Ecology of Brook Trout, *Salvelinus fontinalis*, in Freeman Meadow, California, July 2001

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Abstract

We examined aspects of the population ecology of Brook Trout (*Salvelinus fontinalis*) in a meadow in the Sierra Nevada Mts. during July 2001. Using mark-recapture techniques and Chapman's biased corrected version of the Lincoln estimator and the Model M(0) from the program "Capture," we estimated the abundance of *S. fontinalis* to be 190±83.33 and 253±159.49 individuals, respectively. When expressed as number of fish per m^3 of water, abundances were between 27-35 fish/m^3 (Chapman's estimator = 27±11.62/m^3, estimate from Model M(0) from Capture = 35±22.24/m^3).

Introduction

The Brook Trout, *Salvelinus fontinalis*, is introduced into western North America and occurs in steams and ponds at higher elevations. Breeding occurs in the fall in lakes, ponds, or streams. We studied a population of *S. fontinalis* in a high altitude (2167 m) meadow in the Sierra Nevada Mountains (39^o 38' 53" N and 120^o 31' 01" W) from July 11-12 2001. Our goals were: 1) to estimate the abundance and population density, and to assess the condition of Brook Trout within the study area.

Methods

To estimate the abundance of Brook Trout and estimate population condition, we surveyed a perennial stream in Freeman Meadows. This stream was a shallow, narrow stream with slack current, muddy substrate and emergent vegetation at the margins. At the upstream end of the section of the stream was a larger pool, which fed into a narrower area. Along the narrow reach of the stream the average width was 1.57 m and the average depth was 0.27 m. The deeper pool was 2.35 m wide and 0.3 m deep. The entire sample area was 23.05 meters long with an estimated volume of 7.17 m^3.

Capturing Animals – Brook Trout were sampled on two days (July 11-12). The study section was dumbbell-shaped with a pool on both ends and a narrow section in the middle. The fish were herded from the lower pool and a screen was installed at the bottom of the narrow section. Subsequently, fish were herded from the upper pool and a second screen was installed containing the fish in the narrow area (Figure 1). Fish were repeatedly herded downstream to awaiting nets to facilitate capture. Captured fish were held in five-gallon buckets filled with stream water. Each fish was individually weighed (grams), measured using fork length (mm), and marked by clipping the adipose fin (Figure 2). Fish less than 50 mm were not weighed. After processing the fish were released above the upstream screen.

Recaptured fish were tallied and released without processing on the second day of sampling. Fish captured on the second day were marked for potential future study. Both capture periods occurred from approximately 3:00 pm until 5:00 pm PDST

Figure 1. Herding fish to insure capture.

Figure 2. Measuring and fin clipping fish.

Estimating abundance of *Salvelinus fontinalis* -We estimated the abundance of *S. fontinalis* using the Lincoln population estimator and using the Program "Capture" (Otis et al. 1978, White et al. 1978). Since we anticipated that our exhaustive search of the study patch would not lead to a complete enumeration of the population, we wished to apply an estimator that would not be biased toward under estimating the abundance of Brook Trout. On day one of our study we captured and marked 21 animals ($n_1 = 21$). On day two we captured 25 animals ($n_2 = 25$), 2 of which were recaptures ($m = 2$). Given the small size of the marked population we used these values and calculated our estimate of abundance ($\hat{N}$) using Chapman's biased corrected formula for the Lincoln estimator as:

$$\hat{N} = \frac{(n_1 + 1)(n_2 + 1)}{(m + 1)} - 1,$$

with variance and standard errors given below:

$$Var(\hat{N}|N) = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m)(n_2 - m)}{(m + 1)^2 (m + 2)},$$

and

$$SE(\hat{N}|N) = \sqrt{(Var(\hat{N}|N))}$$

(Skalski and Robson 1992). Using the program Capture, we first tested the assumption of closure for our population, and used the model selection algorithm to choose the best model to fit to the data (Otis et al. 1978, White et al. 1978).

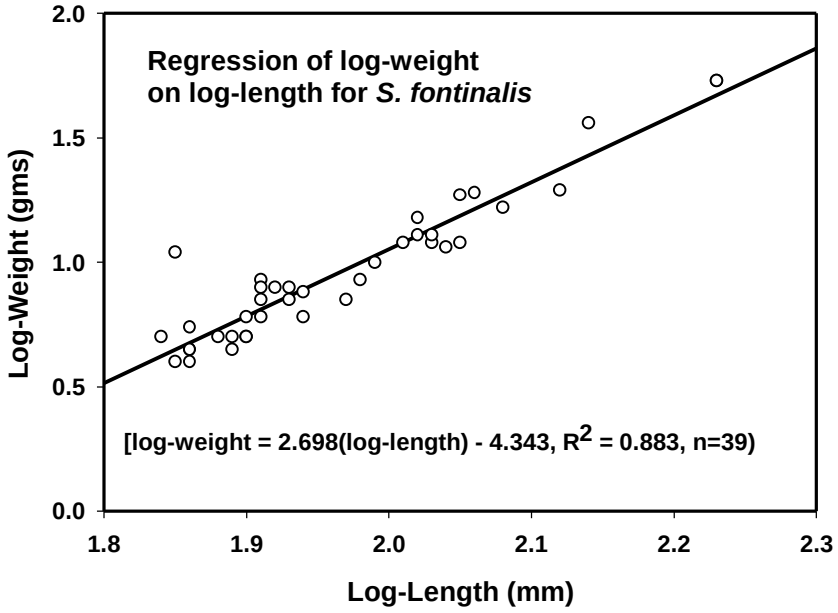
Examining Condition – To determine if large fish are disproportionately small in mass for their length, which might indicate that the growth of fish in this population is stunted due to a lack of food resources and competition, we fit a linear regression model to the log transformed weights and lengths of the 39 fish for which we obtained estimates.

Results

Our estimate of the abundance of *S. fontinalis* in our study stream was using Chapman's estimator was 190±83.33 individuals. The Program Capture indicated that the assumption of closure for our population was not reasonable. However, the model selection algorithm suggested that Model M(0) (one with a constant probability of capture) was most reasonable. The capture probability was estimated as $\hat{p} = 0.0908$, and the estimated abundance of *S. fontinalis* as 253±159.49. These abundance estimates translate into density estimates of 27±11.62 and 35±22.24 fish/m^3, respectively.

The average weight of individual fish was 11.95±1.86 gm, and the average length was 95.23±3.95 mm. Regression of log-weights on log-lengths indicated that large fish were neither disproportionately light nor heavy for their length (t = 1.89, df = 38, 0.1>p>0.05, Figure 3).

Figure 3.



Discussion

In Freeman Meadow, S. *fontinalis* appear to move between stream reaches as evidenced by the rejection of the hypothesis that the population within the sampled reach was closed. Without estimates of abundance form other sites, it is impossible to determine if the population of *S. fontinalis* in Freeman Meadow is unusually large or small. Also, the use of an open

population model may be more appropriate for estimating abundance. Furthermore, large Brook Trout in Freeman Meadow appear to be geometrically similar to small individuals so that their mass per unit length neither suggests that they are heavy or light for their size. Therefore, we have no evidence that the growth of individuals in this population has been stunted by competition for food.

Literature Cited

Otis, D. L., K. P. Burnham, G. C. White, and D. R. Anderson. 1978. Statistical inference for capture data on closed animal populations. Wildlife Monograph No. 62. 135 p.

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