*Aquaculture*, 4(1974)81—84


Short Communications

# GAS-BUBBLE DISEASE IN THE BROWN SHRIMP (*PENAEUS AZTECUS*)*

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(Received February 8, 1974; revised February 28, 1974)

ABSTRACT

Lightner, D.V., Salser, B.R. and Wheeler, R.S., 1974. Gas-bubble disease in the brown shrimp (*Penaeus aztecus*). *Aquaculture*, 4: 81—84.

Gas-bubble disease in larval and juvenile brown shrimp (*Penaeus aztecus*) is described. Stage II protozoeal, larval brown shrimp developed the disease after being placed in water warmed in a closed heater that did not allow excess gas to escape. Juvenile brown shrimp developed gas-bubble disease after being held in a pressure tank for 35 h. The pressure in the tank had been maintained at 2 585 mm Hg with compressed air. The implications of the finding that shrimp are susceptible to gas-bubble disease are discussed in relation to shrimp culture activities, particularly those that use heated water.

## INTRODUCTION

Gas-bubble disease has been recognized as a serious problem by fish culturists since the beginning of this century (Marsh and Gorham, 1905). The "disease" is caused by excess dissolved gases in the water. Supersaturated levels of dissolved oxygen and nitrogen have been reported as causes (Renfro, 1963; Rucker, 1972), but nitrogen is usually responsible (Post, 1970; Rucker, 1972). Oxygen can cause gas-bubble disease at about 350% air saturation, but nitrogen reportedly can cause the disease even below 118% air saturation (Rucker, 1972).

Gas-bubble disease had not been recognized in any invertebrate animal until recently. Sparks (1972) reviewed the existing literature on invertebrate pathology, but did not mention the effects of supersaturated dissolved gas levels on aquatic invertebrates.

Air leaks in the circulating system on the suction side of a pump resulted in supersaturated dissolved nitrogen levels and fatal "gas disease" in cultured lobsters (Hughes, 1968). Although Hughes did not describe clinically "gas disease" in lobsters, it is significant that these animals are apparently susceptible to gas-bubble disease.

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Gas-bubble disease was observed in three species of bivalve mollusks, *Crassostrea virginica*, *C. gigas*, and *Mercenaria mercenaria*, held in heated running seawater during the winter (Malouf et al., 1972). Heating the cold sea water in closed heat exchangers caused it to become supersaturated with atmospheric gases. Bubbles of gas were observed in the gill filaments of the oysters and clams, in the mantle tissue of the oysters, and in conchiolin blisters on the valves of the oysters. Only about 10% of the affected oysters died from the disease, but the survivors reportedly remained in poor condition until late spring. The clams were less severely affected by the disease than the oysters.

In this paper observations are presented on the occurrence of gas-bubble disease in larval and juvenile brown shrimp (*Penaeus aztecus*).

*Larval shrimp*

Gas-bubble disease appeared suddenly in a group of protozoea II, larval brown shrimp soon after being transferred from one 1 900-l tank to another. The water in the second tank had been raised from about 22 to 28.8°C in a closed water heater prior to being placed in the tank into which the shrimp were added. Supersaturation with atmospheric gases, resulting from the temperature increase of the water under pressure, is suspected as the cause of the disease. Approx. 10% of the shrimp were affected by gas-bubble disease, but mortality attributable to the disease was only 5%. Moribund shrimp possessed gas bubbles under the carapace and either in the gut lumen or in the hemocoel surrounding the gut (Fig.1).

*Juvenile shrimp*

To simulate the effect of depth, juvenile brown shrimp were held in a 440-l pressure chamber at 2 585 mm Hg. In one series of experiments, pressure was maintained by compressing air in the gas space within the chamber over the water containing the shrimp. When the pressure in the tank was released either rapidly or over a period of 30 min, shrimp that had been in the pressure tank for 36 h or longer developed gas-bubble disease. In a second series of experiments, the pressure chamber was filled with water so that no gas space was left in the chamber. Pressure in the chamber was maintained at 2 585 mm Hg with the use of a water pump. In the latter tests gas-bubble disease did not occur in the exposed shrimp even when the shrimp were held at pressure for 6 days and were then decompressed instantaneously.

On at least two occasions all juvenile shrimp in the pressure tests, in which compressed air was used to pressurize the tanks, developed gas-bubble disease and subsequently died. The first behavioral change exhibited by the shrimp after the pressure in the tank was released was the onset of convulsions, which were expressed primarily as erratic and disoriented swimming. This behavior soon subsided to stupor, and affected shrimp floated helplessly before finally

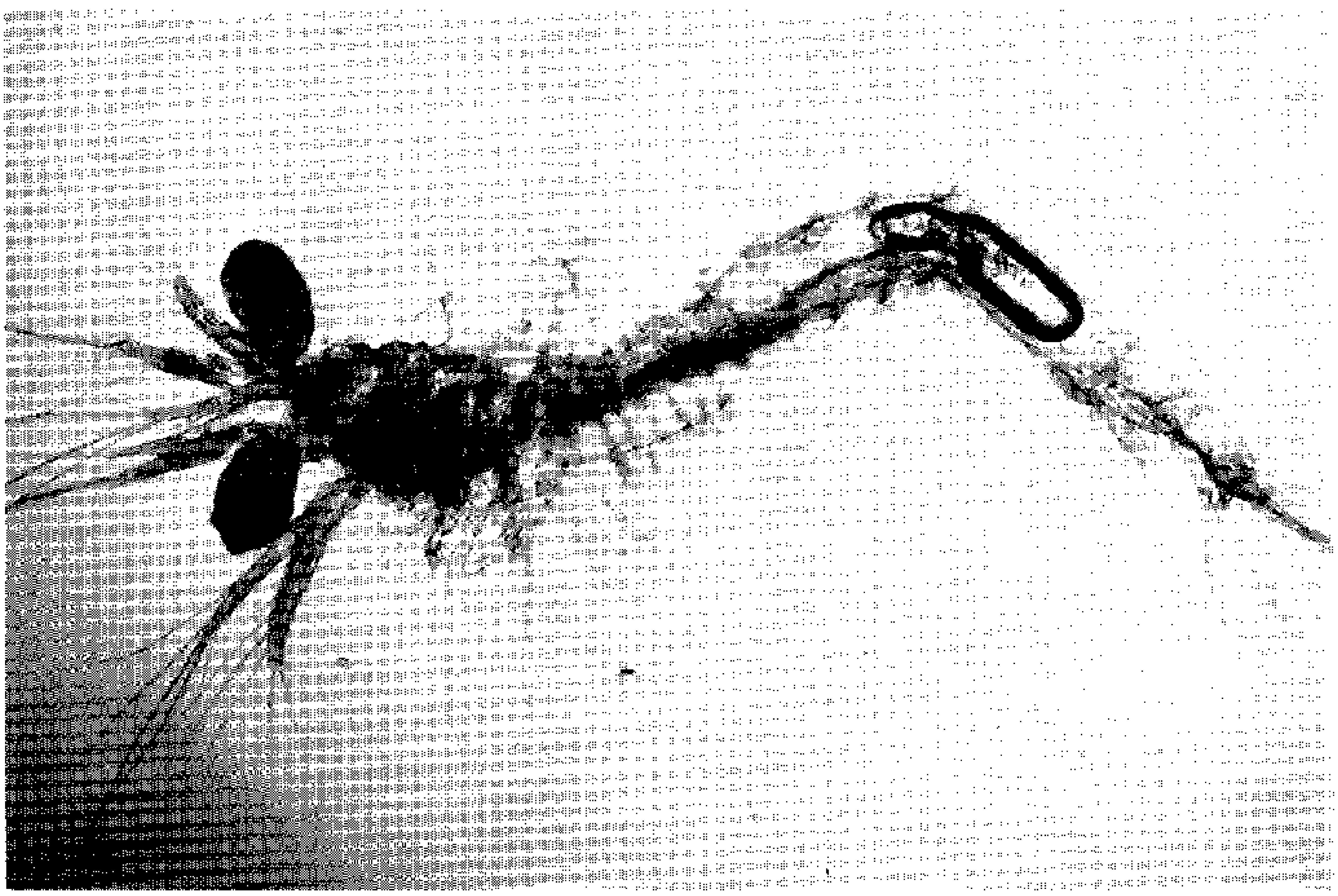

Fig.1. Protozoea II, larval brown shrimp (*Penaeus aztecus*) killed by gas-bubble disease. Gas-bubbles are still visible in the abdomen and were responsible for the separation of the carapace from the cephalothorax. No stain. 30×.

Fig.2. Photomicrograph of gill filaments from a juvenile brown shrimp (*P. aztecus*) killed by gas-bubble disease. Gas-bubbles are present in the hemolymph channels of the gill filaments. No stain. 45×.

dying. Gas bubbles in these shrimp were present throughout the body tissue and were visible grossly on the shrimp's ventral surface, the gills, and in the eye stalks as white "foamy" areas under the cuticle (Fig.2).

## DISCUSSION

Growing interest in shrimp culture has resulted from increased commercial demand for shrimp as food. It seems highly probable that fully operational shrimp hatcheries and rearing units will be developed soon. Because temperatures below 20°C retard the growth of penaeid shrimp, some of these facilities will use heated water from electrical power plants or other sources during periods of low temperature. Since significant losses could occur as a result of gas-bubble disease in these situations, planning for such shrimp culture activities will necessarily include methods for decreasing dissolved gas levels when heated water is used.

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