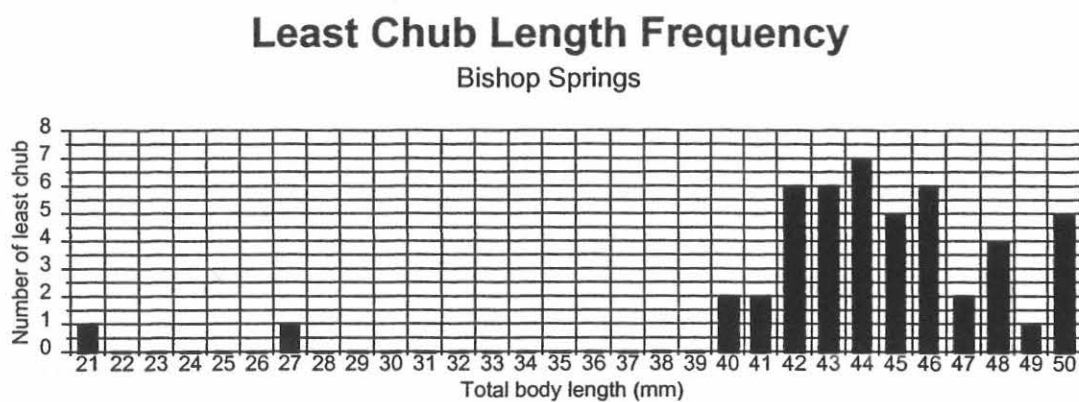


Figure 6. Length frequency distribution of least chub ($n = 48$) captured at Bishop Springs monitoring sites, Snake Valley, Utah, August 2000.

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