Aquatic Macroinvertebrates at Jackson Bottom Wetland: March, 2005 to February, 2006

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Sample Sites and Sampling Methods

From March, 2005, to March, 2006, I sampled the invertebrate life present at three sites in Jackson Bottom Preserve Wetland, visiting each roughly once every week in order to record the changes in macroinvertebrate populations over the course of a year.

Of the three sites sampled, one—the Tualatin River—was moving water. Along the stretch of the Tualatin River flowing through Jackson Bottom Preserve, water level and flow vary considerably over the course of the year. In general, the supply of oxygen is more consistent than it is at the other sites sampled during this study.

A second sample site was the Gene Pool—a permanent, relatively deep pond. Although the Gene Pool is an isolated body of water over much of the year, it mixes with the Tualatin in winter, when the river regularly spills over its banks and floods the other bodies of water at Jackson Bottom.

The final body of water studied was Kingfisher Marsh. This is a temporary pond that often dries up during the summer. In fall, the pond is filled by rain. Like the Gene Pool, it mixes with other bodies of water in the preserve when the Tualatin River floods in winter.

During each visit to the sample sites, a small net was used to collect invertebrates from shallow water. Invertebrates hidden in aquatic plants were netted, as well as benthic (bottom-dwelling) species on the sediment or rock surfaces. When medium-sized rocks were accessible, they were lifted to uncover invertebrates clinging to their undersides. These organisms were often brushed from the lower surface of the rock with the edge of a piece of screen. All of the macroinvertebrates collected were deposited in a sampling tray for identification.

With some exceptions, aquatic insects were identified to the family level. Other invertebrates, such as mollusks, annelids, and crustaceans, often could only be identified to the level of order or class. Most of the insects belonged to families that have been given a Family Biotic Index (FBI) value; this index rates organisms on a scale of 0.00, or very pollution-sensitive, to 10.00, or pollution tolerant (Rideau Valley Conservation Authority). After identification, all invertebrates were released at the sample site where they were found. The great majority of insects were found in their larval or nymphal stages; unless stated otherwise, insect names in this study refer to immature stages.

Tualatin River

Spring, 2005 (March, April, May)

During the first season of this study, the larvae of Baetid, or small minnow mayflies were found on four out of eleven sampling days. Though not extremely sensitive, these insects are given an FBI value of 4 (Edwards 2005). The fact that Baetid mayflies were found fairly frequently throughout the year in the Tualatin River, but did not appear every time, shows that the sampling methods used during this study were not capable of uncovering every type of insect present at the site on a given day. Judging from their frequent appearance throughout the year of this study, it seems probably that Baetid mayflies were present in the Tualatin year-round.

Chironomid midge larvae were found in numbers similar to those of Baetid mayflies; this family is given a FBI value of 8 (Edwards 2005), but despite their ability to tolerate some pollution, they are often found in clear waters along with more sensitive species. Other insects found in spring included stonefly nymphs of unknown family, an aquatic beetle, and a damselfly nymph with FBI value 9 (Edwards 2005). The beetle found belonged to either the family Dytiscidae (diving beetles) or the Hydrophilidae (water scavenger beetles); these organisms are not as commonly used in biomonitoring as many other insects.

In addition to insects, a variety of crustaceans were found during spring. Benthic (bottom-dwelling) Amphipods, as well as the planktonic Copepods and Cladocerans, were fairly common, their numbers varying from one sampling day to the next. A single Isopod—also a benthic crustacean—was found in mid-March. Aquatic snails and, in smaller numbers, aquatic earthworms, comprised the non-arthropod macroinvertebrates recorded during this time.

Summer, 2005 (June, July, August)

Though common at the beginning of summer, Chironomid midges declined quickly, and almost none were found during the second half of the season. Other insects found included stoneflies of unknown family, as well as aquatic beetles (Dytiscidae or Hydrophilidae). A single aquatic mite was found in mid-August.

Baetid mayflies remained common throughout this time period, in addition to members of a second mayfly family, the Heptageniidae. The Heptageniids, or flat head mayflies, are given an FBI value of 4 (Edwards 2005). While Baetid mayflies often cling to aquatic vegetation, Heptageniids were generally found on hard surfaces on the stream-bed. This probably explains why Heptageniids disappear from the data whenever the water level of the Tualatin is high; the high water covers rocks where Heptageniids are usually found, making it impossible to sample their preferred habitat. Even accounting for the influence of water level, however, these insects appear to be less common at the Tualatin sampling site than their relatives the Baetids; Heptageniids were only found on two sampling days throughout the summer.

Three other insect families first recorded during this season were the Hydropsychidae (net spinner caddisflies), the Limnephilidae (northern casemaker caddisflies), and the Simuliidae (black flies). The FBI values of these insects are 4, 4, and 6 respectively (Edwards 2005). Hydropsychids turned out to be quite common, at least during the latter portion of summer. Hydropsychid caddisflies were most often found on the lower

surface of large rocks, in stationary shelters constructed from silk and debris. Like the Heptageniid mayflies, accessibility of their habitat was controlled by the rise and fall of the Tualatin. In contrast to Hydropsychids, the larger Limnephilid caddisflies were found in mobile, cylindrical cases made of plant material. Simuliid flies appeared to be at their most common toward the end of summer.

Though a large diversity of insect families was found in summer, some crustacean populations declined. Populations of planktonic crustaceans dropped from comparatively sparse, at the beginning of summer, to almost non-existence at the end of summer. The benthic Amphipods, on the other hand, remained as common as ever. The Isopods were never a very common group during the year of this study, but a single individual was found in July.

Aquatic earthworms were occasionally recorded during the summer. Aquatic snails were recorded in large numbers, probably due to the low water level, which made their preferred rocky habitat more accessible. Freshwater limpets were recorded for the first time in August; however, the small size and inconspicuous nature of these animals makes it impossible to be sure that they were not present at the study site before that time. An unexpected organism first recorded in early July was a freshwater mussel. Based on identifications of mussels found at the Tualatin site in future months, this species was almost certainly *Margarita falcata,* the western pearlshell mussel. *M. falcata* is the commonest mussel species in the Northwest, but they are best able to survive in water that is relatively uncontaminated by agriculture or urbanization (Nedeau et al 2005). A second *M. falcata* was found in early August.

Fall, 2005 (September, October, November)

A third mayfly family—the Leptophlebiidae, or prong gill mayflies—was found in the Tualatin in early September. These insects are given an FBI value of 2 (Edwards 2005), and are among the most sensitive species recorded at the Tualatin site. Leptophlebiids were found again at the beginning of October. Baetid mayflies were recorded frequently in this season, while Heptageniid mayflies continued to appear occasionally. Hydropsychid caddisflies remained common throughout September and about halfway through October; their eventual decline in the data may have been due to the river's rising water level. Stoneflies were recorded on three consecutive weeks in November, while Chironomid midges reappeared in late fall, and were recorded in small numbers throughout that time. Aquatic mites were recorded three times during this season.

The number of Amphipods recorded declined with time during the fall. This, again, was probably due to the rising level of the river which made some invertebrate habitats inaccessible for sampling. However, other populations appeared to undergo genuine changes, correlated with rising water and increased turbidity in the Tualatin. Populations of some tolerant insect species, such as Chironomids, grew during this time. Similarly, an increase in the number of planktonic crustaceans was roughly correlated with higher turbidity; Copepods and Cladocerans began to reappear in November, the latter group being especially abundant.

A single *M. falcata* mussel was found at the Tualatin site in early September. Freshwater limpets were recorded throughout the first month of fall, while snails were recorded in large numbers until the water level rose drastically.

Table 1: Water Quality and Tolerant Invertebrates, October-November, 2005

Date	River Stage (ft)	Turbidity (NTUs)	Copepods	Cladocerans	Chironomids
10/6/2005	1.78	6.8	0	0	0
10/13/2005	2.14	5.4	0	0	0
10/20/2005	2.48	2.8	0	0	1
11/3/2005	7.72	25.1	3	3	3
11/10/2005	7.67	43.7	Too many to estimate	50-100	2
11/17/2005	7.50	13.5	50-100	20	1
11/25/2005	4.98	13.5	0	0	0

Winter, 2005-06 (December, January, February)

The level of the Tualatin River continued to rise during the winter, making less and less insect habitat accessible from the shore. Even Baetid mayflies were recorded less frequently, although they continued to appear periodically throughout this season. Indeed, the Baetids proved to be perhaps the most consistently common insect family recorded throughout the entire year.

Along with Baetid mayflies, the most commonly found winter insects were Chironomid midges. Insect families recorded in small numbers included Leptophlebiid mayflies, the Limnephilid caddisflies, stoneflies, and Simuliid flies. These last made an appearance for the first time since summer. Fly larvae of the family Tipulidae (crane flies) were also found for the first time. Tipulids have an FBI value of 3 (Edwards 2005).

Aquatic mites were found on one occasion during December. Planktonic crustacean population fluctuated greatly during this season; though their numbers had formerly increased as water level rose, they dropped again when, in the latter portion of December, the river rose much higher. Despite the persistently high water level, populations of Copepods, Cladocerans, and Ostracods increased somewhat in mid to late February. Aquatic snails were only rarely recorded throughout winter.

Kingfisher Marsh

Spring, 2005 (March, April, May)

During the spring of 2005, Baetid mayflies were found in Kingfisher Marsh on two occasions. Though these insects appeared to be present during most of the year, they generally were recorded much less frequently than in the Tualatin River (see above). The two most common insect families in Kingfisher Marsh during the spring were the Chironomid midges, and the Corixids, or water boatmen. Chironomids were found on eight out of twelve sampling days in spring, in numbers ranging from one to ten. Corixids, not generally used in biomonitoring, were recorded on eleven of the twelve sampling days, their number in samples gradually increasing as spring went on.

Aquatic beetles, of either the family Dytiscidae or Hydrophilidae, were found periodically during the spring; larvae, however, were found more often than adults. Two other insect families were recorded in spring; the Tipulidae, or crane flies, were found in moderate numbers, while three Notonectids, or backswimmers, were recorded on the last sampling day in spring.

Aquatic mites were found in small numbers throughout the spring. All three groups of commonly found planktonic crustaceans—Copepods, Cladocerans, and Ostracods—were abundant. Both Copepods and Cladocerans appeared to increase as the spring went on—by the end of the season, each of these groups were frequently present in numbers too large to be estimated accurately. Ostracods appeared somewhat less common.

Among the non-arthropod invertebrates, aquatic earthworms were found occasionally, and planarians (free-living flatworms) appeared once near the beginning of spring. Snails were recorded in small to moderate numbers throughout the season.

Summer, 2005 (June, July, August)

Kingfisher Marsh is a seasonal pond, which often dries up completely toward the end of summer and may remain dry as late as mid-fall. In the fall, this body of water is replenished both directly by rain, and by floodwaters from the Tualatin River, which spill into it. Water from the Tualatin can be expected to transport some invertebrates to Kingfisher Marsh, as well as other organisms, such as fish. During the year of this study, Kingfisher Marsh was completely dry by early August, at least on the end of the pond where invertebrates were sampled. The marsh did not fill up again until about late October.

Baetid mayflies were recorded during the summer about as often as in spring; they were apparently present in Kingfisher Marsh up until the time that the pond dried up. Corixids, Notonectids, and beetle larvae (Dytiscidae or Hydrophilidae) were also present at least until the marsh was nearly dry. The number of Corixids recorded, however, dropped significantly at the beginning of June. Three adult aquatic beetles (Dytiscidae or Hydrophilidae) were recorded during the summer, including one large beetle close to an inch in length. A single Tipulid fly was also recorded, at least two weeks before the marsh was completely dry. Chironomid midges were only recorded once, in early June, and disappeared from the data after that time. Two groups of insects were recorded for the first time during the summer; damselflies were found on two occasions, and dragonflies on one. Both appeared within a few weeks of the marsh completely drying out.

Aquatic mites were found in small numbers until the marsh was dry. Despite the abundance of Cladocerans during the spring, these crustaceans were recorded in comparatively small numbers in the summer. Copepods remained common some weeks longer, but they too dropped drastically by the beginning of July. Macroscopic Ostracods were not recorded at all in the summer. The only non-arthropod invertebrates found were aquatic snails, which were recorded in moderate numbers until mid-July.

Fall, 2005 (September, October, November)

As described above, Kingfisher Marsh, during the year of this study, did not fill with water again until near the end of October. By the first sampling day in November, the marsh was full; on that day, the single insect found was an adult Dytiscid beetle. Aquatic beetles breathe air as adults, and may colonize new habitat by flying to suitable ponds. It is, therefore, not surprising that these were among the first insects to appear in the Marsh. Another adult Dytiscid was found during the second week of November, as well as two Chironomid midges. Chironomids, apparently, remained rare throughout this month. On

both sampling days in the last two weeks of November, Limnephilid, or northern casemaker caddisflies, were recorded.

Copepods were present in large numbers on the first sampling day in November, and for the rest of the month they remained too abundant for their numbers to be estimated in a sampling tray. Macroscopic Cladocerans and Ostracods, on the other hand, were recorded considerably less often. In this month benthic crustaceans were recorded in Kingfisher Marsh for the first time; both Amphipods and Isopods made their first appearance on the first November sampling day. Amphipods reappeared throughout the months, but Isopods were not recorded again.

Planarians were recorded twice in November. Aquatic snails, perhaps surprisingly, seem to have become established in Kingfisher Marsh very soon after it filled, before the Tualatin floodwaters spilled into it.

Winter, 2005-06 (December, January, February)

Baetid mayflies were recorded in Kingfisher Marsh during the month of January—the first time they were found since the marsh's water supply was replenished in fall. These insects continued to appear throughout the rest of winter. Stoneflies were recorded in Kingfisher Marsh for the first time in mid-February; these and other insects may have been carried to the marsh by Tualatin floodwaters. Limnephilid caddisflies were found occasionally, and Chironomid midges remained relatively rare. Tipulid flies were not found again until late February, but on the single sampling day that they did appear, several individuals were present in the tray.

Populations of planktonic crustaceans varied widely over the winter, but seem to have dropped substantially at about the time that water level began to increase greatly. By early February, Copepods were abundant again, while Cladocerans and Ostracods generally remained less common. A single Amphipod was found near the beginning of February. Few non-arthropod invertebrates were found in winter; planarians appeared only at the beginning of December, and a single aquatic earthworm was recorded later that month.

Gene Pool

Spring, 2005 (March, April, May)

No Baetid mayflies were found in the Gene Pool during the spring. Damselfly nymphs were relatively common at least up until early May, but after that time disappeared from the data. Corixids were found throughout the season, while Notonectids and aquatic beetle adults (Dytiscidae or Hydrophilidae) were recorded occasionally. Chironomid midges were relatively rare, and a Tipulid fly larva was recorded only once. Small numbers of aquatic mites were recorded during the last three weeks of May.

Cladocerans were recorded in large numbers throughout the spring, while Ostracods and Copepods remained common until late April. Amphipods were found on every spring sampling day in spring. Both aquatic earthworms and snails were found throughout the spring. A single planarian was recorded in late April.

Summer, 2005 (June, July, August)

Two Baetid mayflies were recorded in summer, both during the month of June. In late June, numbers of Corixids recorded increased greatly in the Gene Pool. During this time, as many as fifty Corixids were found in a single sample; after this, the numbers recorded began to drop gradually. However, despite this decrease, Corixids were recorded on every sampling day in summer.

Notonectids and aquatic beetles were found occasionally throughout this season. Chironomid midges were found very infrequently, and Tipulid flies appeared only during the first half of June. In addition, larvae of the beetle family Haliplidae (crawling water beetles) were recorded for the first time. Adult Haliplids (also aquatic) were never recorded in any water body, but the discovery of their larvae shows these insects were present in the Gene Pool.

With some exceptions, the numbers of Cladocerans recorded in June and July remained high, dropping in August. Copepods and Ostracods varied widely, but both had declined greatly by the end of summer. Amphipods, too, became less common; after the first two weeks of summer, these crustaceans were recorded on only one sampling day.

Until mid-July, planarians, aquatic earthworms, and snails were all recorded in the Gene Pool, though none were extremely common. The disappearance of these organisms, as well Cladocerans and a significant decrease in Copepod numbers, is roughly correlated with a drastic drop in dissolved oxygen (DO) levels that occurred from the end of July to early August, and that reversed only slightly by the end of summer. The decrease in DO concentration was likely brought on by the decay of large amounts of algae in the Gene Pool. Not every invertebrate group that may have been affected declined at exactly the same time, and some might have already begun a trend of decline. However, it is reasonable to hypothesize that a connection between DO concentration and invertebrate diversity exists.

In contrast to crustaceans and non-arthropod invertebrates, most insect populations were already sparse enough that it is impossible to judge whether they were affected by the drop in DO or not. Corixids are an exception, however, and it is interesting to note that they were apparently unaffected. Their numbers had already been declining gradually for some time, and there was no sudden drop at the time of DO decrease. This makes sense, in light of the fact that adult Corixids are air-breathing insects.

Table 2: Gene Pool Macroinvertebrates and DO Concentration, July-August, 2005

Date	Average DO (mg/L)	Snails	Planarians	Aquatic Earthworms	Cladocerans	Copepods	Corixids
7/6/05	6.68	4	1	3	0	0	24
7/13/05	4.86	1	1	5	0	20-50	22
7/18/05	8.97	0	1	1	Too many to estimate	0	27
727/05	3.38	0	0	0	Too many to estimate	Too many to estimate	15
8/3/05	0.25	0	0	0	0	50-100	17
8/11/05	0.47	0	0	0	0	1	11
8/18/05	0.32	0	0	0	0	10	4
8/25/05	4.20	0	0	0	0	0	6

Fall, 2005 (September, October, November)

Damselfly nymphs were again recorded in fall, being found on two sampling days in September. The numbers of Corixids remained low, however. A Dytiscid beetle was found on one sampling day, and Chironomid midges appeared on two. Aquatic mites were found once, in early November.

Throughout September and October, Crustacean diversity was low as well. During this time, macroscopic Cladocerans, Ostracods, and Amphipods were each found on one occasion. Macroscopic Copepods were not found at all during the first two months of fall, although in early-mid November their numbers rebounded dramatically. During the time that Copepods were again abundant, neither Cladocerans nor Ostracods achieved similarly high population levels. No non-arthropod invertebrates were found during the fall.

Winter, 2005-06 (December, January, February)

From late December to early-mid February, the Gene Pool sampling site was rendered inaccessible by the combined floodwaters of the Tualatin River and the ponds and small streams of Jackson Bottom. The only insects recorded during the three sampling weeks before the flood were a single Corixid and a single Chironomid midge, both found on the same day, in early December. When the Gene Pool was again accessible, approximately one week of this study was left. Baetid mayflies, a Dytiscid beetle, a Chironomid midge, and a Tipulid fly were all recorded on the last sampling day.

The Copepod population was high at the beginning of December, although it may have been declining before the flood. After the flood, Copepods were again present in numbers too great to estimate. Cladocerans, Ostracods, and Amphipods were uncommon, both before and after the flood. Planarians made a reappearance in the Gene Pool in late February, after the floodwaters went down.

Final Summary

Of the three sample sites, the Tualatin River contains the greatest family diversity of at least some of the more sensitive insect groups, such as mayflies and caddisflies. The Tualatin can easily be said to be less similar to the two ponds than they are to each other; six groups of insects and mollusks found in the Tualatin were not found at all in the other bodies of water, while some other taxa, such as stoneflies, were recorded outside the river, but only very rarely. The uniqueness of the Tualatin site is unsurprising since, unlike the other two sites, this is a flowing body of water year-round.

Interesting differences can be seen between invertebrates in Kingfisher Marsh and the Gene Pool. Baetid mayflies—the only mayfly family found at all three sites—were recorded with the least frequently in the Gene Pool. Damselflies, on the other hand, appeared more common in the Gene Pool than in either of the other sites. Corixids, too, seemed to reach their greatest numbers in the Gene Pool; though common in Kingfisher Marsh as well, these insects underwent a more dramatic population explosion in the Gene Pool.

In the final analysis, based on the data from this study, the Gene Pool appears to contain the least diversity of insect families, with only one insect group—the Haliplid beetles—found at this site alone. Factors which could have contributed to differences between the Gene Pool and Kingfisher Marsh include the much shallower depth of Kingfisher Marsh and its consequent dry period, as well as the oxygen depletion which occurred in the Gene Pool during late summer. Data from this study, however, can not give a definitive explanation of the differences.

Appendix A: Tualatin River Invertebrate Data

Insects with Incomplete Metamorphosis

Date	Mayflies Baetidae	Mayflies Heptageniidae*	Mayflies Leptophlebiidae*	Stoneflies	Damselflies
3/16/2005	1			2	
3/23/2005					
3/30/2005					
4/6/2005					
4/13/2005					
4/20/2005	5				
4/27/2005	3				
5/4/2005	3				
5/11/2005					
5/18/2005					
5/25/2005					1
6/1/2005	8			1	
6/8/2005	2				
6/22/2005					
6/29/2005					
7/6/2005	4	1			
7/13/2005	2				
7/18/2005	3				
7/27/2005	6				
8/3/2005	3				
8/11/2005					
8/18/2005	1	2			
8/25/2005	2				
9/1/2005			1		
9/7/2005	1				
9/14/2005	4				
9/21/2005	5				
9/29/2005					
10/6/2005	4	1	3		
10/13/2005	1	1			
10/20/2005	2				
11/3/2005				1	
11/10/2005	8			2	
11/17/2005	1			1	
11/25/2005					
12/1/2005					
12/8/2005	2				
12/23/2005					
12/28/2005					
1/20/2006	2				
1/29/2006					
2/4/2006					
2/12/2006	2				
2/24/2006	6		1	3	

* Indicates family found only in this water body.

Appendix A Continued

Insects with Complete Metamorphosis

Date	Caddisflies Hydropsychidae*	Caddisflies Limnephilidae	Flies Tipulidae	Flies Chironomidae	Flies Simuliidae*	Aquatic Beetles (Adults)
3/16/2005				1		
3/23/2005						
3/30/2005						1
4/6/2005				6		
4/13/2005						
4/20/2005				3		
4/27/2005						
5/4/2005						
5/11/2005						
5/18/2005						
5/25/2005				10		
6/1/2005				10		
6/8/2005				2		
6/22/2005						
6/29/2005				1		1
7/6/2005				1		
7/13/2005						
7/18/2005	3					
7/27/2005				1	2	
8/3/2005	2			1*	2	
8/11/2005	2				1	
8/18/2005	3				1	
8/25/2005	2	1				
9/1/2005	2					1
9/7/2005	5					
9/14/2005	1					
9/21/2005	4					
9/29/2005						
10/6/2005	2					
10/13/2005	1					
10/20/2005		3		1		
11/3/2005				3		
11/10/2005				2		
11/17/2005				1		
11/25/2005						
12/1/2005						
12/8/2005				2		
12/23/2005			1			
12/28/2005						
1/20/2006				1		
1/29/2006						
2/4/2006				2		
2/12/2006		1		7		
2/24/2006		1		5	2	

* Indicates family found only in this water body.

Appendix A Continued

Arachnids and Crustaceans

Date	Mites	Cladocerans	Ostracods	Amphipods	Isopods	Copepods
3/16/2005				10	1	
3/23/2005						10-60
3/30/2005						
4/6/2005		30-100		1		50-100
4/13/2005		10				10-60
4/20/2005		50-100				Inestimable
4/27/2005				2		20-100
5/4/2005				4		10
5/11/2005						5
5/18/2005		10				5
5/25/2005		50-100				10-60
6/1/2005				8		15
6/8/2005		1				2
6/22/2005				1		2
6/29/2005						20-100
7/6/2005				23	1	
7/13/2005						
7/18/2005				6		
7/27/2005				4		
8/3/2005				3		
8/11/2005				1		
8/18/2005	1					
8/25/2005				2		
9/1/2005				2		
9/7/2005				1		
9/14/2005	1			3		
9/21/2005	1			1		
9/29/2005						
10/6/2005						
10/13/2005				1		
10/20/2005						
11/3/2005		3		1		3
11/10/2005	1	50-100				Inestimable
11/17/2005		20				50-100
11/25/2005						
12/1/2005						
12/8/2005	2	50-100	2			Inestimable
12/23/2005					1	
12/28/2005						
1/20/2006						10
1/29/2006		3				10
2/4/2006						
2/12/2006			8			50-100
2/24/2006		50-100	30			50-100

Appendix A Continued

Non-Arthropod Invertebrates

Date	Aquatic Earthworms	Mussels*	Limpets*	Snails
3/16/2005				3
3/23/2005				
3/30/2005				
4/6/2005	1			
4/13/2005				
4/20/2005				
4/27/2005	2			8
5/4/2005				5
5/11/2005				
5/18/2005				1
5/25/2005				6
6/1/2005				6
6/8/2005				14
6/22/2005				6
6/29/2005				7
7/6/2005	1	1		6
7/13/2005				3
7/18/2005				8
7/27/2005				24
8/3/2005		1	3	15
8/11/2005				15
8/18/2005			1	20
8/25/2005			1	20
9/1/2005	1	1		20
9/7/2005			1	23
9/14/2005			1	18
9/21/2005				12
9/29/2005			5	28
10/6/2005				22
10/13/2005				28
10/20/2005				20
11/3/2005				
11/10/2005				
11/17/2005				
11/25/2005				
12/1/2005				
12/8/2005				
12/23/2005				
12/28/2005				
1/20/2006				
1/29/2006				
2/4/2006				
2/12/2006				
2/24/2006				

* Indicates family found only in this water body.

Appendix B: Kingfisher Marsh Invertebrate Data

Insects with Incomplete Metamorphosis

Date	Mayflies Baetidae	Stoneflies	Damselflies	Dragonflies*	True Bugs Corixidae	True Bugs Notonectidae
3/16/2005	1				2	
3/23/2005					1	
3/30/2005					1	
4/6/2005					2	
4/13/2005	1				6	
4/20/2005						
4/27/2005					2	
5/4/2005					3	
5/11/2005					6	
5/18/2005					16	
5/25/2005					12	
6/1/2005					13	3
6/8/2005					4	1
6/22/2005	1				4	
6/29/2005						
7/6/2005					3	1
7/13/2005					6	
7/18/2005				1	1	
7/27/2005			2		2	
8/3/2005	2		2			1
8/11/2005	---	---	---	---	---	---
8/18/2005	---	---	---	---	---	---
8/25/2005	---	---	---	---	---	---
9/1/2005	---	---	---	---	---	---
9/7/2005	---	---	---	---	---	---
9/14/2005	---	---	---	---	---	---
9/21/2005	---	---	---	---	---	---
9/29/2005	---	---	---	---	---	---
10/6/2005	---	---	---	---	---	---
10/13/2005	---	---	---	---	---	---
10/20/2005	---	---	---	---	---	---
11/3/2005						
11/10/2005						
11/17/2005						
11/25/2005						
12/1/2005						
12/8/2005						
12/23/2005						
12/28/2005						
1/20/2006						
1/29/2006	2					
2/4/2006	3					
2/12/2006						
2/24/2006	12	4				

* Indicates family found only in this water body.

Appendix B Continued

Insects with Complete Metamorphosis

Date	Aquatic Beetles (Adults)	Aquatic Beetles (Larvae)	Caddisflies Limnephilidae	Flies Chironomidae	Flies Tipulidae
3/16/2005					
3/23/2005					4
3/30/2005		1		2	4
4/6/2005					
4/13/2005	1			6	
4/20/2005				1	
4/27/2005	2	1		5	
5/4/2005	1	1		4	4
5/11/2005				10	
5/18/2005		4		2	
5/25/2005					2
6/1/2005		1		4	
6/8/2005	1				
6/22/2005		1		2	
6/29/2005					
7/6/2005					
7/13/2005	1				
7/18/2005					1
7/27/2005					
8/3/2005		4			
8/11/2005	---	---	---	---	---
8/18/2005	---	---	---	---	---
8/25/2005	---	---	---	---	---
9/1/2005	---	---	---	---	---
9/7/2005	---	---	---	---	---
9/14/2005	---	---	---	---	---
9/21/2005	---	---	---	---	---
9/29/2005	---	---	---	---	---
10/6/2005	---	---	---	---	---
10/13/2005	---	---	---	---	---
10/20/2005	---	---	---	---	---
11/3/2005					
11/10/2005					
11/17/2005				2	
11/25/2005			1	1	
12/1/2005			4		
12/8/2005			3	1	
12/23/2005					
12/28/2005					
1/20/2006					
1/29/2006					
2/4/2006					
2/12/2006			1	4	
2/24/2006					

Appendix B Continued

Arachnids and Crustaceans

Date	Mites	Cladocerans	Ostracods	Copepods	Amphipods	Isopods
3/16/2005		30-100	10-6	50-100		
3/23/2005		30-100	4-20	50-100		
3/30/2005	1	50-100	5-20	50-100		
4/6/2005		50-100		30-100		
4/13/2005	4	30-100	10-60	Inestimable		
4/20/2005		10		Inestimable		
4/27/2005		Inestimable	5	Inestimable		
5/4/2005		Inestimable	Inestimable	Inestimable		
5/11/2005	3	Inestimable	10	Inestimable		
5/18/2005		Inestimable	5	5		
5/25/2005	2	Inestimable	10	Inestimable		
6/1/2005	1			Inestimable		
6/8/2005				Inestimable		
6/22/2005	2			Inestimable		
6/29/2005	1			10-60		
7/6/2005	1			50-100		
7/13/2005	2	5-20				
7/18/2005		5				
7/27/2005	1	10				
8/3/2005	1					
8/11/2005	---	---	---	---	---	---
8/18/2005	---	---	---	---	---	---
8/25/2005	---	---	---	---	---	---
9/1/2005	---	---	---	---	---	---
9/7/2005	---	---	---	---	---	---
9/14/2005	---	---	---	---	---	---
9/21/2005	---	---	---	---	---	---
9/29/2005	---	---	---	---	---	---
10/6/2005	---	---	---	---	---	---
10/13/2005	---	---	---	---	---	---
10/20/2005	---	---	---	---	---	---
11/3/2005						
11/10/2005				Inestimable	2	1
11/17/2005				Inestimable		
11/25/2005		10		Inestimable	1	
12/1/2005		10	5	Inestimable	2	
12/8/2005		4	Inestimable	Inestimable		
12/23/2005				50-100		
12/28/2005				3		
1/20/2006						
1/29/2006						
2/4/2006		10		30		
2/12/2006		50-100	4	Inestimable		
2/24/2006						

Appendix B Continued

Non-Arthropod Invertebrates

Date	Planarians	Aquatic Earthworms	Snails
3/16/2005	4		1
3/23/2005		1	
3/30/2005			
4/6/2005			1
4/13/2005			1
4/20/2005			
4/27/2005			2
5/4/2005			4
5/11/2005			4
5/18/2005		1	2
5/25/2005		5	
6/1/2005			4
6/8/2005			2
6/22/2005			6
6/29/2005			5
7/6/2005			2
7/13/2005			5
7/18/2005			1
7/27/2005			4
8/3/2005			7
8/11/2005	---	---	---
8/18/2005	---	---	---
8/25/2005	---	---	---
9/1/2005	---	---	---
9/7/2005	---	---	---
9/14/2005	---	---	---
9/21/2005	---	---	---
9/29/2005	---	---	---
10/6/2005	---	---	---
10/13/2005	---	---	---
10/20/2005	---	---	---
11/3/2005			
11/10/2005			
11/17/2005	2		
11/25/2005			
12/1/2005	2		
12/8/2005	8		
12/23/2005			
12/28/2005		1	
1/20/2006			
1/29/2006			
2/4/2006			
2/12/2006			
2/24/2006			

Appendix C: Gene Pool Invertebrate Data

Insects with Incomplete Metamorphosis

Date	Mayflies Baetidae	Damselflies	True Bugs Corixidae	True Bugs Notonectidae
3/16/2005			1	
3/23/2005		1	1	
3/30/2005		1		
4/6/2005		8	5	
4/13/2005		1		2
4/20/2005		2	1	
4/27/2005		1	2	
5/4/2005		1	7	
5/11/2005			9	
5/18/2005			1	
5/25/2005			7	2
6/1/2005			11	1
6/8/2005	1		16	
6/22/2005			45	
6/29/2005	1		50	
7/6/2005			24	
7/13/2005			22	1
7/18/2005			27	
7/27/2005			15	
8/3/2005			17	
8/11/2005			11	
8/18/2005			4	
8/25/2005			6	
9/1/2005				
9/7/2005			1	
9/14/2005		1		
9/21/2005		1		
9/29/2005				
10/6/2005				
10/13/2005				
10/20/2005				
11/3/2005				
11/10/2005				
11/17/2005			3	
11/25/2005			2	
12/1/2005			1	
12/8/2005				
12/23/2005				
12/28/2005	---	---	---	---
1/20/2006	---	---	---	---
1/29/2006	---	---	---	---
2/4/2006	---	---	---	---
2/12/2006	---	---	---	---
2/24/2006	2			

Appendix C Continued

Insects with Complete Metamorphosis

Date	Aquatic Beetles (Adults)	Caddisflies Limnephilidae	Caddisflies Rhyacophilidae*	Flies Chironomidae
3/16/2005				2
3/23/2005				
3/30/2005				2
4/6/2005	2			
4/13/2005				
4/20/2005				
4/27/2005				
5/4/2005				
5/11/2005				
5/18/2005	1			4
5/25/2005				1
6/1/2005				
6/8/2005				
6/22/2005			1	1
6/29/2005				
7/6/2005	1			1
7/13/2005				
7/18/2005	3			
7/27/2005	3		2	
8/3/2005	1			
8/11/2005				
8/18/2005				
8/25/2005				
9/1/2005				
9/7/2005				
9/14/2005				1
9/21/2005				
9/29/2005				1
10/6/2005				
10/13/2005				
10/20/2005				
11/3/2005				
11/10/2005				
11/17/2005				
11/25/2005				
12/1/2005				1
12/8/2005				
12/23/2005				
12/28/2005				
1/20/2006				
1/29/2006				
2/4/2006				
2/12/2006				
2/24/2006		1		1

* Indicates family found only in this water body.

Appendix C Continued

Arachnids and Crustaceans

Date	Mites	Cladocerans	Ostracods	Amphipods	Copepods
3/16/2005		30-100	10-60	15	50-100
3/23/2005			5-20	15	30-100
3/30/2005		30-100	5-20	10	30-100
4/6/2005		20-100	5-20	8	50-100
4/13/2005		5-20	50-100	4	50-100
4/20/2005		50-100	50-100	20	
4/27/2005		Inestimable		3	20-100
5/4/2005	1	Inestimable		6	
5/11/2005	2	Inestimable		6	
5/18/2005	3	10		4	20
5/25/2005		Inestimable		5	
6/1/2005		Inestimable		9	20
6/8/2005		Inestimable		10	
6/22/2005		Inestimable	1		20-100
6/29/2005		20-100	5-20		Inestimable
7/6/2005	1		Inestimable		
7/13/2005			50-100		20-100
7/18/2005		Inestimable			
7/27/2005		Inestimable			Inestimable
8/3/2005	2			1	50-100
8/11/2005		1			1
8/18/2005					10
8/25/2005			2		
9/1/2005		1	1		
9/7/2005				1	
9/14/2005					
9/21/2005					
9/29/2005					
10/6/2005					
10/13/2005					
10/20/2005					
11/3/2005					
11/10/2005	2				Inestimable
11/17/2005					Inestimable
11/25/2005		2			Inestimable
12/1/2005		3	1	0	Inestimable
12/8/2005				1	50-100
12/23/2005					
12/28/2005					
1/20/2006					
1/29/2006					
2/4/2006					
2/12/2006					
2/24/2006			5	2	Inestimable

Appendix C Continued

Non-Arthropod Invertebrates

Date	Planarians	Aquatic Earthworms	Snails	Hydras*
3/16/2005			3	
3/23/2005		1		
3/30/2005			1	
4/6/2005		2	1	
4/13/2005		1		
4/20/2005	1	5		
4/27/2005		4	4	7
5/4/2005		1		2
5/11/2005			1	1
5/18/2005			3	
5/25/2005			7	
6/1/2005		2	4	
6/8/2005			2	
6/22/2005	1		1	
6/29/2005			5	
7/6/2005	1	3	4	
7/13/2005	1	5	1	
7/18/2005	1	1		
7/27/2005				
8/3/2005				
8/11/2005				
8/18/2005				
8/25/2005				
9/1/2005				
9/7/2005				
9/14/2005				
9/21/2005				
9/29/2005				
10/6/2005				
10/13/2005				
10/20/2005				
11/3/2005				
11/10/2005				
11/17/2005				
11/25/2005				
12/1/2005				
12/8/2005				
12/23/2005				
12/28/2005				
1/20/2006				
1/29/2006				
2/4/2006				
2/12/2006				
2/24/2006	2			

* Indicates family found only in this water body.

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