Website Record

Project/Plant for which Website was accessed: CCNPP

Date Website was accessed and text copied: October 29, 2009

Team member accessing Website: R K Kropp

Internet location of website captured (URL):
http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=92

Text used from website for EIS below (copy and paste below):

Noel Burkhead - USGS

Corbicula fluminea

Common Name: Asian clam

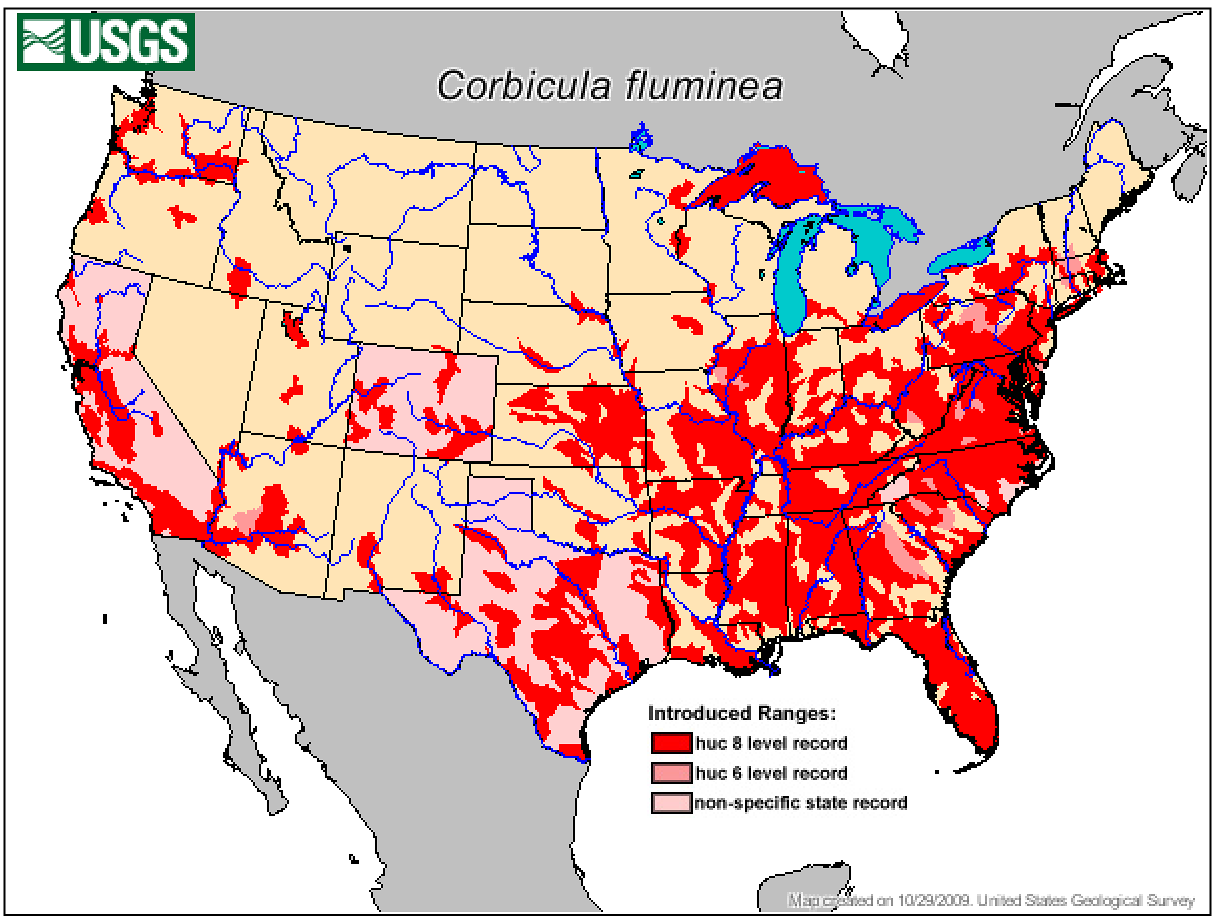
Synonyms and Other Names: Asiatic clam, Corbicula leana, Corbicula manilensis

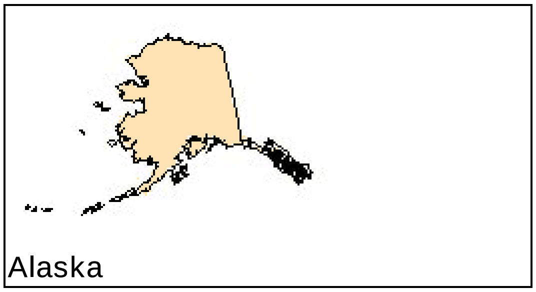
Taxonomy: available through ITIS

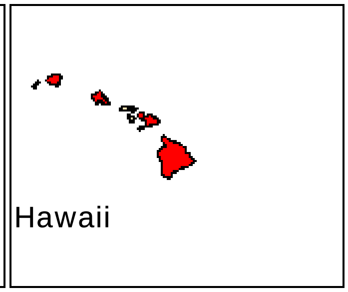
Identification: A small light-colored bivalve with shell ornamented by distinct, concentric sulcations, anterior and posterior lateral teeth with many fine serrations. Dark shell morphs exist but are limited to the southwestern United States. The light-colored shell morph has a yellow-green to light brown periostracum and white to light blue or light purple nacre while the darker shell morph has a dark olive green to black periostracum and deep royal blue nacre (McMahon 1991). Qiu et al. (2001) reported yellow and brown shell color morphs amongst specimens collected from Sichuan Province in China. The shells of the yellow morphs were straw yellow on the outside and white on the inside; those of brown morphs were dark brown and purple, respectively. Further analyses revealed that the yellow and brown morphs are triploid and tetraploid, respectively. Both morphs were simultaneous hermaphrodites and brood their larvae in the inner demibranchs. The results indicate that C. fluminea at different ploidy levels is able to reproduce by self-fertilization. The life span is about one to seven years.

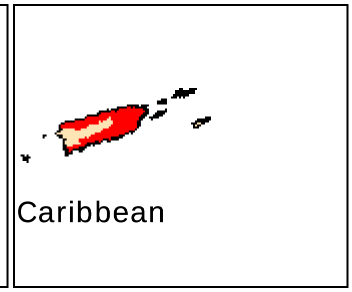
Size: < 50 mm

Native Range: The genus *Corbicula* lives in temperate to tropical southern Asia west to the eastern Mediterranean; Africa, except in the Sahara desert; southeast Asian islands south into central and eastern Australia (Morton 1986).









Interactive maps: Continental US, Alaska, Hawaii, Caribbean

Nonindigenous Occurrences: Since the introduction of *Corbicula fluminea* to the United States in 1938, it has spread into many of the major waterways. The following location information briefly outlines where it is presently found. The [date: author publication date] format associated with each state identifies the first collection or record of *C. fluminea* in that state. The Asian clam has become established in the following states: **Alabama** [1962: Hubricht 1963] widespread (Counts 1991); **Arizona** [1958: Dundee and Dundee 1958] in the Aqua Fria, Colorado, Gila, Salt, and Verde rivers; Lake Martinez; and in several irrigation systems in Maricopa County (Counts 1991); **Arkansas** [1970: Fox 1970] widespread (Counts 1991) White River National Wildlife Refuge (USFWS 2005); **California** [1945: Hanna 1966] in the Sacramento and San Joaquin drainages; Santa Barbara County south to San Diego County and west to the Salton Sea (Counts 1991) in San Francisco Bay (Ruiz 2000); **Colorado** [1995: Livo 1996] in a northwestern reservoir; **Connecticut** [1990: Morgan, pers. comm.] in the Connecticut River**; Delaware** [1986: Counts 1986] in the Delaware River in New Castle County; the Nanticoke River in Sussex County; and the Nanticoke Wildlife Refuge (Counts 1991); **District of Columbia** [1979:Dressler and Cory 1980] in the Potomac River; **Florida** [1964: Heard 1964] widespread (Counts 1991; J. D. Williams pers. comm. 1996); **Georgia** [1971: Sickel 1973] widespread (Counts 1991); **Hawai`i** [1982: Devick 1991] on the islands of O`ahu, Kaua`i, Maui, and Hawai`i; **Idaho** [1959: Ingram 1959] in the Snake River on the Idaho-Washington state line; **Illinois** [1962: Fetchner 1962] in the Illinois River south to the state line (Counts 1991) and Illinois River National Wildlife and Fish Refuges (USFWS 2005) ; **Indiana** [1962: Fox 1969] in the White, lower Wabash, and Blue river drainages; Big Indian and Indian Creeks; and the Ohio River in Clark and Posey Counties (Counts 1991); **Iowa** [1974: Eckblad 1975] in the Mississippi River near Lansing; and the Cedar River in Linn County (Counts 1991); **Kansas** [1983: Mackie and Huggins 1983] in Perry Reservoir on the Delaware River; the Kansas River drainage; the North Fork of the Ninnescah River; Wilson Reservoir on the Saline River; and Cedar Bluff Reservoir on the Smoky Hill River (Counts 1991); **Kentucky** [1957: Sinclair and Isom 1961] widespread (Counts 1991); **Louisiana** [1961: Stein 1962] in the Pearl, Atchafalaya, Mississippi, and upper Red drainages (Counts 1991); **Maryland** [1975: Stotts et al. 1977] in the Choptank River near Goldsboro; Nassawango Creek near Snow Hill; the Susquehanna River below Conowingo Dam; the Wicomico River at Salisbury; the Potomac River in Charles, Prince Georges, and Montgomery Counties; Chesapeake Bay at Havre-de-Grace, and near the mouth of the Susquehanna River (Counts 1991) throughout Chesapeake Bay (Ruiz 2000); **Michigan** [1981: Clarke 1981] in Lake Michigan at the J. H. Campbell Power Plant; and Lake Erie at Detroit Beach, Sterling State Park and Bolles Harbor (Counts 1991); **Minnesota** [1975: Cummings and Jones 1978] in the Minnesota River near Burnsville and St. Croix River (Karns 2004); **Mississippi** [1963: Heard 1966] widespread (Counts 1991); **Missouri** [1969: Fox 1969] in the lower Missouri River drainage south to the state line; **Nebraska** [1991: Peyton and Maher 1995] in the Platte River in Lincoln and Dawson Counties; **Nevada** [1959: Ingram 1959] in Lake Meade (Counts 1991); **New Jersey** [1973: Fuller and Powell 1973] in the Raritan River in Middlesex and Somerset Counties; and the Delaware River near Newbold Island, Wright Point, and Trenton (Counts 1991); **New Mexico** [1966: Metcalf 1966] in Nemexas-West Drain in Dona Ana Co.; the Pecos River impoundment at Riverside Drive in Carlsbad; and the Rio Grande River from Caballo and Elephant Butte reservoirs, south to Percha Dam (Counts 1991); **New York** [1983: Raeihle 1983] in Massapequa Lake on Long Island; **North Carolina** [1970: Fox 1971] in the Cape Fear, Catawba, Chowan, Eden, Little, Meherrin, Neuse, Roanoke, Rocky, Tar, Uhwarrie, and Waccamaw rivers; and Richardsons Creek (Counts 1991); **Ohio** [1962: Pojeta 1964] in the Muskingum, upper Scioto, and upper Great Miami drainages; and the lower Hocking River (Counts 1991); **Oklahoma** [1969: Clench 1971] in the Arkansas River from Cherokee to Wagoner Counties; the Little River near Goodwater; Lake Texoma on the Red River; Lake Overholser; Lake Thunderbird; and Caddo Creek in Carter County (Counts 1991) and Sequoyah National Wildlife Refuge (USFWS 2005); **Oregon** [1948: Ingram 1948] in the Columbia drainage; the John Day River; the Smith River near Scottsburg; and at the mouth of the Siuslaw and Willamette rivers (Counts 1991) and Coos Bay (Ruiz 2000); **Pennsylvania** [1973: Fuller and Powell 1973] in the Ohio and Delaware rivers; the Beaver River in Beaver County; the Monongahela River at Lock and Dam Number 8; and the Schuykill River at the Limerick Power Station and Fairmount Dam (Counts 1991); **South Carolina** [1972: Fuller and Powell 1973] in the Savannah, Cooper, Santee, Pee Dee, Little Pee Dee, Edisto, Waccamaw, and Salkahatchie rivers; the intracoastal waterway; and several industrial facilities in Aiken and Pickens counties (Counts 1991); **Tennessee** [1959: Sinclair and Isom 1961] in the Tennessee drainage (Counts 1991) in Tennessee National Wildlife Refuge (USFWS 2005); **Texas** [1964: Metcalf 1966] in the Angelina, Colorado, Rio Grande, Guadalupe, San Antonio, San Jacinto, Sabine, Red, White, and Brazos drainages; the Clear and West Forks of the Trinity River (Counts 1991); **Utah** [1975: Counts 1985] in Sevier Reservoir; **Virginia** [1968: Diaz 1974] in the Appomattox, Clinch, Potomac, James, and New rivers; Lake Anna; the Chowan River at the mouths of the the Blackwater and Nottoway rivers; and the Chickahominy River at Lanexa; (Counts 1991); **Washington** [1938: Burch 1944] in the Columbia, Snake, Chehalis, and Willapa rivers; Hood Canal in Jefferson County; and Aberdeen Lake in Grays Harbor Lake County (Counts 1986, 1991); **West Virginia** [1964: Thomas and MacKenthum 1964] in the Elk and Kanawha drainages (Counts 1991) and Ohio River Island National Wildlife Refuge (USFWS 2005); **Wisconsin** [1977: Cummings and Jones 1978] in the Mississippi River near Prairie du Chien and La Crosse; and the St. Croix River near Hudson (Counts 1991; Karns 2004).

Ecology: Asian clams are filter feeders that remove particles from the water column. They can be found at the sediment suface or slightly buried. The ability to reproduce rapidly coupled with low tolerance of cold temperatures can produce wild swings in populaton sizes from year to year in northern water bodies.

Means of Introduction:

The first collection of *C. fluminea* in the United States occurred in 1938 along the banks of the Columbia River near Knappton, Washington (Counts 1986). Since this first introduction, it is now found in 38 states and the District of Columbia. *Corbicula fluminea* was thought to enter the United States as a food item used by Chinese immigrants. Or, it may have come in with the importation of the Giant Pacific oyster also from the Asia. The mechanism for dispersal within North America is unknown. It is known mostly as a biofouler of many electrical and nuclear power plants across the country. As water is drawn from rivers, streams and reservoirs for cooling purposes so are Corbicula larvae. Once inside the plant, this mussel can clog condenser tubes, raw service water pipes, and fire fighting equipment. Economic problems can result from the decreased efficiency of energy generation. Warm water effluents at these power plants make a hospitable environment for stabilizing populations. With man shown to be the primary agent of dispersal, no large-scale geographic features function as dispersal barriers (Counts 1986; Isom 1986). Current methods of introduction include bait bucket introductions (Counts 1986), accidental introductions associated with imported aquaculture species (Counts 1986), and intentional introductions by people who buy them as a food item in markets (Devick 1991). The only other significant dispersal agent is thought to be passive movement via water currents (Isom 1986); fish and birds are not considered to be significant distribution vectors (Counts 1986; Isom 1986).

Status: *Corbicula fluminea* has established in L. Michigan, Superior, Erie (U.S.EPA 2008).

Impact of Introduction: Environmental: The most prominent effect of the introduction of the Asian clam into the United States has been biofouling, especially of complex power plant and industrial water systems (Isom et al. 1986; Williams and McMahon 1986). It has also been documented to cause problems in irrigation canals and pipes (Prokopovich and Hebert 1965; Devick 1991) and drinking water supplies (Smith et al. 1979). It also alters benthic substrates (Sickel 1986), and competes with native species for limited resources (Devick 1991).

Economic: In the USA, C. fluminea has caused millions of dollars worth of damage to intake pipes used in the power and water industries. Large numbers, either dead or alive, clog water intake pipes and the cost of removing them is estimated at about a billion US dollars each year (Anon., 2005). Juvenile C. fluminea get carried by water currents into condensers of electrical generating facilities where they attach themselves to the walls via byssus threads, growing and ultimately obstructing the flow of water. Several nuclear reactors have had to be closed down temporarily in the USA for the removal of Corbicula from the cooling systems (Isom, 1986). In Ohio and Tennessee where river beds are dredged for sand and gravel for use as aggregation material in cement, the high densities of C. fluminea have incorporated themselves in the cement, burrowing to the surface as the cement starts to set, weakening the structure (Sinclair and Isom, 1961). Isom (1986) has reviewed the invasion of C. fluminea of the Americas and the biofouling of its waters and industries.

Ecological: C. fluminea is consumed mainly by fish and crayfish. An account of the different species which prey on C. fluminea in the USA is given by McMahon (1983). Garcia and Protogino (2005) describe the diet of some native fishes from Argentina (Rio de la Plata) previously not known to feed on C. fluminea. Their results indicate that several local fish species have modified their diet to feed on invasive molluscan species such as C. fluminea.

Remarks: Factors that may affect population density and distribution of Asian clams include excessively high or low temperatures, salinity, drying, low pH, silt, hypoxia, pollution, bacterial, viral and parasitic infections, inter- and intraspecific competition, predators, and genetic changes (Evans et al. 1979; Sickel 1986). These clams have been found in the stomachs of black buffalo - *Ictiobus niger* (Minckley 1973); carp - *Cyprinus carpio*, channel catfish - *Ictalurus punctatus*, yellow bullhead - *Ameiurus natalis*, redear sunfish - *Lepomis microlophus*, largemouth bass - *Micropterus salmoides*, Mozambique tilapia - *Tilapia mossambica* (Minckley 1982); blue catfish - *Ictalurus furcatus* (M. Moser pers. comm. 1996); and spotted catfish - *Ameiurus serracanthus* (A. Foster pers. comm. 1996). Other predators of *Corbicula* include birds, raccoons, crayfish, and flatworms (Sickel 1986). Densities of *C. fluminea* have also been documented to occur by the thousands per square meter, often dominating the benthic community (Sickel 1986).

References

Burch, J. Q. 1944. Checklist of west American mollusks. Minutes, Concological Club of southern California 38:18.

Clarke, A. H. 1981. *Corbicula fluminea* in Lake Erie. Nautilus 95:83-84.

Clench, W. J. 1971. *Corbicula manilensis* Philippi in Oklahoma. Nautilus 85:145.

Cummings, S. E. and J. A. Jones. 1978. Occurrence of *Corbicula manilensis* Philippi (sic) in the lower Minnesota River. Journal of the Minnesota Academy of Science 34:13-14.

Counts, C. L. III. 1985. *Corbicula fluminea* (Bivalvia: Corbiculidae) in the state of Washington in 1937, and in Utah in 1975. Nautilus 99:18-19.

Counts, C. L., III. 1986. The zoogeography and history of the invasion of the United States by *Corbicula fluminea* (Bivalvia: Corbiculidae). American Malacological Bulletin, Special Edition No. 2:7-39.

Counts, C. L. III. 1991. *Corbicula* (Bivalvia: Corbiculidae). Tryonia: Miscellaneous Publications of the Department of Malacology, No. 21. The Academy of Natural Sciences of Philadelphia. 134pp.

Devick, W. S. 1991. Patterns of introductions of aquatic organisms to Hawaiian freshwater habitats. Pages 189-213 in New Directions in Research, Management and Conservation of Hawaiian Freshwater Stream Ecosystem. Proceedings Freshwater Stream Biology and Fisheries Management Symposium. Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu, HI.

Diaz, R. J. 1974. Asiatic clam, *Corbicula manilensis* (Philippi) in the tidal James River, Virginia. Chesapeake Science 15:118-120.

Dressler, P. V. and R. L. Cory. 1980. The Asiatic clam, *Corbicula fluminea* (Müller), in the tidal Potomac River, Maryland. Estuaries 3:150-152.

Dundee, D. S. and H. A. Dundee. 1958. Extension of known ranges of four Mollusca. Nautilus 72:51-53.

Eckblad, J. W. 1975. The Asiatic clam, *Corbicula*, in the upper Mississippi River. Nautilus 89:4.

Evans, L. P. Jr., C. E. Murphy, J. C. Britton and L. W. Newland. 1979. Salinity relationships in *Corbicula fluminea* (Müller). Proceedings First International *Corbicula* Symposium. Texas Christian University Research Foundation, pp. 194-214.

Fetchner, F. K. 1962. *Corbicula fluminea* (Müller) from the Ohio River. Nautilus 75:126.

Foster, A. - USGS, Gainesville, FL.

Fox, R. O. 1969. The *Corbicula* story: a progress report. Second Annual Meeting, Western Society of Malacologists. 11 pp.

Fox, R. O. 1970. The *Corbicula* story: chapter two. Third Annual Meeting, Western Society of Malacologists. 10 pp.

Fox, R. O. 1971. The *Corbicula* story: chapter three. Fourth Annual Meeting, Western Society of Malacologists. 5pp.

Fuller, S. L. H. and C. E. Powell. 1973. Range extension of *Corbicula manilensis* (Philippi) in the Atlantic drainage of the United States. Nautilus 87:59.

Hanna, G. D. 1966. Introduced mollusks of western North America. California Academy of Sciences Occasional Papers 48:1-108.

Heard, W. H. 1964. *Corbicula fluminea in Florida*. Nautilus 77:105-107.

Heard, W. H. 1966. Further records of *Corbicula fluminea* (Müller) in the southern United States. Nautilus 79:105-107.

Hillis, D. M. and J. C. Patton. 1982. Morphological and electrophoretic evidence for two species of *Corbicula* (Bivalvia: Corbiculidae) in North America. American Midland Naturalist 108:74-80.

Hubricht, L. 1963. *Corbicula fluminea* in the Mobile River. Nautilus 77:31.

Ingram, W. H. 1948. The larger freshwater clams of California, Oregon and Washington. Journal of Entomology and Zoology 40:72-92.

Ingram, W.H. 1959. Asiatic clams as potential pests in California water supplies. Journal of the American Water Works Association 51:363-370.

Isom, B.G. 1986. Historical review of Asiatic clam (*Corbicula*) invasion and biofouling of waters and industries in the Americas. American Malacological Bulletin, Special Edition No. 2:1-5.

Isom, B. G., C. F. Bowman, J. T. Johnson, E. B. Rodgers. 1986. Controlling *Corbicula* (Asiatic clams) in complex power plant and industrial water systems. American Malacological Bulletin, Special Edition 2:95-98.

Livo, L. J. 1996. Colorado Outdoors 45:17-19.

Mackie, G. L. and D. G. Huggins. 1983. Sphaeriacean clams of Kansas. Technical Publications of the State Biological Survey of Kansas, University of Kansas, Lawrence. 92 pp.

McLeod, M. J. 1986. Electrophoretic variation in North American *Corbicula*. American Malacological Bulletin, Special Edition 2:125-132.

McMahon, R. 1991. Mollusca: Bivalvia, pages 315-399 in Thorp, J. H. and A. P. Covich. (eds.) Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc., New York. 911pp.

Metcalf, A. L. 1966. *Corbicula manilensis* in the Mesilla Valley of Texas and New Mexico. Nautilus 80:16-20.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix

Minckley, W. L. 1982. Trophic interrelations among introduced fishes in the lower Colorado River, southwestern United States. California Fish and Game 68:78-89.

Morton, B. 1979. *Corbicula* in Asia. Pages 15-38 in Proceedings, First International Corbicula Symposium, Texas Christian University, Fort Worth, Texas. 13-15 October, 1977. 313 pp.

Morton, B. 1986. *Corbicula* in Asia - an updated synthesis. American Malacological Bulletin, Special Edition No. 2:113-124.

Moser, M. - Center for Marine Science Research, Wilmington, North Carolina.

Peyton, M. M. and J. L. Maher. 1995. A survey of mussels (Mollusca: Bivalvia) in the Platte River system and associated irrigation and hydropower canal and lake systems west of Overton, Nebraska. Transactions of the Nebraska Academy of Sciences 22:43-48.

Pojeta, J. 1964. Notes on the extension of the known range of the Asiatic clam *Corbicula fluminea* (Müller) in Ohio River. Ohio Journal of Science 64:428.

Prokopovich, N. P. and D. J. Hebert. 1965. Sedimentation in the Delta-Mendota Canal. Journal of the American Water Works Association 57:375-382.

Raeihle, D. 1983. *Corbicula fluminea* (Müller, 1774) in Massapequa Lake, Long Island, New York. New York Shell Club Notes 28:9-10.

Sickel, J. B. 1973. New record of *Corbicula manilensis* (Philippi) in the southern Atlantic slope region of Georgia. Nautilus 87:11-12.

Sickel, J. B. 1986. *Corbicula* population mortalities: factors influencing population control. American Malacological Bulletin, Special Edition 2:89-94.

Sinclair, R. M. and B. G. Isom. 1961. A preliminary report on the introduced Asiatic clam *Corbicula* in Tennessee. Tennessee Stream Pollution Control Board, Tennessee Department of Public Health. 31 pp.

Smith, A. L., A. Mula, J. P. Farkas and D. O. Bassett. 1979. Clams - a growing threat to inplant water systems. Plant Engineering 1979:165-167.

U.S. EPA (Environmental Protection Agency). (2008) Predicting future introductions of nonindigenous species to the Great Lakes. National Center for Environmental Assessment, Washington, DC; EPA/600/R-08/066F. Available from the National Technical Information Service, Springfield, VA, and http://www.epa.gov/ncea.

Stein, C. B. 1962. An extension of the known range of the Asiatic clam, *Corbicula fluminea* (Müller), in the Ohio and Mississippi Rivers. Ohio Journal of Science 62:326-327.

Stotts, V. D., K. D'Loughy, and D. B. Stotts. 1977. Waterfowl habitat. Maryland Department of Natural Resources Wildlife Administration Report 77-2. 6 pp.

Thomas, N. A. and K. M. MacKenthum. 1964. Asiatic clam infestation at Charleston, West Virginia. Nautilus 78:28-29.

Williams, C. J. and R. F. McMahon. 1986. Power station entrainment of *Corbicula fluminea* (Müller) in relation to population dynamics, reproductive cycle and biotic and abiotic variables. American Malacological Bulletin, Special Edition 2:99-111.

Williams, J. D. - U.S. Geological Survey, Biological Resources, Florida Caribbean Sciences Center, Gainesville, Florida.

Other Resources:

USGS Nonindigenous Species Information Bulletin - *Corbicula fluminea*

Corbicula fluminea (Asian clam) (Gulf of Mexico Program)

Corbicula fluminea (ANS Clearinghouse Bibliography)

NOAA Sea Grant Nonindigenous Species Site (SGNIS)

Corbicula fluminea (Global Invasive Species Database)

Great Lakes Water Life

CAB International 2008. http://www.cabi.org/isc/Default.aspx?LoadModule=datasheet&dsID=88200&CompID=5&site=144&page=230

Author: A. M. Foster, P. Fuller , A. Benson, S. Constant, D. Raikow

Contributing Agencies:
NOAA - GLERL

Revision Date: 6/22/2009

Citation for this information:
A. M. Foster, P. Fuller , A. Benson, S. Constant, D. Raikow. 2009. *Corbicula fluminea*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=92> Revision Date: 6/22/2009