

To design, build, and maintain perfect ponds for bluegills and anglers

Stephen Spotte 2007. **Bluegills: Biology and Behavior**. American Fisheries Society, Bethesda, USA, 2007, 214 pp, US\$35.00.

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This book was written by an author who loves bluegill (*Lepomis macrochirus*) and fishing. That is clear from the last chapter and the pretty eye of a bluegill illustrated on the cover. I felt something in common with Stephen Spotte, the author of this book, because I went fishing every day in my childhood in Japan. However, the targets of my fishing, silver crucian carp (*Carassius gibelio langsdorfi*), pale chub (*Zacco platypus*), and Japanese minnow (*Pseudorasbora parva*) have largely disappeared from many ponds and lakes in Japan, partly due to the introduction of American centrarchids such as largemouth bass (*Micropterus salmoides*) and bluegill. I was a leader of a research project to find methods to reduce the number and distribution of bluegills in Japan. Thus, my attitude while reading this book is slightly biased in that I am trying to find weak points of bluegills. Although this book sometimes recommends culling small bluegills, the aim is to increase large-sized bluegills as a target for fishing by facilitating the growth rate of the remaining bluegills. I felt, therefore, some hesitation in writing a critique of this “Bluegills”. However, as the author states in the introduction, this book is intended for an audience not specifically of freshwater ecologists, fishery managers,

ichthyologists, experimental biologists, or other specialists but rather for biologists with diverse backgrounds.

This book is well organized and clearly written, and one of the best guides so far published on a single fish species. Bluegill is perhaps the most intensively studied fish in the world, and the wealth of advanced research on the behavior and ecology of bluegill supports this book. “Bluegills” is not too long nor overly complex. It skillfully summarizes the behavior and ecology of bluegills, without being biased to particular theories, while providing a balanced overview of this fish. After explaining the general principles or tendencies, the author never forgets to describe exceptions that have considerable scope to stimulate future studies.

Spotte introduces a lot of clear results on bluegill behavior obtained in the laboratory and experimental ponds. However, the author says “results from studying captive animals provide insight into hypotheses that need to be tested in the field, not data for making managing decisions”. From this viewpoint, the author seems to try to find good management methods for bluegill ponds and lakes with a variety of fish species composition, lake morphology and vegetation.

“Bluegills” is a book of 214 pages composed of an introduction (2 pages), eight chapters (146 pages), endnotes (26 pages), references (24 pages) and index (16 pages). Detailed references are omitted from the main text. They are given in “endnotes” and “refer-

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ences”, allowing comfortable reading of the main text. The full and clear index is very useful for readers and a total of 72 figures and 19 tables help understanding of this book.

The first two chapters are “movement” and “sensory perception”. Many illustrations clearly explain the mechanism of bluegill movement and perception. I thought that marking individual fish by clipping small pieces of the posterior parts of dorsal fins or caudal fins does not have a serious effect on the movement of bluegills. I have in the past cut a part of fish fins to identify individuals in my own research. However, after reading these chapters, I realized that fin clips disrupt fish movements. Movement and sensory systems may be different between fish species. Some of these comparisons between species are described in the text. However, if similarities and differences were summarized in tables, they would clearly contrast bluegill features from other species. Our present knowledge of sensory perception for many species may be limited, and detailed comparisons between species in future editions would enhance this chapter.

The next chapters, foraging, competition and predation, show that bluegills are vigorous fish that succeed in competition with many other fishes. We know that bluegills are not aggressive except for territorial males during the breeding season. Outside the breeding season, bluegills can be chased away by smaller cyprinids, and are not as predatory as largemouth bass. However, in many ponds in America with many species of competitors and predators, bluegills seem to be numerically dominant. Bluegills are good at taking a variety food-items such as water fleas, chironomid larvae and terrestrial invertebrates. Bluegills prey on the larvae of other fishes, and escape swiftly from predation by largemouth bass and pike (*Esox lucius*) using various habitats depending on their size and feeding types.

In chapter 3, some foraging models are explained, but many of the details were slightly difficult to understand. A table summarizing their features and application to bluegills might help readers’ understanding. I am also interested in trophic polymorphisms reported in fishes in the United States and Japan. Those individuals differ in morphology and behavior, and therefore I would like to see some picture or illustrations of each type. The chapter on competition with other fishes was very interesting for me, but for general readers the interspecific relation-

ships might be slightly difficult to understand. Some illustrations with fishes and habitat might make them easier to read.

The chapter on predation is mostly written on the relationship with largemouth bass. The relationship between bass predation and the concentration of vegetation in a habitat was clearly explained. In Japan, freshwater fishes are threatened by predation by birds such as the common cormorant (*Phalacrocorax capillatus*) and common merganser (*Mergus merganser*). I wondered if bird predation is not important for the population dynamics of bluegills in USA, or if it is just not studied due to difficulties in investigation.

Chapter 6 on reproduction describes not only the general reproductive features of bluegills but also how and why individual bluegills behave so as to increase fitness. Bluegills spawn in the shallow, flat parts of ponds and lakes. Males establish nests in colonies and females visit male nests to spawn. Behavioral sequences in mating activities are explained in detail. During spawning a large number of eggs are released, and it is a crucial task for parental males to defend and fertilize eggs. Cannibalism by conspecifics and sneaking behavior by other males to fertilize eggs reduce the fitness of territorial males. It is clear that the mating success of territorial males depends on the nest site and that males are most successful in the central part of colonies. The occurrences of interspecific hybridization and cuckoldry by satellite conspecifics males are particularly interesting features of this fish, and they are explained concisely.

The final two chapters treat development, growth, and mortality (Chapter 7), and management (Chapter 8). These chapters, based on the results of previous chapters, aim at the goal of the author to design, build and maintain the perfect bluegill pond. Spotte says that “fishing, of course, is the classic waste of time, but actually getting ready to fish can keep you pretty busy”. A picture of a fisherman with a record bluegill (page 142) is really impressive and his smile sticks in my memory. However, to make a perfect pond, we need to know fully the ecology of bluegills and their environment. Spotte notes (page 128) that “attempts to correlate environmental factors with growth are sometimes initiated for predictive purposes with the ultimate objective of managing fisheries. The results often fail to meet expectations for three reasons’. The reasons for the failure arise from the interactions between growth of bluegills and environmental and

biological factors in bluegill ponds. This difficulty may be common for all efforts to analyze the relationships between environmental factors and some biological aspect of an organism. I agree that multivariate analyses are possible and perhaps necessary but such analyses are often not enough to allow a complete understanding. After finding possible important factors, it is necessary to test them in the field. These procedures are difficult to do, but it is a goal of environmental biology.

When bluegills grow up to a large size, they are good eating fish and support small scale local fisheries. Bluegills may be one of the most popular freshwater fishes in USA, and have been introduced into some other countries. It was 1960 in the case of Japan. A Chicago mayor at that time presented 17 bluegills to a Japanese prince who visited the USA, and the bluegills were reproduced artificially and stocked into several Japanese water bodies. These bluegills mostly did not grow in Japanese ponds as anticipated and did not seem to be harmful for other fishes. However, after 47 years from the introduction, bluegills are now distributed all over Japan (Kawamura et al. 2006) and are dominant in many ponds and lakes. Most bluegills are thin and small because no other fish except largemouth bass and the rare native catfish (*Silurus asotus*) are able to prey on bluegills and the bluegill population is quite large. Consequently, in Japan bluegills rarely reach a large size and are seldom eaten.

In Japan, in many ponds bluegills coexist with largemouth bass. The absence of native diurnal predatory fishes in Japan allowed predation of Japanese fish by largemouth bass, and reduced many of the native competitors of bluegills, mostly cyprinids. Consequently, there are few rivals of bluegills and bluegills have further reduced native fish by preying on eggs and young of other fish (Azuma 1992). I could understand how and why bluegills are dominant from reading this book.

This book will be enjoyed by many types of readers from a variety of standpoints. Each reader may imagine her or his own perfect pond. For example, fisherman of largemouth bass may like to control the density of weeds to facilitate the predation of bluegills by largemouth bass. As mentioned already, I thought how to reduce the number of bluegills. The fish constructs colonies and nests in the center of colonies increases male mating success. These results imply that the disruption of central nests will be particularly

effective. The removal of aquatic weeds and snags may also reduce bluegills. However, bluegills are difficult to control. Except for by completely draining the water, in no pond in Japan has bluegill been successfully eradicated.

This book does not include some biological aspects such as genetic structure, aquaculture, toxicity testing, distribution, taxonomy and evolution. If some researchers are concerned about the lack of these aspects, perhaps they should write their own books on bluegill. However, in spite of our different motivation for interest in bluegills, I agree almost completely with the author of "Bluegills" on the composition of the book. However, in future revisions, I would suggest that he add information on the relationships between genetic features and behavior or ecology of bluegill. Japanese bluegills are very susceptible to hooking injuries and bluegills that swallow hooks tend to die. This is seldom seen for other fishes as far as I know. I wonder if this susceptibility is related to the lack of genetic diversity of Japanese bluegills, because all of them are estimated to be descendants of 17 bluegills introduced in 1960 (Kawamura et al. 2006).

I was impressed by a sentence in the introduction; "an image of the essential bluegill can emerge only by weaving what we understand into a crude narrative in which mechanism is subsumed in event". However, individual fish show differences in behavior, morphology and disposition and interact with con- and heterospecifics in diverse habitats. In this book, some instances of individual differences in feeding and mating behavior are introduced, but they may not be sufficient. Most fishermen know that individual bluegills are different in their hooking probability and learning ability. Hooking for bluegills may also be affected by laterality (asymmetric development of muscles and bones) as is reported for largemouth bass (Nakajima et al. 2007). Right fish are hooked on the right side of their mouths. Individual bluegills may also be different in other characteristics or disposition from other bluegills. Individual differences in disposition, such as aggressiveness, timidity and curiosity, have been studied previously in other fishes (Huntingford 1976; Clark and Ehlinger 1987; Katano 1987). If we hope to understand the complexities of bluegill ecology, in addition to analyzing general principles, we need to know individual differences and events that may be important in each stage of bluegill life.

This book is of significant interest and therefore will require revision in the future, using new findings to weave an almost perfect narrative on bluegill. Some of my comments might be inadequate because research studies that have been conducted on bluegill are not yet completed. Many things remain unstudied, even for bluegill.

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