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Life in the Rocks

The Newsletter of the Arkansas Game and Fish Commission Nongame Aquatics Program

Notes on the Non Native Asian Clam *Corbicula fluminea* (Muller, 1774)

By Bill Posey, Malacologist

*Introduced into the U.S. in the early 1900's, the Asian clam (*Corbicula fluminea*) is the most widespread and common invasive mollusk in Arkansas. It inhabits a variety of waterbodies, including lakes, ponds, creeks, and rivers. Dense colonies, numbering in thousands of individuals per square meter, occur in optimal conditions. High densities are found in flowing water habitats with gravel or sand substrates, high dissolved oxygen content, and an abundant supply of plankton for food.*

The Asian clam is a small light-colored bivalve with distinct, concentric rings on the exterior of the shell. This clam contains two sets of lateral teeth, anterior and posterior to the cardinal teeth, unlike our native bivalves, which have only one set of lateral teeth. The nacre (mother of pearl) is typically white-to-light blue or light purple in Arkansas populations, while the darker shell morph of the southwestern United States has a deep royal blue nacre. It attains a length of 50 mm (2 in.) or greater in size. As its common name implies, the species is native to southern and eastern Asia, and also inhabits Africa.

Like our native mussels, Asian clams are filter feeders and remove food particles from the water column. They have true "siphons" (water tubes) that transfer water to and from the environment into and out of the shell.

The first collection of the Asian clam from the wild in the United States occurred in the late 1930's along the banks of the Columbia River in Washington State. However, the introduction of the species may have occurred as early as the 1920's in British Columbia. It is believed that it was likely released by Chinese immigrants for use as a food item, but it could have been a result of oyster stocking. By the 1970s, the clam was found in most of the Mississippi Basin, the Gulf Coast, and eastern United States. In later years it was discovered in Delaware, New Jersey, and New York. Although New England was considered environmentally inhospitable, Asian clams were discovered in Connecticut in 1990. It is currently found in 38 states and the District of Columbia.

Humans are responsible for the widespread dispersal of this clam in U.S. waters. Dispersal has been the result of both intentional and unintentional releases, via discarded bait bucket contents, imported aquaculture species stocking, aquarists, researchers, and as a food source. The only other significant dispersal agent is thought to be passive movement via water currents.

The sexes are usually separate, but hermaphrodites (both sexes in the same individual) do occur. Because of this, a new population can become established from the release of single individual. Larvae are brooded in the parent's gills and released through the excurrent siphon into the water column as active post-larval juveniles, which have the ability to resist downstream transport by water flow. A single clam can release hundreds, or even thousands, of juveniles per day - up to 70,000 per year. Spawning can occur almost continuously at water temperatures exceeding l6º F, but temperatures above 98º F inhibit spawning. Several million juveniles may be released daily in dense colonies of Asian clams.

Once released, the juveniles are weak swimmers and are usually found at or near the bottom of the water column. This is one of the reasons why they can become a prominent problem in causing biofouling of water intake pipes, which are normally placed near the bottom of the water column. Juveniles released in early spring can reach sexual maturity and begin spawning in the same year. Most individuals live from one-to-four years.

Asian clam populations in close proximity to power plant or industrial complex water intake systems can obstruct water flow. As live animals, empty shells and body tissues are drawn into intake pipes; they can clog condenser tubes, valves, and service water systems. Buoyant, dead clams can also clog surface intake screens. They have also been documented in causing problems in irrigation canals and pipes, and drinking water supplies.

Nuclear power plant service water systems for fire protection are vulnerable to blockage by the clam. In 1980, Asian clams clogged the service water system at Arkansas Nuclear One Power Plant, near Russellville, jeopardizing all of their fire protection systems. This caused the U.S. Nuclear Regulatory Commission to shut down the plant and order an inspection of every nuclear plant in the country to determine the threat of fouling caused by this mollusk. Asian clams were found at 19 of 32 plants, with another 11 plants at risk due to the clam's proximity to those plants. This inspection process cost an estimated $4.5 million dollars. During the l980s, Asian clam fouling cost an estimated $1 billion annually, in utility and industry downtime, corrective actions, and maintenance costs.

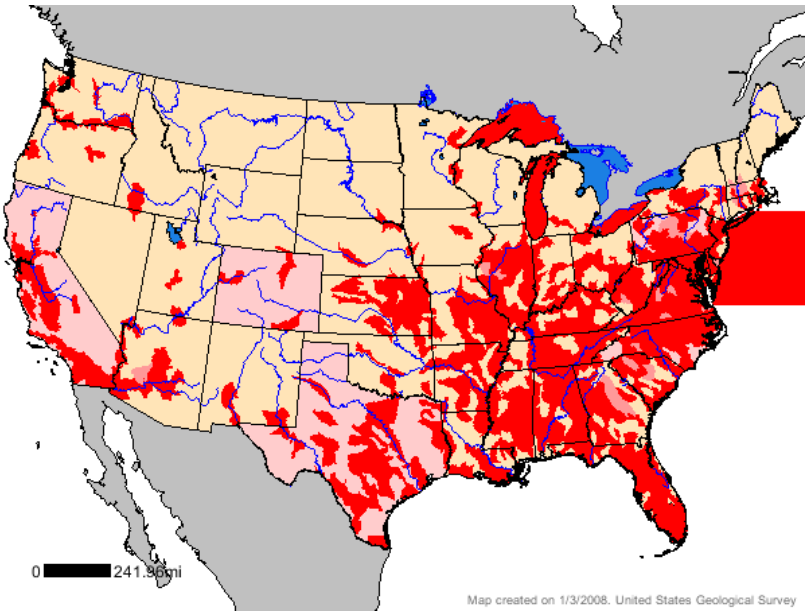
Studies have determined negative ecological impacts can occur in the presence of large Asian clam populations. Asian clams have experienced massive die-offs, during which large amounts of ammonia are released due to

decomposition of the mollusk's body. This ammonia can reach levels that are known to be toxic to juvenile native mussels. In addition, the decomposing clam bodies use up the dissolved oxygen in the water, making it unavailable to other aquatic organisms. The clams can also alter benthic substrates, and live clams compete with native mussels for space, food, and oxygen.

Several native fish species that occur in Arkansas are known predators of the Asian clam. These include the black buffalo, redear sunfish, and several catfish species. Introduced non-native carp have also been documented with Asian clams in their digestive tract. Female Common Map Turtles apparently feed on Asian clams in large numbers, as I have observed their crushed and broken shells littering the streambed of rivers in places where I find large female map turtles sitting on the river bed. Other predators include birds, musk turtles, muskrats, raccoons, crayfish, and flatworms.

There are several ways the Asian clam can be controlled to minimize its impact on power plants, water suppliers, or industry. However, no method has been shown to effectively eradicate a population once it is established.

Thermal regulation is one method, by keeping the water temperature >37º F. However, this is not possible in most existing water systems. Screens and traps have been used to prevent mature clams from entering a water system and to remove clam bodies and shells from a system. Filters have been shown to be effective at preventing planktonic larvae from entering a water system. The use of chlorine or bromine to kill juveniles, and in some cases, adults, is also very effective. However, state and federal environmental agencies are becoming more restrictive in the amount of these chemicals that can be discharged from a facility. The search continues for more environmentally sound and cost-effective treatment methods in combating this aquatic nuisance species.



Distribution of the Asian clam in the United States. Map from USGS.

To Hibernate or Not to Hibernate: Is that the question?

By Kelly Irwin, Herpetologist

For most people the term “hibernation” is applied to any animal that seeks shelter from winter’s cold temperature extremes. However, on a technical level only mammals hibernate, and not all of them. Hibernation in mammals involves a lowering of heart rate, body temperature, and metabolic rate, fueled by stored fat reserves. The animal essentially “sleeps” throughout the winter in the protection of a burrow, den, or other suitable shelter. Other mammals, like bears, do not hibernate, but go into a state of “torpor,” or temporary

sleep, and can wake up for periods of time during the winter months. However, in the case of temperate zone amphibians and reptiles (herps), the technical term for winter inactivity is "brumation," from the Latin word, "bruma" or winter.

Brumation is a hibernation-like state, but with a few differences as compared to mammals. Herps do not go into a "deep sleep" like mammals, and do not rely on stored fat reserves to maintain basic metabolic processes. As in all ectotherms (animals take on the ambient temperature of the environment), herps become lethargic, with concomitant lowered metabolic, respiration, and heart rates, and may become completely inactive while in a hibernaculum. A hibernaculum can be any cover that helps them avoid freezing temperatures, such as burrows, old root tunnels, rock crevices, caves, old wells, deep leaf litter, mucky pond bottoms, etc. Many people have probably seen television programs showing the mass emergence of snakes from their overwintering dens, called "communal dens," where large numbers of snakes congregate to pass the winter months. Communal snake dens can shelter one or several species of snakes. However, not all herps use communal den sites. The majority of herps in the southeastern states generally brumate individually under rocks, logs, or in burrows where there is a lack of geological features such as rock ledges and crevices that could be used as communal brumation sites.

Aquatic turtles, frogs, and salamanders over-winter underwater, burrowed into leaf beds, mud, or muck, where lowered metabolic rates are maintained through the absorption of oxygen, either transdermally in amphibians, or via pharyngeal or cloacal respiration in reptiles. Arkansas' native American alligators will brumate in either a burrow, excavated into a streambank, or remain in deep water where they rise once every hour or so to take a breath. As you can see, our native herps have adapted an array of strategies to avoid freezing winter temperatures, but they do not "hibernate" in the classic sense. This may come as a surprise to some readers, but some species of herps actually become inactive during the heat of summer when most herps are out and active. This period of summer inactivity is called "aestivation".

The chicken turtle is one such species that engages in aestivation. In Arkansas, chicken turtles are most active in the spring and fall when they are actively foraging in their preferred swamp and marsh habitats. However, recent radio telemetry research has shown that chicken turtles leave these aquatic habitats, by mid-June, and wander into the surrounding forest where they burrow several inches down into the soil, under leaf litter, and remain in this protected situation for the duration of the hottest summer months. They re-emerge by early fall, move back into their aquatic habitat, and feed for a period of time before brumating for the winter.

In summary, hibernation, brumation, and aestivation are all types of inactivity and/or dormancy in animals. However, they are applied to discrete groups of animals and seasons, based on the mode of inactivity and environmental conditions. So, the next time the temperature falls below freezing, if you need me, I'll be at home "brumating" under the covers!

Pebbles…

(Quick notes on what we've been up to…)

- Bill, with the assistance of the USFWS and the USFS, completed a status survey for the Arkansas fatmucket mussel.

- With Kelly's help, Brian completed the interview and hiring process for a new part-time technician. We'd like to welcome the successful applicant, Shawn Sanders, to the Nongame Aquatics Program crew. Shawn has a Bachelors degree from Purdue University and a Masters degree from the University of Arkansas – Pine Bluff, and previously worked for the US Fish & Wildlife Service in California. Shawn and his wife came "back home" to Arkansas and we're glad to have him as part of our team!

- Bill conducted a zebra mussel program for the Northwest District of the Arkansas Water Works and Water Environment Association in Eureka Springs.

- Kelly took some vacation time to attend the annual meeting of the Society of Vertebrate Paleontology in Austin, Texas. He presented a poster on fossil fish he collected from the Late Cretaceous of southwestern Arkansas.

- Brian continues to participate in Arkansas' Aquatic Nuisance Species Task Force.

- Bill attended the Missouri/Arkansas (MOARK) meeting near Branson, MO.

- Brian assisted USFWS Karst biologist, David Kampwerth, with an initial biological survey of Wonderland Cave in Bella Vista.

- Kelly spent the last week of October searching for woodland salamanders in the western Ouachita Mountains, with his collaborators, as part of the ongoing multi-year *Plethodon* species boundary project. Preliminary laboratory results look promising in terms of the potential for identifying previously unrecognized taxa within this species complex.

- Bill and the USFWS conducted a mussel kill investigation of Bell Fountain Ditch, in Missouri and Arkansas, where over 40 endangered mussels were killed as the result of a chemical spill.

- Brian attended the Southeastern Fishes Council meeting in Chattanooga, Tennessee, and presented a talk on the results of AGFC's Arkansas darter status survey.

- Kelly gave a public education program at the Pine Bluff Nature Center on alligators and snakes.

- Bill and other Fisheries Division biologists attended a meeting in Mountain Home to discuss the recent finding of zebra mussels in Bull Shoals Lake.

Pebbles...

...continued

- Brian and Shawn spent several days in the field conducting crayfish collections as part of a State Wildlife Grants Project, with help from District 9 biologist, Frank Leone, and Wildlife Management biologist, Brian Infield.

- Bill assisted the Enforcement Division Dive Team in a search for zebra mussels in Bull Shoals Lake.

- Kelly taught the current class of Wildlife Officer cadet recruits at the Mayflower Training Center. He presented two lectures, one on venomous snake identification, and the other on regulated herps.

- The Alligator Management Team met at the Benton Fisheries Field Office, where Kelly played host for the team meeting. The team reviewed the first-ever officially sanctioned alligator hunt in Arkansas history, and discussed the tasks needing to be completed for the USFWS review process coming up in 2008.

- Bill, Bob Limbird, Frank Leone, and Jeff Quinn worked a check station on Ozark Pool to gather biological data on paddlefish.

- Bill assisted an Arkansas State University graduate student in acquiring southern hickory nut mussels from the Little River, above Millwood Reservoir, for genetic analysis.

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