macros that handled the output from my BASIC programs. Timely production of the final program book would not have been possible without the tireless efforts of Scott Holt, who also served as organizer of the Larval Fish Conference.

=RESEARCH NOTES=

Effects of Electrofishing on Fish Reproduction, Gametes, and Offspring

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(Abstracted with little modification from: Snyder, D.E. 1992. *Impacts of Electrofishing on Fish.* Report of Colorado State University Larval Fish Laboratory to Glen Canyon Ecological Studies Aquatic Coordination Team, Flagstaff, Arizona, and U.S. Department of the Interior Bureau of Reclamation, Salt Lake City, Utah -an extensive review with recommendations that should be published and available through the Bureau in the near future).

Spawning fish often aggregate in accessible localities and are sometimes considered more vulnerable to electrofishing than other life stages (Stewart 1967 as cited by Lamarque 1990; Kolz and Reynolds 1990). For these reasons, studies employing electrofishing sometimes target the spawning season. Most of our knowledge of effects of electric fields on fish reproduction, gametes, and subsequent offspring is based on collection of brood stock, hatchery operations, and artificially fertilized eggs. The effects of electrofishing on the natural reproductive behavior of fish exposed while in ripe or near-ripe condition are unknown.

Halsband (1967) reported that gonads were unharmed by electrofishing, and Halsband and Halsband (1975, 1984) explicitly stated that "Harmful genetic effects—or harmful effects to the progeny—are also not produced." According to Vibert (1967), "McGrath reported that . . . no ill effects have been recorded in hatcheries on the offspring of wild trout caught by electricity." Maxfield et al. (1971), who subjected young-of-the-year and yearling rainbow trout (*Oncorhynchus mykiss*) to 8- and 5-hertz (pulses or cycles per second) pulsed direct current, respectively, reported that subsequent fecundity of those fish and mortality of their offspring through eyed-egg, hatching, and initial feeding stages was not consistently different from that of unexposed fish. Khakimullin and Parfenova (1981) reported no ill effects of pulsed 6-hertz, 40-millisecond alternating current on Siberian sturgeon (*Acipenser baeri*) spawners or subsequent (pituitary-induced) gamete maturation and development of eggs and larvae (if the alternating current was rectified, then the current was actually a form of pulsed direct current). Similarly Valdez (pers. commun.) and Pfeifer (pers. commun.) reported no adverse effects of pulsed-direct-current electrofishing on ripe lake trout (*Salvelinus namaycush*) and walleye (*Stizostedion vitreum*), respectively, or on the survival of their artificially fertilized eggs. However, other researchers have observed adverse impacts.

Marriott (1973) compared mortality of artificially fertilized pink salmon (*Oncorhynchus gorbuscha*) eggs from

unshocked and electrocuted (110-volt, 60-hertz alternating current) males and females. He found mortality through a late-eyed stage to be 12% higher for eggs from the electrocuted females. Two of the electrocuted females had severely ruptured internal organs and most of their eggs were loose and bathed in body fluids; this might have accounted for at least some subsequent egg mortality. Additional exposure of a batch of fertilized eggs from electrocuted adults to an electric field resulted in 27% greater mortality than for eggs which were never exposed to an electric field. Marriott recommended that electrofishing not be used to capture ripe females.

Newman and Stone (unpubl. ms. 1992) subjected ripe walleye to 120-hertz pulsed direct current (400 volt, 3 amp, quarter-sine waveform) and documented the viability of subsequently fertilized eggs. The fish were held in a net enclosure as an electrofishing boat made two slow passes about 0.7 m from the net. Mortalities for eggs artificially fertilized from the exposed fish, 63% to 65%, were significantly higher than the overall average, 37%, for unshocked brood stock. The authors also noted that the hatchery manager for the Lac du Flambeau Tribal Hatchery, L. Waronowicz, who cooperated in their experiments, had severe viability problems with eggs from electrofished brown trout (*Salmo trutta*). He and other hatchery managers had observed broken eggs when stripping electrofished brown trout and suspected that the albumen from the eggs might clog the micropyles in many unfertilized eggs. The authors also noted that some researchers suspected that electrofishing ripe males might result in a loss of sperm motility. Next issue: "Effects of Electrofishing on Fish Embryos, Larvae, and Early Juveniles."

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ITEMS OF INTEREST....

ANNOUNCING A NEW PUBLICATION: Chapman & Hall Early Life History of Fish: an energetics approach December 1991: 268 pp, 61 line illus. Hardback.

The early life history of fish is of vital interests to biologists working with fish and fisheries. A full understanding of the developmental stages and processes involved is necessary, for example to help avoid potential commercial losses in aquaculture systems.

This book brings together current knowledge of the growth of fish gonads, the endogenous feeding period and larval life, much of this work appearing here in English for the first time. Special attention is given to the effects of internal and external factors on growth rate and subsequent offspring quality with its effects on aquaculture systems. As well as reviewing present information, the author also points out the relevance of our current knowledge to problems which will require further study in the future.

Contents: Introduction, gonad formation, quality of reproductive products, endogenous feeding period, mixed feeding period, early exogenous feeding period, feeding of fish larvae in aquaculture, index.

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