

THE ASIAN INVASIVE FRESHWATER CLAM *CORBICULA FLUMINEA* AS PREY OF TWO NATIVE WATERBIRDS IN SOUTH-EASTERN BRAZIL

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ABSTRACT: The invasive Asiatic freshwater bivalve *Corbicula fluminea* is regarded as a pest in several countries including Brazil. Two water birds native to South America, the limpkin *Aramus guarauna* and the common gallinule *Gallinula galeata*, are herein recorded preying on *C. fluminea* in a pond of an urban park in South-eastern Brazil. The exotic clam is becoming increasingly common in the diet of both these water birds. This trend is likely due to its increasing population and the consequent rarity of the habitual prey (apple snails and native clams) for the mollusc-specialised limpkin, besides being an accessible animal protein source for the omnivorous gallinule.

KEY WORDS: *Corbicula fluminea*, invasive mollusc, native water birds, foraging, Brazil

The freshwater bivalve *Corbicula fluminea* (O. F. Müller, 1774), Corbiculidae, underwent a global expansion from its native Asia to North America, South America, and Europe, and is still expanding its range in these countries (ARAUJO et al. 1993, KAMBURSKA et al. 2009, MANSUR et al. 2012, MACKIEWICZ 2013). The so called Asian or basket clam is regarded as one of the 100 worst invasive species in Europe (DAISIE 2008), being a source of serious environmental and economic damage (ISOM 1986, DARRIGAN 2002, SOUSA et al. 2008, 2009, MANSUR et al. 2012). The basket clam is the most common and widespread of the four recorded species of the genus *Corbicula* in Brazil (MANSUR et al. 2012).

Corbicula fluminea is preyed on by vertebrates, including fishes in North and South America (ROBINSON & WELLBORN 1988, OLIVEIRA et al. 2010), and turtles and ducks in North America (HOPPE et al. 1988, WILHELM & PLUMMER 2012). Herein we report on two native water birds, the limpkin *Aramus guarauna* (Linnaeus, 1766) (Aramidae) and the com-

mon gallinule *Gallinula galeata* (Lichtenstein, 1818) (Rallidae) preying on *C. fluminea* at an urban park in South-eastern Brazil. The limpkin is a specialised mollusc-eater, whereas the gallinule is an omnivore feeding on both aquatic vegetation and invertebrates (HOYO et al. 1996, CORBO et al. 2013).

The study site is the Parque Ecológico Prof. Hermógenes de Freitas Leitão Filho (22°48'42"S, 47°04'21"W), Campinas, São Paulo, South-eastern Brazil. This park has a total area of 13.4 ha, of which about 75% is occupied by a pond surrounded by trees, bushes and grass patches. The foraging birds were observed with the naked eye and through 10×50 binoculars, and recorded with a 70–300 telephoto zoom lens mounted on a SLR camera from a distance of 4–20 m. Throughout the observational sessions we mostly used "focal-animal" and "sequence" samplings (ALTMANN 1974), both of which are adequate for opportunistic records. Sizes of preyed clams were measured directly from shells taken at limpkins' processing places (see below), or estimated against the bill

size of the photographed birds holding their prey, and checked against actual clam shells and museum specimens of birds. *C. fluminea* shells taken at limpkins' processing places are housed as vouchers at the bivalve collection of the Museu de Zoologia da Universidade Estadual de Campinas (accession number ZUEC BIV 3981). Shells retrieved at such places have small chips on the edges of the valves (see SNYDER & SNYDER 1969 for similar, small damage done to clams by limpkins).

The limpkin waded while foraging for the Asian clam and picked this prey with its bill tip (Fig. 1). The bird carried the clams to the pond bank, anchored the prey hinge down in the wet ground and extracted the soft parts using its specialised bill (see detailed description in SNYDER & SNYDER 1969). Clams up to 4 cm were favoured over the smaller ones (likely due to cost-benefits of foraging on large versus small clams) and opened to extract the soft parts. Small clams (up to 2 cm) were sometimes taken and swallowed whole. The limpkin often used the same bank portions to open the clams, thus creating a sort of processing places full of empty shells (Fig. 2). The limpkin was recorded preying on this clam since 2007, although at that time it preyed mostly on large native molluscs,

the channelled apple snail *Pomacea canaliculata* (Lamarck, 1819) (Ampullariidae) and the also native plate clam *Anodontites trapesialis* (Lamarck, 1819) (Mycetopodidae). The large plate clam was the favoured prey of the limpkin until its visible decrease at the study site from 2007 on, and becoming increasingly rare among the molluscs taken by the bird.

Foraging of gallinules on Asian clams was noticed in 2013 at a particular site, and appeared to spread through family groups composed of an adult couple and their grown chicks able to dive. While foraging for clams the gallinule swam over a site within radius limited to about 10 m, peered intently into the water and dove after the prey (Fig. 3). This water bird picked only small clams (up to 2 cm) and swallowed them whole (Fig. 4). Currently the gallinules forage at the clam bank regularly and this prey likely became an important part of their omnivorous diets. We recorded other sites at which the gallinules foraged for clams, but the one described above was the most favoured site.

Possibly influenced by an increase of *C. fluminea* populations in the studied pond (as noticed from some spots of massive mortality), *Pomacea canaliculata* and *Anodontites trapesialis* populations began to visibly



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Figs 1–4. Asian clam (*Corbicula fluminea*) preyed on by native water birds in Brazil: 1 – carrying a clam in its bill, a limpkin (*Aramus guarauna*) wades towards the pond bank to open the shell; 2 – several empty shells of the Asian clam and one of the apple snail *Pomacea canaliculata* on the bank portion where a limpkin opened the clams and extracted the soft parts; 3 – its feet still visible on the water surface, a young common gallinule (*Gallinula galeata*) dives to pick a clam from the bottom of the pond; 4 – upon surfacing, the young gallinule holds a small clam in the middle of its bill



dwindle at the study site from 2007 on (see MANSUR et al. 2012 for comments on decrease of mycetopodid clams due to increase of Asian clam populations). This decrease of the apple snail and the plate shell likely led the limpkin to shift from its habitual foraging for snails and large clams to the smaller but abundant *C. fluminea*. This shift is similar to that reported for the musk turtle *Sternotherus odoratus* (Latreille in Sonnini & Latreille, 1801) in an urban stream in North America, in whose diet this invasive Asian clam became increasingly important (WILHELM & PLUMMER 2012). On the other hand, the Asian clam seems to be a novel prey in the diet of the gallinule at the studied pond, since it went almost unnoticed until 2013 (we recorded a single instance of an adult feeding its accompanying chick with a small Asian clam in 2010). As clam foraging by this water bird is characterised by its conspicuous diving, it is unlikely that the

clam was an important prey of the gallinule before 2013. Two North-American duck species of the genus *Aythya* F. Boie, 1822 also dive to feed on *C. fluminea* banks (HOPPE et al. 1986).

As *Corbicula fluminea* is still expanding its range in Brazil (MANSUR et al. 2012), we suggest that it will be reported elsewhere as prey of the limpkin, the gallinule, and possibly other water birds such as ducks able to handle this invasive bivalve as food.

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