FRESH-WATER SHRIMP, A NATURAL FISH FOOD

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Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

BULLETIN OF THE BUREAU OF FISHERIES : : : : : : VOL. XXVIII, P. 853-858

Document No. 685 : Issued April, 1910

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It has been my belief for years that the greatest benefit to accrue from modern fish culture is to the individual grower, the utilizer of inland waters under control and observation. But the basic need to effect such a result is a natural food of abundance and cheapness, a food that can be grown out of the natural productiveness of the water, a food corresponding to the natural grass on which wild animals feed, to the nectar of the wild flowers which honey bees gather, conserve, and consume. If the agriculturalist reaped no return except from the fertilizer he employed, if there was nothing afforded by the natural elements of the soil, his work would be heavy, requiring pound for pound, so to speak. 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 fresh-water shrimp we have an example of such a gatherer and conservator.

Palæmonetes exilipes is indigenous to the coastal plain region of North Carolina. The species is not the so-called fresh-water shrimp *Gammarus*, but a true shrimp, a miniature of the salt-water shrimp and prawn. It is meaty, like those species and the American lobster. In fact, in a time of stress it would sustain man. Though small, it is incomparably larger than *Gammarus*, measuring by actual count 136 to 140 to a fluid ounce or about 2,200 per pint, as taken in the early fall, young and old, with no culling. It is a favorite bait for black bass and crappie, two abundant game fishes of the region, the crappie taking this bait when all others are refused. The angler impales several shrimps upon his hook at a time, and I have observed that they sometimes remained alive for two hours, thus displaying considerable vitality.

The exceeding abundance of fresh-water 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. They dwell in masses of water mosses and grasses, and in the region referred to such growth is practically universal on all bottom. Rarely, the shrimps swim in schools in open water, jumping

entirely above the surface when suddenly alarmed by moving objects in or above the water. Ordinarily they are in hiding, to escape their legion enemy, the numerous species of fishes which abound along with them—bass, crappie, sunfish, pike, catfish, yellow perch, and many others. They are captured by a small bait or hand net operated from the bank or from a small boat, but in Sampson County the fishermen use a slat basket instead of the net, the latter clumsy mode of capture suggesting the presence of large numbers. In a place at which I had collected five days before, I dipped up 476 within a space of 4 yards square—114 per square yard. At another place I took 741 in 11 dips, at another 350 at 2 dips, and at another place I gathered 1,000 in thirty minutes' time and at the rate of 900 per square rod. With a 10-foot seine I gathered 1,250 in 3 hauls. Owing to the thick plant growth and the presence of innumerable boughs and leaves of trees, and the small size of many of the shrimps, it is obvious that I gathered but a small proportion of what was there. Hundreds of acres of water in many counties are teeming with this unrivaled natural food of fish. It exists by the millions and by the ton, but scattered, of course.

The fresh-water shrimp abounds in creeks, mill ponds, ponds or lakelets formed by river overflow, and in clay holes or borrow pits along railroad lines where earth was obtained for throwing up railway embankments. In the latter class of locality the shrimp is landlocked and dependent upon rainfall for water supply in holes but 2 to 8 inches deep, unshaded, and subjected to extremes of heat and cold, the thermometer ranging from 10 degrees to approximately 100 degrees Fahrenheit. In summer the water at times approximates or even exceeds 100 degrees, and in the severest winters it freezes several inches thick. The overflows from the Roanoke River, which afford as thick, muddy water (from a clay country) as can be imagined in a stream of its size, appear to have no decimating effect upon the engulfed shrimp. While trees grow along the sides of streams and ponds, and largely out in their waters also, their shade appears to contain no elemental saving quality, the productive borrow-pit pools being in railroad rights of way and denuded of all tall growth.

Instead of hibernating or burrowing during freezing weather, the fresh-water shrimp appears merely to seek greater water depths. Here is another similarity to the salt-water shrimp and prawn, which, in North Carolina at least, pass out to sea when cool weather reigns, seeking the deeper water and remaining in it till springtime. In Northampton County, N. C., I know an angler who annually gathers up quantities of fresh-water shrimp and, in a running, open ditch, holds them through the winter for bait.

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. But while I forecast the possibilities with

this food of nature, it is to be considered that ponds and streams which are deluged with sand and gravel from land washing by rains to an extent to bury and obliterate the bottom-plant growth will prove disappointing. I also mention that the fresh-water shrimp can not swim against a strong current.

To determine its power of resistance in any work looking to diffusion of the species, I made experiments in 1896, as an agent of the United States, in transporting fresh-water shrimps over long distances by express, with no attention en route. The results were gratifying.

I found the species extremely slimy, and that "sliming" was a necessary prerequisite in order to hold them in tanks or transport them. The prevalence of slime aided the removal of broken bits of bark, cypress-tree leaves, twigs, and all sediment. An upright tin dipper was immersed in the center of the pan, and all the foreign matter, clinging together from the sticky slime in a coagulated mass, was easily skimmed off, the shrimp bearing off to the sides of the pan and none being caught in the dipper. Siphons and strainers and hand nets were useless, the antennæ of the shrimp, which are of wonderful length, becoming tangled and fatal injuries being inflicted. In gathering captures from the nets the fingers were the sole instrument, though slight wounds were received from the sharp needles about the head of the shrimp.

Experimental shipments were made in 4-quart tin pails, the same in which German carp were then being distributed, the covers being ventilated by means of punched holes. Ten pails were packed in an open crate composed of thin wood strips and the crate cover secured against opening. Each pail was about two-thirds filled with water and contained shrimp as follows: Ten pails contained 150 each, another ten 180 each, another ten 125 each, and yet another ten 150 each, these several lots being turned over to the express company October 7, 9, 12, and 13, respectively, at Halifax, N. C., for delivery at Washington, D. C., 200 miles distant. The water temperature of streams at Halifax was 53 to 55 degrees Fahrenheit, the railroad journey 8 hours, and the lay-over in the warehouse (at night) at Washington 11 hours, a total confinement in pails, without icing, aerating, or other attention, of 19 hours. The losses were, respectively, 2, 94, 15, and 10, or 121 out of the total of 6,050, or 2 per cent. The second lot appeared to have been overcrowded, 40 out of the 94 being dead in one pail. In two pails, containing 100 and 150 shrimp each, shipped October 15, from the same place to the Neosho, Mo., station, and en route 92 hours, there were but 2 alive at the destination; but in four pails, in the cooler weather of November 14, containing 50, 75, 100, and 150, all reached their destination alive except the 150 in one pail, all of which were dead. It was discovered early that the species is quickly responsive to overcrowding; in fact, notably so. When too thick in the pails they spring out of the water and die

while clinging to the exposed surfaces of the metal sides, apparently glued by their own slime.

I have personally observed beef cattle fattened on two exclusive articles, cotton-seed meal and cotton-seed hulls, the animals haltered in the stall till slaughtering day; a profitable commercial accomplishment, doubtless, but producing a kind of beef that I would turn away from, so far removed are the two food articles employed from the usual, natural food of the beef animal. In the nourishing of fish at cultural establishments a number of articles have been utilized which were as foreign to the usual diet of the fish as the cotton-seed products to the beef animal. The angle or fish worm is universally conceded to be a natural food of fish, but the fresh-water shrimp (*Palæmonetes*) is yet a more rational one, and while the growing of angleworms in quantity by cultural methods might be a doubtful investment of time as a fish-food creative process, there can be no doubt that *Palæmonetes exilipes* is entirely capable of being easily and cheaply multiplied, requiring no better accommodations than a typical mosquito hole minus the larger natural enemies of the shrimp—i. e., the native fishes—which the hole might contain.