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Usefulness of Structural and Condition Indices in Management of High-Mountain Stream Salmonid Populations

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Abstract.—We assessed the utility of relative weight (W_r), young-to-adult ratio (YAR), and a stock density index (SDI) calculated in a manner similar to the proportional stock density index as management tools for populations of brook trout *Salvelinus fontinalis* in six high-elevation streams. On each stream, estimates were made for production, biomass, production : biomass ratio, and brook trout density, as well as 14 environmental variables. The SDI varied substantially among streams and was significantly related to mean depth and conductivity, but not to any other environmental variables or to any of the population parameters. Values of W_r varied substantially over the growing season and were inversely related to mean depth for fish 100–150 mm and more than 150 mm total length, and directly (but marginally) related to production : biomass ratio for medium (>150-mm) and large (>200-mm) fish. Estimates of YAR were related only to the production : biomass ratio. Structural indices, in general, were correlated with no habitat characteristics except mean depth. There was sufficient seasonal variation in the indices to recommend that researchers restrict comparisons between streams to samples collected within as short a period as possible, preferably 2 months or less.

Cost-effective stock assessment and management of salmonids in high-elevation streams present difficult challenges for the fishery manager. The streams' small sizes, cold water temperatures, short growing seasons, and heavy winter snow cover often result in low production and low standing stocks of salmonids, as well as in slow growth and poor condition of individual fish. These low-productivity streams are, however, sufficiently numerous to constitute, in aggregate, an important fishery.

When it becomes apparent that fishing effort and harvest on a stream are sufficient to warrant management intervention, managers like to know several characteristics of the fish populations, including: (1) if sufficient numbers of desirable-sized fish are recruited to the fishery, (2) if fish growth is satisfactory, (3) if condition (plumpness) of the fish is acceptable, and (4) if mortality is such that the fishery can be maintained. Answers to these questions also provide indirect information on habitat quality. Although indices to quantify the answers to these questions have not been developed for small coldwater streams, several indices—proportional stock density (PSD; Anderson 1976), relative weight (W_r; Wege and Anderson 1978), and young-to-adult ratio (YAR; Reynolds and Babb 1978)—developed for managing fisheries in warmwater impoundments, may have applicability to stream trout populations. However, despite the widespread use of these indices in warmwater systems, their interpretation and causative factors are still not well understood (Carline et al. 1984). In addition, for several trout species, standard stock and quality sizes for the calculation of PSD, as well as standard weight formulas for the calculation of W_r, have neither been tested nor widely accepted.

We used data from six populations of brook trout *Salvelinus fontinalis* (Scarnecchia 1983; Scarnecchia and Bergersen 1986, 1987) to evaluate

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the usefulness of YAR, W_r, and a stock density index (SDI) similar to PSD in managing salmonid populations in high-mountain streams. More specifically, we evaluated how closely these indices were related to physical and chemical habitat characteristics and brook trout population parameters for the six streams.

Methods

Site Description

Seven study sites were located on six perennial streams in northern Colorado: Cow, Dale, Davis, Indian, McCreavy, and Porcupine creeks (two study sites were located on Dale Creek, Dale 1 and Dale 2). The streams ranged in elevation from 2,146 to 3,066 m above mean sea level, and all of them contained populations of brook trout. Cow Creek and McCreavy Creek contained small populations of brown trout *Salmo trutta*. The two Dale Creek sites were inhabited by rainbow trout *Oncorhynchus mykiss* in roughly similar densities to those of brook trout, as well as by small numbers of brown trout. Brown trout were rarely found in Davis Creek, and no other trout species besides brook trout were found in Porcupine and Indian creeks. The streams were lightly fished or unfished. (Only Dale Creek, which was on private land, was known to be unfished.) Dale Creek was the lowest in elevation and had the longest growing season of the six creeks. Length of five of the study sections was 200 m; the other two study sections were 100 and 190 m long. Detailed descriptions of the study sites, including water chemistry, habitat measurements, and trout population dynamics, were given by Scarnecchia (1983) and Scarnecchia and Bergersen (1986, 1987).

Physical and Chemical Characteristics

Fourteen physical and chemical characteristics were measured for each stream section between August 1 and October 31 in 1979 and in 1980. In each stream section horizontal transects were established, beginning at the lower end and then every 20 m upstream. Seven equidistant measurement stations were located on each transect, with the fourth station always placed midstream. Stream widths (m), measured at each transect, were used to calculate mean stream width. At each station on each transect we determined mean depth (cm), substrate diversity (Shannon–Weiner index), and mean velocity (m/s). These data were used to estimate the ratio mean width : mean depth, percentage of zero velocity stations, and discharge (m^3/s). At each section a measurement was made for maximum temperature (°C), alkalinity (mg/L), total hardness (mg/L), conductivity (μS), and total nitrates (μg/L). Also measured were the amount of undercut bank (cm/m) and stream elevation above sea level (m).

Population Characteristics

Fish within each section were sampled with backpack electrofishing gear in 1979 (two sample periods) and 1980 (three sample periods). In 1979, the sampling periods were June 19–August 22 and August 23–October 26. In 1980 the three periods were June 24–July 30, August 5–September 20, and September 24–November 10 (exact dates of samples are given by Scarnecchia and Bergersen 1987). Because of snow storms, Dale 1 and the upper two-thirds of Dale 2 were not sampled in November 1980. Similarly, an October 1980 storm prevented sampling of one-half of Porcupine Creek. Population-size estimates in these partially sampled sections were adjusted based on estimates made in the portions sampled and previously recorded population-size ratios of the sampled to unsampled stream section. Thus, we assumed that the ratio of the estimated population sizes for the sampled portion to that of the unsampled portion was consistent with that of previous samples.

Before sampling, each section was blocked at the upper and lower ends with a fine-meshed seine. Three electrofishing passes were made on each section and population estimates made with the three-pass removal method (Zippen 1956, 1958). Details of population-size estimation and production calculations were given by Scarnecchia (1983) and Scarnecchia and Bergersen (1986, 1987). Fish were aged primarily by an examination of scales and interpretation of length-frequency distributions, supplemented by the examination of a small number of otoliths and pectoral fin rays. To estimate the number of fish in each age-class ($\geq$ age 1), the population estimate was partitioned into age-classes based on the proportion of each age-group identified in the three electrofishing passes (Scarnecchia 1983). Equal catchability of all fish age 1 and older was assumed, as well as constant probability of capture of individuals among successive passes (Zippen 1956). Estimation of SDI and YAR were based on actual catches, which is the standard method, rather than on the population estimates. Estimates of annual production (g/m^2), biomass (g/m^2), and the production : biomass ratio (P/B) were obtained from Scarnecchia and Bergersen (1987).

Stock and Condition Indices

Stream brook trout stock and quality sizes of 130 and 200 mm, respectively, have been proposed (Anderson 1980). These sizes, if applied to the slow-growing brook trout populations studied here, would result in PSD values of zero for several streams. Populations with PSD of zero still exhibit population structure, but it is not quantified by the proposed stock and quality sizes. Because this study was concerned with relationships among stock structure, habitat, and population characteristics rather than with defining characteristics of populations at various PSD values, we redefined stock and quality sizes for use with these high-elevation brook trout populations.

Stock size was originally conceived as the minimum size of fish having recreational value (Weithman and Anderson 1978). This size also happened to be approximately the size for reproductive maturity for many species (Gabelhouse 1984). Quality size was interpreted by Weithman and Anderson (1978) to be the minimum size that anglers prefer to catch. Thus, stock and quality sizes were based primarily on angler expectations, and such expectations may be lower in small, high-elevation salmonid streams than in more productive rivers or lakes. We therefore computed SDI similarly to PSD but used a stock size of 100 mm and a quality size of 150 mm. Confidence intervals for SDI were calculated following Gustafson (1988).

We calculated W_r according to Wege and Anderson (1978) and used the standard weight (W_s) formula proposed by Whelan and Taylor (1984):

$$\log_{10} W_s = -5.085 + (3.0431)\log_{10}(\mathrm{TL}),$$

where W_s is the standard weight (g), and TL is total length (mm). The value of W_r was calculated for each fish individually and then averaged into three length-groups: 50–100, 101–150, and >150 mm TL. Because measurement precision for brook trout shorter than 100 mm was poor, we did not include that length-group in further analyses.

Young-to-adult ratio was calculated following Reynolds and Babb (1978), except that we used age-classes rather than size to separate young and adult. Age-0 fish were considered young and age-2 and older brook trout were considered adults (Scott and Crossman 1973).

Stock density index and W_r were calculated from the electrofishing catch data for each of the five individual samples on each stream. All correlations between structural indices (SDI, W_r, and YAR) and population and habitat variables were based on data from fish samples taken in August or September, except for Dale 1 and Dale 2 in 1979, where we used the October samples because temporally they were the closest to August–September. This time period was chosen because by then numbers of age-0 fish had stabilized and generally adults had not yet spawned, and it was the period most likely to be sampled by managers conducting an annual inventory.

Statistical Analysis

Because our data set contained only six brook trout streams but numerous measured variables, we limited our analysis to selected variables in an attempt to reduce the experiment-wise type I error rate. Conductivity, total alkalinity, and total hardness were highly correlated ($r \geq 0.94$, $P < 0.001$, $N = 14$), so we included only conductivity, which is the most easily measured of the three in the field. Mean velocity and the percentage of stations with zero velocity were also highly correlated ($r = -0.96$, $P < 0.001$, $N = 14$), so we used only mean velocity. We selected elevation, substrate diversity, width : depth ratio, mean width, discharge, and amount of undercut bank because, according to Scarnecchia and Bergersen (1986, 1987), they were the best single-variable or multivariate predictors of production or biomass. Mean depth was included because other studies have found correlations between mean depth and population size structure or fish size (Nyman 1970; Kozel and Hubert 1989; Johnson et al. 1992). Finally, neither maximum summer temperature nor total nitrates were found by Scarnecchia and Bergersen (1987) to be related to production or biomass, so they were excluded. Thus, of the original 14 physical and chemical variables, we excluded five from our analysis: total alkalinity, total hardness, percentage of stream with no velocity, maximum summer temperature, and total nitrates concentration.

We used Pearson correlation coefficients to assess relationships between untransformed measures of structural and condition indices (SDI, W_r, and YAR) and each of the nine stream habitat variables selected. Each structural index was tested separately against the nine habitat variables. To reduce probability of type I error, we used sequential Bonferroni adjustments to the probability levels (Rice 1978), which corrects the probability of type I error by dividing the P-value ($\alpha = 0.05$) by the number of tests conducted (e.g., $P = \alpha/k$, where k is the number of tests, in this case, 9). First, the P-values were ordered from lowest to highest. If the lowest P-value was less than the

TABLE 1.—*Stock density values for brook trout sampled during 1979 and 1980 in high-mountain streams. Sample* dates for the first, second, and third samples, respectively, were June or July, August or September, and October or November (dates given in Scarnecchia and Bergersen 1987). Dale 1 was not sampled in November 1980. Stock and quality sizes were 100 and 150 mm, respectively, and numbers of stock- and quality-sized fish are given in parentheses (quality/stock).

Creek	Year	Sample		
		1	*2*	*3*
Cow	1979		21 (25/121)	20 (29/145)
	1980	33 (55/167)	32 (60/187)	32 (55/174)
Dale 1	1979		62 (38/61)	61 (83/137)
	1980	53 (54/101)	71 (60/85)	
Dale 2	1979		65 (103/158)	62 (113/182)
	1980	51 (99/194)	74 (78/106)	83 (79/95)[a]
Davis	1979		37 (25/68)	27 (18/66)
	1980	31 (23/75)	26 (22/86)	31 (15/48)
Indian	1979		40 (36/90)	43 (35/81)
	1980	55 (37/67)	75 (30/40)	67 (26/39)
McCreavy	1979		29 (18/63)	27 (14/51)
	1980	23 (15/65)	18 (16/87)	25 (21/83)
Porcupine	1979		47 (44/94)	38 (38/99)
	1980	37 (38/103)	39 (32/82)	45 (10/22)[a]

[a] *Dale 2 and Porcupine creeks were only partially sampled in Oct 1980. Data used were actual catches and not adjusted to reflect* percent of sample completed.

Bonferroni corrected *P*-value, it was considered significant; if the value was higher, the test was stopped and all correlations were considered nonsignificant. If the first test was significant, the next lowest *P*-value was tested using the correction: $P = a/(k - 1)$. This process continued, reducing the denominator by one each time until nonsignificance was found. Thus, for tests between structural or condition indices and the nine environmental variables, a probability of 0.0056 (=0.05/9) was required for significance of the test with the lowest *P*-value. In the results, only tests with *P*-values less than the Bonferroni-corrected probabilities were reported as being significant, and only the uncorrected *P*-values are shown. Tests failing to meet this Bonferroni-corrected criteria, even though uncorrected *P*-values may have been less than 0.05, were reported as marginally significant (with $\alpha = 0.15$) or were not reported (if *P*-value exceeded $\alpha = 0.15$). Similarly, we tested for relationships between the structural indices and condition and the following population parameters: production, biomass, P/B, and fish density (number/100 m^2 for fish ≥ 200 mm and ≥ 150 mm).

Results

Stock Structure

Brook trout SDI ranged from 18 to 83 and varied greatly among streams (Table 1). Cow, Davis, and McCreavy creeks all had consistently low SDIs (the highest being 37). The Dale Creek sites and Indian Creek generally had high SDIs, and Porcupine Creek was intermediate. Generally, SDI did not vary greatly within years in a given stream (as indicated by widely overlapping confidence intervals; Figure 1). However, Dale 1, Dale 2, and Indian creek populations had considerable variation in SDI in 1980. In Dale 2, SDI increased significantly from a low of 51 in June to 74 in August and 83 in November. Histograms of brook trout length-frequencies (Figure 2) for Dale 2 in 1980 showed a progression of the age-2 fish from mostly stock size (June sample) to all quality size (November). The drastic reduction in the number of age-1 fish in the population (virtually all stock-size fish) was equally important in terms of SDI. However, interpretation of this change was limited by the incomplete sample taken in November 1980.

For Indian Creek, SDI estimates increased from 55 in late July to 75 in mid-September (Figure 3). Between these samples, catch of age-1 fish (part of which were stock size) decreased from 18 to 7, and age-2 fish (part stock and part quality size) decreased from 35 to 13. At the same time, age-2 fish were growing into the quality-size category. Thus, the change in SDI may have resulted from the combination of mortality and growth that occurred during the 2-month period between samples. These changes also coincided with a period when observations indicated that habitat quality changed greatly because of heavy cattle grazing

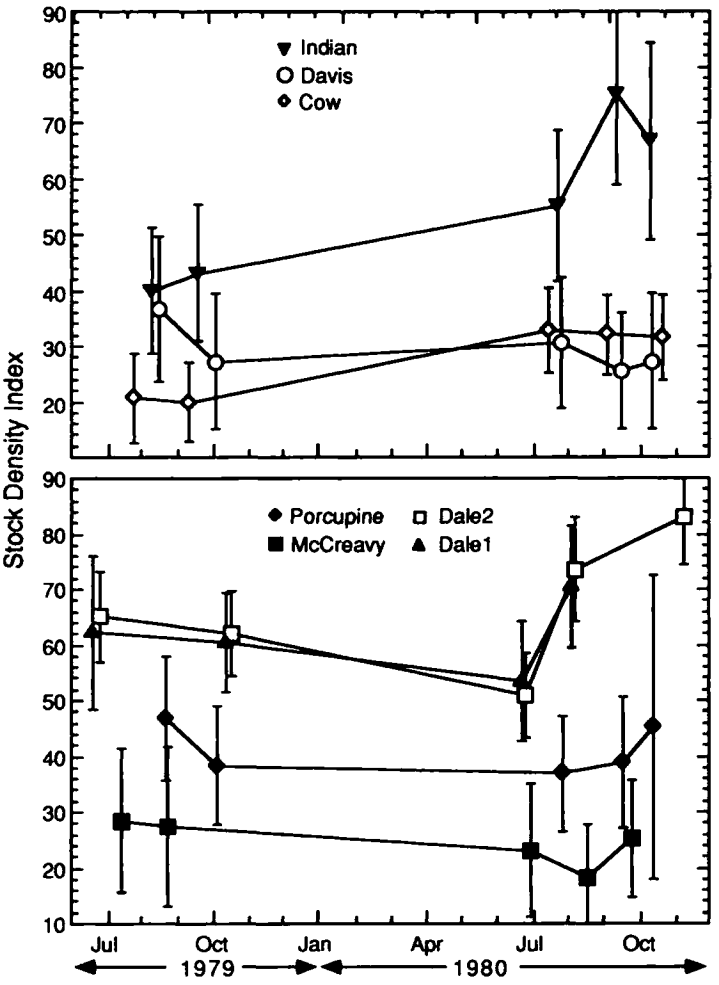

FIGURE 1.—Change in brook trout stock density index (SDI) during 1979 and 1980 at seven sites in six Colorado high-elevation streams. Vertical lines indicate 95% confidence intervals.

along the streambank, which could have affected mortality and growth by destroying instream and bank habitat.

Of the nine environmental variables, SDI was significantly related to mean depth ($r = 0.81$, $P < 0.001$, $N = 14$) and conductivity ($r = 0.76$, $P = 0.001$, $N = 14$). SDI was not significantly related to any of the population parameters.

Relative Weight

The condition of brook trout varied by season and size category. For brook trout in the 100–150 mm (Figure 4) and >150 mm (Figure 5) size categories, W_r in fall samples was generally lower than in summer samples; most likely this was a postspawning response. Late summer samples generally showed brook trout of 100–150 mm with W_rs similar to those of fish in the >150 mm category. Early summer samples showed a mixed response; some streams had declines in W_r with size, others had increases, and some had no change.

Summer estimates of brook trout W_r in both size-classes were not significantly related to production, biomass, total density, SDI, or YAR. However, there was a marginal direct relation between P/B and W_r of brook trout in the 100–150 mm size-group ($r = 0.66$, $P = 0.010$, $N = 14$) and a significant relationship for >150-mm brook trout ($r = 0.71$, $P = 0.005$, $N = 14$). Mean depth was inversely correlated with W_r of 100–150 mm brook trout ($r = -0.74$, $P = 0.002$, $N = 14$) and >150 mm brook trout ($r = -0.74$, $P = 0.003$, $N = 14$). There was also a significant inverse correlation

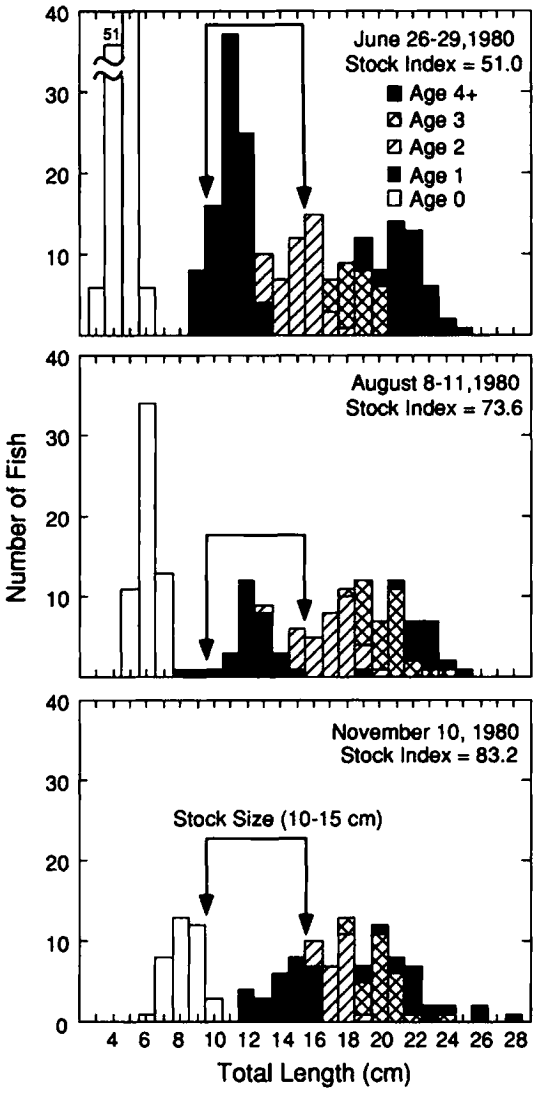

FIGURE 2.—Length-frequency histogram of brook trout in Dale Creek site 2 in 1980. Range of stock-size fish is marked by arrows on each graph. Numbers at top of some frequency bars indicate number of fish where number exceeded axis limits.

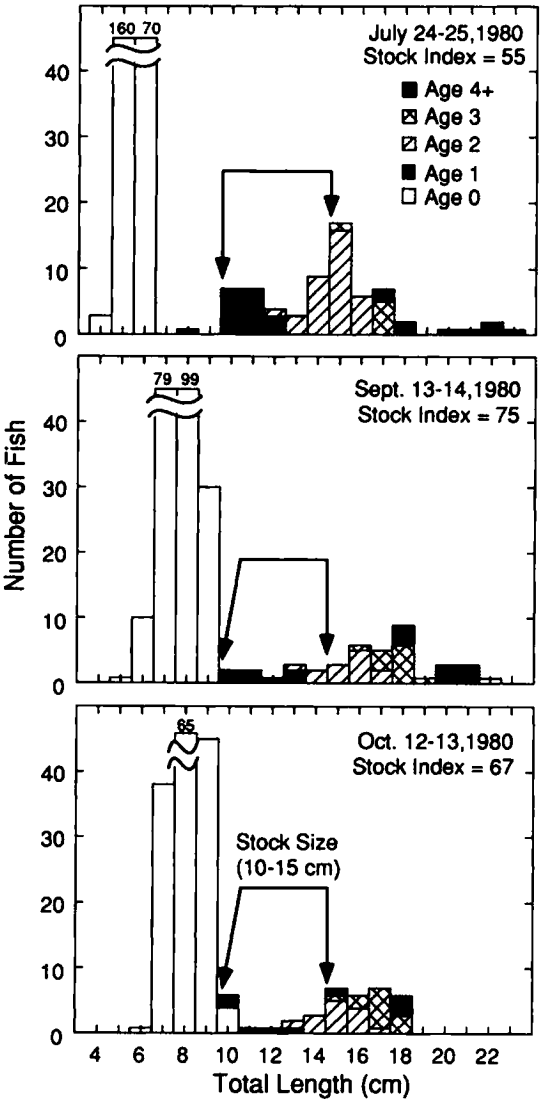

FIGURE 3.—Length-frequency histogram of brook trout in Indian Creek in 1980. Range of stock-size fish is marked by arrows on each graph. Numbers at top of some frequency bars indicate number of fish where number exceeded axis limits.

between discharge and W_r of 100–150-mm brook trout ($r = -0.72$, $P = 0.002$, $N = 14$).

Young-to-Adult Ratio

The YARs varied substantially among the brook trout populations (Table 2), ranging from 0 to 8.69. For most populations, YAR was at or below 1.0. However, YAR estimates for Indian and McCreavy creeks in 1980 were greater than in 1979, and generally greater than estimates for all of the other streams during 1979 and 1980. For summer samples, the only significant correlation between YAR and other habitat or population variables was a marginal correlation with P/B ($r = 0.61$, $P = 0.033$, $N = 12$).

Discussion

Stock Structure

The structure of a population is a complex function of recruitment, growth, and survival (Carline

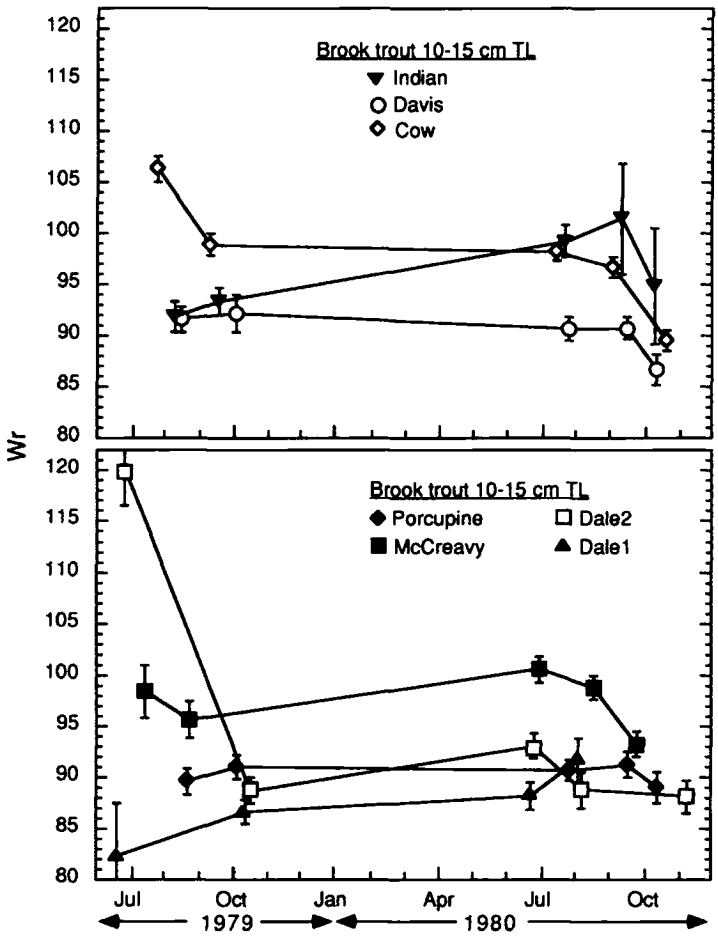

FIGURE 4.—Change in relative weight (W_r) of brook trout 100–150 mm total length during the 1980 growing season at seven sites on six high-elevation Colorado streams. Vertical lines indicate ±SE.

et al. 1984). For example, for fish with highly variable annual reproductive success and recruitment, strong recruitment in one year followed by weak recruitment the next year can initially decrease PSD when recently recruited fish are of stock size, but later increase PSD as those fish grow to quality size and are not replaced by sufficient new recruits. This sort of variation was observed in our study where, for example, the SDI of the Dale 2 population increased greatly in 1980 (Figure 1), coincident with the growth of the strong year-class of age-2 fish from stock size to quality size (Figure 2). Carline et al. (1984), in assessing PSD in Ohio impoundments, also had difficulty in distinguishing among the effects of survival, growth, and recruitment on stock structure. Their modeling showed that populations with markedly different growth and survival rates could be described by the same PSD. They also concluded that variation in recruitment merely set the bounds for variation in PSD and that growth and survival ultimately determined the stock structure. More years of data on brook trout recruitment would be needed to support or refute this contention. However, our results and those of others (e.g., Serns 1985) emphasize the necessity of interpreting any PSD value with reference to growth, survival, and recruitment.

Of the nine environmental variables used in our study, only mean depth and conductivity were significantly related to SDI. Both results are consistent with results of other studies. Depth is recognized as an important type of cover for large brook trout (Raleigh 1982), because deeper streams often provide shade and protection from terrestrial or avian predators and buffer the effects of weather

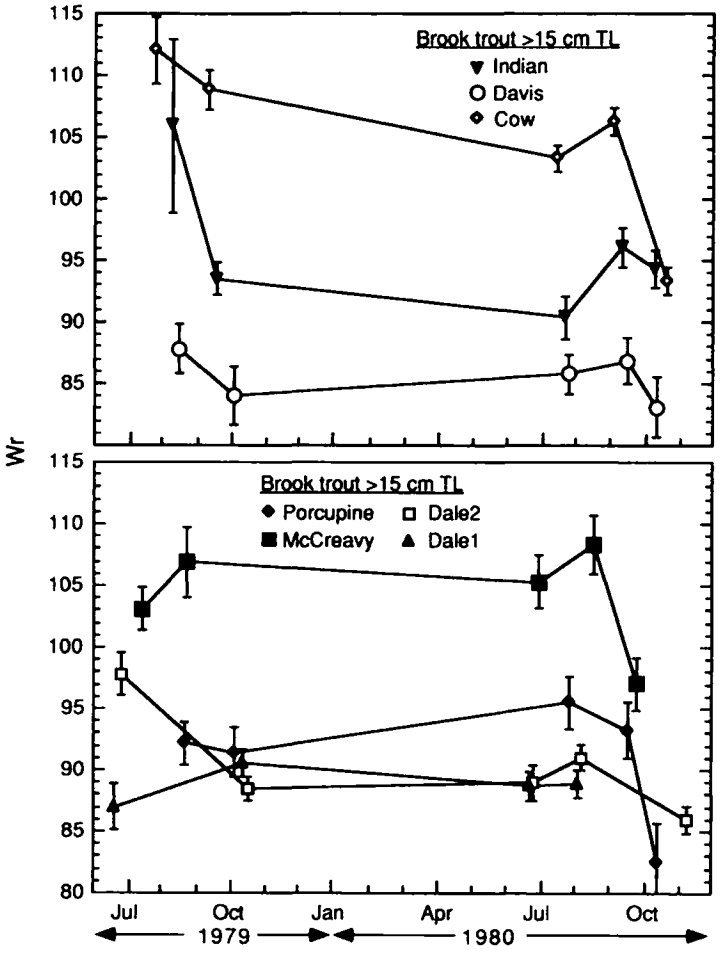

FIGURE 5.—Change in relative weight (W_r) of brook trout >150 mm total length during the 1980 growing season at seven sites on six high-elevation Colorado streams. Vertical lines indicate ±SE.

variations. During winter, Cunjak and Power (1986) found that older brook trout generally occupied positions in deeper and faster water than age-0 brook trout. Deeper waters often provide refuges from heavy ice cover, which may result in increased survival of larger fish and thus higher SDIs. Similarly, several studies have noted the association of larger brook trout and other salmonids with deeper water and cover during summer (Nyman 1970; Kozel and Hubert 1989). Thus, access to deeper water, by providing potential for increased overwinter survival and important habitat for larger fish during summer, may be reflected in the size structure as indicated by SDI.

The presence of other trout species has been found to influence brook trout populations (Fausch and White 1986; Fausch 1988; Kozel and Hubert 1989). In our streams, Dale 1 and Dale 2 were inhabited by populations of rainbow trout in densities roughly equivalent to those of brook trout; minor populations of brown trout were found in other streams. The Dale Creek brook trout populations generally exhibited high SDIs, but Indian Creek had SDI values similar to Dale Creek in 1980, yet contained only brook trout. The two streams with highest brown trout densities, Cow and McCreavy creeks, had low SDIs, but this was matched by Davis Creek which rarely contained any brown trout. Thus, although the presence of other trout species might have influenced SDIs, it is impossible to delineate those effects based on our data.

In Dale Creek and Indian Creek we found dramatic changes in SDI over as little as 2 months. Such changes indicate that samples taken at different times of the year would result in very dif-

TABLE 2.—Ratio of young (age-0) to adult (≥age-2) brook trout for six stream sections. Sample dates, which were typically in June or July for the first sample, August or September for the second, and October or November for the third, are given in Scarnecchia and Bergersen (1987). Only two samples were taken in 1979; Dale 1 was not sampled in 1980. Number of fish given in parentheses (age-0/≥age-2).

Creek	Year	Sample		
		1	2	3
Cow	1979		0.95 (112/118)	1.64 (213/130)
	1980	1.10 (184/167)	1.05 (156/149)	1.61 (197/122)
Dale 1	1979		0.0 (0/40)	1.75 (138/79)
	1980	0.40 (23/58)	1.02 (59/58)	
Dale 2	1979		0.09 (10/106)	1.56 (168/108)
	1980	0.91 (102/112)	0.75 (58/77)	0.58 (37/64)[a]
Davis	1979		0.01 (1/74)	0.10 (7/70)
	1980	0.00 (0/93)	0.304 (28/92)	0.47 (24/51)
Indian	1979		0.46 (19/41)	0.46 (18/39)
	1980	4.66 (233/50)	6.64 (219/33)	4.97 (149/30)
McCreavy	1979		1.03 (36/35)	2.35 (40/17)
	1980	1.25 (40/32)	8.36 (209/25)	8.69 (252/29)
Porcupine	1979		0.06 (6/105)	0.31 (34/111)
	1980	0.01 (1/165)	0.80 (94/117)	0.31 (11/35)[a]

[a] Dale 2 and Porcupine creeks were only partially sampled in October 1980. Data used were actual catches and not adjusted to reflect percent of sample completed.

ferent interpretations of the effects of habitat or biological variables in influencing stock structure. This finding is consistent with previous fish population evaluations using PSD or W_r in warmwater fisheries (Carline et al. 1984; Austen and Orth 1988; Mesa et al. 1990), where it was shown that these indices are sensitive to the time of year of sampling. Carline et al. (1984) suggested that movements of fish inshore or offshore, recruitment of fish from stock size to quality size, spawning, and energetic expenditures during winter can have large impacts on the values estimated for these parameters. Thus, the presence of seasonal and size-related sources of variation should indicate that researchers comparing samples among streams ensure that the samples were taken at about the same time. At the least, investigators and managers can examine the length-frequency distributions to see if year-class modes are near stock or quality sizes. Such a juxtaposition will indicate that large changes in structural indices have recently taken place or will likely occur.

Relative Weight

Whereas greater mean depth was associated with higher SDIs, we found higher W_r values to be associated with shallower mean depth. Shallower streams may have higher invertebrate production than deeper streams, but because we did not assess food availability or consumption by brook trout, we cannot presume that food availability differences were a causative factor in determining relative weight. Also, O'Conner and Power (1976) found no relation between condition and relative benthic invertebrate densities in four Quebec brook trout streams. Ensign et al. (1990) proposed that suitable habitat might be influential in determining brook and rainbow trout condition, particularly in one of their study streams that had the highest invertebrate densities but lowest average brook trout condition. However, habitat variables not measured in this study may have influenced condition, and further study is necessary. Relative weight estimates are not easily explained by any single environmental variable and are probably the result of a complex interaction of food availability, habitat, or some combination of both.

Young-to-Adult Ratio

Our data had about a two order-of-magnitude range in YAR estimates, but the reasons for this are unknown. Davis and Porcupine creeks had low YARs in both years, had some of the lowest SDIs, and had no large (>200-mm) brook trout. However, when all streams were included in the analysis, there was no significant relation between YAR and either SDI or density of large brook trout. Further, none of the physical or chemical variables was significantly correlated with YAR. Finally, as was true for SDI, a particular YAR value can reflect very different population situations. For example, in 1979 and 1980 estimated YAR was 0.31 for Porcupine Creek, but in 1979 there were three times as many fish as in 1980 (Table 2). Con-

versely, Cow Creek had very similar YAR and population estimates in both years. Thus, interpretation of individual YAR values must consider population size as well as year-to-year variability.

In the only other study, to our knowledge, that assessed YAR, Reynolds and Babb (1978) suggested that optimal reproduction by largemouth bass populations in midwestern impoundments was indicated by a YAR of 1–10, assuming there were moderate adult densities. They also reported that ponds with high PSDs were associated with high YAR (mean YAR of 22 for eight ponds with PSDs of 68–100), low adult densities, and relatively high percentage of populations with one or more missing year-classes. However, their findings were based on only 1 year of data and do not reflect the yearly variation seen in our data. Insufficient time series of data may have prevented us from better assessing the relation of YAR to other population or habitat characteristics. Long-term data sets or future studies conducted over 10–15 years (three times the maximum age of 4–5 years) are needed to address this problem.

Conclusions

Managers always look for easier and quicker ways to assess the fisheries they manage. Decreasing budgets and increasing demands on time result in a greater need for rapid methods of assessing stocks. Do structural and condition indices such as SDI, YAR, and W_r provide such tools? For this particular set of high-elevation streams the answer is ambiguous. Each of these indices provides a snapshot of the population. For example, extremely high or low SDI values often provide one way of cryptically saying that "there are only very large fish" or "there are no quality-size fish." At more intermediate SDI levels, however, interpretation becomes more difficult and ambiguous. High SDIs can thus, potentially, indicate the presence of a quality fishery, but only if sufficient reproduction, growth, survival, and recruitment are occurring. Although production may be the most direct indicator of fishery potential, given the presence of desired-size fish, none of the rapid assessment variables was related to production. These indices do, however, provide convenient ways of describing populations and are perhaps particularly useful for comparative work involving similar water bodies over short periods. As shown by this study, though, it is important to consider the dynamic nature of the populations and to account for the possibility of this source of variation in the indices.

Acknowledgments

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