

***Corbicula fluminea* (O. F. Müller, 1774), an Invasive Bivalve Mollusk, First Identified at Numerous Sites in Bangladesh**

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ABSTRACT While identifying Invasive Alien Species (IAS) from different locations and aquatic habitats in Bangladesh, *Corbicula fluminea* (O. F. Müller, 1774), an invasive alien species belonging to the family Cyrenidae was recorded for the first time. Significant impacts caused by this invasive species were detected in a number of different habitats (river side, lake side, wetland, and stream) in Bangladesh.

KEY WORDS: Invasive alien species, Mollusca, *Corbicula fluminea*, Bangladesh.

INTRODUCTION

The first collection of *Corbicula fluminea* in the United States occurred in 1938 along the banks of the Columbia River near Knappton, Washington (Counts 1986). The original distribution of the *Corbicula* genus was confined, in the beginning of the last century, to Asia, Africa and Australia and since then it has dispersed worldwide (Mouthon 1981, Counts 1986, Araujo *et al.* 1993, Ituarte 1994, McMahon 2000). The first documented occurrence of this genus outside its original distribution was on the Pacific coast of the United States in the 1920s, possibly being introduced by Chinese immigrants as a food resource (Counts 1981). Alternatively, it may have come in with the importation of the Giant Pacific oyster also from Asia. 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 firefighting

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. Humans are the primary agent of dispersal, and no large-scale geographic features function as barriers to dispersal (Counts 1986, Isom 1986). Current methods of introduction include bait bucket introductions, accidental introductions associated with imported aquaculture species (Counts 1986), and intentional introductions by people who sell 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). *Corbicula fluminea* is consumed mainly by fish and crayfish. An account of the different species which prey on *C. fluminea* in the USA was presented by McMahon in 1983. The most prominent effect of the introduction of the Asian clam 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). Diver assisted suction removal and bottom barriers are being researched as potential methods for physical control of *Corbicula* populations in Lake Tahoe (UC Davis TERC, 2004). Benthic barriers have been demonstrated to be effective for short-term control of *C. fluminea*, but non-target mortality to other benthic invertebrates can be high (Wittmann *et al.*, 2012).

Invasive species, whether called nonnative, alien, exotic, non-indigenous or introduced are those life forms that have evolved elsewhere and been purposely or accidentally moved to a new location. The invasive species spread quickly and easily in the new environment, as there are no natural predators. In their native habitats, these species are often harmless. However, when they enter new environment, for example water where natural controls are absent, they may out-compete native plants and animals. So far 22 freshwater mollusk have been recorded from Bangladesh (Siddiqui *et al.*, 2008). During 2011 to 2012, a total of 15 freshwater mollusk (10 gastropod and 5 bivalve species) were identified in the Old Brahmaputra river, Mymensingh, Bangladesh (Hossain and Baki 2014). To date there has been no evaluation of *C. fluminea* in the tropical Bangladesh area, until this study.

MATERIALS AND METHODS

Invertebrate samples were collected by hand from different locations in Bangladesh from May 2014 to August 2015. Invertebrate samples were also collected by fishermen

during fishing season on river banks. Samples were identified by the Department of Zoology, University of Dhaka; Department of Zoology, Jagannath University, Bangladesh, and by the authors Sousa *et al.* 2008. Specimens were photographed with a Nikon D3200 DSLR camera.

RESULTS AND DISCUSSION

This study was the first to record and document *C. fluminea* (O. F. Müller, 1774) from a variety of habitats and locations in Bangladesh. (VSN0017/BR/FM/JnUZM; VSN 006/FM/DUZM).

Common Name: Asian clam, golden clam.

Classification: Kingdom: Animalia; Phylum: Mollusca; Class: Bivalvia; Subclass: Heterodonta; Order: Veneroida; Super Family: Cyrenoidea; Family: Cyrenidae; Genus: *Corbicula*; Species: *Corbicula fluminea*.

Morphology: This freshwater bivalve mollusk has distinct concentric rows of elevated ridges on the exterior of the shell. The shell is rounded to slightly triangular. Each valve has three cardinal teeth; the outside of the shell is transparent or yellow brown in color while alive; the inside of the shell is polished and a grey to light purple color when alive and dark brown when dead; thick, with distinct elevated rings on the exterior of the shell. The size ranges from approximately 2.5 to 3cm in length.

Habitat and Ecology: *Corbicula fluminea* occurs in sandy, muddy or gravel-bottomed streams, rivers, ponds and shallow lake shorelines. It can tolerate a wide range of environmental conditions in tropical ecosystem. It lives in streams, as well as hilly areas with wetlands at depths of 0.9 to 3m and in approximately 17.8 cm of sediment. This

clam is a filter feeder that removes particles from the water column. It is found on the benthic sediment surface or slightly beneath it. The ability of *Corbicula* to reproduce rapidly, coupled with its low tolerance of cold temperatures (2-30°C), can produce wild swings in population sizes from year to year in northern water bodies. Both yellow and brown morphs occur simultaneous as this species is hermaphroditic and broods its larvae in the inner demibranchs (Qiu *et al.* 2001).



Figure 1. *Corbicula fluminea* (O. F. Müller, 1774) (shows both green and yellow-brown morphs).

Life history: Life span is 1 to 5 years, age at maturity is 3 to 9 months, fecundity 68 678, Juvenile size at release 250 µm, position of broods inner demibranchs, type of released larvae (juveniles) D-shaped configuration, brooding type synchronous, juvenile survivorship low, adult survivorship usually low, number of reproductive events usually two but may vary, assimilated energy respired 11 - 42 %, non-respired energy transferred to growth 58 - 71 %, non-respired energy transferred to reproduction 5 - 15 % (Sousa *et al.* 2008).

Habitat requirements: Tolerate low water temperatures and prefer sandier sediments mixed with silt and clay (which enhance the organic matter content). Intolerant to high salinity and even moderate hypoxia conditions (this species is usually restricted to well-oxygenated areas). However, in some ecosystems this species can be found in all types of sediments (with or without submerged vegetation) (Sousa *et al.* 2008).

Distribution: *Corbicula fluminea* was found in:

Kamrangichar, Buriganga River (GPS 90°35'07.9''E and 23°74'11.79''N) and the portion of Buriganga River flowing through the heart of the Dhaka city, at an average depth of 7.6 metres (25 ft) and a maximum depth of 18 metres (58 ft); during 2012 to 2013 under the MS Research grant program of Dept. of Zoology, JnU.

Old Brahmaputra River, Mymensingh, (GPS 90°37'59.93''E and 24°19'25.35''N) originates from the left bank of the Brahmaputra to the north of Bahadurabad. Flowing more or less to the southeast it passes the cities of Jamalpur and Mymensingh and joins into the Meghna at Bhairab Bazar Kaptai Lake, Rangamati (GPS 92°12'49.78''E

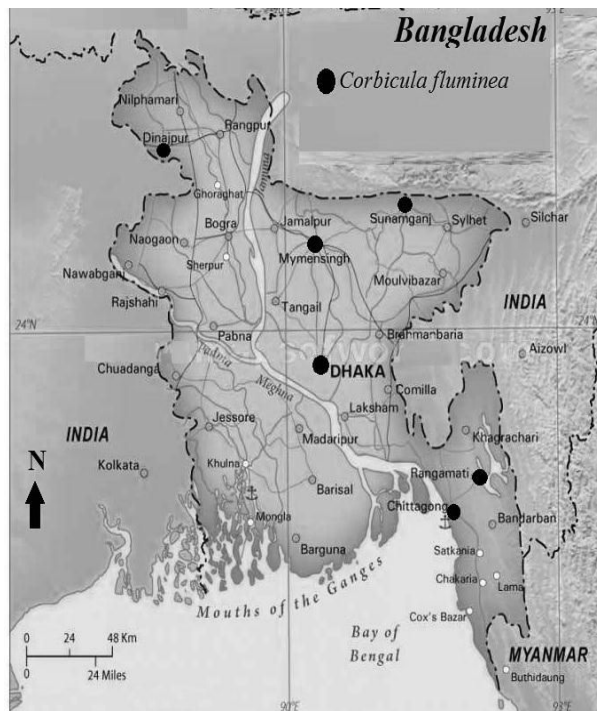


Figure 2. Distribution of Invasive Species *Corbicula fluminea* (O. F. Müller, 1774) in Bangladesh.

and 22°35'33.96''N), a man-made lake with an average depth of 30 meters in south-eastern Bangladesh. The lake is located in the Kaptai Upazila under Rangamati District of Chittagong Division.

Karnaphuli River (GPS 91°48' E and 22°15' N; 91°52' E and 22°20' N) which is the largest and most important river in Chittagong, and the Chittagong Hill Tracts, is a 667-metre wide river in the south-eastern region.

Tanguar Haor, Sunamganj (GPS 91°04'12.7''E and 25°08'45.3''N), is located in the Dharmapasha and Tahirpur upazilas of Sunamganj District in Bangladesh. This is a unique wetland ecosystem of national importance and has come into international focus.

Punarbhaba River, Dinajpur (GPS 88°37'20.39''E and 25°37'33.18''N), is situated between Bangladesh and West Bengal

in India. It is about 160 kilometres in length and 3 to 8 kilometres wide, having a mean depth of 1.96 meters, and originates from the lowlands of Thakurgaon District of Bangladesh (Figures 1 & 2).

Water Quality: During October 2012 to August 2013, the water quality parameters of the Buriganga River namely temperature, pH, salinity, TDS, EC, DO and COD were 22.0-31.6°C, 6.2-7.8, 69-642 mg/l, 97-871 mg/l, 146-1309 μ s, 1.1-4.1 mg/l and 140-800 mg/l respectively (Sarkar *et al.*, 2015). In April 2008, surface water quality parameters of Kaptai reservoir such as, pH, TDS, DO and COD were 5.7-6.4, 50-120 mg/l, 6.58-6.66 mg/l and 8.00-15.00 mg/l (Karmaka *et al.*, 2011). In May to June 2012, the water quality in this region specifically the temperature, pH, DO and TDS in Tanguar Haor, were 27.8-28, 6.9-7.6, 4.5-5.5 mg/l and 670-1036 mg/l respectively (Mamun *et al.*, 2013).

CONCLUSION

Corbicula fluminea has become a major component of benthic communities in several lotic and lentic habitats in different regions of the world and, thus, has wide spatial distributions. It may be found in both pristine and polluted environments, and presents a very strong invasive dynamics in rivers, channels and lakes where it reaches very high abundance (Phelps 1994, Sousa *et al.* 2008). *Corbicula fluminea* is a bioindicator species for ecotoxicological studies (Doherty 1990, Inza *et al.* 1997, Cataldo *et al.* 2001) and food resource for pelagic and benthic species (Cantanhêde *et al.* 2008). *Corbicula fluminea*'s abundance, biomass and abiotic factors will be important for future risk analysis. This study has increased our knowledge about an important ecological processes mediated by *C. fluminea* that can be responsible for changes in the functioning of

the aquatic ecosystem. In spite of the information presented here there is still considerable need for further research on water quality, habitat, population and abundance of the species.

ACKNOWLEDGEMENTS

This research was supported by Faunal Survey and Enrichment of Facilities for Biodiversity Research Sub-Project (CP 2216), HEQEP, UGC, Bangladesh and Department of Zoology, University of Dhaka. Also, acknowledgement is extended to Department of Zoology, Jagannath University, Dhaka that provided information about Invasive Alien Species (IAS).

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