Reprinted from the 1975 Spring Issue of Farm Pond Harvest, Vol. 9, No. 2, pages 8, 9, & 24

FRESHWATER SHRIMP

NATURAL FOOD FOR POND FISHES

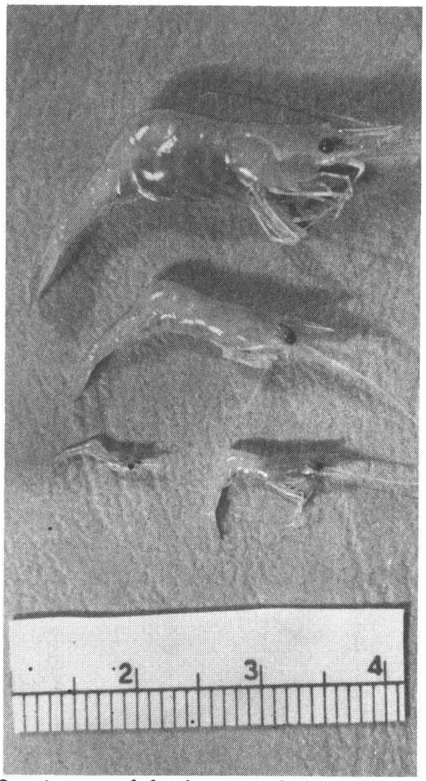
by
Larry A. Nielsen and James B. Reynolds

Missouri Cooperative Fishery Research Unit
Stephens Hall, University of Missouri
Columbia, Missouri 65201

". . . There is, of course, a natural fertility in the waters which is available, similarly to that of the soil, with the proper agent to take up and conserve it. In the freshwater shrimp we have an example of such a gatherer and conservator . . . . The exceeding abundance of freshwater shrimp may be compared with that of house flies in summer, flying ants on their emergence from the decaying stump, or angleworms in favorable soil . . . . From the foregoing it is practically certain that the species is adapted to broadcast distribution in the temperate zone of the globe, and capable of becoming a resource of incalculable value . . . ."

So wrote S. G. Worth (1908), a fishery manager in South Carolina, in praise of a small shrimp which inhabits ponds, lakes, and stream backwaters across the eastern United States. The potential envisioned by Worth re-surfaced in 1939, when H. S. Swingle (1968), of Auburn University, stocked shrimp and bluegill in experimental ponds and noted an 88% increase in bluegill production. In recent years, interest in freshwater shrimp has expanded, providing the stimulus for our studies at the University of Missouri. The reason for our research, however, goes beyond the value of the freshwater shrimp; it is rooted in basic principles of ecology.

More than a school subject or a scapegoat for rising fuel prices, the science of ecology was born of pioneering observations, often of the lakes, ponds, and streams of America. The principles derived from these observations are of practical value to the pond owner and angler who desire quality fishing now and for generations to come.



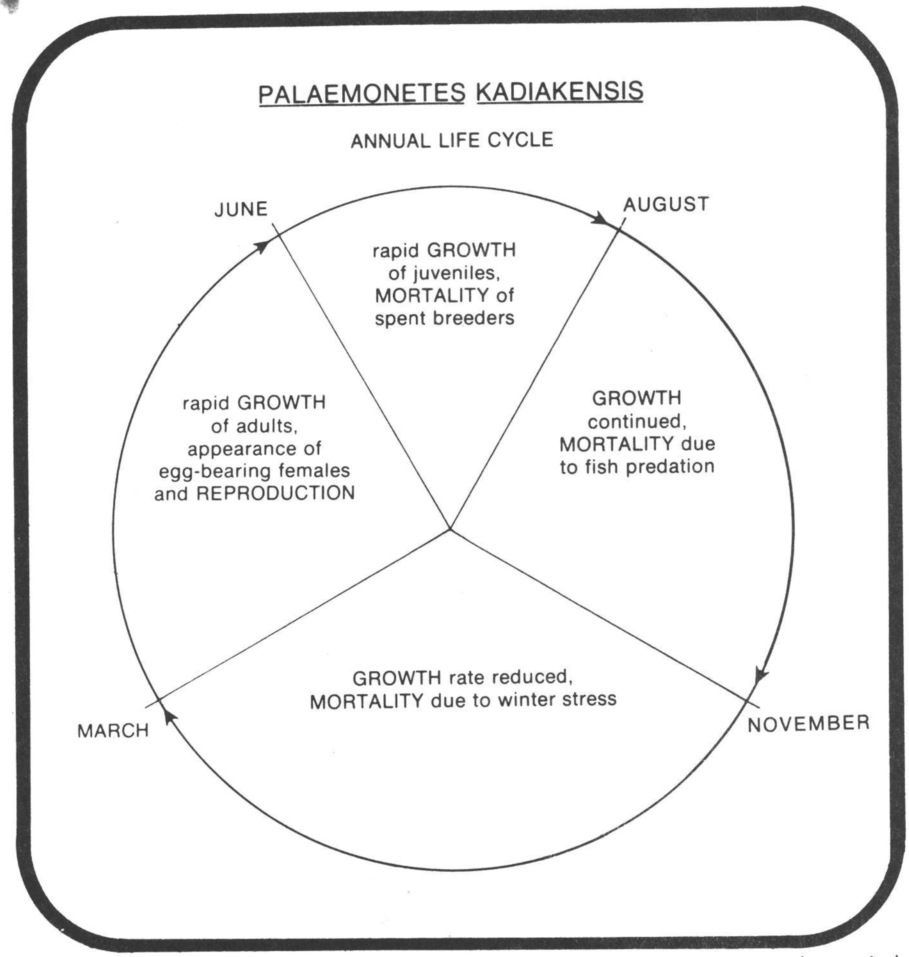
Specimens of freshwater shrimp. Upper, gravid female; middle, mature male; lower, juveniles. Scale is 1.25 inches long.

Two basic concepts of ecology bear directly on the management of farm ponds. First is the fact that the productivity of a pond (that is, its capacity to form organic material) is ultimately limited by green plants which utilize sunlight and transform inorganic nutrients into living cells. A common method for increasing pond productivity is fertilization, designed to stimulate the growth of microscopic plants, and ultimately increase fish production. Unfortunately, fertilization, besides being expensive, is unpredictable — nuisance growths of rooted plants or filamentous algae may result. Moreover the natural fertility of most midwestern ponds is adequate for good fishing; adding nutrients or artificial food may be unnecessary.

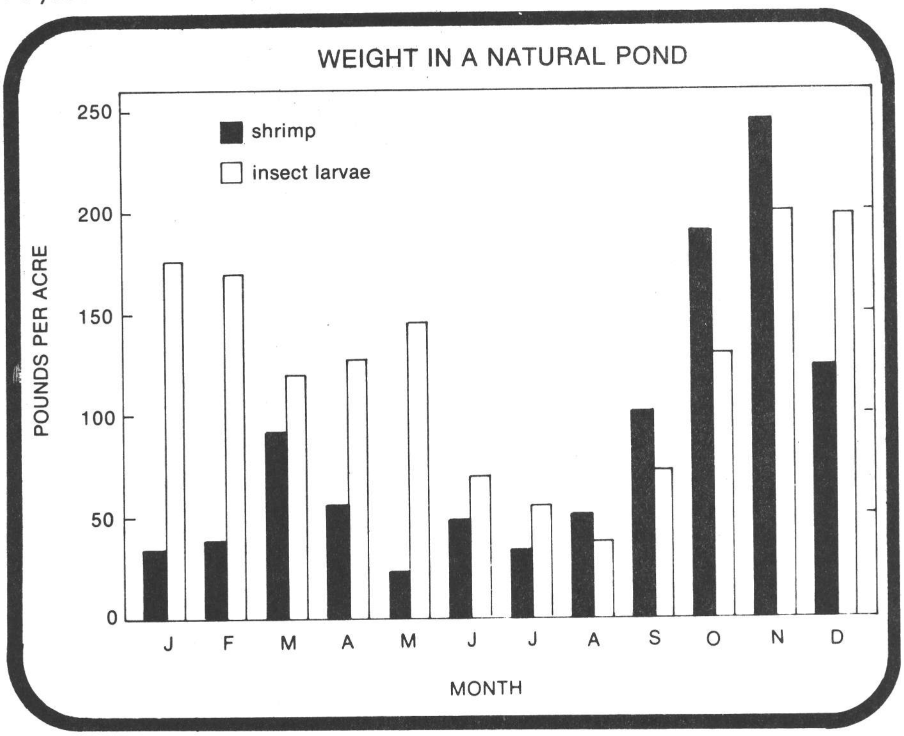
The second important ecological principle concerns the pathway of production from green plants to fishes—the food chain. The food chain is a complex association of animals which prey and are preyed upon in such a way that the organic material synthesized by green plants is passed along, eventually reaching carnivores such as bluegill and bass. In a typical farm pond, the food chain incorporates a vast array of invertebrates, such as aquatic insects, worms, crayfish and animal plankton. The number of "links" in the food chain between plants and fishes is critical since about 90% of the available organic matter disappears as lost energy at each link in the chain. The shorter the food chain, the more efficient is fish production. Shortening the food chain by manipulation of the invertebrate community is a relatively new technique in fishery mangement.

Our research focused on freshwater shrimp as a promising agent for increasing the efficiency of the aquatic food chain (Figure 1). Freshwater shrimp are decapods—a large family of ten-legged crustaceans which includes crayfish and their larger marine relatives, commercial shrimp, lobsters, and crabs. Most

[1]Contribution from the Missouri Cooperative Fishery Research Unit, a cooperative program of the U.S. Fish and Wildlife Service, Missouri Department of Conservation and University of Missouri. Based on part of a thesis by Larry A. Nielsen (1974) submitted to the University of Missouri for the Master of Science Degree. The research was jointly financed by the Edward K. Love Foundation and the Missouri Cooperative Fishery Research Unit.



Simplified life history of the freshwater shrimp. Size of segments are proportional to periods of a year.



Monthly weight of freshwater shrimp and insect larvae in a mid-Missouri pond during 1973.

shrimp lack large claws and are good swimmers for their size. Freshwater shrimp resemble the commercial shrimp, but are much smaller, reaching a maximum length near 1.5 inches. There are two species of freshwater shrimp. One occurs in tributaries along the Atlantic coastal states. We studied the other, *Palaemonetes kadiakensis* (pronounced "pay-lay-mon-ee-tees kay-dee-ah-ken-sis") a native of the Midwest. It inhabits the quiet backwaters of some streams and lakes from southern Canada to Texas and Louisiana.

Despite its small size, the freshwater shrimp seems ideal for shortening the food chain and increasing fish production. Descriptions of shrimp food habits show that they will eat plants and animals, dead or alive. This suggests that they are opportunistic feeders, willing to consume whatever foods are abundant. Such flexibility favors increased food chain efficiency. We estimated that the shrimp population in one pond added at least 200 pounds per acre to the annual production of invertebrates. That additional production could theoretically increase the total weight of bluegill by 20 pounds per acre in a typical farm pond.

The life cycle of the freshwater shrimp is well-suited to the rolè of a fish food organism. Unlike aquatic insects, which can emerge from the water and disperse as flying adults, shrimp remain aquatic throughout their one-year life span. Shrimp are therefore available as fish food during their entire life cycle.

Shrimp hatch in early summer, and grow rapidly until winter (Figure 2). The shrimp life cycle is in phase with that of fish like bluegill and bass. During the summer shrimp serve as small food items for young-of-the-year bluegill. Further growth as the summer progresses makes them suitable morsels for small bass and adult bluegill during late summer when food supply is critical. In contrast, most aquatic insect larvae are large in early summer, and small in late summer and fall.

The annual cycle of shrimp abundances (Figure 3) further illustrates their potential benefit as fish food. Throughout summer and fall the weight of the shrimp population is similar to that of the entire community of aquatic insect larvae. Late summer provides ideal environmental conditions for fish growth. However, the emergence of aquatic insects during late spring and early summer reduces the fish food supply. The result may be a period of decreased fish growth. Shrimp represent a possible remedy since their presence doubles the available forage, particularly in August and September. As winter approaches the shrimp population assures an abundant supply of large food items for as long as the water remains warm enough for active fish feeding. The consequences are betterfed fish which have an improved chance of surviving the rigors of winter.

We assessed the benefits of shrimp to fish production by examining both natural and experimental associations of shrimp and bluegill. In August 1973 we collected 81 bluegill from a pond filled with aquatic vegetation. Most were less than 5 inches long, but some were as long as 8 inches. Shrimp were present in the stomachs of 64% of the fish, whereas midge larvae, a favorite bluegill food, were in only 39%. These bluegill were plump and fast-growing. In contrast, heavily vegetated ponds often contain "stunted," slow-growing bluegill populations.

In a more controlled experiment, we stocked various combinations of shrimp and bluegill in 14 ponds during June 1973. Five months later, we drained the ponds and found that shrimp were 5 times more abundant in ponds without bluegill than in ponds with bluegill. Apparently, bluegill were feeding heavily on shrimp. The average weight of an adult bluegill increased 0.9 ounces in ponds not containing shrimp, but increased 2.0 ounces in ponds containing shrimp. Weight increase of bluegills was about two times greater when shrimp were available as food.

As a management technique, shrimp introduction is still in the experimental stages. The exact conditions under which freshwater shrimp will fulfill a practical role can be determined only by more trials in ponds, but our work suggests that the range of conditions is wide. Freshwater shrimp seem adaptable to different waters in many climates. Observations in Missouri and elsewhere support the conclusion that shrimp tolerate water of marginal quality. They reproduce and survive best in the weedy habitat found in many ponds. They do not become abundant when stocked in larger lakes and reservoirs—or in ponds containing sport fish and few aquatic weeds. As far as we know, these shrimp are not carriers of fish diseases or parasites, but the possibility does exist.

Freshwater shrimp are not available through commercial outlets in large quantities for stocking. However, large numbers of breeding adults can be caught in May and June by seining or dip-netting in weedy areas of ponds, ditches and streams. They are not common, however, and locations are best determined by local inquiry of fishermen and biologists. We recommend that interested pond owners locate and use wild shrimp within their county or state rather than transport them from other regions of the country.

Our success in raising shrimp in experimental ponds confirms the potential for large-scale shrimp culture. With virtually no care, shrimp populations increased by about 150 times in one summer. The most striking case involved a 0.1-acre pond in which an initial stocking of 500 adults produced an estimated 96,000 shrimp. This capacity for reproduction illustrates that limited pond or hatchery space can provide considerable numbers of shrimp and that a small stocking may expand into a sizeable forage crop in a minimum of time.

Stocking freshwater shrimp is not a panacea for all pond conditions and problems. As every experienced and informed pond owner will attest, there is no miracle solution to pond management and no substitute for a balanced harvest schedule in harmony with the productive capacity of the pond. As a supplement to effective pond management, the technique of manipulating forage organisms, such as freshwater shrimp, may improve fish production and the quality of fishing.

AUTHORS

In their article, Nielsen and Reynolds suggest that fresh water shrimp can increase small pond productivity. They have written about their work with the fresh water shrimp in conjunction with the Missouri Cooperative Fishery Unit, the U.S. Fish and Wildlife Service, Missouri Department of Conservation and the University of Missouri.

Larry Nielsen and his wife, the former Sharon Florini, are both natives of Illinois. They have one daughter. In 1970 Larry received a B.S. degree in Honors Biology from the University of Illinois. After two years in the U.S. Army, and a summer at the Federal Fish Hatchery in New London, Minnesota, he entered graduate work at the University of Missouri. Under the advisement of Dr. James B. Reynolds, he completed an M.S. degree in August, 1974. Since then, he and his family have resided in Ithaca, New York, where Larry is pursuing a Ph.D. degree in Fisheries Biology at Cornell University. He is studying yellow perch populations in Oneida Lake under Dr. John L. Forney.

Of his personal interests, Larry says, "I enjoy hiking, camping, swimming, observing nature, and am an enthusiastic, though skill-less, fisherman. My wife and I share an interest in history, which we pursue by reading and by visiting historical locations whenever possible. During our brief stay in

cont. on pg 4

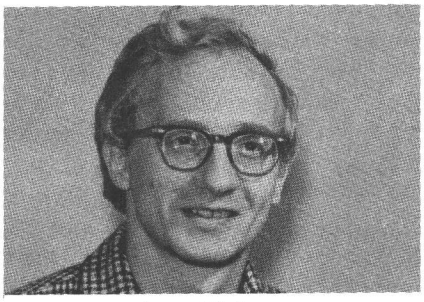
REFERENCES

Nielsen, L.A. 1974. Life history of a freshwater shrimp, *Palaemonetes kadiakensis,* and its potential use as fish forage. Master of Science Thesis, University of Missouri, Columbia, 124 pages.

Swingle, H.S. 1968. Biological means of increasing productivity in ponds. Proceedings of the World Symposium on Warm-water Pond Fish Culture, United Nations Food and Agriculture Organization, Fisheries Report Number 44, pages 243-257.

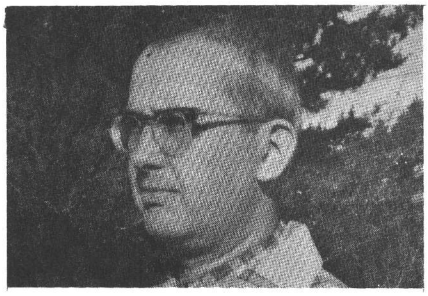
Worth, S.G. 1908. Freshwater shrimp, a natural fish food. Bulletin of the U.S. Bureau of Fisheries, Volume 28, pages 855-858.

the East, we have learned that we are midwesterners at heart. We hope to reside in the Midwest after completion of my degree."



Larry Nielsen

Dr. James ("Jim") Reynolds is the Assistant Leader of the Missouri Cooperative Fishery Research Unit for the U.S. Fish and Wildlife Service (USFWS).



Dr. James Reynolds

He is also an Assistant Professor in the School of Forestry, Fisheries and Wildlife at the University of Missouri - Columbia. In his dual role, his primary duties are research and training graduate students in Fishery Biology.

As a youth in Michigan and Pennsylvania he spent much of his spare time at camping, fishing and Scouting. In 1961, he received a B.S. degree in Wildlife Management from Utah State University. He married the former Carrie Jane Robinson, a native of Utah. The Reynolds moved to Ames, Iowa, where Jim pursued graduate work in Fishery Biology, receiving an M.S. degree in 1963 and a Ph.D. degree in 1966. Before coming to Missouri in 1972, he was a research biologist for the USFWS at the Great Lakes Fishery Laboratory, Ann Arbor, Michigan.

Part of Dr. Reynolds' research has focused on the importance of invertebrates as a tool for the management of freshwater fisheries. His research continues on freshwater shrimp, and now includes crayfish. Outdoor activities are still important to him and his family. Jim serves as Scoutmaster for a troup of 24 Scouts, including his eldest son. The Reynolds have four children and reside in Columbia, Missouri. □