OBSERVATIONS ON THE BIOLOGY OF THE RIVER SHRIMP FROM A COMMERCIAL BAIT FISHERY NEAR PORT ALLEN, LOUISIANA

JAY V. HUNER, Department of Biological Sciences, Southern University, Baton Rouge, LA 70813

Abstract: Weekly samples of river shrimp (*Macrobrachium ohione*) were collected from the commercial bait fishery located at Port Allen, Louisiana. Mean size was 30.6 ± 0.2 mm (total length) (n = 7,058); the mode was 27 mm (n = 851); and the range was 17-92 mm. Mean size declined from approximately 39 mm in early March (when fishing began) to approximately 28 mm in mid-August (when fishing ended). The mean size of ovigerous females was 66.1 ± 1.7 mm (n = 88); and the range was 27-92 mm. Bopyrid parasitization is discussed. A comparison is made with data collected from the same area in the early 1930's prior to extensive industrialization.

Proc. Annual Conf. S.E. Assoc. Fish & Wildlife Agencies 31:380-386

The river shrimp is found in the coastal waters of the United States from Virginia to Texas, and it has invaded rivers as far north as Ohio and Missouri (Hobbs 1952). Prior to the early 1970's few reports on the biology of this species were available. These included Gunter's (1937) study in the lower Mississippi River and McCormick's (1934) study in the Illinois River. Papers by Hedgepeth (1949) and Viosca (1957) reviewed distribution and life history data generated, for the most part, by others. Recently, however, there has been a proliferation of studies on the biology of river shrimps. This activity appears to have resulted from 2 factors. First, environmental monitoring has increased greatly because of concern for man's impact on the environment. Second, considerable interest has been generated in the culture of tropical freshwater prawns of the genus *Macrobrachium*. Despite their small size, native American *Macrobrachium* such as *M. ohione* are especially attractive to aquaculturists for several reasons: their tolerance of the colder temperature experienced in subtropical-temperate latitudes; unsolved questions about the introduction of exotic species, and the opportunity to study representatives of the genus when exotics are unavailable.

Recent studies on the ecology of the river shrimp include those of Reimer et al. (1974) in the lower Trinity River (Texas), Mermilliod (1976) in the Atchafalaya Spillway, the major distributary of the lower Mississippi River (Louisiana), and Jones (1976) in the San Bernard River (Texas). Goodwin and Hanson (1975) included much unpublished data on the biology of *M. ohione* in a review on the culture of *Macrobrachium* spp. Dugan et al. (1975) discussed reproduction and development of the species with respect to its suitability for culture.

Commercial river shrimp fisheries exist in Mississippi (W. G. Tatum, pers. comm., 1976) Louisiana (Gunter 1937, Viosca 1957, Mermilliod 1976) and Texas (Jones 1976). Such shrimp are normally sold for fish bait although a food fishery does exist in Louisiana (Mermilliod 1976).

Despite the recent effort devoted to the study of river shrimp biology, there are virtually no biological data available on specific river shrimp fisheries. In early 1976, this study was made to obtain such data on the river shrimp bait fishery at the navigation lock connecting the Intracoastal Canal with the Mississippi River at Port Allen, Louisiana. The site of this fishery was especially fortuitous because it was within 1-2 km of Gunter's (1937) study area, thus providing an opportunity to compare data with that collected prior to extensive industrialization of the lower Mississippi River.

This study could not have been conducted nor could the data have been analyzed without the assitance of the following individuals: W. Mermilliod, D. Dixon, J. S. Forester, R. Romaire, D. P. Klarberg, and E. Icaza. I should also like to thank the fishermen who provided the shrimp samples and much valuable information. These fishermen wished to remain anonymous. Review of this manuscript by J. B. Black and H. H. Hobbs, Jr. is acknowledged with appreciation.

METHODS

The shrimp fishery is located in the Intracoastal Canal at the navigation lock connecting the canal with the Mississippi River at Port Allen, Louisiana. Fishing is conducted exclusively at night. Shrimp were captured with bow mounted scoops of hardware cloth having a 6.25 mm square mesh. The scoops, built to accommodate each fisherman's boat, were 1.25 m wide and extended below the water surface approximately 0.75 m.

Each fishing run lasted 10-15 min. Boats proceeded along the wooden piling leading to the lock (about 50 m) and along the concrete lock walls but did not enter the lock itself. One or 2 passes were made in front of the lock entrance where large flood lights are positioned on both sides.

A weekly grab sample of approximately 300 *M. ohione* was obtained from the unsorted commercial catch from the first fishing run of the night, just after total darkness. Samples were taken from 16 March shortly after commercial fishing began through 17 August 1976 when the fishing season ended. Shrimp larger than 50 mm represented a very small proportion of the catch so approximately 200 additional shrimp larger than 50 mm were collected for examination. The total length (tip of rostrum to tip of telson) of all shrimp was measured to the nearest millimeter. Shrimp were not sexed but the presence or absence of eggs was noted.

Surface water pH, dissolved oxygen, total hardness, and total alkalinity were measured using a Hatch Water Chemistry Kit. Temperature was measured with a thermometer.

RESULTS AND DISCUSSION

Size Distribution

Specimens examined ranged in size from 17-92 mm. Small shrimp were 80.5% of the total number caught from unsorted samples (less than 34 mm) Fig. 1. Mean size

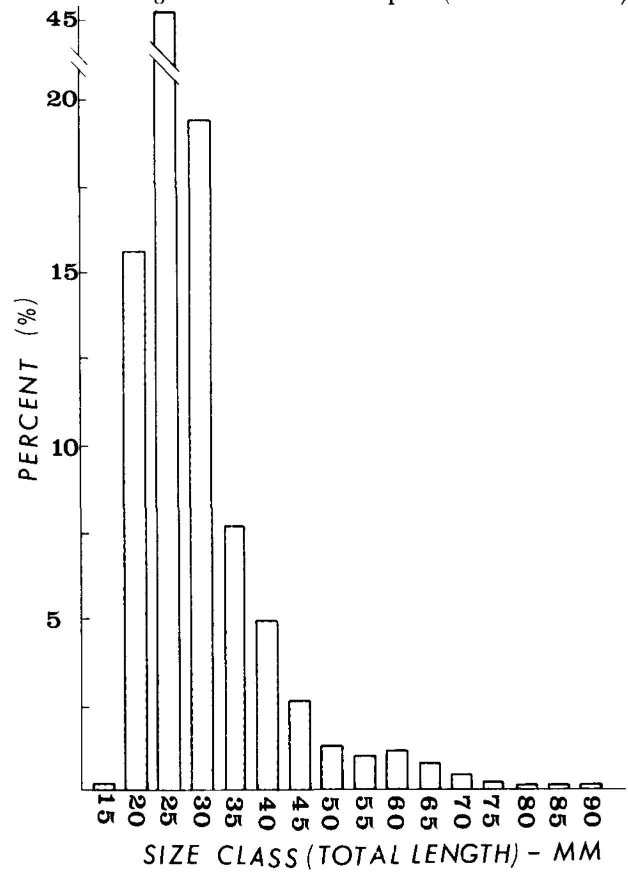

Fig. 1. Length frequency of shrimp in weekly samples of commercial catch in 5 mm size classes (total length).

was 30.6 ± 0.2 mm (n = 7,058 and the mode was 27 mm (n = 851). Although one would expect a reduction in the numbers of shrimp in larger size classes because of natural mortality, the size distribution was apparently abnormally skewed toward smaller individuals because of gear selectivity. Other studies showed that trapping (Gunter 1973) or seining (Jones 1976, Mermilliod 1976) in shallow waters invariably selected for small shrimp whereas samples taken from deeper waters with traps selected for larger shrimp. Samples taken by both gears could then be combined to obtain a more realistic picture of the true population structure. Despite the skewed nature of the size distribution observed in this study, the size ranges observed by Gunter (18-92 mm), Jones (15-77 mm), and Mermilliod (15-98 mm), were virtually identical to those observed in this study.

Growth and age

Individual size groups could not be followed over the collection season because shrimp larger than 40 mm were poorly represented in weekly samples. However, analyses of pooled data using the probability paper method (Cassie 1954) revealed modes at 5-6 mm intervals (25.8, 31.0, 36.0, 44.0, 52.7, 57.0, 62.3, and 67.4 mm). These values suggest that 5-6 mm represents the normal growth increment per molt but they must be viewed with considerable caution because of the marked differences in size between sexes (Gunter 1937, Reimer et al. 1974, Mermilliod 1976). If males and females undergo the same number of molts in reaching maturity, the 5-6 mm molt increment is obviously too great for males.

I attempted to collect larger shrimp to supplement the regular samples. It is apparent from data in Fig. 2 and 3 that the supplemental collections introduced a bias

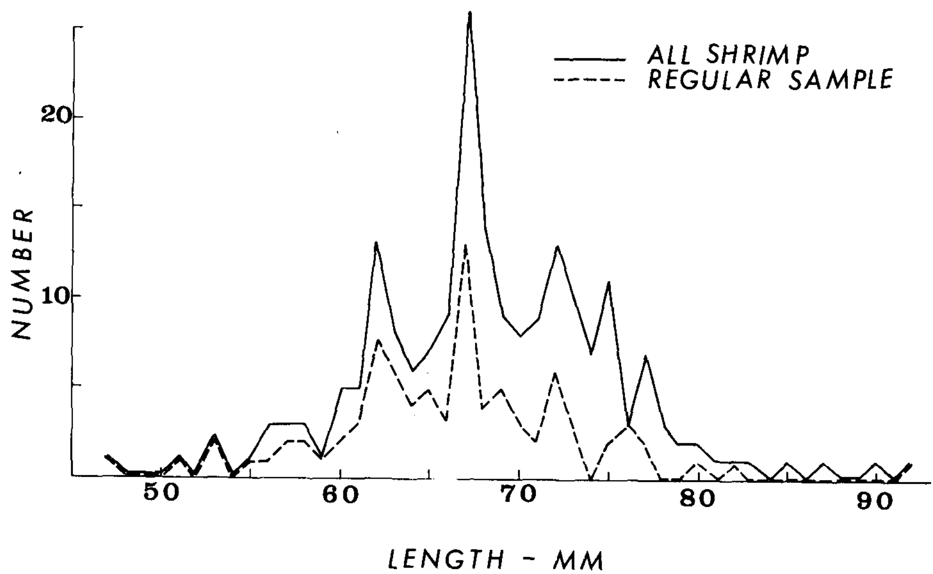

Fig. 2. Size distribution (total length) of shrimp larger than 50 mm.

toward larger shrimp and that samples did not reflect the true size distributions of the catch. The data do, however, emphasize modes noted above.

The bulk of the shrimp greater than 60 mm fell in the 60-70 mm range (Fig. 2). Based on Mermilliod's (1976) data these were apparently 1 year old, and most were probably female. There were very few shrimp larger than 70 mm and these were probably 2 years old.

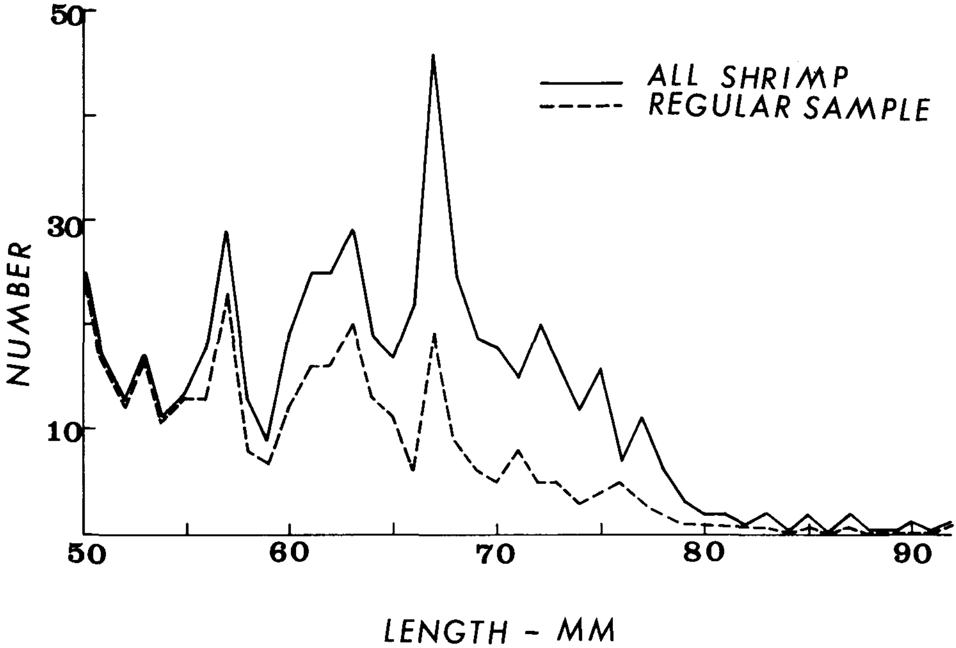

Fig. 3. Size distribution (total length) of ovigerous shrimp.

Survival

Typical survival rates in the sense of Ricker (1975) could not be calculated because larger shrimp were poorly represented in the catch. I did, however, use all data, summing the total catch into 5 mm size classes (15-19 mm. 20-24 mm, etc.) (Gunter 1937, Mermilliod 1976) for a "survival" rate calculation of 0.59 which actually represents both mortality and reduction in vulnerability to the fishery.

Sex Ratio and Reproductive Activity

Shrimp were sexed only by noting the presence or absence of eggs. *M. ohione* exhibits sexual dimorphism as discussed above. Most investigators have found few adult males over 55 mm in length and few adult females less than 55 mm in length. In this study, ovigerous females appear in significant numbers above this 55 mm cut off (Fig. 3).

Mean size of ovigerous females from regular samples was 66.1 ± 1.7 mm (n = 88); the mode was 67 mm (n = 13); and the size range was 27-92 mm.| Only 2 ovigerous females were less than 51 mm (27 mm and 47 mm). This size distribution approximates that reported by other workers (McCormick 1934, Gunter 1937, Reimer et al. 1974, Mermilliod 1976) although the 27 mm shrimp represents the smallest reported to date.

The first ovigerous females were observed in the 7 April catch. They were present through August when fishing ceased. They represented less than 2 percent of the catch; therefore, I could not detect any periodic spawning activity.

The first appearance of ovigerous females has been shown to be temperature related (Reimer et al. 1974, Mermilliod 1976). Critical temperatures are approximately 15-17 C. Temperatures at the Port Allen Lock increased from 13.9 C on 1 April to 17.2 C on 14 April. No records of temperature were available for 7 April.

Water Quality

Oxygen concentrations were consistently high (mean—7.3 ± 0.6 ppm; range—4.5 ppm to 9.5 ppm) and did not decline noticeably as temperatures increased. Mean temperature was 23.7 ± 2.6 C with a range of 13.9 to 30.2 C, increasing dramatically in late June from 23 C to 29 C in less than 2 weeks. Mean pH was 8.3 ± 0.1 with a range of 7.5 to

8.75, and total hardness (mean—155.6 ± 8.6 ppm; range—127.5 ppm to 195. ppm) was consistently higher than total alkalinity (mean—119 ± 7.9 ppm; range—93.5 ppm to 161.5 ppm). Seasonal trends were not apparent for these 3 water characteristics.

Recruitment

The mean shrimp length in weekly catches declined significantly ($P < 0.01$) from March (about 39 mm) through August (about 28 mm) when fishing ceased (Fig. 4).

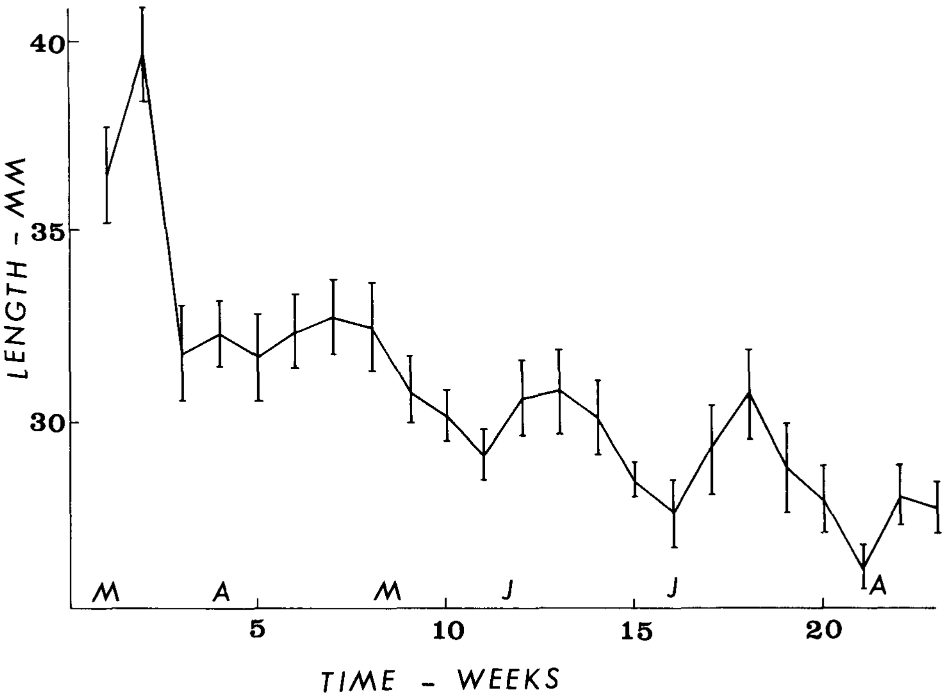

Figure 4. Mean total length of shrimp in weekly samples.

Peaks and troughs in the graph occur at 30-40 day intervals. Troughs in mean length may represent influxes of new recruits with peaks representing subsequent growth as well as exploitation of the smaller shrimp. Since the first ovigerous females were not noted until 7 April and the larval period is reported to be 40-70 days (Mermilliod and Truesdale 1976), the first 2 or 3 troughs probably reflect recruitment of young spawned the previous fall which grew slowly because of low winter temperatures. Later troughs could be from young of the year recruitment.

It is generally felt that *M. ohione* must complete its larval development in brackish water (Goodwin and Hanson 1975, Dugan et al. 1975), however, its distribution into the interior of the United States (Ohio and Illinois) (Hobbs 1952) would suggest that there are either physiological races that do not require a higher salinity during larval development or that there is some region within the environment that can supply the necessary ions to complete development. Such a region of high ion concentration is readily accessible to larval shrimp in the lower Mississippi River via the salt wedge which annually moves upriver in late spring. Since surface waters were clearly fresh, larval shrimp may have moved, at least temporarily, into the salt wedge. The presence of the estuarine bay anchovy (*Anchoa mitchelli*) in the shrimp catch emphasizes the transitional nature of the Port Allen region though it is about 240 km, by water, from the Gulf of Mexico.

Seasonality

Fishermen reported that fishing normally begins in late February or early March. Peak catches are made in May and June, and fishing ceases in mid-summer when the shrimp disappear. Fishermen were reluctant to discuss total catch, but nightly catches were approximately 20-40 l per boat early and late in the season and were as high as 400 l per boat during May and June. Both Jones (1976) and Mermilliod (1976) found a similar pattern in that shrimp increased in abundance as spring progressed into summer; however, Jones observed peak abundance in early summer while Mermilliod observed it in early fall.

Fishermen seemed to feel that shrimp abundance was related to water levels. That is, as levels rose in the spring, the catch increased while it decreased in late spring to early summer as the spring flood passed and water levels subsided. They noted that shrimp increase in abundance in the fall if a rise in river level occurs during that period.

It is possible that shrimp disappear because they move into deeper waters with declining water levels (and increasing temperatures?). Mermilliod (1976) postulated that shrimp population levels in shallow water declined in the fall when shrimp move into deeper waters. Gunter (1937) had previously reported that rising river levels drove shrimp into shallow waters.

Bopyrid Parasitization

Seven shrimp were captured either with parasitic bopyrid isopods (*Probopyrus bithynis*) or empty parasite cavities in the gill chambers. Dates of capture included 7 April, 5 May, 11 May, 25 May, and 16 June. Sizes were 27, 35, 37, 41, 46, 58, and 62 mm. The 62 mm shrimp was ovigerous.

The 7 parasitized shrimp represented only 0.1 percent of all shrimp collected in this study. This was considerably lower than the 1.4-5.5 percent levels found by Mermilliod (1976). However, he found heaviest parasitization in larger shrimp, well represented in his study but comparatively rare in this study. In addition, his peak catches were obtained in the fall, a season during which no collections were available in this study.

Change Over Time

As noted above, Gunter (1937) collected river shrimp in the same vicinity in the early 1930's prior to extensive industrialization of the area. The Port Allen Lock, in fact, was not built until the late 1950's. Surprisingly, there was virtually no difference between the overall size distribution of his shallow water trap samples which selected for small shrimp and my samples taken from boats utilizing surface scoops in shallow waters. Ovigerous females appeared at about the same time in both studies and exhibited approximately the same size range. It appears that, at least qualitatively, there has been no great change in the river shrimp population near Port Allen since the early 1930's.

Unfortunately, Gunter did not discuss the river shrimp population quantitatively. Mermilliod (1976) noted a dramatic decline in the reported river shrimp fisheries in the lower Mississippi Rver from 900,000 kg/yr in the 1930's to about 1,500 kg/yr in the early 1970's; however, a commercial bait retailer/wholesaler reported that he purchased 700 kg of shrimp from 1 of the 3 commercial fishermen who regularly fished in the Port Allen Lock area in 1976 (D. Dixon, pers. comm., 1976). Records were not readily available from the fishermen themselves. Thus, the catch at the Port Allen Lock equaled or exceeded the entire reportd catch for the lower Mississippi Rivr and although population levels may have declined, they are still supporting a relatively intense, localized fishery.

LITERATURE CITED

Cassie, R. M. 1954. Some uses of probability paper in the analysis of size frequency distributions. Aust. J. Mar. Freshwater Res. 5:513-522.

Dixon, D. 1976. Personal Communication. Address: Dickie's Sportsman's Center, 5035 Airline Highway, Baton Rouge, Louisiana 70811.

Dugan, C. C., R. H. Haywood, and T. P. Frakes. 1975. Development of spawning and mass larval rearing techniques for brackish-freshwater shrimps of the genus *Macrobrachium* (Decapoda: Palaemonidae). Fla. Marine Res. Pub. No. 12. 28 pp.

Goodwin, H. L., and J. A. Hanson. 1975. The aquaculture of freshwater prawns (*Macrobrachium* species). The Oceanic Institute. Waimanalo, Hawaii. 95 pp.

Gunter, G. 1937. Observations on the river shrimp, *Macrobrachium ohionis* (Smith). Amer. Midl. Nat. 18:1038-1042.

Hedgepeth, J. W. 1949. The American species of *Macrobrachium*. Texas J. Sci. 1:28-38.

Hobbs, H. H., Jr. 1952. The river shrimp, *Macrobrachium ohione* (Smith), in Virginia. Virginia J. Sci. 3:206-207.

Jones, W. G. 1976. Observations on the biology of *Microbrachium ohione* (Smith) from the San Bernard River, Brazoria County, Texas. Unpub. Master's Thesis. Auburn Univ., Auburn, Al. 36830. 60 pp.

McCormick, R. N. 1934. *Macrobrachium ohiensis,* the large fresh water shrimp. Proc. Indiana Acad. Sci. 43:218-224.

Mermilliod, W. J. 1976. Life history and ecology of the large river shrimp, *Macrobrachium ohione* (Smith). Unpub. Master's Thesis. Louisiana State University, Baton Rouge, La. 70803. 87 pp.

Mermilliod, W., and F. M. Truesdale. 1976. River shrimp. Something special. Aquanotes 5(3):3-4.

Reimer, R. D., D. Strawn, and A. Dixon. 1974. Notes on the river shrimp *Macrobrachium ohione* (Smith, 1874) in the Galveston Bay system of Texas. Trans. Amer. Fish. Soc. 103:120-126.

Ricker, W. E. 1975. Computations and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191:1-383.

Tatum, W. 1976. Personal Communication Address: Marine Resources Division, P. O. Box 214, Gulf Shores, AL 36542.

Viosca, P., Jr. 1957. The Louisiana shrimp story. Louisiana Wildlife and Fish Comm. Wildlife Ed. Bull. No. 40. 16 pp.