



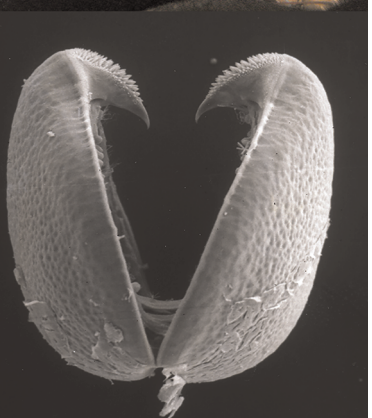

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NOTE

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NOTE

FUNNEL TRAPS FOR SAMPLING CHINESE MYSTERY SNAILS, *CIPANGOPALUDINA CHINENSIS* (VIVIPARIDAE)

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ABSTRACT

No previous studies have evaluated funnel traps (e.g., minnow or crayfish traps) as a method for sampling large freshwater gastropods. We captured Chinese Mystery Snails (*Cipangopaludina chinensis*), an invasive species in North America, in Rose Valley Lake, Pennsylvania, USA, as bycatch while sampling crayfishes with baited funnel traps with a 5-cm diameter opening. Mean catch per unit effort (CPUE)/trap was 1.2 CMS/night ± 0.3 SE (range = 0–6). We later tested baited vs. unbaited traps and found no significant difference in CPUE related to baiting, suggesting that snails entered traps incidentally. Funnel traps may be an alternative for sampling snails when conventional methods are limited by deep or turbid water, dense aquatic vegetation, or strong currents. If density estimates are desired, it will be necessary to derive and evaluate the relationship between CPUE in traps and observed estimates of snail density.

KEY WORDS: trapping, invasive snail, Susquehanna basin, aquatic invasive species

INTRODUCTION

Chinese Mystery Snails (*Cipangopaludina chinensis*, family Viviparidae; hereafter, CMS) have been introduced into North America and Europe in recent decades (Van den Neuker et al. 2017; Dillon et al. 2019; Kingsbury, McAlpine et al. 2021). CMS are large freshwater gastropods, reaching up to 4.7 cm spire length, native to Asia (Dillon et al. 2019; Kingsbury, McAlpine et al. 2021). They likely were introduced by escapes, releases, or intentional stocking from the aquarium pet trade and inadvertent transport among water bodies on boats and boat trailers (Solomon et al. 2010; Kingsbury et al. 2021a). CMS are live-bearers, with females producing 25–100 young/year (Stephen et al. 2013; Kingsbury, McAlpine et al. 2021). Once established, CMS can attain high biomass, dominating the benthos (Chaine et al. 2012; Kingsbury, McAlpine et al. 2021). They may compete with native mollusks and impact microbial communities (Olden et al. 2013). Impacts on native gastropods are unclear: an experimental study suggested negative impacts via competition (Johnson et al. 2009), but a field study reported negligible impacts (Solomon et al. 2010). CMS habitat use may overlap with native freshwater mussels, suggesting the potential for competition (Kingsbury, Fong et al. 2021). CMS also may serve as reservoirs for parasites harmful to both humans and wildlife (Kingsbury, McAlpine et al. 2021). They are considered an aquatic invasive species in North America, and the sale or possession of live animals has been banned in several U.S. states (Kingsbury, McAlpine et al. 2021).

Several studies have surveyed North American waters for CMS, as well as its congener, the Japanese Mystery Snail (*Cipangopaludina japonica*), to inform management efforts (e.g., Solomon et al. 2010; McAlpine et al. 2016; David and Cote 2019; Fowler et al. 2022). Sampling methods for CMS are similar to those for other freshwater gastropods (Dillon 2006) and typically consist of timed, visual surveys along shorelines or in shallow water (e.g., Chaine et al. 2012; McAlpine et al. 2016; David and Cote 2019; Fowler et al. 2022) or snorkeling (Solomon et al 2010). We captured large numbers of CMS as bycatch while sampling crayfishes with baited funnel traps in a lake. To our knowledge, funnel traps have not been used previously to sample CMS, but other freshwater gastropods can be attracted to carrion (e.g., *Campeloma*, family Viviparidae; Dillon 2006).

We report on and evaluate the success of funnel traps for sampling CMS and potentially other freshwater snails. Additionally, we assess how the presence of bait influenced the capture of CMS in funnel traps.

METHODS

Our study area was located within the northern lobe of Rose Valley Lake (Susquehanna River system), a publicly owned 150-ha impoundment in Gamble Township, Lycoming County, Pennsylvania, USA (41.395949, -76.996907). The

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Figure 1. Funnel trap containing Chinese Mystery Snails (Cipangopaludina chinensis) at Rose Valley Lake, Lycoming County, Pennsylvania, USA. Note the larger funnel opening (5 cm) relative to most commercially available minnow traps (2.5 cm).

lake has a well-established population of CMS, which occur at densities of 0–4/m^2 (S. Hartzell, unpublished data). We refer to the Mystery Snail population at this site as CMS because morphological characters keyed to that species (Dillon et al. 2019). However, considerable overlap in morphological characters exists among populations of CMS and *C. japonica* in North America (Fowler et al. 2022), and positive identification of this population is tentative pending genetic analysis.

On June 6, 2023, we set 18 funnel traps to sample crayfishes. To allow capture of larger crayfishes, we used crayfish traps with funnel openings of 5-cm diameter (Cabela's, Sidney, NE; https://www.cabelas.com/shop/en/bass-pro-shops-crawfish-trap) instead of 2.5 cm, as is typical of most commercially available minnow traps (Stuechelli 1991; Fig. 1). We baited each trap with a can of moist cat food. We set traps about 10 m from the shoreline at 0.5–1.5 m depth and tied them with rope in arrays of three traps each. Substrate in the vicinity of traps consisted mainly of mud, sand, cobble, and patches of submerged aquatic vegetation (*Elodia* sp.). We deployed the traps for 48 hours and then identified and counted snails and crayfishes captured in each trap.

We deployed the same 18 traps at the same site on September 12, 2023. We baited nine of the traps with canned cat food and left the other nine traps unbaited. We deployed baited and unbaited traps in an alternating fashion within a trap line. After 24 hours, we identified and counted snails in each trap. We did not collect data on crayfishes captured during our second trapping effort.

We expressed capture rates in each trap as catch per unit effort (CPUE), calculated as the number of CMS/number of trap nights. We performed statistical analyses with the program R (R Core Team 2021) using the native "stats" package. Because data were non-normally distributed, we used a Mann-Whitney *U*-test to evaluate if the number of snails captured differed significantly between baited and unbaited traps ($\alpha = 0.05$).

RESULTS

During our first trap set in June 2023, we captured 42 CMS among 18 baited traps over 48 hours. Mean CPUE/trap was 1.2 CMS/night ± 0.3 SE (range = 0–6/night). We captured no other snail species in the traps. We captured four crayfishes across all traps (all *Faxonius virilis*, Virile Crayfish). During our second trap set in September 2023, we captured 11 CMS in baited traps and seven CMS in unbaited traps (means, baited = 1.2/night; unbaited = 0.8/night). The number of snails captured did not differ significantly between baited and unbaited traps ($w = 33.5$, 16 df, $P = 0.54$). We captured no other snail species in the traps.

DISCUSSION

Funnel traps are a common, relatively inexpensive method for sampling aquatic organisms such as crayfishes (Somers and Stetchey 1986; Stuchelli 1991), small fishes (Diana et al. 2006), and salamanders (Bilak and Whiles 2021). However, to our knowledge, funnel traps have not been reported as being used to sample large freshwater snails, such as CMS. The openings on commercially available minnow traps are of a smaller diameter (~2.5 cm) that may exclude larger CMS and other snails, resulting in underestimates of snail abundance and a nonrepresentative size-frequency distribution for the population. Because the maximum spire height of CMS is 4.7 cm (Dillon et al. 2019), funnel traps with 5-cm diameter openings, such as those used to sample larger crayfishes (Stuechelli 1991), should provide unbiased estimates of CMS abundance and size structure. However, we did not compare CPUE or size distributions in our traps with those obtained from conventional sampling methods, and such comparisons are necessary to further evaluate the usefulness of funnel traps for sampling snails.

We found no significant effect of baiting on the number of snails captured, suggesting that the snails simply wandered into the traps rather than being attracted to the bait, possibly using the traps as a refuge. This finding indicates that messy, laborious baiting of traps is unnecessary to capture CMS. However, we used only one type of bait, and it is unknown if bait type affects the capture rate of CMS as observed for crayfishes (e.g., Rach and Bills 1987).

Although funnel traps are useful for sampling CMS, this method does not provide direct estimates of snail density. In shallow, clear water, timed search or quadrat sampling may be equally effective as trapping, and those methods can be conducted in a single visit to the site. However, funnel traps

could be alternatives for sampling snails when conventional methods are limited by deep or turbid water, dense aquatic vegetation, or strong currents. If density estimates are desired, it will be necessary to derive and evaluate the relationship between CPUE in traps and observed estimates of snail density from conventional sampling.

We captured no other snails in our traps, but traps may be useful for sampling other large viviparid snails, such as Japanese Mystery Snails (*Cipangopaludina japonica*) and native species such as Brown Mystery Snails (*Campeloma decisum*). Future evaluation of funnel traps in other areas is needed to better understand the effectiveness of this technique for sampling freshwater gastropods.

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