

PERSPECTIVES

To the Millenium and Beyond: A Commentary on Early Life History Research

The force that drives most early life history (ELH) research, and fisheries management in general, is the desire to monitor, predict, or manipulate the size and distribution of fish populations. In most cases our goals have been to increase, maintain, or restore the size or number of "desirable" populations, usually commercial, recreational, and more recently, endangered species. Sometimes our goal has been to reduce or eliminate native, non-native, or exotic fishes that we believe substantially impact desirable populations.

In all cases, an understanding of reproduction, early survival, recruitment, and the factors significantly affecting them are keys to maintaining or manipulating fish populations, hence a necessary focus on the embryonic, larval, and early juvenile periods. ELH research to these ends includes field investigations of the spatial and temporal distribution and abundance of early life stages; detailed examination of collected specimens and parts thereof (e.g., otoliths, gut contents); development of successful rearing techniques; studies of morphological, physiological, and behavioral ontogeny; and a variety of field and laboratory experiments.

In prior Perspectives articles, Professor John Blaxter reviewed some land-mark developments in the past 50 years that have spurred ELH research and Dr. Art Kendall discussed the history and challenges of population enhancement programs. For this commentary, I've been invited to briefly contrast marine and freshwater ELH research. I conclude with a few observations on taxonomic considerations.

Marine versus Freshwater

Many aspects of marine and freshwater ELH research, including related aquacultural concerns, are similar, but there are notable differences in sponsorship (clients), categories of target fishes and habitats, and the nature, size, and scope of programs. Marine ELH research has a long history of governmental support on behalf of commercial fisheries. In part because of the difficulty and expense of effectively sampling vast open seas, marine ELH programs are often large in scale, budget, and duration. Witness the large number of national and state or provincial marine fisheries laboratories that are heavily involved in ELH research. In contrast, most freshwater and estuarine ELH research is sponsored by a much wider variety of government entities, foundations, industries, and consortiums, usually in response to recreational fishery, environmental impact, exotic species, or endangered species concerns. In part because of the non-commercial status and smaller size of most target populations, the diversity of concerns, and more geographically restricted habitats, freshwater and

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Darrel began work on fish larvae while still an undergraduate in 1968 as an employee of Ichthyological Associates, a consulting firm monitoring the impacts of power stations on the Susquehanna River. From there he joined another consulting firm, and studied eggs and larvae in east coast and central United States rivers and in the Great Lakes and Finger Lakes of New York.

During the mid-70s, he and Ron Kernehan independently conceived of a Larval Fish Section within the American Fisheries Society and together circulated petitions for its establishment. As a result, the Early Life History Section was authorized in September 1979 and became official a year later. Darrel was elected as the Section's first President (1980-81).

estuarine ELH programs are usually smaller in scale, budget, and time frame. Of all freshwater ELH research in North America, programs in the Great Lakes, where commercial fisheries have been an important concern, are perhaps most similar to marine programs.

ELH investigations in freshwaters of the United States received their greatest boost in the 1960's and 70's in response to federal laws that require assessments or monitoring of adverse environmental impacts on the country's waters, aquatic communities, and endangered fishes. The effects of chemical discharges from industry, thermal effluents from power plants, entrainment in power-plant cooling systems, transport through hydroelectric and pumped-storage turbines, impoundments, other habitat changes, and introductions of non-native species on fish early life stages were, and in many cases remain, significant concerns across the country.

Much ELH research is conducted in response to conspicuously declining populations. The predominant causes of such declining populations in marine systems have been overfishing and natural shifts in ocean currents. In freshwater and estuarine systems, the predominant causes have been loss or degradation of natural habitats, adverse impacts on those habitats, and introduction of non-native or exotic species (both fish and other aquatic organisms). Because significant changes in target fish populations do not happen independent of the rest of the community and ecosystem, and because those populations are often only one of many concerns regarding the system, much ELH research is and increasingly should be integrated into efforts to conserve or restore whole communities and habitats.

A Still Weak Taxonomic Foundation

Before any monitoring or other field collection programs can be successfully implemented, researchers must be able to accurately identify the early life stages of target and similar-appearing species. If the species of concern have not been adequately described, one of the critical steps in most programs is to determine the appearance and diagnostic characteristics of the target and all potentially similar species throughout those portions of early ontogeny likely to be encountered. This is usually accomplished by rearing embryos and larvae of target and similar species or, with great care, deducing their presence in

the first season's collections by working backward from morphologically identifiable juveniles. In some cases, two or more sympatric species are so similar in some developmental stages that they cannot be confidently distinguished using external morphological criteria. Although time consuming, costly, and inconvenient, we then must turn to skeletal and other internal characters or to unique biochemical or genetic markers.

Unfortunately, the vast majority of fishes remain undescribed or inadequately described as embryos, larvae, or early juveniles for identification purposes. Richards (1985) estimated that less than 10% of the world's approximately 22,000 fishes had been illustrated for at least one larval stage (< 4% for eggs and embryonic stages). Regional guides to early life stages of fish do not exist for most of the world. For regions where guides do exist, species coverage is highly variable. Kendall and Matarese (1994) found that for marine species present in nine regions covered by ELH guides, the percentage of regional species represented by at least one larval-stage illustration ranged from 10 to 82%. The percentages of species sufficiently described for identification of all or most larval stages are probably much lower. Twenty years ago I estimated that less than 15% of North America's approximately 800 species of freshwater and anadromous fishes had been adequately described and illustrated as eggs and larvae for identification purposes. Although many additional freshwater and anadromous species have been at least partially described as eggs or larvae since that time, and many of the existing descriptions have since been compiled in at least one of several regional ELH guides, I doubt that the percentage of North American species adequately described and illustrated yet exceeds 25%.

Early life stage descriptions, keys, and guides are the foundation for field research. There are many challenges for ELH research, whether in the open seas or inland rivers and lakes; but as we approach the year 2000, it is obvious that we still have many gaps in our foundation. It must be impressed upon sponsors of ELH research that descriptive biology remains a vital part of that research and needs to be funded accordingly. The Early Life History Section of the American Fisheries Society should play a substantial role in documenting those gaps and coordinating and promoting efforts to fill them.

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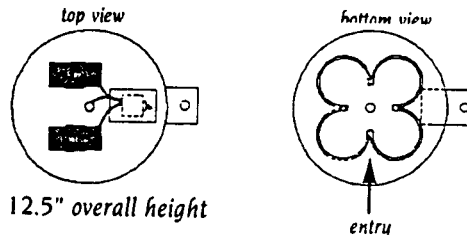
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