

Chignik Lakes Research

D. ROGERS AND J. MILLER

INTRODUCTION

The purpose of this work is to annually measure the relative abundance and size of juvenile sockeye salmon (*Oncorhynchus nerka*); relative abundance and size of potential competitor and predator species; the biological and physical environment for sockeye salmon in the lakes; and abundance, size, and age of seaward migrants, which is conducted by Alaska Department of Fish and Game (ADF&G). A long-term database resulting from these measurements provides a basis from which to evaluate changes in the production of adult sockeye salmon from the Chignik Lakes and perhaps a means of stabilizing or increasing production.

The choice of measurements depends on the likely impact on sockeye salmon, cost of the measurement, and the availability of past data. An annual smolt program was undertaken by ADF&G in 1993 while our main research effort was conducted in the lakes. Our 1997 field work was done in two periods: May 20 through June 19, and August 10 through September 13.

The following work was done:

- Water transparency (Secchi depth), phytoplankton (chlorophyll *a*), and zooplankton densities were measured on May 26, June 11, and August 15 and 28 to assess the summer standing crop of primary producers and zooplankton (the main source of food for sockeye salmon in Chignik Lake).
- Emergent fry traps were employed along Hatchery Beach. The traps were set in mid-May and checked about every 4 days to assess the relative abundance and timing of emergent sockeye fry.
- Beaches were seined weekly at seven established stations on Chignik Lake from May to June to assess the relative abundance of juvenile sockeye salmon and associated species nearshore.
- Townetting was conducted in both Black and Chignik lakes during early September to assess the relative abundance and lengths of juvenile sockeye salmon in the pelagic region. This report presents statistics from limnological sampling and catch statistics from emer-

gent fry traps, townetting, and beach seining in 1997, with comparisons to past years where available.

In addition, a special study of predation on the eggs and alevins of beach spawners in Chignik Lake was completed in 1997. This work will be reported in a Master's thesis by J. Miller in June 1998.

LIMNOLOGY

Methods

Water temperature, water transparency, phytoplankton, and zooplankton samples were collected four times (two stations, Fig. 1) on Chignik Lake. Black Lake was sampled only on June 2 and August 29 (Fig. 2). Water clarity was estimated with a Secchi disk. Water temperatures were taken with a pocket thermometer on the lake's surface at Black Lake and from water taken with a van Dorn bottle at Chignik Lake. Water samples were taken immediately below the surface for Black Lake, which is shallow and well mixed, and at 0, 1, 5, 10, and 20 m below the surface in Chignik Lake. Chlorophyll *a* analysis was conducted on water that was sieved through Millipore filters; the amount filtered depended on how much algae was in the water (i.e., denser samples clogged the filter faster). The filters were then processed with a Spectronic® 20 spectrophotometer. Zooplankton samples were taken with a 153-mm mesh, .5-m diameter net in Chignik Lake by hauling the net 40 m vertically through the water.

Results

Black Lake is shallow and turbid. Secchi readings are not very deep, with measurements ranging from 2.2 to 2.3 m in 1997. Near the outlet, a reading of 2.2 m was made (Table 1). Chignik Lake, which is deeper and not as well mixed, had deeper Secchi readings: During the summer, the Clark Bay site averaged 2.6 m and the Delta site averaged 1.9 m (Table 2). The Delta site was more turbid because of the influence of the Black River. Surface temperatures were taken from Black Lake whereas a depth

profile was taken in Chignik Lake (down to 20 m). An average surface temperature of 12.5°C was recorded on June 2 in Black Lake and at about the same time the surface temperature was 9.2°C at Chignik Lake. Black Lake warms rapidly in the spring because of its shallow depth; however, by mid-July the two lakes have similar surface temperatures. Chlorophyll *a* at the Hydro and Outlet (Black Lake) sites were lower (2.35 and .72 mg m⁻³, respectively) than the chlorophyll *a* concentration in Alec Bay (2.38 mg m⁻³). Usually, Alec Bay has a lower concentration of phytoplankton because of the inflow from the Alec River. The average 1997 concentrations over all stations were similar to averages in past years (Table 3). Clark Bay and Delta (Chignik Lake) had similar chlorophyll *a* densities in 1997 (Table 2). Average chlorophyll *a* densities were highest on June 11 for both locations (3.64 mg m⁻³; Table 4). Total zooplankton densities generally increased in Chignik Lake at the end of the summer at both the Clark Bay and Delta sites; however, zooplankton density was unusually high at the Clark Bay site on August 26 (Table 5). The 1997 total zooplankton counts were higher than observations from past years (Table 6).

Calanoid copepods, *Daphnia*, and *Bosmina* all bloomed towards the end of summer 1997, but cyclopoid copepods decreased after initial high levels during May and June (Table 6). This change in species composition during the summer is similar to past years with the exception of the decrease observed in cyclopoid numbers. The observed high counts of *Chydoris* and the rotifer *Asplanchna*, beginning in 1996, continued in 1997.

EMERGENT FRY

Since 1986, numbers of emergent fry have been estimated on two beach spawning areas of Chignik Lake. No field work was done in 1994, but our sampling resumed in 1995 on the Hatchery and Delta beaches. Starting in 1991, the averages for stations during 1986–90 have been used to estimate emergence rates for South Hatchery south and the North Hatchery locations (Table 7). In 1997, we sampled only South Hatchery south and the average emergence rate was 31.4 m⁻² month⁻¹. The number of emergent traps used during this period was 20. All other locations have estimates based on South Hatchery south values. The average for 1997 on South Hatchery south was somewhat lower than the record numbers observed in 1996.

TOWNETTING

Townet hauls were made annually in the Chignik Lakes from 1960 to 1973 (Rogers et al. 1996). Although tow lengths sometimes varied, all catches were standardized to 10 min (Parr 1972). Arithmetic and geometric means have been calculated in the past; however, only arithmetic means are presented here. Since 1973, townetting has been sporadic; however, we did tow in both lakes in September 1996 and 1997 (Table 8). Catches of juvenile sockeye salmon were low in Black Lake and high in Chignik Lake.

BEACH SEINING

Beach seining was also conducted in Chignik Lake in several years prior to 1973 (Rogers et al. 1996). Catches of juvenile sockeye salmon were usually recorded as larger or smaller than 45 mm. The small fish were likely to be fry (age 0) whereas the larger fish likely were a mixture of small yearlings from Chignik Lake and large fry from Black Lake. Beach seining has been done intermittently since 1980 in Chignik Lake (Table 9). Juvenile coho salmon are usually more abundant in beach seine catches than in townet catches, which reflects their preference for the nearshore habitat. Catches of juvenile sockeye salmon were high in 1997, especially for yearlings that presumably originated in Chignik Lake.

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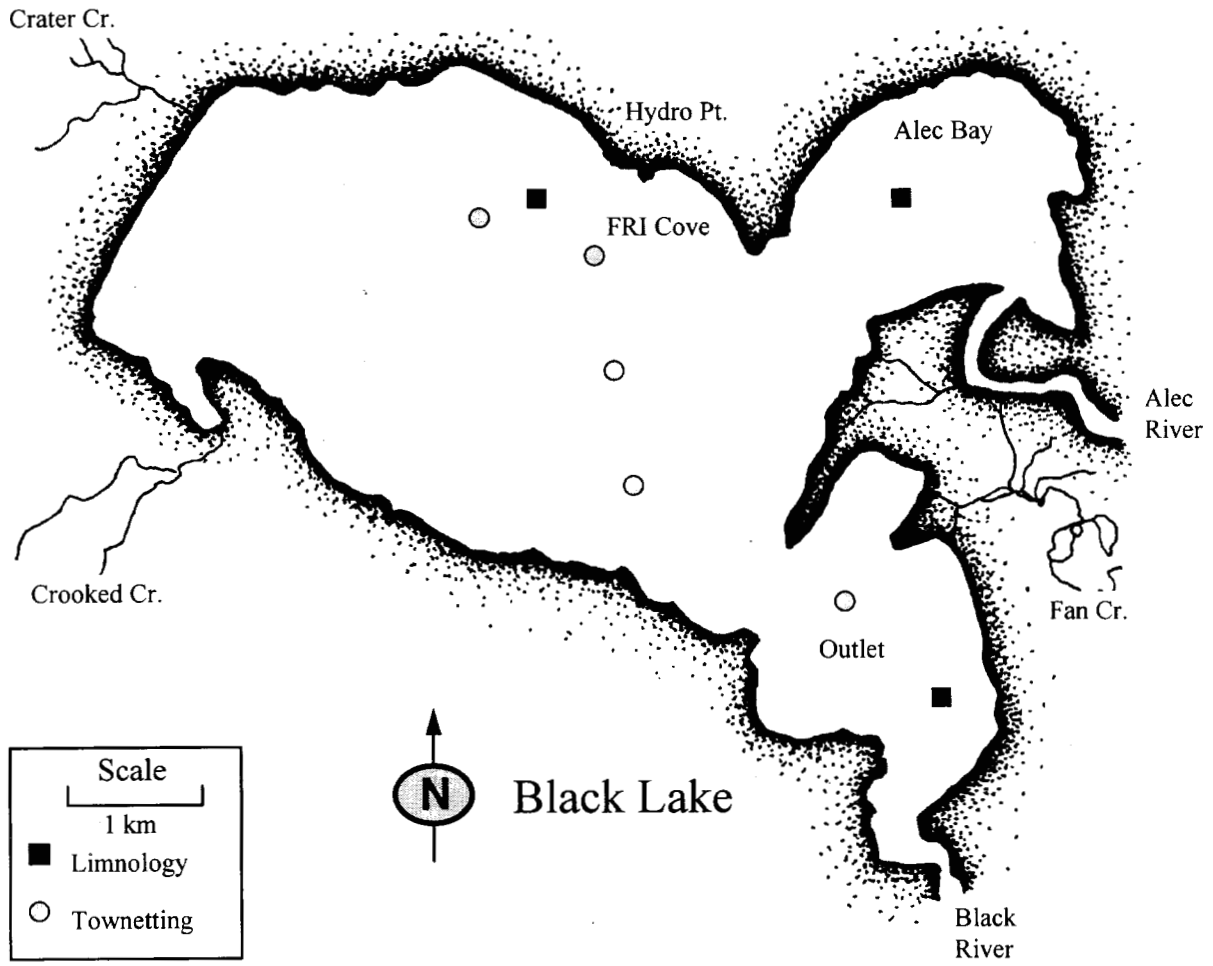


FIGURE 1. Black Lake sampling sites.

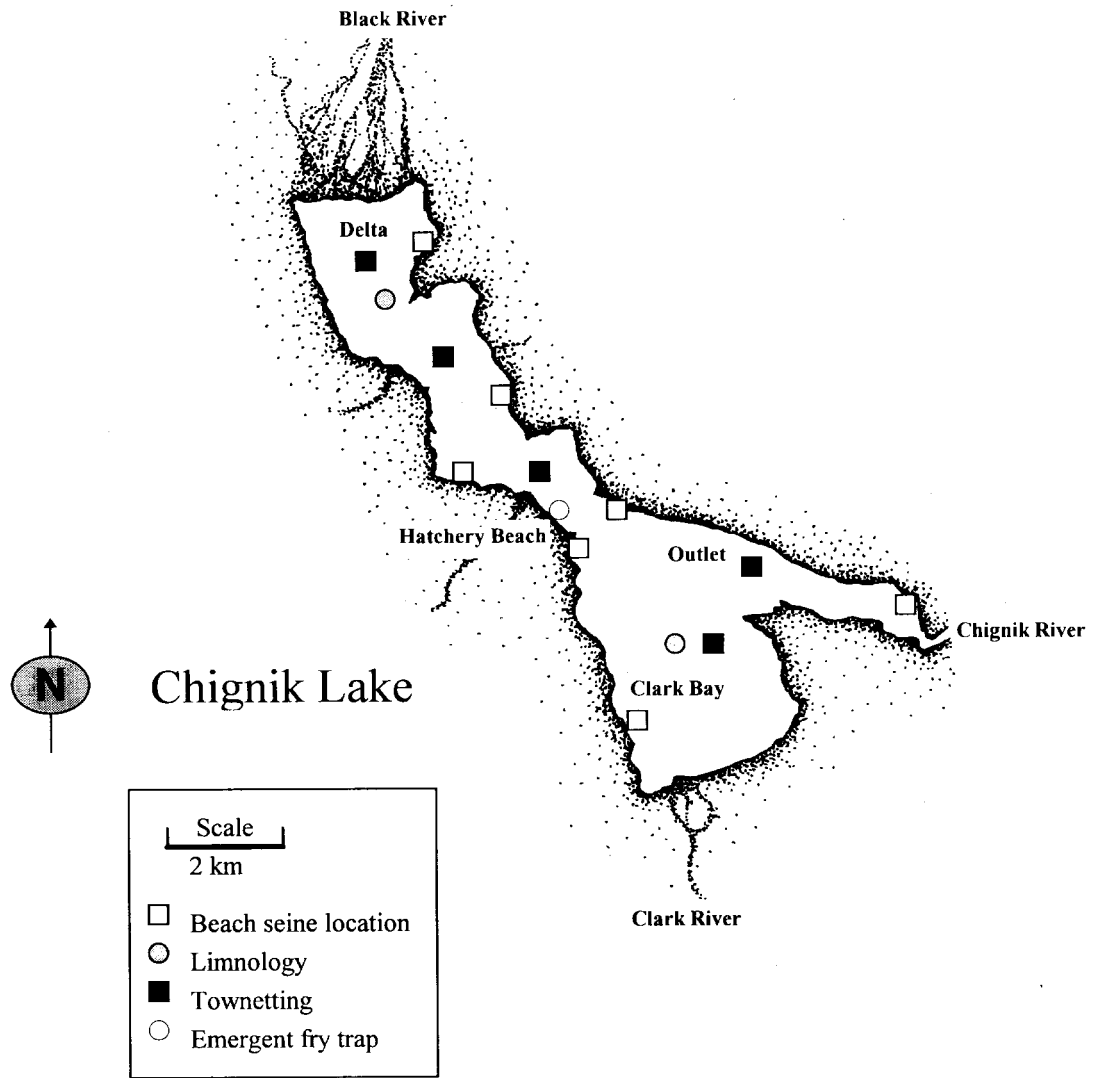


FIGURE 2. Chignik Lake sampling sites.

TABLE 1. Limnological data from Black Lake, 1997.

| Date | Location | Secchi depth (m) | Surface temp. (°C) | Chlorophyll <i>a</i> mg m ⁻³ |
|------------|-----------|------------------|--------------------|---|
| 6/2 | Hydro Pt. | 2.3 | 14.2 | 2.35 |
| | Alec Bay | 2.2 | 14.1 | 2.38 |
| | Outlet | 2.2 | 9.2 | 0.72 |
| 8/2 | Outlet | | | 1.58 |
| 1997 means | | 2.2 | 12.5 | 1.75 |

TABLE 2. Limnological data from Chignik Lake, 1997.

| Date | Clark Bay | | | | Delta | | | |
|------|------------------|-----------|-----------------|---|------------------|-----------|-----------------|---|
| | Secchi depth (m) | Depth (m) | Water temp (°C) | Chlorophyll <i>a</i> mg m ⁻³ | Secchi depth (m) | Depth (m) | Water temp (°C) | Chlorophyll <i>a</i> mg m ⁻³ |
| 5/26 | 4 | 0 | 6.5 | | 2.3 | 0 | 8 | |
| | | 1 | 6 | 2.68 | | 1 | 8 | 3.14 |
| | | 5 | 6.5 | 3.16 | | 5 | 8 | 3.07 |
| | | 10 | 6.8 | 3.05 | | 10 | 7.5 | 2.94 |
| | | 20 | 6 | 3.18 | | 20 | 7 | 2.23 |
| 6/11 | 2.5 | 0 | 9 | | 2 | 0 | 10 | |
| | | 1 | 9 | 4.26 | | 1 | 10 | 4.24 |
| | | 5 | 9 | 4.04 | | 5 | 9.5 | 5.02 |
| | | 10 | 9 | 3.36 | | 10 | 9.5 | 2.73 |
| | | 20 | 8 | 2.55 | | 20 | 9 | 2.94 |
| 8/15 | 2 | 0 | 13 | | 1.2 | 0 | 13.5 | |
| | | 1 | 13 | 1.77 | | 1 | 13.5 | 0.91 |
| | | 5 | 13 | 2.35 | | 5 | 13 | 1.52 |
| | | 10 | 13 | 1.4 | | 10 | 13 | 2.03 |
| | | 20 | 12.5 | 1.81 | | 20 | 13 | 2.03 |
| 8/28 | 2 | 0 | 12.5 | | 2.2 | 0 | 12 | |
| | | 1 | 12.5 | 2.13 | | 1 | 12.5 | 1.99 |
| | | 5 | 12.5 | 2.93 | | 5 | 12 | 2.27 |
| | | 10 | 12.5 | 1.64 | | 10 | 12 | 2.15 |
| | | 20 | 12 | 1.73 | | 20 | 12 | 1.95 |

TABLE 3. Averages of limnological data from Black Lake, 1992–97.

| Date | | | Secchi depth (m) | Surface water temp (°C) | Chlorophyll <i>a</i> (mg m ⁻³) |
|------|-----|------|------------------|-------------------------|--|
| Mo. | Day | Year | | | |
| 6 | 20 | 92 | n/a | n/a | 3.24 |
| 7 | 8 | 92 | n/a | n/a | 2.28 |
| 9 | 3 | 92 | n/a | n/a | 4.59 |
| 5 | 18 | 93 | 1.6 | 8.8 | 1.26 |
| 6 | 16 | 93 | 1.7 | 9.7 | 0.98 |
| 7 | 16 | 93 | 1.8 | 15.5 | 0.6 |
| 8 | 15 | 93 | 0.9 | 12.7 | 4.33 |
| 9 | 9 | 93 | 0.7 | 12.5 | 3.32 |
| 6 | 9 | 95 | 1.4 | 11.2 | 3.67 |
| 6 | 20 | 95 | 1.4 | 10.7 | 1.34 |
| 7 | 11 | 95 | 1.5 | 12.3 | 1.15 |
| 7 | 23 | 96 | 1.8 | 13.8 | 2.26 |
| 6 | 2 | 97 | 2.2 | 12.5 | 1.75 |

TABLE 4. Averages of limnological data from Chignik Lake, 1992–97.

| Date | | | Secchi depth (m) | Averages over 1–20 m | |
|------|-----|------|------------------|----------------------|--|
| Mo. | Day | Year | | Temp. (°C) | Chlorophyll <i>a</i> (mg m ⁻³) |
| 6 | 23 | 92 | 1.8 | 9.6 | 3.27 |
| 7 | 11 | 92 | 2.6 | 9.9 | 2.68 |
| 9 | 3 | 92 | n/a | 10.8 | 5.42 |
| 5 | 10 | 93 | 2.2 | 4.3 | 7.96 |
| 6 | 17 | 93 | 1.4 | 9.1 | 0.88 |
| 7 | 26 | 93 | 0.6 | 12.4 | 0.81 |
| 8 | 18 | 93 | 0.8 | 11.7 | 1.49 |
| 9 | 10 | 93 | 0.8 | 11.6 | 1.71 |
| 6 | 8 | 95 | 1.7 | 7.5 | 4.89 |
| 6 | 17 | 95 | 1.6 | 9.0 | 3.23 |
| 6 | 29 | 95 | 2.5 | 9.1 | 2.61 |
| 7 | 7 | 95 | 2.4 | 10.1 | 1.85 |
| 7 | 17 | 95 | 2.7 | 11.1 | 2.91 |
| 6 | 17 | 96 | 2 | 9.0 | 3.22 |
| 7 | 4 | 96 | 2.7 | n/a | 1.50 |
| 7 | 12 | 96 | 2.6 | 9.6 | 2.03 |
| 7 | 30 | 96 | 2.8 | 12.3 | 1.94 |
| 8 | 8 | 96 | 4.2 | 11.2 | 1.92 |
| 5 | 26 | 97 | 3.15 | 7.0 | 2.93 |
| 6 | 11 | 97 | 2.25 | 9.2 | 3.64 |
| 8 | 15 | 97 | 1.6 | 13.1 | 1.73 |
| 8 | 28 | 97 | 2.1 | 12.3 | 2.10 |

TABLE 5. Zooplankton densities (1,000 m⁻²) in Chignik Lake, 1997.

| Lake | Location | Date | | Calanoids | <i>Cyclops</i> | <i>Daphnia</i> | <i>Bosmina</i> | <i>Asplanchna</i> | Nauplii | <i>Chydoris</i> | Total |
|---------|-----------|------|-----|-----------|----------------|----------------|----------------|-------------------|---------|-----------------|-------|
| | | Mo. | Day | | | | | | | | |
| Chignik | Clark Bay | 5 | 26 | 10 | 2183 | 27 | 78 | 12 | 194 | 23 | 2525 |
| | | 6 | 11 | 90 | 2044 | 77 | 45 | 0 | 191 | 32 | 2477 |
| | | 8 | 15 | 268 | 383 | 1025 | 948 | 274 | 191 | 8 | 3095 |
| | | 8 | 26 | 2200 | 387 | 2057 | 2281 | 468 | 998 | 0 | 8391 |
| Chignik | Delta | 5 | 26 | 31 | 1548 | 20 | 31 | 10 | 413 | 15 | 2067 |
| | | 6 | 11 | 63 | 1740 | 32 | 13 | 0 | 79 | 78 | 2003 |
| | | 8 | 15 | 1086 | 635 | 1133 | 2335 | 171 | 406 | 17 | 5782 |
| | | 8 | 26 | 697 | 457 | 2627 | 1621 | 329 | 652 | 12 | 6393 |
| Black | Hydro | 6 | 2 | 6 | 298 | 0 | 23 | 6 | 75 | 159 | 565 |
| Black | Outlet | 6 | 2 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 4 |
| Black | Alec Bay | 6 | 2 | 4 | 160 | 0 | 30 | 0 | 111 | 38 | 343 |
| Black | Outlet | 8 | 29 | 9 | 15 | 9 | 53 | 5 | 6 | 5 | 102 |

TABLE 6. Historical zooplankton densities (1,000 m⁻²) in Chignik Lake, 1992–97.

| Date | | | No. of sites | Haul depth (m) | | | | | | | | Total |
|------|-----|------|--------------|----------------|------------|----------------|----------------|-----------------|--------------------|---------|------------------|-------|
| Mo. | Day | Year | | | Cala-noids | <i>Cyclops</i> | <i>Daphnia</i> | <i>Bos-mina</i> | <i>As-planchna</i> | Nauplii | <i>Chy-doris</i> | |
| 5 | 19 | 92 | 5 | 40 | 1 | 488 | 29 | 1 | 7 | 11 | 0 | 537 |
| 6 | 6 | 92 | 3 | 40 | 2 | 292 | 12 | 1 | 19 | 6 | 0 | 332 |
| 6 | 23 | 92 | 5 | 40 | 17 | 251 | 18 | 4 | 66 | 11 | 0 | 367 |
| 7 | 11 | 92 | 5 | 40 | 22 | 199 | 34 | 16 | 231 | 9 | 0 | 511 |
| 8 | 31 | 92 | 5 | 40 | 285 | 177 | 206 | 338 | 37 | 133 | 0 | 1176 |
| 5 | 9 | 93 | 2 | 40 | 74 | 144 | 2 | 4 | 0 | 0 | 0 | 224 |
| 6 | 19 | 93 | 2 | 40 | 48 | 77 | 0 | 22 | 0 | 0 | 0 | 147 |
| 7 | 26 | 93 | 2 | 40 | 380 | 239 | 16 | 423 | 0 | 0 | 0 | 1058 |
| 8 | 16 | 93 | 2 | 40 | 82 | 67 | 35 | 120 | 0 | 0 | 0 | 304 |
| 9 | 9 | 93 | 2 | 40 | 17 | 26 | 82 | 109 | 0 | 0 | 0 | 234 |
| 6 | 8 | 95 | 2 | 40 | 9 | 115 | 7 | 7 | 6 | 24 | 2 | 170 |
| 6 | 17 | 95 | 2 | 40 | 5 | 124 | 6 | 7 | 10 | 20 | 3 | 175 |
| 6 | 29 | 95 | 2 | 40 | 7 | 155 | 16 | 20 | 38 | 16 | 4 | 256 |
| 7 | 7 | 95 | 2 | 40 | 15 | 205 | 25 | 56 | 68 | 44 | 7 | 420 |
| 7 | 16 | 95 | 2 | 40 | 39 | 258 | 32 | 107 | 78 | 52 | 3 | 569 |
| 9 | 5 | 95 | 2 | 40 | 356 | 224 | 537 | 498 | 43 | 108 | 18 | 1784 |
| 6 | 17 | 96 | 2 | 40 | 33 | 69 | 4 | 19 | 59 | 20 | 11 | 215 |
| 7 | 4 | 96 | 2 | 40 | 51 | 131 | 4 | 27 | 116 | 78 | 24 | 431 |
| 7 | 12 | 96 | 2 | 40 | 286 | 258 | 10 | 97 | 152 | 215 | 34 | 1052 |
| 7 | 29 | 96 | 2 | 40 | 108 | 96 | 10 | 62 | 176 | 13 | 34 | 499 |
| 8 | 8 | 96 | 2 | 40 | 182 | 117 | 36 | 159 | 159 | 62 | 17 | 732 |
| 5 | 26 | 97 | 2 | 40 | 21 | 1866 | 24 | 55 | 11 | 304 | 19 | 2296 |
| 6 | 11 | 97 | 2 | 40 | 77 | 1892 | 55 | 29 | 0 | 135 | 55 | 2240 |
| 8 | 15 | 97 | 2 | 40 | 1449 | 422 | 2342 | 1951 | 399 | 825 | 6 | 7392 |
| 8 | 28 | 97 | 2 | 40 | 677 | 509 | 1079 | 1642 | 223 | 299 | 13 | 4439 |

TABLE 7. Sockeye fry emergence rates during June on Chignik Lake beaches.^a

| Year | South Hatchery south | South Hatchery north | North Hatchery | Delta | Average | Area weighted averages |
|-------------------|----------------------|----------------------|----------------|-------|---------|------------------------|
| 1986 | 6.3 | 26.3 | 17.5 | 12.8 | 15.7 | 18 |
| 1987 | 9.5 | 40.3 | 28.3 | 25.1 | 25.8 | 29.2 |
| 1988 | 18.4 | 43.5 | 32.7 | 40.4 | 33.8 | 36.4 |
| 1989 | 6.6 | 2.9 | 8.4 | 15.8 | 8.4 | 7.8 |
| 1990 | 2.8 | 6.2 | 8 | 12.3 | 7.3 | 7.5 |
| 1991 | 3 ^b | 13.4 | 6.5 | 2.7 | 6.4 | 7.7 |
| 1992 | 2.2 | 5 | 4.8 | 6.3 | 4.6 | 4.8 |
| 1993 | 0.9 | 2.6 | 2 | 2.1 | 1.9 | 2.1 |
| 1994 | | | | | n/a | n/a |
| 1995 | 5.5 | 7.5 | 12 | 20.3 | 11.3 | 11.3 |
| 1996 | 36.6 | 70.4 | 36.6 | 2.9 | 36.6 | 41.4 |
| 1997 | 12.57 | 31.4 | 20.93 | 19.4 | 21.1 | 23.2 |
| 1986-1997 Average | 10.1 | 22.7 | 16.2 | 14.6 | | |

^aCalculations based on Ruggerone et al. 1993, 1994.^bItalics = estimates of missing data.

TABLE 8. Average townet catches for Chignik and Black lakes, 1980–97.

| Date | | No. of tows | Species | | | | | | |
|--------------|------|-------------------|----------------|-----------------------------|------------------|------------------|---------------|-------------|---------|
| Mo. | Year | | Sockeye salmon | | Juvenile coho | Juvenile king | Pond smelt | Stickleback | |
| | | | Fry | Yearling | | | | 3-spine | 9-spine |
| Chignik Lake | | | | | | | | | |
| 7 | 80 | 20 | 52 | 50 | 0 | 0 | 20 | 2 | 8 |
| 7 | 82 | 5 | 8 | 1 | 2 | 0 | 0 | 1 | 1 |
| 6 | 83 | 5 | 33 | 87 | 0 | 0 | 0 | 0 | 1 |
| 7 | 83 | 10 | 173 | 101 | 0 | 0 | 1 | 0 | 1 |
| 9 | 92 | 9 | 65 | 9 | 0 | 0 | 5 | 2 | 3 |
| 8 | 93 | 7 | 61 | 23 | 0 | 0 | 39 | 47 | 11 |
| 9 | 93 | 8 | 44 | 18 | 0 | 0 | 108 | 19 | 16 |
| 9 | 95 | 5 | 38 | 17 | 0 | 0 | 17 | 8 | 3 |
| 9 | 96 | 6 | 16 | 24 | 0 | 0 | 4 | 58 | 4 |
| 9 | 97 | 5 | 95 | 200 | 0 | 0 | 58 | 59 | 24 |
| Black Lake | | | | | | | | | |
| 9 | 92 | 7 | 347 | 0 | 1 | 0 | 110 | 70 | 78 |
| 6 | 93 | 2 | 3260 | 0 | 0 | 0 | 148 | 10 | 30 |
| 7 | 93 | 1 | 478 | 0 | 0 | 0 | 13 | 0 | 0 |
| 8 | 93 | 9 | 143 | 0 | 11 | 0 | 729 | 910 | 1148 |
| 9 | 93 | 4 | 126 | 0 | 23 | 0 | 1914 | 565 | 269 |
| 6 | 95 | 6 | 28 | 4 | 0 | 0 | 19 | 4 | 2 |
| 9 | 95 | 5 | 176 | 1 | 0 | 0 | 49 | 15 | 12 |
| 9 | 96 | 3 | 82 | (All other fishes released) | | | | | |
| 9 | 97 | 3 | 80 | 0 | 3 | 0 | 173 | 217 | 64 |

TABLE 9. Average beach seine catches for Chignik Lake, 1980–97.

| Date | | No. of sets | Species | | | | | | | | |
|------|------|-------------------|----------------|-------|------------------|------------------|------|-------------|---------|---------|--------------------|
| Mo. | Year | | Sockeye salmon | | Juvenile coho | Juvenile king | Char | Stickleback | | Sculpin | Pygmy whitefish |
| | | | <45mm | >45mm | | | | 3-spine | 9-spine | | |
| 6 | 80 | 5 | 47 | 0 | 2 | 0 | 7 | 16 | 1 | 28 | 0 |
| 7 | 80 | 12 | 52 | 9 | 3 | 1 | 2 | 22 | 1 | 16 | 1 |
| 5 | 85 | 10 | 113 | 189 | 103 | 2 | 6 | 3317 | 53 | 12 | 2 |
| 6 | 85 | 18 | 15 | 71 | 112 | 3 | 36 | 1031 | 136 | 18 | 28 |
| 7 | 85 | 17 | 9 | 217 | 30 | 4 | 104 | 399 | 28 | 11 | 6 |
| 8 | 85 | 6 | 20 | 183 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 85 | 6 | 0 | 2 | 7 | 0 | 18 | 943 | 18 | 25 | 6 |
| 5 | 86 | 33 | 33 | 85 | 48 | 8 | 10 | 499 | 33 | 22 | 7 |
| 6 | 86 | 49 | 49 | 3 | 31 | 8 | 17 | 111 | 15 | 14 | 7 |
| 7 | 86 | 46 | 46 | 4 | 12 | 2 | 12 | 162 | 9 | 13 | 5 |
| 8 | 86 | 12 | 2 | 15 | 6 | 2 | 24 | 154 | 5 | 14 | 11 |
| 5 | 87 | 12 | 1048 | 714 | 136 | 7 | 25 | 639 | 54 | 13 | 19 |
| 6 | 87 | 54 | 6 | 230 | 113 | 9 | 65 | 260 | 6 | 13 | 15 |
| 7 | 87 | 58 | 16 | 51 | 17 | 0 | 8 | 44 | 5 | 14 | 3 |
| 6 | 92 | 15 | 10 | 15 | 13 | 0 | 7 | 123 | 22 | 13 | 2 |
| 7 | 92 | 6 | 9 | 2 | 20 | 2 | 23 | 192 | 16 | 7 | 7 |
| 5 | 93 | 6 | 1 | 173 | 57 | 0 | 13 | 224 | 7 | 9 | 41 |
| 6 | 93 | 6 | 1 | 20 | 6 | 0 | 15 | 24 | 0 | 8 | 13 |
| 6 | 95 | 21 | 27 | 9 | 11 | 1 | 13 | 244 | 26 | 18 | 8 |
| 7 | 95 | 21 | 16 | 13 | 13 | 1 | 10 | 49 | 6 | 17 | 6 |
| 6 | 96 | 7 | 12 | 121 | 39 | 1 | 15 | 117 | 3 | 22 | 0 |
| 7 | 96 | 21 | 9 | 47 | 30 | 0 | 24 | 215 | 9 | 7 | 19 |
| 8 | 96 | 7 | 3 | 16 | 41 | 0 | 22 | 82 | 7 | 1 | 9 |
| 5 | 97 | 6 | 77 | 324 | 15 | 7 | 19 | 1367 | 24 | 61 | 0 |
| 6 | 97 | 6 | 5 | 125 | 7 | 0 | 6 | 14 | 3 | 6 | 2 |

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D. ROGERS AND J. MILLER

to

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KEY WORDS

beach seine, Black Lake, Chignik Lake, fry emergence, limnology, sockeye salmon, townet