WALKERANA, 16(1): Pages 1-8, 2013

CYANOBACTERIA-RICH DIET REDUCES GROWTH RATES OF THE HYACINTH SILTSNAIL *FLORIDOBIA FLORIDANA* (GASTROPODA: HYDROBIIDAE)

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ABSTRACT

The freshwater gastropod genus *Floridobia* comprises 13 species in Florida, 11 of which are endemic to unique freshwater springs. Recent overgrowth of mat-forming filamentous algae and cyanobacteria in Florida spring runs could negatively impact growth, reproduction, and ultimately, the persistence of these native snail species. To determine the effect of nuisance cyanobacteria on siltsnail growth, we fed a cosmopolitan species, *Floridobia floridana*, diets composed of algae commonly found in Florida springs. Diets consisted of a) the cyanobacteria *Lyngbya* sp., b) a non-cyanbacteria control consisting of the eukaryotic yellow-green alga *Vaucheria* sp., and c) a mixture of both species. We predicted snails fed *Lyngbya* would have reduced growth due to low highly unsaturated fatty acid (HUFA) content. Snails fed *Vaucheria* were predicted to have an intermediate growth rate, and the highest growth was predicted for the mixed diet because multi-algal diets typically provide superior nutrition for grazers. Snails in all treatments were fed equal carbon content weekly for a period of 15 weeks. At the conclusion of the study, snails fed *Lyngbya* or *Vaucheria* had reduced relative growth rates compared to those fed the mixed diet ($p = 0.0002$). Reduced growth rates most likely resulted from poor nutritional content of *Lyngbya*, although cyanobacteria cell morphology may have also played a role. Our study suggests that though *Vaucheria* may provide adequate nutrition, continued increases in the standing crop of cyanobacteria in Florida springs could threaten the persistence of endemic siltsnails. Efforts to preserve the integrity of these springs should therefore focus on limiting cyanobacteria blooms.

KEY WORDS freshwater springs, gastropod, filamentous algae, *Lyngbya, Vaucheria*

WALKERANA, 16(1): Pages 9-20, 2013

CLEARANCE RATES OF *VILLOSA IRIS* (BIVALVIA: UNIONIDAE) FED DIFFERENT RATIONS OF THE ALGA *NEOCHLORIS OLEOABUNDANS*

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ABSTRACT

We investigated effects of algal cell concentration and mussel size (shell length) on the clearance rate (CR) of the rainbow mussel, *Villosa iris*. Mussel were either batch-fed a single ration of algae for 24h, or were fed three different algal rations that were replenished every hour for 3 hours. Mean CR of *V. iris* batch fed a single ration (1.3×10^6 c/mL, 8.8 mg/L) of algae (*Neochloris oleoabundans*) decreased with time and the concomitant decline in cell concentration, but never reached zero. As length increased, so did clearance rate ($p<0.0001$). Pseudofeces were produced by all individuals in the first three hours of feeding, and were irregularly produced as algal cell concentration dropped later in the test.

Mussels fed the lowest ration (0.34 mg dry wt/L) maintained elevated CRs over time with no production of pseudofeces; CR of mussels fed the middle ration (1.02 mg dry wt/L) decreased with time, and produced pseudofeces – intermittently. CR's of mussels fed the high ration (3.4 mg/L) increased with time, and produced a large amount of pseudofeces throughout the test. Following the premise that the optimum ration yields greatest net particle ingestion without incurring sorting costs of pseudofecal production, we estimated that *V. iris* would require 2.8 mg dry wt of algae (4.2×10^8 cells of *N. oleoabundans*) on a daily basis, based upon CR's measured for the middle ration in this study.

KEY WORDS Freshwater mussels, clearance rate, algal ratio

WALKERANA, 16(1): Pages 21-28, 2013

EFFECT OF SMALL DAMS ON FRESHWATER MUSSEL POPULATION GENETICS IN TWO SOUTHEASTERN USA STREAMS

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ABSTRACT

The global imperilment of freshwater mussels is strongly linked to widespread habitat destruction by dams, but more subtle mechanisms by which dams impact mussels are not well studied. For example, dams fragment populations in free-flowing reaches, potentially leading to low survival probability due to genetic effects, but few studies have addressed the genetic effects of fragmentation on mussel populations. We examined patterns of genetic variation in the mitochondrial CO1 and ND1 genes in populations of two mussel species that were fragmented by >175 y old small dams. We found that only a few rare haplotypes were restricted to reaches either upstream or downstream of the dams, and an array of genetic parameters showed little differentiation among upstream and downstream reaches. These results can be interpreted in one of two ways. First, gene flow across these dams may remain high, resulting in little genetic fragmentation. Alternatively, the apparent lack of population differentiation could be a historical artifact of high, pre-dam gene flow, and the genetic markers we used may not yet reflect relatively recent population isolation.

KEY WORDS stream; dam; conservation; biodiversity; invertebrates

WALKERANA, 16(1): Pages 29-40, 2013

VERTICAL MIGRATION AND REPRODUCTIVE PATTERNS OF A LONG-TERM BROODING FRESHWATER MUSSEL, *VILLOSA CONSTRICTA* (BIVALVIA: UNIONIDAE) IN A SMALL PIEDMONT STREAM

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ABSTRACT

We delineated a permanent 15 m by 9 m reach of a mussel bed in a small piedmont stream in the Cape Fear River Basin of North Carolina, USA. A total of 14 surveys were conducted at the study site from May 2005 to September 2006 at time intervals ranging from 2 weeks to 3 months. The study area was divided into fifteen 1-m-wide transects, and each transect was thoroughly searched twice during each survey event for any mussels on the substrate surface. We recorded species identification, length, gravidity (for known females) and replaced the mussel in the exact spot it was found. A pilot study was conducted to determine detection success with one, two, and three passes per transect and detection success was monitored on all transects throughout the study. We estimate that two passes over these transects yielded approximately 90% of the mussels on the sediment surface. Vertical migration patterns of *Villosa constricta*, and in particular females, were highly seasonal. Additional within-season variation could not be explained by seasonal patterns alone. Larger individuals were recaptured more frequently. Female mussels became gravid from August through March indicating that spawning and glochidial release took place over an extended period. In 2005, glochidial release was 1-2 months later than in 2006 and lasted through June. In 2006, glochidial release began before 7 February in 2006 and lasted through April. Smaller *V. constricta* (23-28 mm) were more likely to be gravid, and about half of the individual females were observed to spawn in consecutive years.

KEY WORDS burrowing, surveys, spawning, reproductive timing, glochidial release

WALKERANA, 16(1): Pages 41-52, 2013

SHORT-TERM EFFECTS OF SMALL DAM REMOVAL ON A FRESHWATER MUSSEL ASSEMBLAGE

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ABSTRACT

Dam removal is increasingly used to restore lotic habitat and biota, but its effects on freshwater mussels (family Unionidae) are not well known. We conducted a four-year study to assess short-term effects on mussels after removal of a small hydropower dam on the Deep River (Cape Fear River drainage), North Carolina, USA, in 2006. We conducted annual pre- and post-removal monitoring of mussel density, richness, and survival (post removal only) with transect surveys and quadrat excavation, and assessed changes in substrate composition at two impact sites (tailrace and impoundment) and two reference sites. Before-after-control-impact (BACI) analyses of variance did not detect a significant change in mussel density (total or individually for the three most abundant species), species richness, Eastern Elliptio (*Elliptio complanata*) mean length, or substrate composition in the tailrace or drained impoundment following dam removal. Apparent annual survival estimates of Eastern Elliptio at the tailrace site did not differ among sampling periods and were similar to control sites. We observed minimal mussel mortality from stranding in the dewatered reservoir. These results demonstrate that adverse short-term impacts of dam removal on downstream mussel assemblages can be minimized with appropriate planning, timing, and removal techniques, but additional monitoring is warranted to determine long-term effects on mussels within the restored river reach.

KEY WORDS Apparent survival, BACI, *Elliptio*, imperiled species, mussel density, quantitative sampling, restoration, Unionidae