Polychaetes and their potential use in aquaculture

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The aquaculture of Polychaeta (Annelida) in Europe began in the United Kingdom and Netherlands and has been further developed in the last few years. However, demand is still considerably higher than the actual production (Olive 1999). Besides profit, its implementation in different countries aims to prevent the intense stock depletion of natural populations. Culture can be of the intensive type, like the one currently adopted in the United Kingdom with *Nereis virens*, or semi-intensive culture using residual waters from aquaculture, which are rich in pseudofeces and in residues. The integrated aquaculture system, which has been adopted predominantly in Asia and Oceania for other species, is another choice that produces a reasonable quantity of biomass with reduced environmental effects (Folke *et al*. 1998).

There are various reasons for producing marine worms on aquaculture farms, but the reduction of bait digging and its deleterious effect is seldom paramount. The main effect of bait digging on conservation interests, however, is the disturbance of feeding shore birds coupled with the reduction in available prey items because of competition with the bait diggers. Physical disturbance and the return of heavy metals to the surface, rendering them biologically available, as well as the release of ammonia and phosphorus compounds from the sediments leading to eutrophication, are effects on the habitat that are of greater concern.

Several families of polychaetes are gaining popularity very rapidly within another niche - the marine aquarium trade. Those worms are used either as ornamentals, favored by the hobbyist, or as scavengers when given an appropriate substratum and a bit of care, to control physical and chemical conditions. Actually, some worms are also regarded as a very important component for maintaining a thriving sand bed. They are excellent scavengers and detritus consumers. Their activity turns over the upper layers of aquarium sand beds, working detritus into the sand, thereby preventing clumping. In this way, ammonia will be reduced and eventually released as nitrogen gas. Sometimes one can see little gas bubbles escaping from the sand. Other organics are processed and moved through the food chain. Recently, booming interest in utilizing deep sand beds also increased the demand for bristle worms, spaghetti worms and several other types of worms.

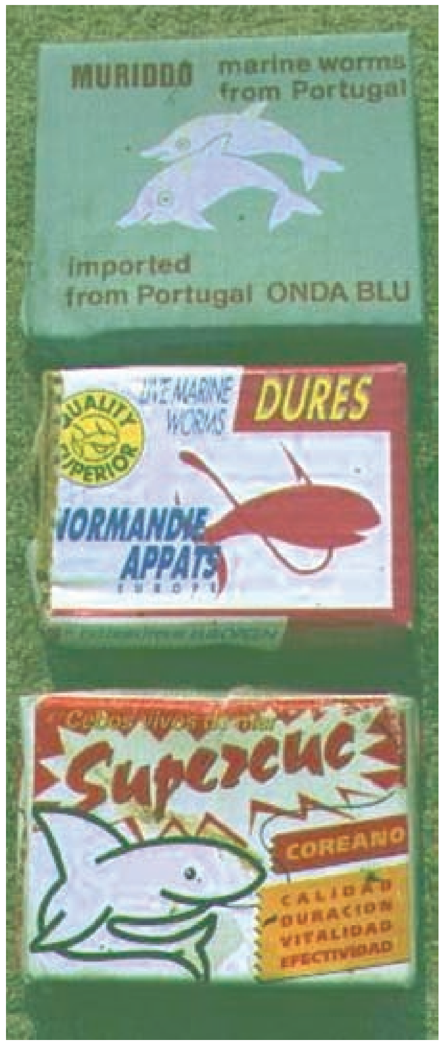

Fig. 1. Live marine worms commercialized in several countries around Europe.

The use of polychaetes for feeding crustaceans and fish is also increasing because it ensures adequate nutrition for reared broodstock. Polychaete worms have been identified as a sources of essential fatty acids and have an important role in the development of the gonads. Generally, the best results come from high lipid, coldwater species such as *Nereis* spp. and *Glycera* spp.

Polychaetes are also becoming more significant as a result of their use as fresh bait in sport and commercial fishing (Figure 1). The demand for polychaetes for use as bait has led to the development of a small but economically viable niche aquaculture sector in Europe providing cultured specimens of a number of species such as *Nereis virens*, *Arenicola marina* and *A. defodiens*. The reproductive biology and growth characteristics of several other species from a wide geographical range, including *Marphysa* spp., *Diopatra* spp. and *Glycera* spp. are being actively researched. Another species currently used as fresh bait and commonly present in estuaries and coastal lagoons, is the polychaete *Nereis diversicolor* (Figures 2 and 3). This species is known to tolerate a wide range of salinities, temperature and dissolved oxygen levels and to live and breed in different sediment types.

N. diversicolor is a geographically widely distributed inhabitant of the intertidal zone of marine and brackish waters.

Fig. 2. Anterior portion of N. diversicolor*.*

Fig. 3. General view of adults used as reproducers in laboratory cultures.

Fig. 4. High densities of N. diversicolor *obtained under controlled conditions.*

It can be found as far north as Scandinavia and as far south as Morocco, in the cold and brackish Baltic Sea as well as in the hot and hypersaline lagoons of the Black Sea. In the Caspian Sea, the presence of this species has been attributed to anthropogenic action.

The feeding habits of *N. diversicolor* are quite general; it has a wide capacity for the size range of food it feeds upon, from micro- and macrozoobenthos and diatoms, to fragmented organic matter (including detritus). The species has various feeding strategies: 1) deposit feeding: it captures its food on the sediment surface and around the gallery; 2) suspension feeding: it releases a web of mucus in the gallery and through dorsal-ventral movements it generates a continuous current capturing phytoplankton or suspended microphytobenthic species in the web to be ingested afterward; 3) detrivorous: by ingesting sediment and its organic content, thus promoting a cleaning of the bottom substrate; and 4) carnivore: this species has an important role in the structure of brackish water ecosystems because it acts as a predator of different benthic species.

N. diversicolor has traits that promote its growth, such as a totally benthic life cycle, easy artificial fertilization and lecithotrophic larvae (larvae with food reserves). This last trait results in the delay of the beginning of feeding, which allows the larvae to be fed early with the same food given to adults. Under laboratory conditions, which is an important step for beginning of its culture, this species demonstrates the ability to use a variety of food items, such as extruded soy, *Artemia* cysts and pollen, and apparently is able to biosynthesize and metabolize some fatty acids (Fidalgo e Costa *et al*. 2000).

Reproduction and growth in captivity of *N. diversicolor* was has been successful (Fidalgo e Costa 1999). Development from larvae to adult stage has been performed in the laboratory for four generations and high densities have been achieved (Figure 4). Commercial size, according to observations at the local markets, could be obtained on a laboratory scale in 64 days (Figure 5). To optimize some aspects of the rearing conditions, such as temperature, salinity and sediment type, experiments were initiated that lasted for 60 days with specimens of *N. diversicolor* born in captivity. All experiments were conducted beginning 30 days after hatching, with animals weighing in average 32.7±19 mg live weight. The food item provided from the time the larvae began feeding was commercial Tetramin®, which has been used successfully by polychaete culturists (Fidalgo e Costa *et al*. 2000).

Our results showed that the type of sediment tested, medium and fine sand (0.25-0.125mm), did not cause differential growth of *N. diversicolor*. The results obtained in medium sand revealed significant differences in the growth of at the tested temperatures evaluated (15, 20 and 25°C). The differences were significant between 15 and 25°C. Survival of 100 percent was obtained at 15°C in all salinities tested (5, 15, 25 and 35 ppt) and highest daily growth rates were found at 15 at 25°C, with a value of 6.31±0.33 percent daily. The range of growth as measured by weight increased between 13.1 mg and 541 mg wet weight.

Based on this study, we conclude that *N. diversicolor* has a high growth rate under the sediment, salinity and temperature conditions tested. The species demonstrated a preferential adaptation to brackish environments. A temperature of 25°C seems to be the best choice, combined with a salinity of 15 ppt. Sand is the best option for the culture of *N. diversicolor* because it allows easier observation and collection of reared organisms. On the other hand, it decreases the risks of anoxia associated with finer sediments that contain high percentages of organic matter.

In the future it will be important to optimize the fundamental aspects of *N. diversicolor* culture, such as manipulation of reproduction and find methods of controlling size differences among individuals of the same age. Differential sizes were often observed in animals produced in the laboratory, and became more and more evident over time, because the larger worms would be more successful in competing for food and control of territory. It is extremely important to continuously select broodstock from among the larger sized animals to minimize the negative impacts associated with the culture of this species. The high commercial value explains the importance that this resource has to aquaculture, to commercial trade (fishermen) and to aquaculture professionals. Its use to enhance bottom quality by the reduction of organic content of sediments may be another goal for the production of this worm under controlled conditions and provides an additional argument to continue research on the culture of the species.

Fig. 5. Size of worms obtained after 64 days of culture. According to observation at the local market, this size is approximately 70 percent of the commercial size.

Notes

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