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Epioblasma penita: The Southern Combshell—Go Forth and Multiply

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You have probably never heard of the southern combshell (*Epioblasma penita*), but you can likely learn something from it. In many ways, this freshwater mussel species is at the cutting edge of efforts to restore endangered aquatic species in the United States, and it thus serves as a case study for the practical and legal issues inherent in such efforts.

The United States boasts the largest freshwater mussel variety in the world with nearly 300 species—70 percent of them listed as endangered or threatened under the Endangered Species Act (ESA), among them is the southern combshell. *See* U.S. Fish and Wildlife Service (FWS), Discover Freshwater Mussels: America's Hidden Treasure, www.fws.gov/news/mussels.html [hereinafter Discover Freshwater Mussels]. The southern combshell's historic home, the Mobile River Basin, is among the top ten river basins in the world in diversity of freshwater mussels. *See* FWS, RECOVERY PLAN FOR MOBILE RIVER BASIN AQUATIC ECOSYSTEM (2000) [hereinafter MOBILE RIVER BASIN RECOVERY PLAN]. The Mobile River Basin drains 43,173 square miles of the state of Alabama and includes the Alabama, Black Warrior, Cahaba, Coosa, Tallapoosa, and Tombigbee River systems. *Id.*

The southern combshell's outer shell is yellowish, greenish-yellow, or tawny, sometimes with darker dots. 52 Fed. Reg. 11,162–63 (Apr. 7, 1987). It ranges in size to about 55 millimeters (mm) long, 40 mm high, and 34 mm wide. *Id.* Historically, it was found in the Tombigbee River, the Alabama River, the Cahaba River, and the Coosa River; today, however, the only known extant population is in lower Buttahatchee River in Alabama. *Id.* The FWS listed the species as endangered under the ESA in 1987. *Id.* No critical habitat has been designated.

The southern combshell is included in two federal recovery plans, one issued in 1989 and another in 2000. *See* FWS, RECOVERY PLAN FOR FIVE TOMBIGBEE RIVER MUSSELS (1989) [hereinafter TOMBIGBEE RIVER RECOVERY PLAN]; MOBILE RIVER BASIN RECOVERY PLAN. In both recovery plans, FWS determined that the southern combshell population would benefit from controlled propagation in captivity, followed by augmentation of existing populations or reintroduction of new populations in historic habitat. *See* MOBILE RIVER BASIN RECOVERY PLAN (stating that one of the goals of the recovery plan is to "continue to promote research efforts on life histories, sensitivities, and requirements of imperiled aquatic species, and develop technological capabilities to maintain and propagate them"); *see also* TOMBIGBEE RIVER RECOVERY PLAN (listing propagation as a way to implement the recovery plan). As discussed below, these propagation activities are already underway, with more aggressive plans in the works.

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The Birds and the Bees of Mussel Reproduction

In the past thirty years, FWS has listed approximately seventy species of freshwater mussels as either threatened or endangered, including the listing of the southern combshell as endangered in 1987. *See* FWS Chart of Endangered Species: Clams, http://ecos.fws.gov/tess_public/Boxscore.do. The reason for the decline in mussel populations, especially freshwater species, is primarily habitat alteration and aquatic habitat loss. *See* Discover Freshwater Mussels.

Some of the most sensitive freshwater mussels are, generally speaking, those found in riverine habitat—flowing rivers and streams. These mussels live in gravel and sand substrata at the bottom of streams and rivers and require a certain type of current for survival. The southern combshell lives in gravel and sand at the bottom of medium to large rivers with moderate to swift current. *See* RALPH MIRARCHI ET AL., ALABAMA WILDLIFE: IMPERILED AQUATIC MOLLUSKS AND FISHES VOL. 2 51 (2004) [hereinafter ALABAMA WILDLIFE].

River current is important because it aids a mussel's feeding and reproduction. Because mussels are mostly stationary and cannot "hunt," they eat food that drifts by them, which mainly consists of tiny plants and animals called plankton. *See* Discover Freshwater Mussels. Many activities that impact a mussel's habitat can affect the species' ability to eat, such as the building of dams and dredging, increased siltation, reduction of water flow, and possible disturbances of host fish movements. For example, one of the southern combshell's historical habitats was the Tombigbee River, and that population was affected by the construction of the Tennessee-Tombigbee Waterway, which began in 1972. *See* ALABAMA WILDLIFE at 11.

Habitat and flow are also important to a riverine mussel's ability to reproduce. To say that a mussel's reproductive technique is unique is an understatement. Some aspects of it are downright bizarre.

A mussel's unusual life cycle begins when eggs held inside the female become fertilized by sperm released from a male

that enter the female when it draws in water. *Id.* These fertilized eggs develop inside the gills of the female. *Id.* After developing inside the female, the fertilized eggs, called "glochidia," are released into the water and must attach to an appropriate host fish for development to continue. *Id.* The glochidia of some mussel species can only attach to specific host fish. *Id.* Other species can use different types of fish as hosts, but having a specific host fish is the "rule rather than the exception in most freshwater mussels." *See* Richard Neves, et al., *Status of Aquatic Mollusks in the Southeastern United States: A Downward Spiral of Diversity*, www.sherpaguides.com/southeast/aquatic_fauna/chapter_3/index.html [hereinafter *Aquatic Mollusks in the Southeast*].

Because mussel reproduction is essentially a game of chance, female mussels have specialized tissue to increase the chances of the glochidia attaching to the appropriate fish. *See* Discover Freshwater Mussels. When the glochidia are developed and ready to be released, some female mussels display adapted tissue that looks like fish prey in an attempt to lure fish to swim nearby. *Id.* When the female senses a fish swimming nearby, she releases the glochidia into the water to attract the fish. *Id.* Once attached, the glochidia are essentially hitchhikers on the fish, developing into larvae and juvenile mussels. ALABAMA WILDLIFE at 11.

The glochidia are attached for a few days or weeks and do not harm the fish while developing. *Id.* The developed mussels detach from the fish and settle at the bottom of rivers and streams, where they begin life as a juvenile mussel. *Id.* The juvenile mussels continue to develop in the stream bottoms and may live up to seventy years. *Id.*

The host fish for many mussel species are unknown. This is true for the southern combshell. *See* FWS: Southern Combshell, http://ecos.fws.gov/docs/life_histories/F012.html. In fact, less than 20 percent of freshwater mussels in the Southeast have known host fish. *See Aquatic Mollusks in the Southeast*.

This complex reproductive cycle underscores the difficulty in recovering populations whose numbers have dwindled. Even if mature mussels are present in suitable habitat, other factors must be present—including the needed host fish—for reproduction and repopulation to be successful. This is why, for many species, Mother Nature needs a little help from science.

Farming Mussels

The science and practice of controlled propagation holds great promise for the recovery of many freshwater mussel species. Species that are unable to reproduce in the wild, or do so in very small numbers, can be reproduced in significant numbers in the lab. Though still in its early stages, the science of mussel propagation is moving forward quickly. Already, lab protocols and other research have been developed and disseminated. *See* Barnhart, M. C., *A Compact System For Rearing Juvenile Freshwater Bivalves*, 254 AQUACULTURE 227–233 (2006).

The southern combshell is among the mussel species that have been successfully propagated as part of a cutting-edge project in Alabama called the Alabama Aquatic Biodiversity Center (AABC). The AABC was established by the Alabama Department of Conservation and Natural Resources' Division (ADCNR) of Wildlife & Freshwater Fisheries in 2004 to promote the conservation and restoration of rare freshwater species in Alabama waters. The AABC is dedicated to restoring Alabama's mollusk populations and will serve as an important center for culturing snails and mussels and ultimately returning them to rivers and streams. Beginning propagation efforts are already underway for the southern combshell, and 954 individuals were propagated from 2000 to 2005.

Propagation efforts are not only being conducted in Alabama, but also nationwide. Universities and private organizations are developing facilities to aid in mussel propagation, such as the Freshwater Mollusk Conservation Center at Virginia Tech and the Southeast Aquatic Research Institute associated with the Tennessee Aquarium. Additionally, partnerships with these universities, private organizations, and state and federal agencies are increasing funding and awareness. In the case of the AABC, private and federal dollars are already committed to the project.

Even when FWS is not the party doing the work, FWS plays a central role in propagation efforts for species listed under the ESA. Capturing species and holding them in a lab are activities that clearly fall under the "take" prohibition of the ESA, 16 U.S.C. § 1538, and so require a scientific or "enhancement of survival" permit under Section 10(a) of the statute. *See* 16 U.S.C. § 1539(a); 50 C.F.R. §§ 17.22(a), 17.32(a). In fact, the statute expressly states that Section 10(a) permits can authorize the establishment and maintenance of experimental populations. 16 U.S.C. § 1539(a).

In addition, the FWS has established a policy (Propagation Policy) to ensure consistency in the usage of controlled propagation as a component of species recovery. *See* 65 Fed. Reg. 56,916 (Sept. 20, 2000). The goals of FWS's Propagation Policy include "coordinating recovery actions specific to controlled propagation activities; maximizing benefits to the listed species from controlled propagation efforts; assuring that appropriate recovery measures other than controlled propagation and that other existing recovery priorities are considered in making controlled propagation decisions; and ensuring prudent use of funds." 65 Fed. Reg. at 56,920. Under the policy, controlled propagation is a strategy of last resort—to be employed "only when other measures [] have failed" or are likely to fail. *Id.* The policy also provides that controlled propagation efforts should be consistent with an approved ESA recovery plan. *Id.*

In order to facilitate propagation activities for the southern combshell and other Mobile River Basin species, FWS has developed a specific working document entitled *Freshwater Mussels and Snails of the Mobile River Basin: Plan for Controlled Propagation, Augmentation, and Reintroduction* (Mar. 11, 2003) [hereinafter REINTRODUCTION PLAN]. The overall objectives of the plan are to (1) establish basic protocols for propagating endangered and threatened mussels and snails; (2) ensure communication and coordination among partners prior to relocation of wild stock or the release of hatchery stock to the wild; and (3) facilitate mollusk augmentation and reintroduction activities in the basin. *Id.* at 2–3.

Under the Reintroduction Plan, controlled propagation "will be treated as experimental in nature" and requires detailed proposals prior to issuance of appropriate permits. *Id.* at 7. There is quite a bit of advance work that must be done prior to undertaking controlled propagation activities. Any party wishing to conduct controlled propagation of listed mussels and snails must (1) present a detailed plan to the FWS outlining its expertise, facilities, and methodology, species to be propagated, source of stock, and the disposition of any progeny; (2) provide justification for the work, including benefits; (3) obtain all necessary state and federal permits; (4) take all necessary precautions to prohibit introduction or spread of diseases and parasites into controlled environments or suitable habitats; (5) conduct all activities in a manner that will prevent the escape or accidental introduction of individuals outside their historical range; and (6) keep detailed notes and records of life-history observations, fecundity, survival and mortality, water chemistry, seasonality, and any other conditions and observations important to successful propagation of these species. *See* REINTRODUCTION PLAN at 7–8; 65 Fed. Reg. at 56,920–21.

One caveat should be noted. The FWS Reintroduction Plan was drafted by a selected group of federal officials and academics, unfortunately without any input from private landowners or public-interest groups or other opportunities for public comment. In fact, the document is not even currently posted on FWS's Web page.

Where to Put Them

Raising mussels in the lab is only the first step; the end game is to put them back into suitable habitat in the wild so that the species can recover.

Reintroduction of listed species is expressly addressed in Section 10(j) of the ESA. Section 10(j) permits FWS to authorize the release of any listed species *outside* its current range if it determines that such release will further the conservation of the species. 16 U.S.C. § 1539(j). Such a reintroduced population is termed an "experimental population." Prior to authorizing such a release, however, FWS must first, by regulation, identify the experimental population and determine whether it is essential to the continued existence of the species in question. *Id.* at § 10(j)(2)(B). Generally, an experimental population is treated as a "threatened species," 16 U.S.C. § 1539(j)(2)(C), which means FWS will issue a special rule detailing what types of "take" are allowed and what types are prohibited. *See* 16 U.S.C. § 1533(d). This allows FWS to tailor the prohibitions applicable to the reintroduced species to accommodate existing and future land use activities. If an experimental population is also found *not* to be essential to the continued existence of the species, then it is treated as a "proposed species" for purposes of any consultation under ESA Section 7 (which means only a conference, not full consultation, is required), and FWS may not designate critical habitat for that experimental population. *See* 16 U.S.C. § 1539(j)(2)(C)(i), (ii).

FWS has already used Section 10(j) to authorize the release of "non-essential experimental" populations (NEPs) of freshwater mussels in certain areas in Alabama. In 2001, FWS issued a final rule designating as NEP populations of sixteen listed mussels and one listed aquatic snail that were planned for reintroduction in the Tennessee River. *See* 66 Fed. Reg. 32,250 (June 14, 2001). This rule was issued at the prompting of ADCNR. *Id.* at 32,254. To date, FWS has not proposed an NEP rule for species to be reintroduced from ADCNR's AABC into areas where the species do not currently exist. Under Section 10(j), such a rule will be necessary prior to any efforts to reintroduce listed species into rivers and streams outside their current range.

Section 10(j), however, is silent on releases of cultured specimens in areas *within* the current range of the species. The Section does not expressly authorize or prohibit the Secretary of the Interior from authorizing such a reintroduction (sometimes called an "augmentation" because numbers are being added to an existing population). This also means that an "experimental" designation under Section 10(j) is not an option for augmentation activities. This presents somewhat of a conundrum in the case of mussels in the Mobile River Basin because FWS's Reintroduction Plan provides that both reintroductions and augmentations "should be considered as individual experiments." REINTRODUCTION PLAN at 8. As discussed below, other regulatory mechanisms outside of Section 10(j) are available to allow augmented species to be for all practical purposes "experimental" in nature and to alleviate their impact on existing and future land use activities.

FWS's Reintroduction Plan has additional requirements for reintroduction and augmentation activities in the basin. Parties wishing to plan, sponsor, or conduct specific augmentation or reintroduction actions (which could include a state agency or a private party) must produce a Site Augmentation/Reintroduction Plan (Site Plan) prior to conducting any activities. *See* REINTRODUCTION PLAN at 8–9; 65 Fed. Reg. 56,916 (Sept. 20, 2000). Site Plans must be developed and distributed to the appropriate FWS Field Office(s) and Regional Office prior to the spring/summer propagation season. Site Plans should contain as much information as possible, such as the exact location where animals are to be introduced, status of the target species at the site, and why reintroduction is necessary. The Site Plan must include a copy of all appropriate permits—one of which would be a Section 10(a) permit authorizing the transportation and release of the species, activities that would otherwise be a prohibited "take."

There are also public notice requirements. Under the plan, all recovery partners, and any other affected private or public entities identified by the partners, will be notified of planned reintroduction activities and will be provided with the Site Plan at least twenty days prior to relocating or releasing animals in the wild. REINTRODUCTION PLAN at 9.

Public Support Is Critical

Public support on all sides is critical to the success of reintroduction efforts. Although hard numbers are not available, it is safe to say that many threatened and endangered species are found in significant numbers on private lands and, in some cases, exclusively on private lands. Even where a species

is planned for reintroduction or augmentation on public lands, activities on adjacent private lands can impact the species' ability to survive and reproduce. This is particularly true for aquatic species such as mussels that can be impacted by off-site runoff and sedimentation. Conservation groups, who can bring funding, manpower, and expertise to the table, are also needed partners in reintroduction efforts.

For private landowners, the first question with a reintroduction is often, "How will this impact the future use of my land?" If landowners and businesses think that the species will prevent or curtail their activities (whether it be forestry activities, dredging, construction, or point source discharges), they will be loathe to support such efforts. Fortunately, regulatory tools exist to assuage such concerns. As discussed above, an NEP designation can solve the problem for reintroductions outside current range.

For augmentations within current range, a perfect fit is a safe harbor agreement under FWS's safe harbor policy and regulations. *See* 64 Fed. Reg. 32,717 (June 17, 1999); 50 C.F.R. §§ 17.22(c), 17.32(c). Under a safe harbor agreement, a private party agrees to undertake specified voluntary conservation measures and in exchange receives an "incidental take" permit that absolves the party of any liability for the loss of the species that were added. A safe harbor agreement requires the establishment of a "baseline" for the existing population, and that baseline serves as the floor for the incidental take permit. In the case of mussel reintroductions, private landowners could agree to provide access to FWS and other partners across their lands and/or to implement other measures, such as observing a stream buffer zone, and in exchange receive protection with respect to any new individuals added to the stream. There is already precedent for safe harbor agreements of this variety. *See, e.g.*, Chewacla Creek Safe Harbor Agreement, 68 Fed. Reg. 11,405 (Mar. 10, 2003) (covering ovate clubshell, southern clubshell, and threatened fine-lined pocketbook mussels).

One downside to relying on safe harbor agreements for widespread reintroduction efforts is that they can be time-consuming to implement on a parcel-by-parcel basis. Fortunately, FWS has established so-called "programmatic" safe harbor agreements that can cover an entire propagation and augmentation effort, even if the augmentations are undertaken on separately owned and noncontiguous properties. Under a programmatic agreement, FWS would issue to the state (in the case of the Mobile River Basin, to ADCNR) a permit for "take" and authorize ADCNR to issue "certificates of inclusion" to private property owners that would give them permit protection. The agreement would specify what actions the private property owner would need to take to obtain a certification of inclusion. One qualifying action could be contributing funds to the population augmentation efforts of ADCNR.

As with the NEP approach, there is precedent for the programmatic safe harbor agreement approach in Alabama. First, ADCNR is currently a party to a safe harbor agreement covering certain listed mussels in Chewacla Creek in Lee County. 68 Fed. Reg. 11,405 (Mar. 10, 2003). Though not a programmatic agreement, the Chewacla Creek agreement does involve multiple parties and landowners and involves aquatic species. Second, ADCNR has experience with programmatic safe harbor agreements because it has recently signed a statewide agreement for red-cockaded woodpeckers. 71 Fed. Reg. 34,154 (June 13, 2006). Moreover, the Arkansas Game and Fish Commission has recently created a programmatic safe harbor agreement for the endangered speckled pocketbook mussel that covers the entire Little Red River Watershed. 71 Fed. Reg. 53,129 (Sept. 8, 2006). This Arkansas agreement could provide guidance for the framework for a programmatic safe harbor agreement for the proposed activities of the AABC involving the southern combshell and other Mobile River Basin species.

Programmatic safe harbor agreements also provide a mechanism for harnessing the expertise and muscle of nonprofit conservation organizations. Nonprofits can serve as administrators or consultants under such agreements, undertaking day-to-day administration or providing overall direction and guidance. For example, The Nature Conservancy is a signatory and partner on the Little Red River safe harbor agreement in Arkansas.

Finally, of interest to private landowners and nonprofits, federal grant money is available for endangered species restoration efforts. FWS's Private Stewardship Grant Program was established in 2002 under the ESA to encourage landowners to voluntarily plan and implement projects to conserve federally listed species on private, nonfederal land. *See* FWS, 2007–Private Stewardship Grants Program, www.fws.gov/endangered/grants/ private_stewardship/index.html. The program provides federal grants on a competitive basis to individuals and groups who voluntarily implement conservation efforts on private land that will benefit federally listed, proposed, or candidate species.

In 2006, grant money was awarded to the Mississippi Fish and Wildlife Foundation to work with private landowners to restore and enhance 750 acres of native prairie habitat within the Mobile River Basin's Blackland Prairie. The project targeted five federally listed mussels, including the southern combshell. *See* FWS, Private Stewardship Grants Program Regional Award Summaries FY 2006, www.fws.gov/endangered/grants/private_stewardship/PSGP2006Awards.pdf.

In 2007, FWS handed out over $7.2 million in private stewardship grants. *See* FWS, 2007–Private Stewardship Grants Program. Competition can be stiff. The presence of a safe harbor agreement, like a programmatic agreement discussed above, can provide an attractive target for a grant, because it provides assurance that the conservation benefits will endure over the life of the agreement. Several recipients of 2007 grants were involved in the safe harbor program.

As the science and practice of controlled propagation continues to develop, the restoration of freshwater mussels in the United States will continue to grow and be enhanced. However, the science can only take us so far; public support for the success of reintroduction efforts is critical. Alabama continues to develop public support for the AABC and its efforts to propagate rare freshwater species and return and restore them to Alabama waters. Hopefully, one day we can look back on these efforts as a turning point to the recovery—and delisting—of the southern combshell and other imperiled freshwater mussels.