Trends in Relative Stock Density Indices of Walleye Populations in Wyoming Reservoirs

Todd D. Marwitz and Wayne A. Hubert
National Biological Service
Wyoming Cooperative Fish and Wildlife Research Unit [a]
University of Wyoming
Laramie, Wyoming 82071-3166

ABSTRACT

We assessed the length structure of walleye *Stizostedion vitreum* populations over time in five high-elevation (>1340 m above mean sea level) reservoirs in Wyoming using relative stock density (RSD). Four populations showed moderate to large fluctuations in RSD values across years, while one population was relatively stable. Fluctuations in RSD values were associated with variability in annual recruitment. Incremental RSD values allowed identification and tracking of weak year classes through time. Because of inconsistent annual recruitment, the utility of RSD for assessing the rates of recruitment, growth, and mortality of walleye populations in large reservoirs is limited.

INTRODUCTION

Relative stock density (RSD), an index used to describe length-frequency data from samples of fish populations, was proposed by Wege and Anderson (1978). It was developed more fully by Gabelhouse (1984a) and its use when describing fish populations has since proliferated (Willis et al. 1993). As an index of population structure, RSD allows evaluation of potential angling quality and facilitates description of length structure for fish populations. Recent studies indicate that RSD may also provide insight about densities and rates of recruitment, growth, and mortality of fish populations in some waters (*see* Willis et al. 1993).

A growing demand for walleye *Stizostedion vitreum* angling has led to the expanded range, via introductions, of the species (Ellison and Franzin 1992). Walleye are now found in most large reservoirs in eastern Wyoming, and sampling regimes have been established to monitor these populations. Because the use of structural indices such as RSD has been concentrated on warmwater fishes in small ponds and impoundments (Carline et al. 1984, Willis et al. 1993), their usefulness for assessing walleye in large reservoirs remains a question.

The objectives of this study were to (1) describe the variation in incremental RSD values of five walleye populations over time and (2) determine the utility of RSD for assessing the dynamics of walleye populations in large reservoirs in Wyoming.

STUDY AREA

The five study reservoirs were in the North Platte River drainage of Wyoming. Seminoe (1938 m above mean sea level, AMSL), Pathfinder (1783 m AMSL), Alcova (1676 m AMSL), and Glendo (1413 m AMSL) reservoirs are mainstem impoundments on the North Platte River. Grayrocks Reservoir (1342 m AMSL) is on the Laramie River, 16 km upstream from the confluence with the

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North Platte River, and is a relatively new (circa 1980) impoundment.

Self-sustaining walleye populations have developed in Seminoe, Pathfinder, Alcova, and Glendo reservoirs (Marwitz 1994). Although their origin has never been verified, walleyes were first captured from Seminoe Reservoir in 1961. They moved downstream into Pathfinder Reservoir in 1973 and Alcova Reservoir in 1983 and 1984, when heavy spring runoff required surface releases from upstream reservoirs. Walleyes were stocked into Glendo Reservoir from 1972 to 1975 by the Wyoming Game and Fish Department (WGFD). Grayrocks Reservoir was first stocked with walleye fry in 1980 by WGFD and has been stocked on an almost annual basis due to limited natural recruitment (Marwitz 1994).

METHODS

Length (mm total length, TL) data of walleyes sampled annually from the five reservoirs were obtained from WGFD. To minimize seasonal variation in RSD values, we included only data collected during late August through October. Additionally, only samples with $n \geq 40$ fish were used.

Walleyes were sampled with sinking (45.7 X 1.8 m) and floating (45.7 X 2.4 m) monofilament gill nets having six progressively ordered panels (32-, 38-, 45-, 51-, 57-, and 64-mm bar mesh). Also used were sinking gill nets (48.8 x 1.8 m) with eight randomly ordered panels (19-, 25-, 32-, 38-, 45-, 51-, 57-, and 70-mm bar mesh). Trap nets were set in conjunction with gill nets in Grayrocks Reservoir.

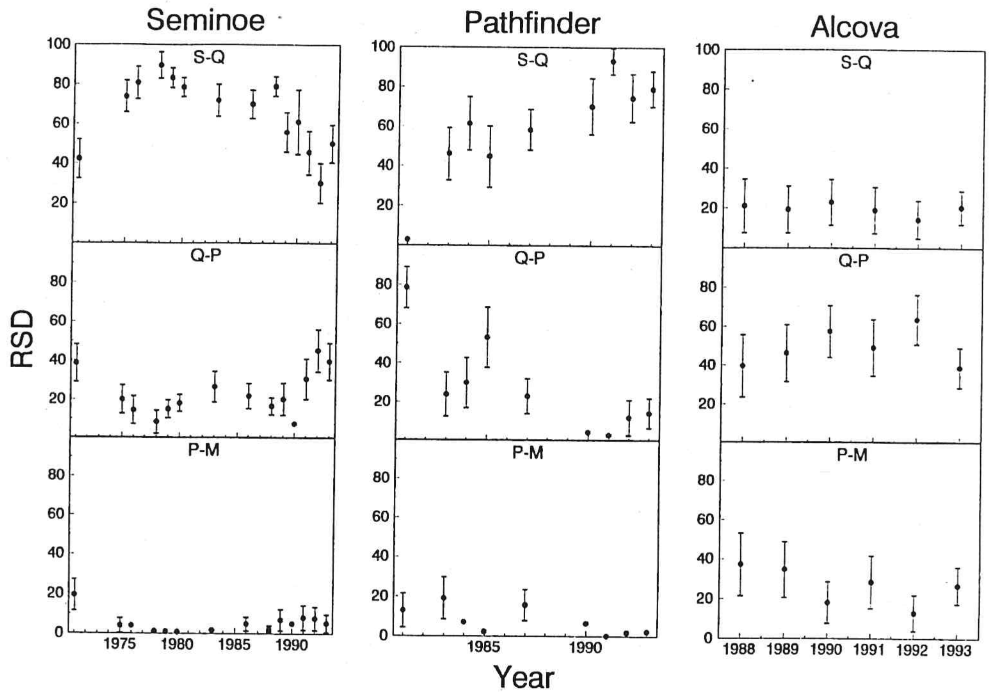
We calculated incremental RSD values (proportion of stock-length fish consisting of individuals between minimum lengths for size categories; Willis et al. 1993) and corresponding ninety-five percent confidence intervals (Gustafson 1988) for each sample. Minimum stock (S), quality (Q), preferred (P), memorable (M), and trophy (T) lengths for walleye were 250, 380, 510, 630, and 760 mm TL, respectively (Gabelhouse 1984a). Linear regression analysis was used to determine if relationships existed between incremental RSD values over time within reservoirs. Statistical analyses were performed using SPSS/PC+ (SPSS Inc. 1991) with significance determined at $P \leq 0.05$.

RESULTS AND DISCUSSION

Incremental RSD values (with 95% C.I.) for walleye samples from the five reservoirs (Figure 1) showed moderate to large fluctuations across years, with the exception of Alcova Reservoir (Figure 1). And, although the length structure in Alcova Reservoir was relatively stable through time, the RSD values suggest it should be otherwise.

Alcova Reservoir is a steep-sided impoundment that receives its primary inflow via a tunnel from Pathfinder Reservoir, and thus spawning habitat is limited. During each of the six years of record, S-Q fish comprised only about 20% of the stock-length walleyes captured from Alcova Reservoir, whereas RSD Q-P ranged from 40-60 and RSD P-M ranged from 15-40. These values indicate limited within-reservoir recruitment and suggest that larger (≥ Q-length) walleyes occasionally move from Pathfinder Reservoir into Alcova Reservoir. In a current study using coded wire tags, trout stocked in Pathfinder Reservoir have been captured in Alcova Reservoir (B. Wichers, WGFD, personal communication), supporting the notion that fish from Pathfinder Reservoir move into Alcova Reservoir and contribute to the population.

In Grayrocks Reservoir, where primary walleye recruitment is by stocking of fry, weak year classes occurred when no fry were stocked in 1984 and 1985, as well



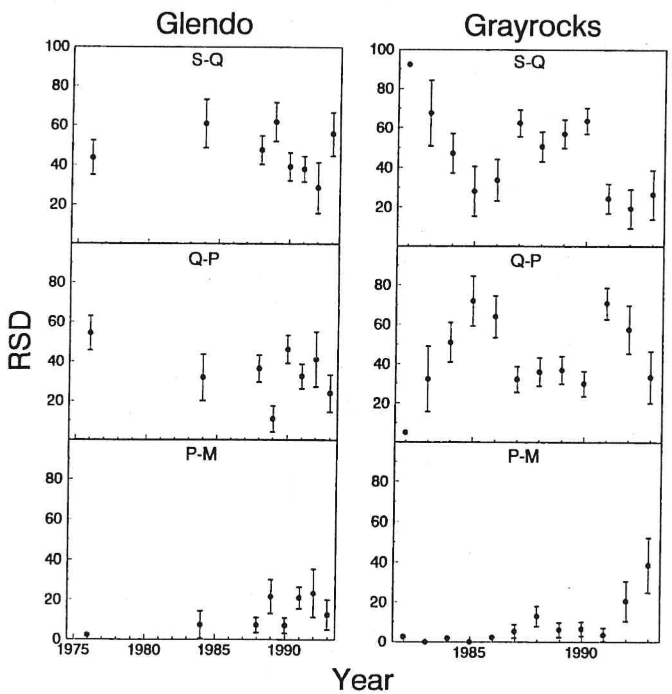


Figure 1. - Incremental relative stock density (RSD) values of walleyes collected from five reservoirs in Wyoming. Vertical lines represent 95% confidence intervals. Minimum stock (S), quality (Q), preferred (P), and memorable (M) lengths for walleyes were 250, 380, 510, and 630 mm total length, respectively.

as in 1989 and 1990. These weak year classes were observed within two years as sharp declines in RSD S-Q values, followed by declines in RSD Q-P values two years later (Figure 1). In this particular case, incremental RSD values allowed weak year classes to be identified and tracked, and also provided a general estimate of growth rate.

Values of RSD S-Q were inversely related to corresponding RSD Q-P values for Seminoe (r = -0.83), Pathfinder (r = -0.93), and Grayrocks (r = -0.84) reservoirs (Figure 1). Proportions of larger ($\geq$ P-length) walleyes in these reservoirs were either low or remained relatively stable through time. Therefore, RSD S-Q and RSD Q-P were sufficient to describe changes in length structure of these walleye stocks over time.

Fluctuations in incremental RSD values were likely caused by variable annual recruitment. The effect of variable recruitment on length structure of fish populations has been detected in other fisheries. Wide fluctuations in the length structure of walleyes in Escanaba Lake, Wisconsin, were caused by variability in year-class strength and sampling techniques (Serns 1985). Similarly, Carline et al. (1984) concluded that variation in recruitment had a much greater influence on the length structure of fish populations in medium to large impoundments than either growth or survival.

Although RSD values are believed to reflect the density and rate functions (recruitment, growth, and mortality) of fish populations, RSD alone provides little interpretable information on growth and mortality when recruitment is inconsistent from year to year (Willis et al. 1993). Additionally, the inverse relation between population density and RSD reported for centrarchids in small impoundments (Reynolds and Babb 1978, Gabelhouse 1984b, Guy and Willis 1990) and brook trout *Salvelinus fontinalis* in beaver ponds (Johnson et al. 1992), tends to deteriorate as the size of the water body increases (Carline et al. 1984). Therefore, there may be little relationship between RSD and density of walleyes in large reservoirs.

Although the utility of RSD alone for assessing the dynamics of walleye populations in large reservoirs seems to be limited, the RSD values observed in these case histories raise questions that can provide direction for future research. In some cases, incremental RSD values may allow strong or weak year classes of walleyes to be identified and tracked. At the very least, incremental RSD values allow length-frequency data to be quantified in a concise manner, thereby facilitating communication among biologists.

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