



Observations on the freshwater zooplankton of Dominica, West Indies, including records from the former Matthieu landslide-dam Lake

BRIAN P. O'MALLEY^{1*} & BRYAN M. MAITLAND²

¹Cornell University Biological Field Station, 900 Shackleton Point Road, Bridgeport, NY, 13030, USA

²Department of Renewable Resources, University of Alberta, 751 General Service Building, Edmonton, AB T6G 2H1, Canada

*Current Address: Rubenstein Ecosystem Science Laboratory, University of Vermont, 3 College Street, Burlington, VT, 05401, USA

Email: bpomalley89@gmail.com

Abstract. New records of freshwater zooplankton are presented from the island of Dominica, West Indies, including taxa from the unique temporary Matthieu landslide-dam lake. We demonstrate that Dominica is far behind in terms of freshwater zooplankton investigations relative to nearby islands.

Key words: Rotifers, cladocerans, cyclopoids, landslide-dam, Dominica

Resumen. Observaciones sobre el zooplancton de agua dulce de Dominica, Antillas, incluyendo registros en el extinto Lago Matthieu. Se presentan nuevos registros del zooplancton de agua dulce de la isla de Dominica, en las Antillas, incluyendo el extinto lago de barrera Matthieu. Demostramos que Dominica se encuentra muy retrasada en las investigaciones de zooplancton de agua dulce en relación con otras islas cercanas.

Palabras clave: Rotíferos, cladóceros, ciclopoideos, lago de barrera, Dominica

Freshwater zooplankton (*i.e.* cladocerans, copepods, and rotifers) of small Caribbean islands are perhaps the most understudied component of neotropical plankton research (Frey 1982, Collado *et al.* 1984, Dussart *et al.* 1984). Dominica is a small (surface area = 754 km²) and relatively young volcanic island centrally located within the Lesser Antilles Arc (Fig. 1). The island is steep-sloped and as such drains relatively quickly; most precipitation is directed downslope through the island's myriad of streams and rivers. There are multiple locations where precipitation accumulates, including four major lakes and small agricultural ponds (see Fig. 1; James 1988, Werner & Raymond 1993). Research documenting the freshwater zooplankton on Dominica is lacking (Dussart *et al.* 1984), with only three zooplankton taxa recorded to date from the island (Rotifera: *Keratella quadrata*, *Lecane*

quadridentata [Hart & Hart 1969, DeRidder 1977]; Copepoda: *Diaptomus* spp. [Hart & Hart 1969]). In contrast, the islands directly adjacent to Dominica (*i.e.* Guadeloupe and Martinique; see Fig. 1), though similar in size, have received more rigorous investigations with at least 50 species of rotifers (Pourriot 1975) and at least fourteen species of copepods (Dussart 1982) documented. Because describing distributions of invertebrates is key to elucidating and understanding biogeographical patterns in aquatic biodiversity, and because zooplankton are amongst the first organisms to colonize new bodies of freshwater (Holland & Jenkins 1998), we sought to describe the freshwater zooplankton of Dominica using water bodies that differ in age of formation and elevation. Specifically, the objective of this study was to document the species of freshwater zooplankton

present in two crater lakes (*i.e.* Boeri and Freshwater Lakes), a small agricultural pond (Beehive Pond) and the former Matthieu Lake (Fig. 1). We hypothesized that species richness would be high in water bodies at low elevation (*i.e.* Matthieu Lake and Beehive pond) and lower at high elevation crater lakes (*i.e.* Boeri and Freshwater Lakes). We also expected Boeri and Freshwater Lake to have similar species compositions considering their close proximity and similar characteristics.

Ecological characteristics of the water bodies

sampled in this study are summarized in Table I. Samples were collected during March 13-16, 2011 by pulling a plankton net (50- μ m mesh, 20 cm diameter) from shore or towing a net behind a small raft in the open water of each lake (except for Beehive Pond which was sampled from shore only). Samples were preserved in a 5% buffered formalin solution. The plankton net was thoroughly rinsed with deionized water, shaken vigorously and dried to prevent transport of species between sites.

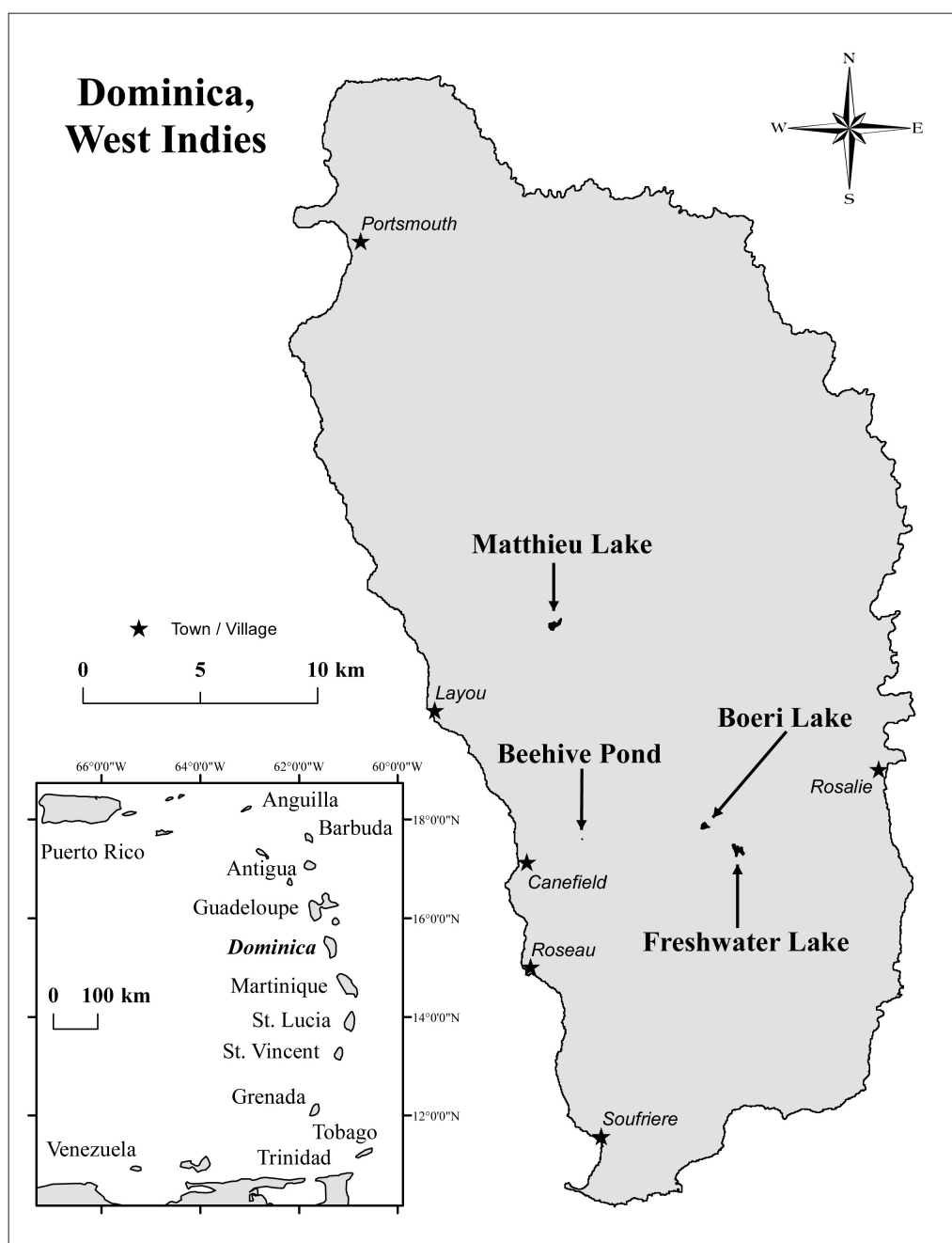


Figure 1. Map of study sites visited during March 13-16, 2011, Dominica, West Indies.

Table I. Ecological characteristics of Boeri Lake, Freshwater Lake, Matthieu Lake, and Beehive Pond. Data were compiled from James (1988), Werner & Raymond (1996), De Graff *et al.* (2010), James & De Graff (2012), and this study. Surface areas and depths refer to the average water depths except for Boeri Lake, which describes the lake near the high water mark.

Site	Elevation (m ASL)	Origin Event	Year Formed	Fish Present	Area (km ²)	Depth (m)			Aquatic Vegetation	Substrate	Forest Type
						Mean	Max	Fluctuation			
Boeri	869	volcanic crater	30,000 ya	No	0.016	14.9	39.6	12.5	none	boulders/silt	montane
Freshwater	719	volcanic crater	30,000 ya	Yes	0.036	5	15	1	shoreline/ emergent	boulders/silt	montane
Matthieu	194	landslide	1997	No	0.028	NA	40	6	none	leaves/wood/ mud	rainforest
Beehive	357	anthropogenic	1960s	Yes	0.001	< 1.0	2	1	<i>Hydrilla</i> spp.	mud	rainforest

Entire samples were scanned and individuals were identified using the following identification keys: Stemberger (1979), Segers (1995), Fernando (2002) and Mirabdullayev et al. (2003). Immature cyclopoids and nauplii were noted but not classified further.

Overall, twelve zooplankton taxa were recorded across all sampling sites (Table II). Each taxon observed is considered to be cosmopolitan within the neotropics and with the exception of cladocerans, most have been reported on the nearby islands of Guadeloupe and Martinique (Pourriot 1975, Dussart 1982, Fernando 2002), but not yet from Dominica (Hart and Hart, 1969; De Ridder 1977). Cyclopoid copepods were represented by a single species, *Thermocyclops decipiens*. Rotifers were the most species rich group (Table II), which is consistent with previous research indicating high species richness in rotifers of neotropical freshwaters as compared with cladocerans or copepods (Collado et al. 1984, Elias-Gutierrez et al. 2001). The rotifers *Brachionus falcatus* and *B. angularis* occurred in each of the three lakes. In Beehive pond (the smallest water body), only copepod nauplii were observed. The youngest and lowest water body in terms of elevation – Matthieu Lake (sampled approximately four months before its collapse and subsequent draining) – had the highest

richness (12 taxa), as compared with the older but higher in elevation Boeri (5 taxa) and Freshwater Lakes (8 taxa; Table I; Table II). This suggests Dominica's high elevation crater lakes have relatively depauperate zooplankton communities. Although we are unable to conclude whether the taxa recorded in this study were the first to colonize Matthieu Lake, we did find overlap in occurrence of several rotifer taxa between the three larger water bodies sampled.

The high level of species richness observed in Matthieu Lake provides partial support to our hypothesis that lower elevation lakes, albeit of a relatively short-lived duration, harbor more species than higher elevation lakes in the montane zone. Beehive Pond is an exception because it occurs at an intermediate elevation and we only were able to detect copepod nauplii in our samples. Factors explaining this might be due to its relatively small size (0.001 km²) and shallow depth (< 1m), or teeming abundance of non-native guppies (*Poecilia reticulata*). Human influence can also mask potential effects of lake age on species richness (Alfonso et al., 2010), however Dominica's lakes are in relatively remote locations due to the island's mountainous interior, thus removing bias from anthropogenic impacts.

Table II. Zooplankton species collected from the island of Dominica during March 2011. Sites are ML = Matthieu Lake, BP = Beehive Pond, FW = Freshwater Lake, BL = Boeri Lake.

Taxon	Sites			
	ML	BP	FW	BL
Rotifera				
<i>Anuraeopsis fissa</i>	-	-	x	-
<i>Brachionus angularis</i>	x	-	x	x
<i>Brachionus falcatus</i>	x	-	x	x
<i>Lecane curvicornis</i>	x	-	-	x
<i>Lecane lunaris</i>	x	-	-	-
<i>Trichocerca pusilla</i>	x	-	-	x
<i>Notommata</i> spp.	x	-	-	-
<i>Keratella cochlearis</i>	-	-	-	x
Cladocera				
<i>Ilyocryptus spinifer</i>	x	-	-	x
<i>Ceriodaphnia</i> spp.	x	-	-	-
<i>Chydorus</i> spp.	x	-	-	-
Copepoda				
<i>Thermocyclops decipiens</i>	x	-	-	-
Cyclopoid copepodites	x	-	x	x
Nauplii	x	x	x	x

Our findings suggest that young lakes on Caribbean Islands occurring at low elevations may be more species rich than higher elevation lakes that have been around for longer time periods. Unfortunately there remain many knowledge gaps in the distribution of freshwater zooplankton in the Caribbean Islands region to properly assess whether elevation or lake age are better predictors of species richness in lakes.

While we can only speculate on the pathways and mechanisms that contributed to the zooplankton colonization of Matthieu Lake, a few deserve attention given Dominica's rugged tropical terrain and sparse distribution of lakes. Overtopping events which regularly occur in Boeri Lake during the wet season (Werner & Raymond 1996) could serve as a potential pathway for zooplankton dispersal on tropical islands. It is unlikely however that either Boeri or Freshwater Lakes directly contributed to Matthieu Lake's zooplankton fauna as they occur approximately 10 km to the southeast and are found at higher elevations in watersheds that do not directly overlap. Indirectly however, these lakes may serve as source populations for lake plankton that can disperse across the island through downslope overtopping and lateral transfers such as splash events and transport via animal vectors (e.g. avi-fauna). Small-scale habitats such as phytotelmata or ephemeral pools existing within close proximity to the Matthieu watershed could have served as source populations for colonization, possibly facilitated by Dominica's annual wet season (i.e. high amounts of rainfall produce more ephemeral habitat which are connected through flood events). However, little is known about these small-scale ephemeral habitats or the extent to which they provide refuge for invertebrates in the Lesser Antilles. Groundwater seepage may also provide a dispersal route (*sensu* Pesce 1985) for colonization of Matthieu Lake from nearby source waterbodies or pools, particularly due to Dominica's volcanic geologic origin and associated prevalence of porous rock substrate (Maury *et al.* 1990). For example, Pesce (1985) noted that *T. decipiens* was one of the most common copepod species found in groundwater samples from the West Indies, but did not sample Dominica. According to Hutchinson (1951), *T. decipiens* is an early colonizer with strong dispersal abilities and is likely to be found in dammed areas or other artificial bodies of water; our finding of this species in Matthieu Lake supports this claim regardless of colonization mode. These, along with phytotelmata and avi-fauna transport

mechanisms, are fruitful topics for further inquiry. Given that Dominica has not been extensively examined for freshwater zooplankton, we anticipate that future studies will contribute more records to the island.

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