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Development of Techniques to Propagate Rare Fishes in Virginia

The spotfin chub (*Cyprinella monacha*), slender chub (*Erimystax cahni*), and yellowfin madtom (*Noturus flavipinnis*) are on the federal list of threatened fishes in Virginia. Although recovery plans for these species recommend captive propagation, recent population surveys indicate that all three are too rare to be used experimentally for developing captive breeding techniques. Consequently, we used common congeneric species as surrogates to develop protocols for propagation of the rare fishes. Surrogates were carefully selected to help ensure that their spawning requirements and behaviors were similar to those of the target species. The whitetail shiner (*Cyprinella galactura*) was selected as the surrogate species for the spotfin chub, the streamline chub (*Erimystax dissimilis*) and blotched chub (*E. insignis*) were selected as surrogates for the slender chub, and the margined madtom (*Noturus insignis*) was selected as the surrogate for the yellowfin madtom. We investigated methods to promote gonadal maturation, induce spawning, and rear larvae of these fishes.

Slender Chub Surrogates

Efforts to rear the streamline chub and blotched chub were abandoned relatively early because these species are extremely sensitive to electrofishing (mortality of collected fish is typically more than 50%) and are difficult to maintain for long periods in

the laboratory. Thus, attempts to propagate the slender chub and other chubs in captivity should not be undertaken until these problems are resolved.

Spotfin Chub Surrogate

Six species of *Cyprinella* have readily spawned in tanks under simulated natural conditions; however, several other species, including the whitetail shiner, spawn infrequently or not at all under these conditions. Methods for rearing larval *Cyprinella* have not been evaluated. We induced spawning of whitetail shiner females by injecting them with human chorionic gonadotropin (HCG) and carp pituitary extract (CPE) at mean dosages of 1,688 I.U./kg and 20 mg/kg, respectively (14 of 45 females spawned), or with luteinizing hormone-releasing hormone analogue (LHRHa) and domperidone at mean dosages of 363 µg/kg and 36 mg/kg, respectively (21 of 86 females spawned). Most females spawned within 30 h of the first injection. Captive whitetail shiners developed mature gonads under a variety of temperature and photoperiod conditions. Spawning condition was maintained for more than 2 years when they were held at constant warm temperature (≈24°C) and long photoperiod (16 h light). Stripped ova were effectively wet-spawned, and larvae hatched in 8 days at 25°C. Dry spawning is not suggested because the eggs are too adhesive. We obtained a mean hatch rate of 55%, but lack of swimbladder

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inflation resulted in poor survival of several batches of eggs. Larvae began feeding within 2 days of hatching, and survival rates of 50–90% after 16 days were obtained when larvae were fed twice daily on a diet of brine shrimp nauplii at a rate of about 10/L per day, and a commercially prepared larval fish diet at a rate of about 14 mg/L per day.

Yellowfin Madtom Surrogates

Two species of madtoms have spawned in aquariums under simulated natural conditions, but spawns are produced too sporadically by this method to be useful for controlled propagation. Injections of the hormone HCG were required to induce captive spawning of five other species of madtoms. We found that captive margined madtoms did not spawn in tanks unless they were injected with the hormones HCG and CPE at mean dosages of 5,256 I.U./kg and 58 mg/kg, respectively (25 of 33 females spawned), or LHRHa and domperidone at mean dosages of 554 µg/kg and 55 mg/kg, respectively (34 of 44 females spawned). Most females ovulated within 78 h of the first injection. Nineteen females were strip-spawned and 40 spawned in tanks. Twenty of the 40 egg masses spawned in tanks were not observed, and we assumed they were eaten by the parents. Inclusion of more than one breeding pair per tank inhibited spawning. Changing photoperiod, but not temperature, was required to induce oocyte maturation in most captive female margined madtoms. Sperm production in mature male madtoms was enigmatic; motile sperm were observed only once. Plasma testosterone concentrations in males peaked just prior to the spawning season at 6.5 ng/mL, but levels were not correlated with male gonadosomatic values. Plasma 17β-estradiol levels in females peaked just prior to the spawning season at 15 ng/mL, and were correlated with gonadosomatic values. Embryos did not develop in 55% of ova spawned in tanks, or from any strip-spawned ova. We suspect that problems with viability of the embryos were related to limited production of viable sperm. Parents consumed spawned egg masses if they remained with the nest. Hatch rates of more than 65% were obtained by suspending egg masses in a large-mesh basket over turbulent aeration at 28–30 °C. Larvae hatched in

7 days at 28°C. Survival rates of more than 50% after 15 days were obtained when larvae were fed salmon starter twice daily at a rate of 20 mg/L per day, and tanks were thoroughly cleaned daily.

Overview of Propagation Efforts

A variety of species-dependent problems were encountered while attempting to develop propagation techniques for the threatened species. Consequently, we strongly suggest the use of surrogates to test the suitability of holding facilities and to develop expertise in handling and propagating techniques before working with threatened fishes from depauperate populations. We consider the techniques developed for the whitetail shiner adequate for preliminary trials with the spotfin chub, but techniques for the madtoms need to be developed further. Additional work with other nonthreatened species of *Noturus* and *Cyprinella* would be useful to further develop protocols for propagating congeneric species. The protocols will be useful for the propagation of other rare fishes, because 12 of the 24 described species of *Cyprinella* are protected by law or are of special concern, and 25 (18 of which are madtoms) of the 40 species of Ictaluridae are legally protected or are of special concern.

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