Factors affecting the inflow of organisms in the two experimental wetland basins at the Olentangy River Wetlands

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Introduction

Various factors contribute to the recruitment of organisms into a wetland. Disturbance events in streams play an important role in disrupting the ecosystem, community, and population of the stream. During periods of disturbance, the river can become a significant source of new organisms (Pulliam, 1988). Several of these displaced organisms find their way to adjoining wetlands in search of sanctuary from the disturbance.

The recruitment of species into a newly created wetland plays an important role in the development and maintenance of the community structure. As more organisms assemble into the community, the community becomes more stable and harder to invade by other species (Pimm, 1991). Some constructed wetlands may limit the recruitment of certain species and thereby control community structure. Recruitment of species into wetlands occurs through many means.

This study investigated the recruitment of individuals through the pumping system in the experimental wetlands at the Olentangy River Wetland Research Park (ORWRP) (Fig. 1). Except during periods of high floods, the importation of aquatic species occurs primarily through the pumping of river water into the wetland basins. The basins are outfitted with two pumps: a conventional and a Discflo™ pump. This study focused on the differences between the Discflo and conventional pumps on the recruitment of organisms. The conventional pump pushes water through it by means of an impingement device such as a vane, impeller, paddle, lobe or screw. According to the Discflo Corporation (www.discflo.com) "the Discflo pump is a series of parallel discs called a discpac. As fluid enters the pump, it adheres to the surface of the discs. As the discs rotate, energy is transferred to successive layers of molecules in the Discpac. The combination of boundary layer and viscous drag creates a powerful frictional force across the width of the Discpac that 'pulls' the product through the pump in a smooth, pulsation-free flow. The fluid moves parallel to the discs so there is no 'impingement' by the fluid on the moving parts of the pump."

Methods

Aquatic species pumped into the wetland basins with the river water were sampled using a conical net one-meter wide by five meters long with a mesh size of 300µm

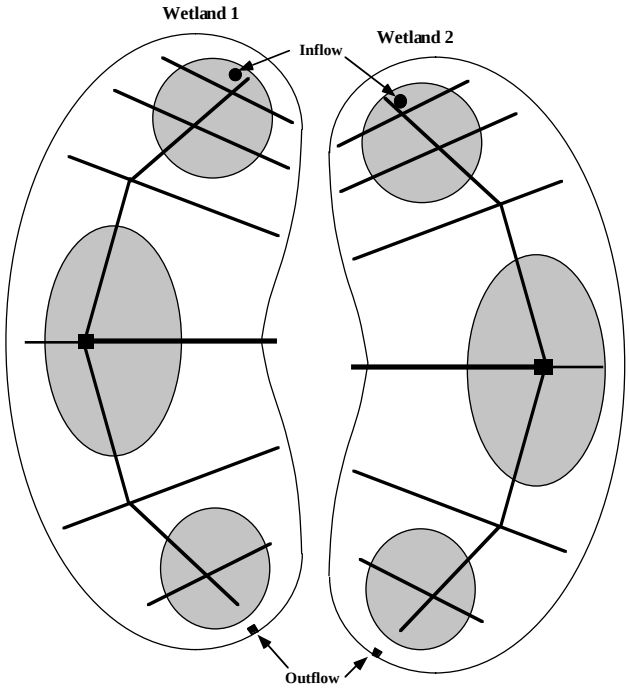

Figure 1. Location of the intake risers (inflows) in the experimental wetlands at the Olentangy River Wetland Research Park

(Gardner and Johnson, 1995). It was fastened to the top of an intake riser with a bungy chord. The intake riser is an upright pipe in each wetland basin connected to the pump system with an elbow at the end diverting the water up into the basin. Sampling was alternated between the two basins to avoid restricting the inflow of organisms to one basin.

Sampling began on October 15 and ran through November 9, 1998. The net was set each Monday and Saturday and left on the intake riser for 48 hours. The pump was changed weekly, alternating between the Discflo and the conventional pump. Samples were collected from the net by using a hose to wash the contents of the net into one end of the net. The contents were then removed and transferred to plastic bags. Organisms larger than 5 mm were counted, and identified. Organisms in the Saturday sample were counted and identified that day, while organisms in the Monday sample were counted and identified the following morning. The condition of the organism was recorded as dead or alive.

Pumping rate and cumulative volume of water flowing

into the basins have been recorded Average flow rate was calculated by taking the total gallons pumped on the last reading before the net was removed, subtracting total gallons pumped after the net was placed on the intake riser and dividing by the total minutes elapsed between readings. Total gallons filtered were calculated by taking the total minutes that the net was on the intake riser and multiplying by the average flow rate.

Results

Much more water was pumped through the discflo pump than the conventional pump. The discflo pump also pumped water through at a much faster rate than the conventional pump (Table 1). On November 7 water was not flowing through the intake pipe when the net was removed and the sample was collected. The pump was not turned on again until 12:40 p.m. on November 8. This accounts for the low number of gallons filtered during the last week of sampling with the conventional pump.

Our data indicated a weak positive correlation ($r = 0.367$, $p = 0.371$) between flow rate and the number of organisms captured (Fig. 2). There also was a weak negative relationship ($r = -0.114$, $p = 0.788$) between the number of organisms captured and the number of liters filtered (Fig. 3), which resulted from the two samples collected using the standard pump during the last week when we were having problems with the pump.

There was an obvious increase in the amount of detritus being pumped in from the first week to the last week of the sampling period. Organisms seemed to increase with the amount of organic matter being imported into the wetland.

Out of the organisms captured and identified (Table 2), the dragonfly naiad, crayfish, leeches, and snails were chosen to determine differences between the two pumps. These organisms were more representative of species that had been captured throughout the sampling period. The dragonfly naiad, crayfish, and snail pumped through both the discflo pump and conventional pump were all found dead (Figs. 4 and 5). Thirteen of fifteen leeches were found alive that were pumped through the Discflo pump, while all eleven leeches pumped through the conventional pump were alive. Additionally, three caddis fly cases were found, and we began to find clamshells during the third week of sampling. Of the eight scuds found in the last sample, four were dead. The last sample was obtained by pumping water through the conventional pump.

Discussion

The use of an "impingement" mechanism in the conventional pump to push river water through the pipe could cause damage to organisms flowing through the pump. However, the data indicated that there was no difference in the condition of the organisms flowing through the two pumps in this study. Few species were captured, and it is hard to determine what the conditions of those species were before they entered the pump. A sample of organisms

Table 1. Date, time, flow rate, and total liters of water filtered by both pumps during October and November 1998.

Date	Time, hrs	Flow rate, gpm	Total Flow, gallons
Discflo Pump			
10/15 to 10/17	46.5	744	2,077,099
10/17 to 10/19	48.5	575	1,674,065
10/29 to 10/31	48	887	2,555,597
10/31 to 11/2	47.5	1357	3,871,969
10/15 to 11/2		713	10,178,730
Conventional Pump			
10/22 to 10/24	47	737	2,078,227
10/24 to 10/26	48.5	474	1,378,642
11/5 to 11/7	46[a]	556	746,277
11/7 to 11/9	49[b]	842	1,111,757
10/22 to 11/9		522	5,314,903

[a]Indicates number of hours the net was placed on the outflow pipe. It is unknown how many hours water was flowing through the pipe. [b]Indicates number of hours the net was on the outflow pipe. Water was flowing through the pipe for 22 hours.

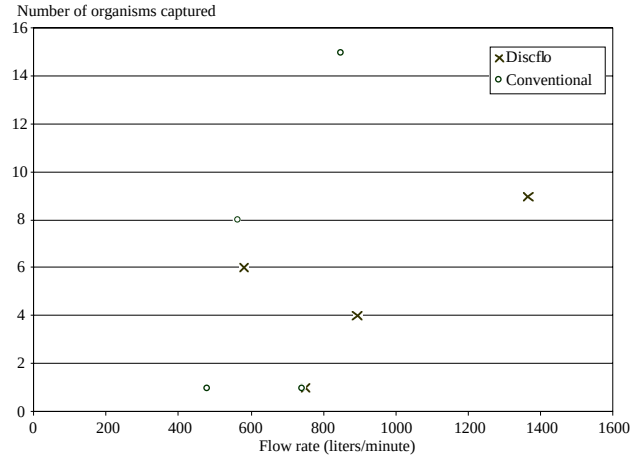

Figure 2. A comparison between the flow rates and the number of aquatic organisms captured.

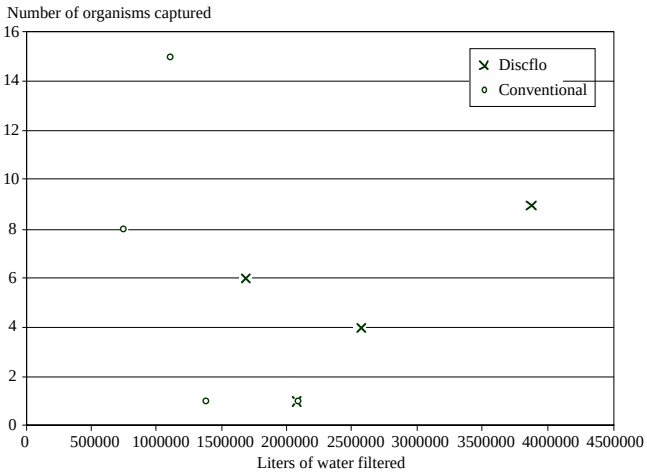

Figure 3. A comparison between the number of liters filtered and the number of aquatic organisms captured.

Table 3. List of aquatic species captured and identified from the intake riser

Name	Order	Family	Genus	Total Captured
Dragonfly	Odonata	Aeshnidae	*Anax*	1
Crayfish	Decapoda			4
Leech	Arhynchobdellida	Hirudinidae	*Hirudo*	26
Scud	Amphipoda	Gammaridae	*Gammarus*	8
Snail	Basomatophora	Physidae	*Gyraulus*	4

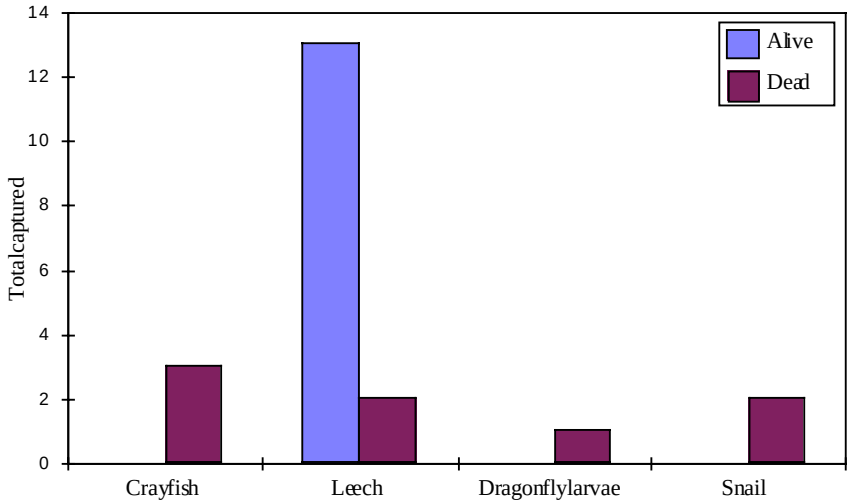

Figure 4. A summary of the condition (dead or alive) and the total numbers of organisms captured using the Discflo pump

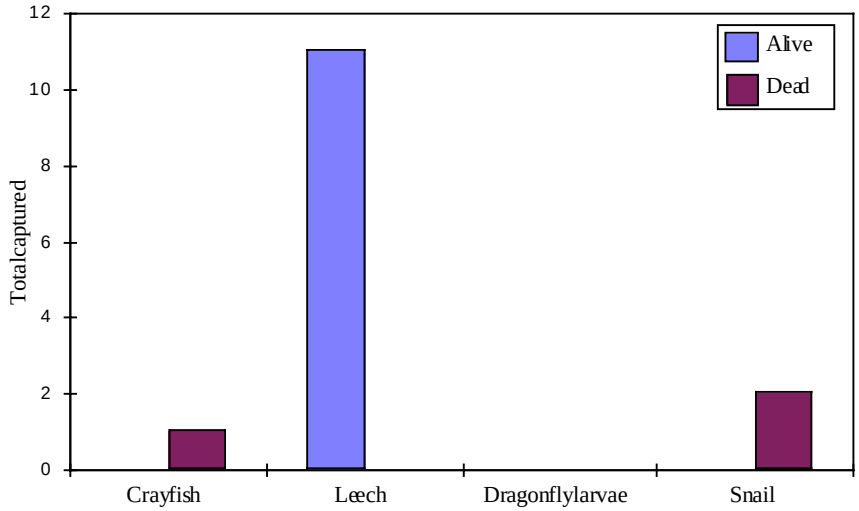

Figure 5. A summary of the condition (dead or alive) and the total numbers of organisms captured using the conventional pump

flowing by the intake pipe in the river may provide better insight into the condition of the organisms entering the pump. The condition of most specimens was known at the time of collection. Two leeches and four scuds that were found dead may have died before they were found and identified in the sample. They were contained in a Monday sample that was not inspected until Tuesday morning. No large vertebrate species were captured. The conventional pump would likely cause more damage to a fish species than the smaller soft-bodied invertebrates. However, certain species may have difficulty surviving either pumping system. For example, crayfish were found dead in samples from both the conventional and Discflo pumps. While there is no "impingement" mechanism in the Discflo pump, it creates a "powerful frictional force" with which the soft body of the crayfish may not be able to cope. While the data

do not indicate any differences between the pumps, they do indicate that the use of pumps to import organisms into a wetland may prevent the importation of certain organisms that cannot cope with the stresses placed on them by the pumping system.

While our data did not show a strong correlation between flow rates and the number of organisms captured, flow rates may be an important factor in the recruitment of species into the wetlands at the ORWRP. Gardner and Johnson (1996) noted that no fish were captured at flow rates below 688 L/min. Stronger flow rates may be important in capturing certain types of organisms. Fish may be able to elude capture at lower flow rates.

There are several important variables that need to be considered when determining what influences the inflow of organisms to the wetland. While our data are too limited to make definite conclusions, it appears that rainfall is an important factor that contributes to the recruitment of organisms in the ORWRP wetlands. Resh et al. (1988) found that extreme flows can cause a large loss of numbers or biomass of certain taxa through flood scour or desiccation. If organisms are swept into the water column during these periods of disturbance, they may become susceptible to being captured by the pumping system. They also may be searching for places of refuge, which could also cause them to be captured by the pump.

Litterfall also may contribute to increasing the numbers of organisms recruited into the wetland. One problem with the conventional pump is that detritus from litterfall can obstruct the flow of water through the pump. This was a problem in our last week of sampling. The Discflo pump is designed to handle problems of this nature and may be able to contribute more to the recruitment of organisms during periods with high litterfall.

Variation in species recruitment can also be attributed to the season and life history of the species. Gardner and Johnson (1996) found an increase in fish import as the season progressed. Schlosser (1995) found that "temporal variation in the life history attributes of the fish fauna also appeared to cause considerable variability in the timing and amount of dispersal between pond and stream environments."

Conclusions

More research needs to be done to determine what affects litterfall and rainfall have on the recruitment of organisms through the pump, and also to determine what affects the different pumps have on larger species going through the pumps. It would also be useful to determine seasonal contribution of aquatic organisms into the wetlands. This can aid in determining what time of year pumping may contribute the most organisms into the wetland.

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