

**Pennsylvania Fish and Boat Commission  
Fish Production Services  
Anadromous Fish Restoration Unit**

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**“Raceway Shad: Rearing Juvenile American shad For Hatchery Mark  
Retention & Verification”**

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## **Raceway Shad: Rearing Juvenile American shad For Hatchery Mark Retention & Verification**

Since 1985, all American and hickory shad fry cultured at and released from the PFBC's Van Dyke Research Station for Anadromous Fishes receive hatchery marks via immersion in tetracycline antibiotic baths (Figure 1). This is done to distinguish hatchery-produced shad from wild-produced shad, and to evaluate stocking efforts for population restoration.

Tetracycline permanently marks growing bone tissues of fish, and the otoliths (ear stones) are the only true bones present during the early larval stage of life. Otoliths grow in daily increments starting at hatching; adding a growth ring for every day of life (resembling annual growth rings found in trees) (Figure 2). Because of this, otoliths are able to be marked with tetracycline within days of shad fry hatching. Multiple immersions in tetracycline baths over the 20 to 30 days the fry remain in the hatchery produce unique mark sequences which are coded to represent stocking locations, rivers where eggs were obtained, and age at stocking.

To detect tetracycline marks, otoliths are removed from the fish, ground on both sides (to expose earliest days of growth), and viewed under magnification with ultraviolet light. When viewed with ultraviolet light, the tetracycline mark(s) glow a yellowish-green, confirming that the shad was hatchery-produced (Figure 3).

Biologists from the PFBC's Anadromous Fish Restoration Unit (AFRU) retain samples of larval shad to evaluate the retention of tetracycline marks administered in the hatchery. As shad fry are being stocked into the Susquehanna, Juniata, Lehigh, Schuylkill and Delaware rivers during May and June, AFRU biologists also stock samples of those fry into raceway units at the Benner Spring State Fish Hatchery. Multiple intensive culture raceway units which are segregated from one another are each stocked with uniquely marked fry. The fry are fed and monitored throughout the summer months until they reach fingerling size (3 to 4 inches). Sometime in August or September, fingerling shad are harvested for otolith extraction and tetracycline mark evaluation (Figure 4). During the summer months of grow-out, AFRU biologists have the opportunity to observe and record the development of feeding and schooling behaviors (Figure 5).

Please enjoy the below videos of juvenile American shad feeding and schooling within a raceway unit at Benner Spring State Fishery Hatchery (Video 1 and 2). These videos may deepen your appreciation for the once prolific American shad that has been severely depleted through commercial overfishing, loss of access to suitable spawning habitat, and degradation of water quality.

In closing, imagine tremendous schools of juvenile shad swimming the Susquehanna River and its tributaries as they make their fall migration to the Atlantic Ocean; foraging on phytoplankton, zooplankton and invertebrates, while serving as abundant forage themselves.

-J.D. Tryninewski

Figure 1) Tetracycline antibiotic solution being added to a culture tank of shad fry.



Figure 2) American shad otolith ground to show earliest growth increments and microstructure.

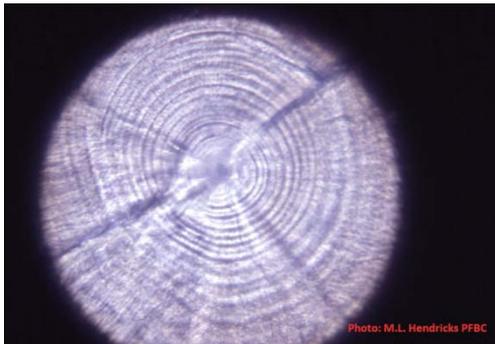


Figure 3) American shad otolith marked with tetracycline on days 3, 6, 9, 12 and 15.

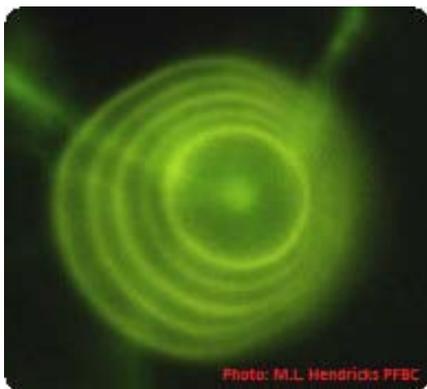


Figure 4) American shad fingerlings being harvested for tetracycline mark retention and evaluation.



Figure 5) Schooling raceway shad (approximately 130 day old American shad)



Video 1) Feeding behavior of juvenile American shad (approximately 90 days old)

[AMS Feeding.wmv](#)

Video 2) Schooling behavior of juvenile American shad (approximately 130 days old)

[AMS Schooling.wmv](#)