

Working Paper 81-3

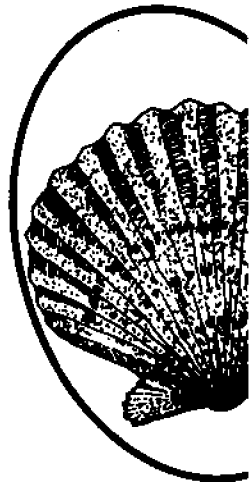
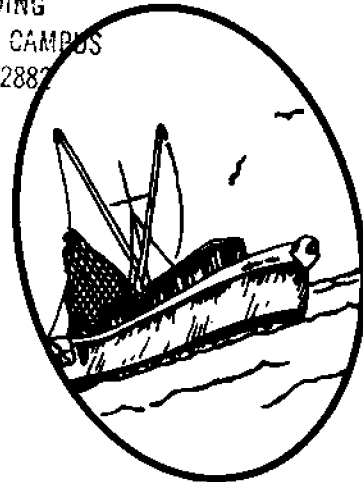
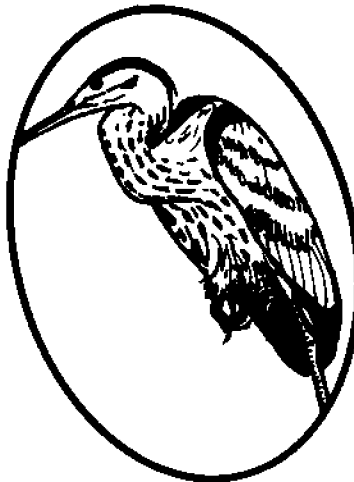
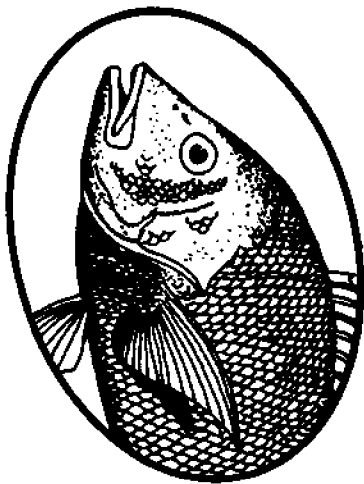
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Teaching Young American Eels To Consume Prepared Feeds

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TEACHING YOUNG AMERICAN EELS
TO CONSUME PREPARED FEEDS

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This publication contains a description of the methods used to teach elvers to feed upon a pelleted ration under culture conditions. Also included are qualitative observations comparing the use of commercial pellets with the more traditional dough diet.

Background

Several problems related to feeding have plagued the developing eel aquaculture industry in the United States since its beginning. The traditional feed used in eel culture throughout the world is a dough-like mixture consisting of dry ingredients, and perhaps a little fish oil, combined with water. This method and slight modifications of it are used in Japan, Taiwan, Italy, Germany, France and Great Britain as well as the United States. While the exact diet ingredients and their proportions may vary, the basic feeding method is the same. Furthermore, the same preparation is used for all grow-out stages once the eels have been taught to consume prepared food. Problems with the availability and/or storage of the dry ingredients as well as the expense for equipment and labor required for mixing the feed have limited the development of small and pilot scale operations, especially in the United States.

Attempts by NCSU Eel Culture Project personnel to convert eels from the dough feed to commercially prepared pellets were unsuccessful until the spring of 1980 when very young eels (elvers) $3\frac{1}{2}$ to 4 inches long were trained to feed completely upon a commercial pelleted crumble. The culture procedure began with an orientation period in which the elvers were taught to eat a prepared ration. Unlike previous attempts, the successful 1980 approach included small amounts of commercial fish feed added to the ration from the onset of the feed orientation period. Pelleted crumbles added to a paste of ground fish were used to establish a controlled feeding behavior among the elvers. Once established, this feeding behavior could be manipulated and modified. About three weeks were required to completely convert the elvers to a crumble feed which was sprinkled on the surface of the water in indoor tanks.

Traditional Feeding of Eels

Feed orientation began soon after elvers were captured during their late winter migration from the sea to inland waters. The elvers were transported to the eel culture facility and stocked in indoor tanks. If external parasites were found during examination, a one-hour per day formalin treatment was administered at 200 ppm active ingredient. This treatment was continued for three days and the entire sequence was repeated after eight days. Feeding orientation began on the second day following capture of the elvers. A more complete description of general culture techniques for the American eel was published earlier (Rickards, Foster and Jones, 1978).

Prior to 1980, the initial diet was a thin paste of blended fish, water and earthworms. Approximately one pound of fish was converted into a thick puree using only enough water for thorough blending. Deboned grey seatrout and croaker (with the texture of fish hamburger) or several types of fresh fish fillets were used. During the first three days of feeding, five to eight earthworms were added to the fish while it was pureed in a kitchen blender. The worms attracted the eels to the feed. The puree was thickened into a thin paste by gradually mixing in small amounts of table salt until the desired consistency was obtained. Most elvers were actively feeding on this diet in three days and the worms were eliminated from the preparation. The elvers were given up to 25% of their body weight per day divided into three feedings.

Use of this fish-based paste presented problems: 1) the fish supply was not constant, and storage required a freezer; 2) diet preparation and cleanup required a great deal of labor; and 3) uneaten tissue clogged drain screens and provided an excellent surface for bacterial and fungal growth. Despite such problems, many eel farms still use this procedure for about the first month, and the elvers are then gradually converted to feeding upon the dough-like feed of dry ingredients mixed with water. This formula is fed at about 5% of the weight of the eels per day. A description of this feeding method was published earlier (Rickards, Jones and Foster, 1978).

Several problems were also associated with use of the dry formula feed: 1) fish meal was available only by the ton; 2) while small quantities of vitamin mix were used, it was available only in 20 pound drums; 3) since no other fish was fed the same formula, only a large eel culture operation could obtain the formula on a pre-mixed basis. Thus, diet preparation and storage became laborious, and some spoilage occurred during storage of the fishmeal, particularly during the summer. Attempts were made to refrigerate or freeze the prepared dough so that rations for several days could be mixed at once, but neither refrigerated nor frozen preparations were completely satisfactory. Consequently, fresh feed was mixed every day.

There were additional concerns about use of the dough feed: 1) it did not appear to be as acceptable to the elvers as the paste feed. While feeding aggressiveness was generally good, the quantities consumed by individuals were lower and this may have limited the growth of the eels. 2) Grinding the fishmeal was required since some particles, i.e. bone slivers and eye lenses, were large enough to damage the elvers if consumed or, if not eaten, they added to the wasted food which accumulated on the bottom of the tanks. 3) Instability of the formula feed in the water presented a constant problem. The water became very cloudy around the feeding trays because of dislodged particles which were wasted when the eels were feeding. As the eels grew, larger mesh sizes were used for the feeding trays and small chunks of food fell through the mesh. This waste accumulated and had to be removed from the tanks with a dip net, but it could not be easily removed from the grow-out ponds. Undoubtedly, some water quality deterioration occurred because of the unconsumed food.

Fungus (*Saprolegnia* sp.), always present in the tanks, became virtually uncontrollable after conversion from blended fish to the formula feed. The uneaten food provided an even more favorable medium for fungal growth than the fish paste. Water quality was also reduced in the ponds. Dissolved food materials contributed to a nutrient enrichment of the water, and filamentous algae blooms developed. An area low in dissolved oxygen developed near the pond bottom beneath the feeding trays where uneaten food accumulated. A modified feeding tray was developed to overcome some of these problems (Rickards, Foster and Jones, 1978). This feeder greatly reduced wasted food, and eels were able to consume food that would have fallen to the pond bottom. However, periodic cleaning and maintenance of the feeder were both imperative and laborious.

Use of Pelleted Feed

Because of the problems noted with traditional diets, recent efforts have been directed toward using a commercially produced pelleted feed even though it was not specifically formulated for eels. Such a pelleted feed was expected to reduce waste, as well as improve sanitation, feed conversion and growth if the elvers could be trained to eat it. Previous limited attempts to introduce pellets into the formula feed had not achieved adequate feeding activity. However, attempts during 1980 proved successful.

Partly by necessity and partly because of convenience, some crumble-size trout feed was introduced at the beginning of the 1980 feeding orientation period. At this time, canned mackerel and herring were substituted for the frozen trout and croaker usually used to prepare the paste. After blending one can of fish with a few worms and water, salt was added to thicken the paste, but several tablespoons of salt did not produce the desired consistency. One-half teaspoon of GFS gum binder was added to two tablespoons of dry #1 trout crumbles and thoroughly mixed. The crumbles coated with binder were then added to the blended fish mixture to produce the required thin paste.

Several teaspoonsfuls of the mix were placed on the bottom of the tank containing elvers, and some feeding activity began almost immediately. All uneaten food was removed after thirty minutes. Initially, this procedure was repeated five times per day. The worms were eliminated after three days, and feeding activity remained vigorous. A feeding tray (one-quarter inch mesh) was placed on the tank bottom and food was subsequently placed in the tray rather than scattered on the bottom. Each day, a proportionately greater amount of crumbles was added to the paste, and more water was added to avoid making the paste too thick for consumption by the elvers. The suspended mesh feeding tray was raised slightly towards the water surface each day. After about two weeks, the paste consisted of only binder-coated crumbles mixed with water, and the feeding tray was suspended so that its bottom was at the water surface. Training the elvers to feed at the surface was desired so that their condition could be observed after they were stocked in the outdoor ponds.

Once surface feeding was established, the elvers were converted to feeding on individual pellets. Initially, some dry crumbles were sprinkled onto the paste in the suspended feeding tray. After a few feedings, several elvers were observed feeding upon the dry pellets. Thereafter, crumbles were gently sprinkled onto the surface of the water where they floated and some elvers began eating. Feedings were repeated 3 times each day. After about three days, all elvers were feeding on crumbles sprinkled onto the water and the paste was eliminated. Virtually all feeding took place at the water surface or on the bottom of the tank where some crumbles settled. No feeding was observed as the crumbles fell through the water column. The feed was sprinkled around and in the feeding tray to maintain a feeding area since feeding in outdoor ponds is easier if the elvers are trained to a specific feed location.

When learning to feed on the loose pellets, most elvers would swim open-mouthed at the surface while pushing against the crumbles. Few elvers would actually bite at individual pieces of food. This behavior may have been due to the initial training where elvers ate from a mass of soft food. Many elvers would feed similarly on the bottom. The elvers fed aggressively on the pellets, and their stomachs became distended with food. The elvers were also presented a loose paste of pellets coated with a small amount of binder mixed with water, and this too was readily consumed.

Many of the problems associated with the formula feed were reduced with the commercial pellets. Pellets were readily available in bulk or in fifty pound bags with no preparation and little labor needed for feeding. Spoilage during storage was reduced by ordering feed as needed. While the commercial feed used was not designed for eels, it may have been nutritionally more complete than the traditional fish meal-starch-vitamin ration. The costs were roughly the same for the commercial feed and the traditional formula.

The fungus problem was reduced after conversion to the commercial diet because of two factors. The traditional formula feed clouded the water and produced more suspended particles than the pellets. Thus, both the substrate and source of nutrients for fungal growth were greatly reduced. Cleaner drain screens and tank walls permitted improved water quality conditions which probably contributed to the noticeably improved health and vigor of the 1980 elvers.

While some questions remain concerning the use of pelleted feeds for eels, the management advantages appear to be substantial. Also, since some eel farmers want to begin with larger stock than elvers, the same techniques should be considered for teaching larger eels to eat a prepared diet. The demonstration proved that elvers could be completely converted to a pelleted feed. These qualitative observations justify further research since the availability of a nutritionally complete commercial eel pellet would greatly expand eel culture opportunities in the United States.

Literature Cited

Rickards, W. L., J. E. Foster and W. R. Jones. 1978. A feeding tray for use in eel farming. Univ. of North Carolina Sea Grant Pub. UNC-SG-78-04. Raleigh, NC. 11p.

Rickards, W. L., W. R. Jones and J. E. Foster. 1978. Techniques for culturing the American eel. Proceedings of the World Mariculture Society, 9: 641-646.