Prawn Population Diversity in the Check Hall River

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Abstract

We conducted a study to expand on a previous project done in 2011 which found that the prawn populations had been negatively impacted by the pollution during a 2010 construction project on the Imperial Road bridge crossing the Check Hall River, with 61% of the prawn population density was above the bridge and 39% was below the bridge. We looked at whether the pollution was still having any effects on the prawn populations as well as examining the diversity of the individual prawn species throughout the river. The prawn population densities downstream from the road construction were found to no longer be impacted by the pollution, as the overall numbers and population densities have drastically increased from those recorded nine years ago. Our data showed that *Atya innocuous* is the most widespread and numerous of the prawn species, being found in each pool tested throughout the entire river. *Macrobrachium hetrochirus* was also found throughout the entire river but most notably continued to have a strong presence amidst pools with smaller volumes as compared to the other *Macrobrachium* species. *Macrobrachium crenulatum* and *Macrobrachium carcinus* were found to be more prevalent in deeper pools and were seen exclusively in the basin areas of the pools. Overall, it was found that depth and volume have a positive impact on diversity with species other than *Atya innocuous* being found in much greater numbers in pools with these attributes.

Introduction

Dominica is rich in biodiversity for its size with a great variety of habitats (Evans & James, 1997). The freshwater ecosystems, which includes prawns, are an important part of the island's biodiversity. Pollution from urban areas can be extremely detrimental to the quality of the surrounding water (National Geographic, 2017). In 2011 a Texas A&M project found that prawn populations in the Check Hall River were still being negatively affected by the road construction from 2010, with 61% of the prawn population density above the bridge and 39% below the bridge (Zemanek, 2011). These prawns are an important part of the ecosystem which means this kind of negative impact must be monitored. For example, the genus *Macrobrachium* is an important source of food within the food chain (Valencia and Campos, 2007), and three of the five prawns prawn species found in the Check Hall river that will be studied in this project belong to this genus. *Atya innocuous*, *Xiphocaris elongata*, *Macrobrachium carcinus*, *Macrobrachium crenulatum*, and *Macrobrachium heterochirus* are the species found within the Check Hall river as outlined in a previous project done by Texas A&M researchers that additionally provided visual aides detailing morphological characteristics that were used to identify prawns throughout the project (Lemmon, 2004). To better get an assessment of the status of the Check Hall River's biodiversity after the 2010 construction introduced pollution, this study was expanded to include a prawn diversity assessment of pools within the river. There has not been a diversity assessment of the individual prawn species populations in the Check Hall River since 2006 which was prior to the construction project (Zapalac et al., 2006), therefore a current evaluation of the prawns in the Check Hall would be greatly beneficial to the community.

Materials and Methods

Pools were identified along the Check Hall River of Dominica and measured for length, width, and depth using a standard tape measurer and the volume of the pool was then calculated using the formula for an inverted triangle (Zemanek, 2011). Pools were chosen based on preliminary examinations of whether they will contain measurable prawn populations and accessibility of measurement. Pools that were obscured by rapid flowing water or that did not contain any deep areas were avoided, with the exception of pool 9 which was chosen for its location just past the bridge and would be most impacted by the debris, despite containing both rapid flowing water and a lack of deep areas. A pool was chosen upstream (pool 10) as a control for debris occurring downstream of the bridge on the Imperial Highway over the Check Hall River. The chosen pools were all marked with blue flagging tape. Debris was observed and recorded during a walkthrough of the river in the morning. Ten pools were visually surveyed at night with a strong white light headlamp and a handheld phone light. For deeper areas of the pools, one person used a mask and snorkel with the handheld light to identify prawns while the other illuminated the area with the headlamp and recorded the prawns identified on an underwater writing tablet. Observations were made starting at the most downstream pool (pool 1) and moving upstream to our control pool (pool 10) to avoid stirring up debris reducing visibility and double counting disturbed prawns that floated downstream. Data collected was then correlated based on pool size and characteristics, amount of debris in the area, and to a past Archbold Tropical Research Education Center (ATREC) project measuring prawn density.

Results

There was minimal evidence, through visual inspection, of residual trash in the Check Hall River from the construction project on the Imperial Road Bridge in 2010. Debris was spotted along the river from pool 10 down to pool 1 sparingly at best, with only rare sightings blocks of concrete and metal sheets being observed outside of the water in the areas between the pools. The effects cited in Zemanek's paper regarding pollution, such as sightings of dead prawns and significantly decreased prawn numbers moving downstream of the bridge, were not observed.

With the exception of pools 7 and 9, all prawn species were found throughout the Check Hall River (Figure 3). Most abundantly found was *Atya innocuous*, which had a major presence in every pool measured and was found in disproportionately high numbers compared to all of other species (Figure 4). They were commonly found in large groups on rocks in fast flowing portions of the pools as well as throughout deeper areas amidst the other species. *Xiphocaris elongata* was seen commonly within the pools in shallow areas amongst the rocks and was generally scarce in deeper parts of the pools. The three *Macrobrachium* species were much more dominant within the larger pools with *Macrobrachium crenulatum* often congregating in groups, *Macrobrachium carcinus* growing to be the largest of the prawns, and *Macrobrachium heterochirus* being the most numerous of the genus *Macrobrachium* (Figures 2 and 4).

Figure 1: All pool dimensions in meters along with volume in meters cubed (m^3)

	1	2	3	4	5	6	7	8	9	10 (control)
Width	10.36	8.94	4.75	6.1	3.76	4.19	4.34	7.92	7.77	2.87
Length	4.57	8.22	10.06	4.98	8.79	4.42	11.89	3.96	5.13	9.14
Depth	0.99	1.29	0.66	0.66	1.3	0.43	0.36	0.71	0.46	1.14
Volume (lwh)/3 (m^3)	15.62	31.6	10.51	6.68	14.32	2.53	6.19	7.42	6.11	9.96

Figure 2: Comparison of the volumes of the pools in m^3

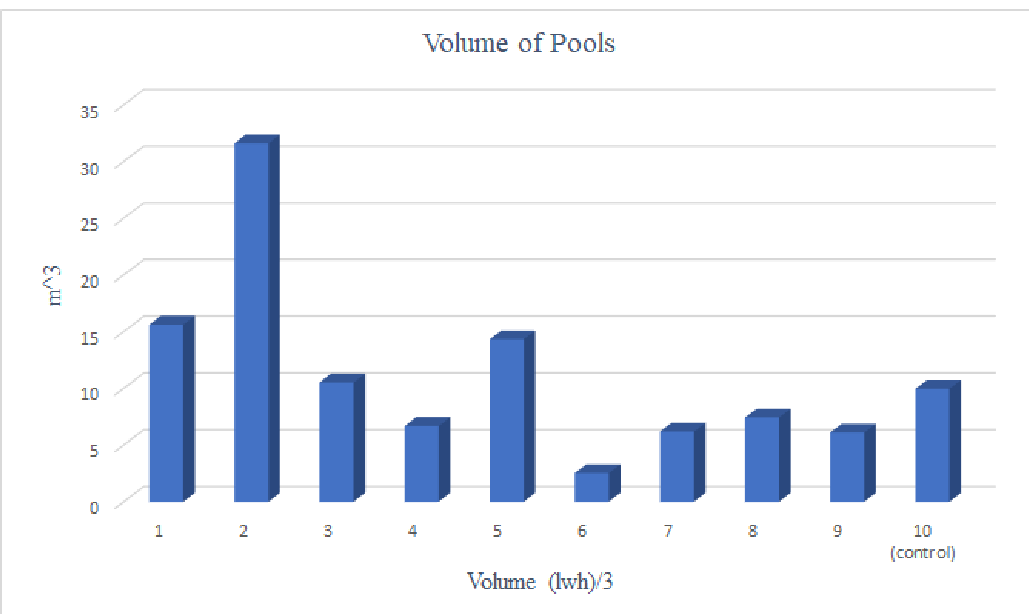

Figure 3: Number of each prawn species found throughout all 10 pools and combined prawn density

	1	2	3	4	5	6	7	8	9	10 (control)
Atya innocuous	222	80	31	29	304	24	90	29	20	34
Xiphocaris elongata	10	24	7	2	22	0	0	2	0	7
Macrobrachium crenulatum	6	25	1	6	20	0	0	1	0	7
Macrobrachium carcinus	17	16	2	7	21	1	6	12	2	9
Macrobrachium heterochirus	17	19	14	8	15	1	10	22	8	18
Unidentified	5	8	1	3	1	1	0	2	2	1
Total prawns	277	172	56	55	383	27	106	68	32	76
Total Prawn Density 1m^3	17.73 : 1	5.44: 1	5.33 : 1	8.23: 1	26.75: 1	10.67 : 1	17.12: 1	9.16: 1	5.24: 1	7.63: 1

Figure 4: Each of the pools compared based on the percent of each species found in the pools

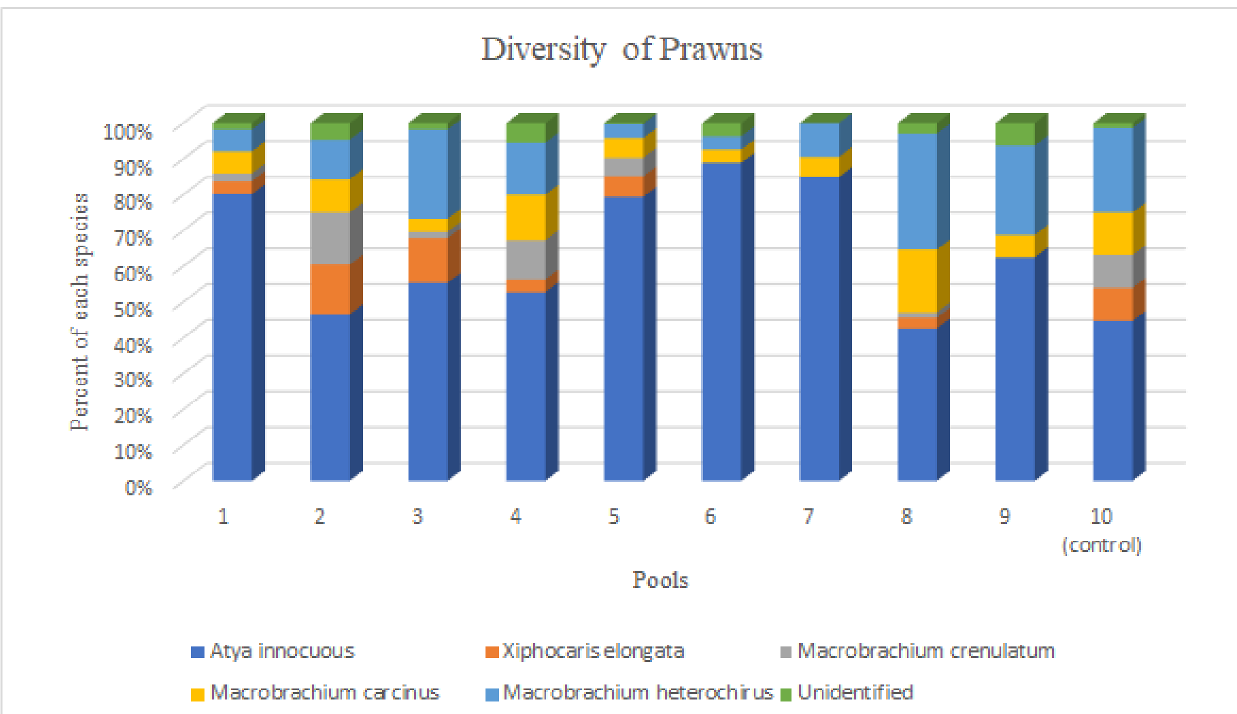

Figure 5a: Prawn density of all 5 species of prawns as well as unknown.

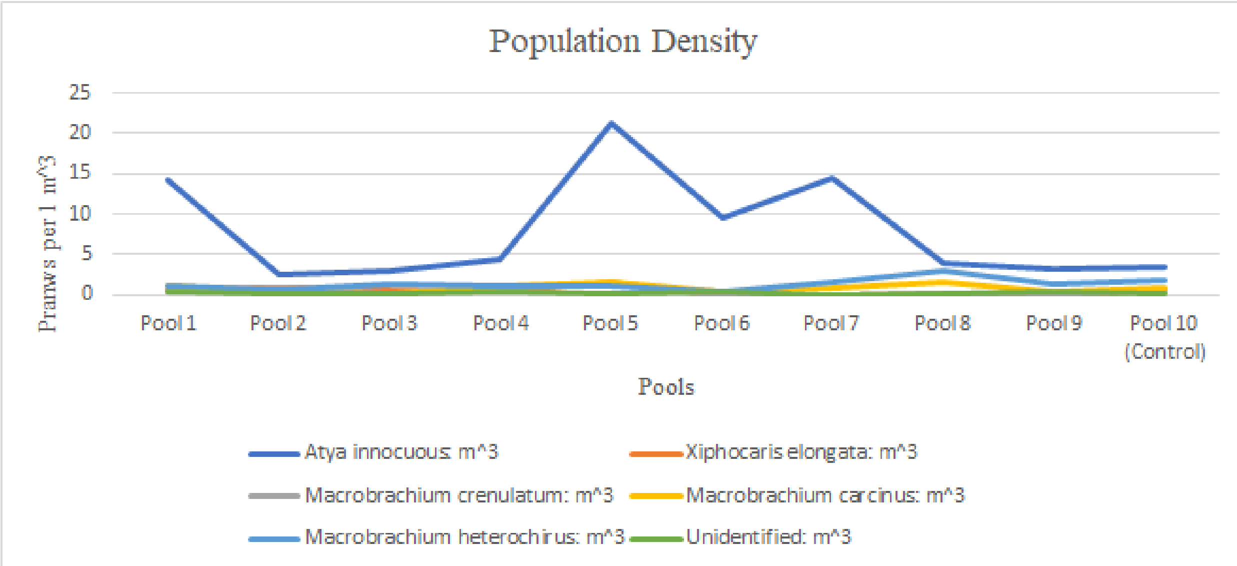

Figure 5b: Density of prawns excluding *Atya innocuous* in order to obtain a better visual representation of the other results.

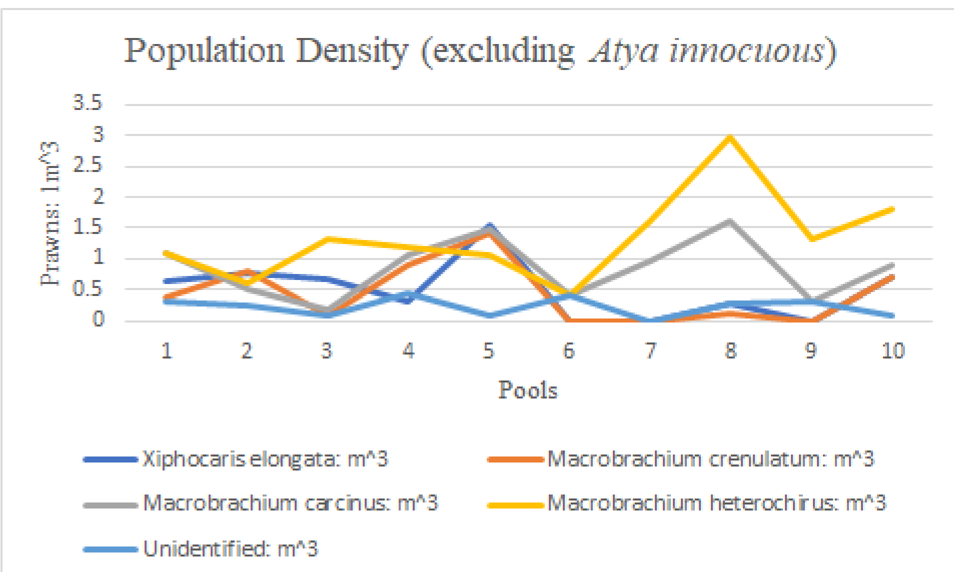

Figure 6: Comparison of 2011 and 2017 Total Prawn Density of Pools (Prawns: m^3)

	2011 Results	2017 Results
Lowest Density	0.44: 1	5.24: 1
Highest Density	4.31: 1	17.73: 1
Average Density	1.91: 1	11.33: 1

Discussion

While debris created by the construction project in 2010 may have had an impact on the health of the Check Hall River in the past, with so little debris being observed within the river itself it can be assumed the impact has been significantly reduced in subsequent years. Prawn population numbers were found significantly higher in the pools furthest downstream of the bridge due to the increase in quality of the pools, as they were generally deeper and contained more features such as small waterfalls and basins collecting litter. There was no sign of decreasing population densities of prawns as the pools approach the bridge where the construction took place, and the population densities have strongly rebounded compared to Zemanek's results in his pools (see Figure 6). Therefore, it can be concluded that prawn species are no longer suffering negative effects from the construction done in 2010 due to their significant increase in numbers since 2011.

Atya innocuous are the most widespread of the species and by far the highest in number. We saw them congregating in large groups with up to 60 individuals in a cluster but this only occurred in areas with fast flowing waters which led us to the conclusion that they are taking advantage of the filter feeding opportunities presented by these locations of the river. This is supported by the fact that they have slender bristles which aid in extracting particles in flowing water (Fryer, 1977). *Atya innocuous* was not seen to have a significant trend with pool depth or volume due to the fact that they were found in high numbers in all of the pools. The reasons for the fluctuation in density seen in Figure 5a are a result of differing amounts of areas with fast flowing water. Pools 1, 5, and 7 contained rocks with a large surface area in fast flowing areas which gave rise to extremely inflated numbers, whereas pools 2, 3, and 10 were made up of primarily still basins resulting in lower numbers. Pool depth was found to be an important factor in relation to prawn diversity. Several of the deeper pools such as pools 2 and 5 contained the highest numbers for each species of prawn. The species that were seen to be the most affected by this were two of the *Macrobrachium* species *Macrobrachium crenulatum* and *Macrobrachium carcinus*. This result was expected for *M. carcinus*, as it is the largest of all the prawn species and would hence require adequate room to grow and a large food source. Additionally, *M. carcinus* is historically found in quiet, deep basins of rivers which fits the descriptions of the pools with the highest numbers of this species (Zamore, 2000). Our results have been found to go against many forms of literature in relation to *M. crenulatum*, which has historically been found in shallow, fast flowing rocky pools whereas we observed this species only in the basins of the pools with higher volume (Zamore, 2000; Evans & James, 1997). The third of the *Macrobrachium* species *M. heterochirus* was seen prominently in all of the pools observed. Generally these individuals were seen in the more shallow areas of the pools amongst the rocks as well as within the faster flowing water. This preference for rocky, fast flowing areas was reflected in our data as two of the *Macrobrachium* species dwindled as pool volume declined, while *M. heterochirus* numbers remained consistent in pools such as 7, 8, and 9. The main problems faced in this project were reduced visibility due to our movements stirring up debris or fast flowing water creating bubbles as well as prawns hiding under rocks, both of which could have resulted in missed individuals and hence lowered the numbers in our results.

Acknowledgements

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