

DIFFERENCES IN PREDATION BETWEEN WILD AND HATCHERY-REARED JUVENILES OF TIGER PUFFER IN A SALT POND MESOCOSM

Daisuke Shimizu*, Kazutaka Sakiyama, Yoshitaka Sakakura,
Tomohiro Takatani, and Yoh-ichi Takahashi
Miyako Station, National Center for Stock Enhancement
Fisheries Research Agency, Iwate 027-0097, Japan
dshimizu@affrc.go.jp

Tiger puffer, *Takifugu rubripes*, is a commercially important species targeted for stock enhancement in Japan. However, unsatisfactory results with stock enhancement of this species due to low recapture rates are problematic, and the cause of this problem is not understood. Because tracking the behavior of released juveniles in the open ocean is difficult, we conducted release experiments in a semi-natural environment using a salt pond mesocosm (5300 m², 2 m deep). We then compared the effects of predation on the post-release mortality, behavior, and physiological condition of wild and hatchery-reared juveniles of the tiger puffer.

Two release experiments were conducted between 2003 and 2005. In the first release trial, 300 hatchery-reared juveniles and 300 wild juveniles (40 mm mean total length, TL) were released into 2 separate ponds without predators. Survival at 8 days post-release in the reared fish (73.0%) was the same as in the wild fish (66.4%). In contrast, when the fish were released into ponds with 30 predators (sea bass, *Lateolabrax* sp., 30 cm TL), the survival rate of the reared fish (14.9%) was significantly lower than that of the wild fish (71.5%; chi-squared test, $P < 0.001$). In the second release trial, when we released 100 reared juveniles together with 100 wild fish (64–82 mm TL) into a pond without predators, survival of the fish 25 days after release was judged as equal (66.7% for reared fish and 65.5% for wild fish). However, when the fish were released into a pond with predators in the same manner, survival of the reared fish (56.0%) was significantly lower than that of the wild fish (86.0%; chi-squared test, $P < 0.001$) 5 days after release. These results indicate that predation is one of the major causes of unsatisfactory results of stock enhancement programs of tiger puffer.

We marked all fish used in the above release trials individually by using Visible Implant Elastomer Tags (Northwest Marine Technology, Inc.), and investigated their predation from examination of the gut contents of sea bass. We also examined the growth and feeding incidence of the recaptured fish. Predation of released fish by sea bass was observed mostly within 3 days post-release, and reared fish were mainly found from sea bass. The growth rates of reared fish in the mesocosm were about 25% to 50% lower than those of wild fish. Also, the feeding incidence of reared fish (42.3%) was lower than that of wild fish (78.2%). We also compared the body compositions of tetrodotoxin (TTX), a remarkable marine toxin that accumulates in this species through the food web. TTX was detectable in the wild fish (1.43 MU fish⁻¹), but reared fish had no detectable TTX, even after recapture.

We observed the behavior of released fish and estimated the numbers of surviving fish by line-transect observation. Wild fish swam around the bottom of the pond and often showed bottom-dwelling behavior, whereas reared fish swam mostly in the water column. The same behavioral difference between reared and wild fish was observed in laboratory-scale observations.

We concluded that predation shortly after release and behavioral defects in reared fish, such as changes in swimming behavior and feeding behavior, could be among the main causes of

mortality in the stock enhancement program of this species. We discuss a practical method of improving the quality of released fish on the basis of laboratory-scale experiments.