5.2.4 Macrofauna

The macrofauna monitored for in this program were nekton (motile water column organisms such as fishes and shrimp, greater than 1 cm in length) and birds. Nekton sampling occurred seasonally from late spring to early fall. Bird monitoring was intended to occur during nesting season (late spring-early summer) and mid-winter. However, winter bird monitoring only occurred in the winters of 2004-2005 and 2006-2007, and so these data will not be extensively analyzed.

5.2.4.1 Nekton

All nekton data sets were analyzed using Kolmogorov-Smirnov tests, with significance determined at $p<0.05$. Test data are provided in the Addendum, pages pp. 232-233 and 243-244. More details regarding the statistical tests are provided in Section 5.1, above.

The Before (pre-treatment) data for Area 1 (an Impact or Treatment area) were from 2003-2004. The control Before (pre-treatment) data Area 1 controls were Area 3 and Area 4 2003-2004 data. Post-treatment (After) data for Area 1 was 2005-2007 data, and its Control post-treatment (After) data were Area 3 and Area 4 data for 2005-2007. The Before (pre-treatment) data for Area 2 (also an Impact or Treatment area) were 2003-2005 data sets. The control Before (pre-treatment) data Area 2 controls were Area 3 and Area 4 2003-2005 data. Post-treatment (After) data for Area 2 was 2006-2007 data, and its Control post-treatment (After) data were Area 3 and Area 4 data for 2006-2007. There was only one sampling event in 2003.

Table 59 summarizes the nekton sampling data. When looking at total data, it needs to be understood that only one sampling event occurred in 2003, and so comparisons between 2003 and other years should not be heavily weighted (except when declines in abundance were measured). However, these data strongly suggest that the number and diversity of fish increased in Area 1 following alterations to the marsh there, and that the abundance of nekton in Area 2 also increased following the changes made there. In Area 3, abundances were much greater in 2005 and 2007 than in other years; in Area 4, 2004 was clearly the year of peak abundance. Thus, although abundance varied in the control areas, it is fair to note that abundance consistently increased post-treatment in Area 1 and Area 2, suggesting the changes made in the

marsh improved fish habitat. It also seems that the changes increased overall diversity, although the changes were not consistent (as discussed immediately below).

Table 59. Nekton Sampling Summary

Area	Year	Species Caught	Total Caught
1	2003	2	49
	2004	3	27
	2005	9*	375
	2006	8*	745
	2007	7	439
2	2003	4	164
	2004	4*	444
	2005	5*	259
	2006	7	695
	2007	8*	621
3	2003	3	144
	2004	3	182
	2005	7*	380
	2006	5*	155
	2007	5	474
4	2003	4	116
	2004	6*	332
	2005	6*	151
	2006	5	58
	2007	5	94
Total	2003	5	473
	2004	8*	985
	2005	10*	1165
	2006	9*	1653
	2007	9*	1628

* plus unidentified juvenile fish

Table 60 provides more detail regarding the distributions of the fish caught in sampling. Post-treatment in Area 1, *Fundulus heteroclitus* (mummichogs) increased in abundance tremendously, as did *Cyprinodon variegates* (sheepshead minnow). *Palaemonetes spp*. (grass shrimp) numbers were also greatly increased (at least for 2005-2006; there was a decline in 2007 from the initial increases). *Menidia menidia* (Atlantic silverside) spiked in the second year post-construction. On the other hand, abundances of *Lucania parva* (rainwater killifish) declined.

For Area 2, almost the exact same patterns were seen (except grass shrimp abundances declined in 2007 in only the second year post-treatment; this is unlikely to be solely the result of particular 2007 marsh conditions, as numbers were maintained in Area 3 relative to preceding years). This suggests that the installation of tidal channels and ponds increases the overall quality of fish habitat compared to the pre-treatment ditches.

Table 60. Total Nekton Abundance

Year	Area	*Anguilla rostrata*	*Apeltes quadracus*	*Callinectes sapidus*	*Cyprinodon variegates*	*Fundulus diaphanus*	*Fundulus heteroclitus*	*Fundulus luciae*	*Lucania parva*	*Menidia spp.*	*Palaemonetes spp.*	*Bolinopsis infundibulum*	*Pungitius pungitius*	Juvenile Unknown	**TOTAL NEKTON**
2003	**1**	-	-	-	-	-	6	-	43	-	-	-	-	-	**49**
	2	-	-	-	2	-	75	-	18	-	69	-	-	-	**164**
	3	-	-	-	-	-	45	-	30	-	69	-	-	-	**144**
	4	-	-	-	-	-	20	-	6	-	89	-	1	-	**116**
2004	**1**	-	2	-	-	-	5	-	20	-	-	-	-	-	**27**
	2	-	-	2	-	-	201	-	123	-	111	-	-	7	**444**
	3	-	-	-	-	-	89	-	39	-	54	-	-	-	**182**
	4	-	-	-	-	-	125	1	11	1	192	-	1	1	**332**
2005	**1**	5	1	1	50	-	132	1	35	31	96	-	-	23	**375**
	2	-	-	-	-	1	81	2	28	-	146	-	-	1	**259**
	3	1	-	-	4	-	189	13	55	2	111	-	-	5	**380**
	4	-	-	-	5	-	86	2	20	1	33	-	-	4	**151**
2006	**1**	2	2	3	238	-	335	-	14	1	145	-	-	5	**745**
	2	-	-	5	48	-	409	-	6	46	177	4	-	-	**695**
	3	-	-	4	11	-	23	-	24	-	89	-	-	4	**155**
	4	-	1	-	2	-	10	-	34	-	11	-	-	-	**58**
2007	**1**	5	-	-	102	-	282	2	9	5	34	-	-	-	**439**
	2	-	-	2	128	-	379	17	2	73	15	1	-	4	**621**
	3	-	-	-	13	-	210	-	159	15	77	-	-	-	**474**
	4	-	-	2	1	-	44	-	37	-	10	-	-	-	**94**

Table 61 compares overall pre-treatment and post-treatment distributions of the numerous, persistent species (so Atlantic silverside data were not included in the analysis). The differences

in distributions between pre- and post-treatment abundances of sheepshead minnow, mummichogs, rainwater minnows, grass shrimp and total nekton abundances for Area 1 and its controls were all statistically significant, as were pre- and post-treatment differences in the Area 1 results, and pre- and post-treatment differences for the controls. The differences in distribution for post-treatment Area 2 and its controls were all significant; distribution differences for pre-treatment and post-treatment Area 2 data were significant (using non-parametric tests) for sheepshead minnow and rainwater killifish, but not for the other comparisons.

Table 61. Pre- and post-treatment nekton comparisons (fish per sample)

Class		**Area 1**	**Area 1 controls**	**Area 2**	**Area 2 controls**
C. variegates	Pre-treatment	0	0	0.0	0.1
	Post-treatment	4.8	0.2	3.4	0.2
F. heteroclitus	Pre-treatment	0.3	3.5	5.1	4.0
	Post-treatment	9.1	3.1	15.2	2.4
L. parva	Pre-treatment	1.6	1.1	2.4	1.2
	Post-treatment	0.7	1.8	0.2	2.1
Palaemonetes spp.	Pre-treatment	0	5.1	4.7	3.9
	Post-treatment	3.4	1.8	3.7	1.6
Total	Pre-treatment	1.9	9.7	12.4	9.3
	Post-treatment	19.0	7.2	25.3	6.5

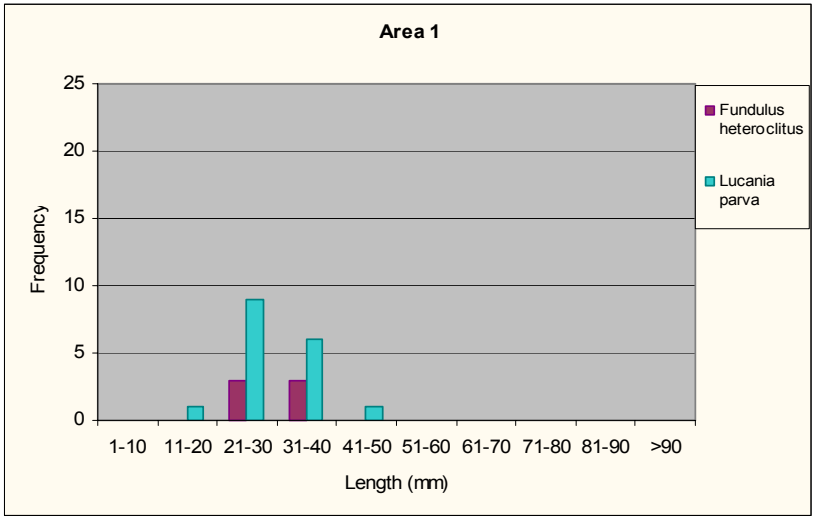
Comparisons of the distribution of the nekton post-treatment in Areas 1 and 2 (Table 62) show that different distributions of fish are found in the new habitat areas, although each habitat area had approximately the same overall abundance per sample. The dominant species in ponds was sheepshead minnows, with mummichogs also important. In the modified tidal channels, mummichogs were the dominant fish. The modified ditches were a mummichog-grass shrimp distribution, which was similar to what was found in most of the unmodified ditches (although rainwater killifish were also common in the unmodified ditches).

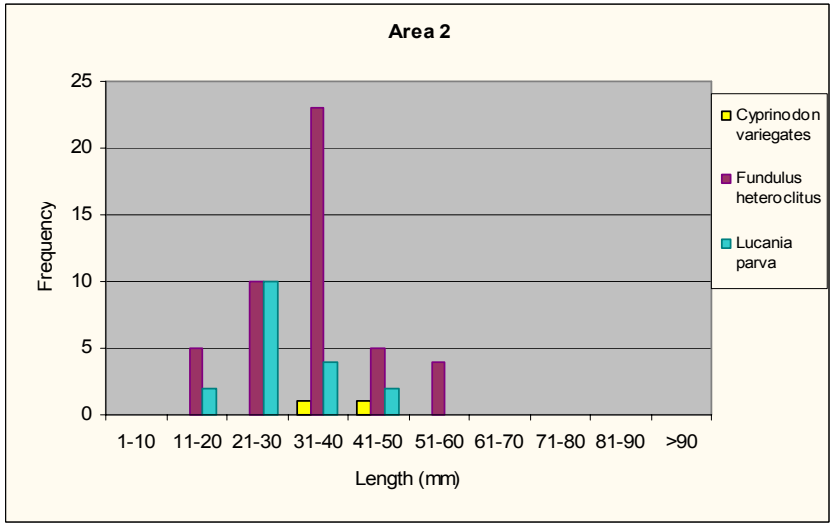
Table 62. Distribution of nekton detected post-treatment, Area 1 (2005-2007) and Area 2 (2006-2007) (fish per sample)

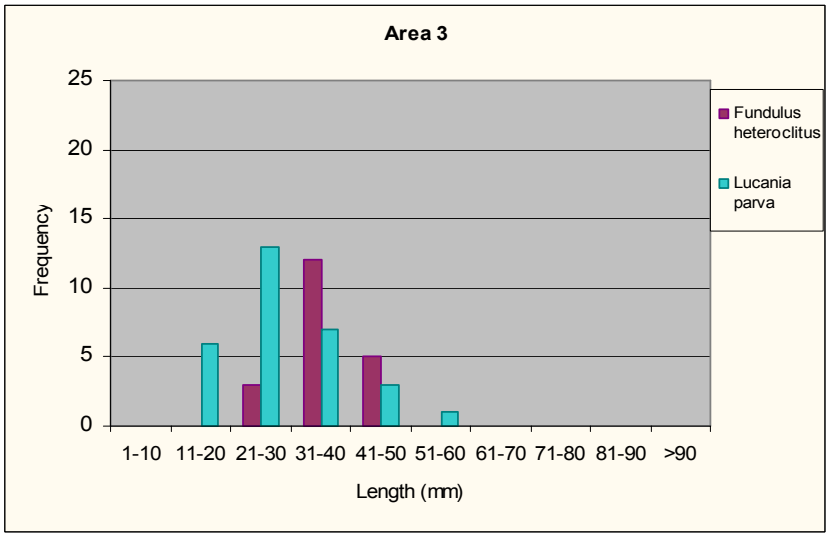
HABITAT	*Anguilla rostrata*	*Apelies quadracus*	*Callinectes sapidus*	*Cyprinodon variegates*	*Fundulus heteroclitus*	*Fundulus luciae*	*Lucania parva*	*Menidia spp.*	*Palaemonetes spp.*	*Bolinopsis infundibulum*	Juvenile Unknown	**TOTAL NEKTON**
Ponds	0.0	0	0.1	11.4	7.9	0.4	0.6	1.3	3.1	0	1.6	**25.4**
Tidal channels	0.0	0.0	0.0	0.3	16.4	0.0	0.6	1.4	1.3	0.0	0.1	**20.3**
Modified ditches	0.4	0	0.1	3.0	14.2	0.1	0.3	0.1	7.5	0	0	**25.6**

Size distributions are a means of identifying changes in the ages of fish if all the fish are of one size, they are presumed to be of similar age; wider distributions of size indicate that fish may be surviving in the marsh for some length of time. The data are suggestive of single size classes for Area 1 in 2003 and 2004, Area 2 in 2003, 2004, and 2005, Area 3 in 2003 and 2006, and Area 4 in 2003 and 2004. The data suggest there may be another size class or classes for Area 1 in 2005, Area 3 in 2004 and 2005, and Area 4 in 2005 and 2006. They strongly imply multiple size classes for Area 1 in 2006 and Area 2 in 2006. Therefore, the project may have resulted in conditions that tend to support more than one generation of some of these fishes. Figures 60 through 64 show nekton length frequency distribution for years 2003-2007.

Figure 60. Nekton Length Frequency Distribution 2003







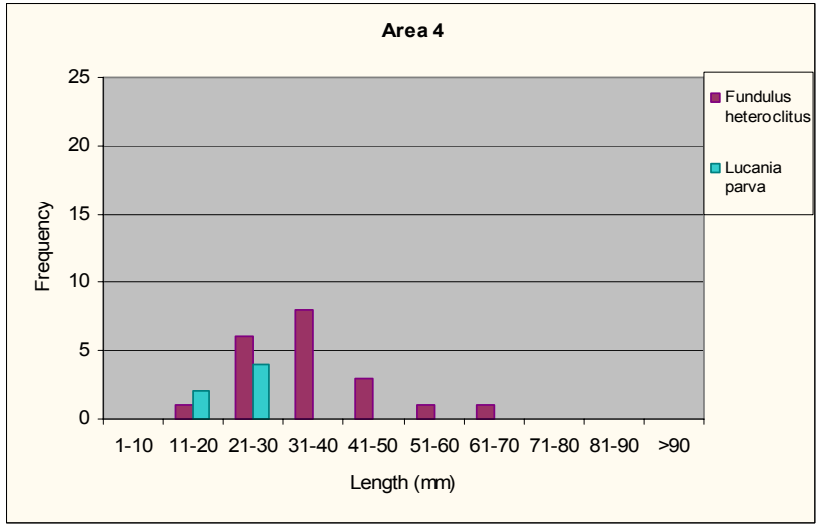
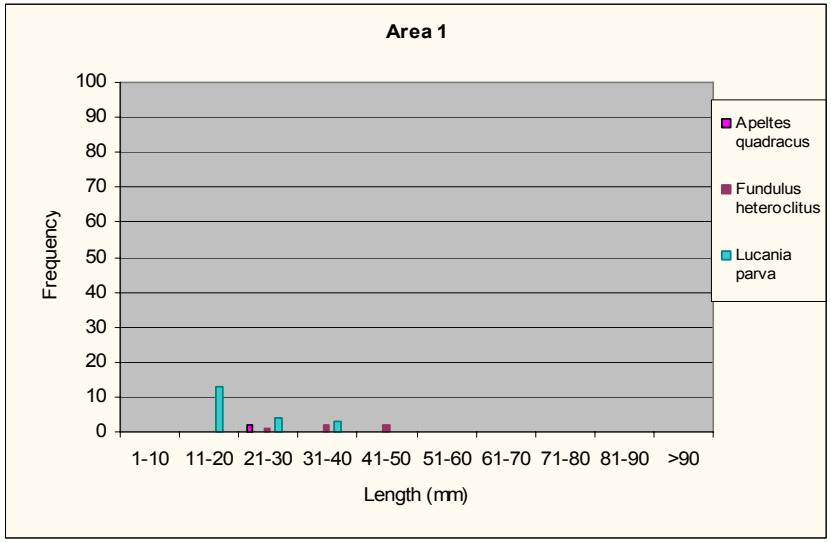
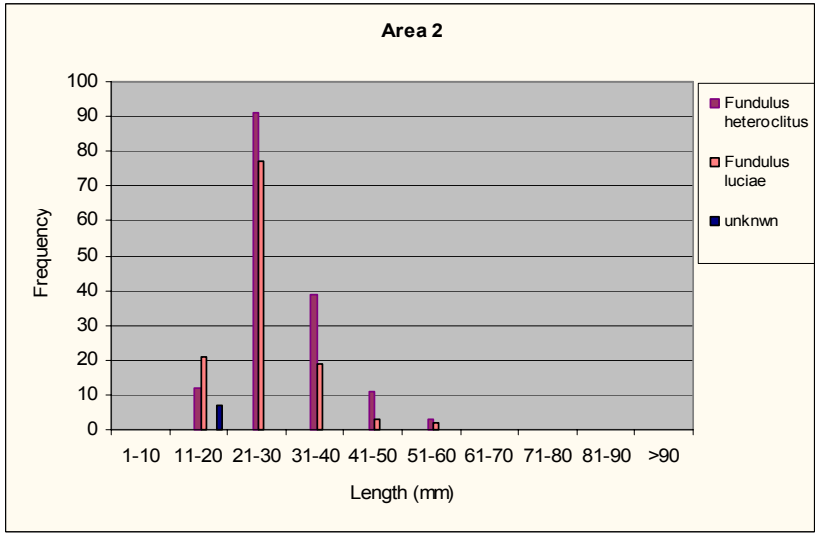
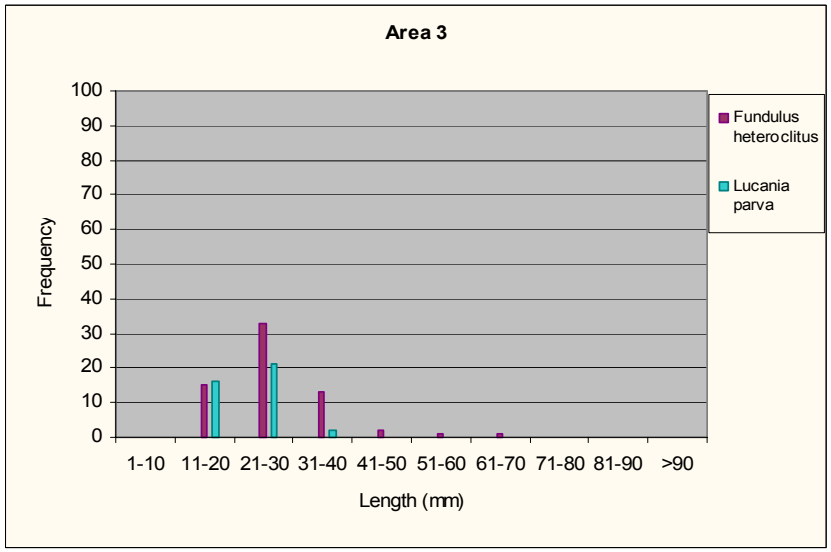


Figure 61. Nekton Length Frequency Distribution 2004







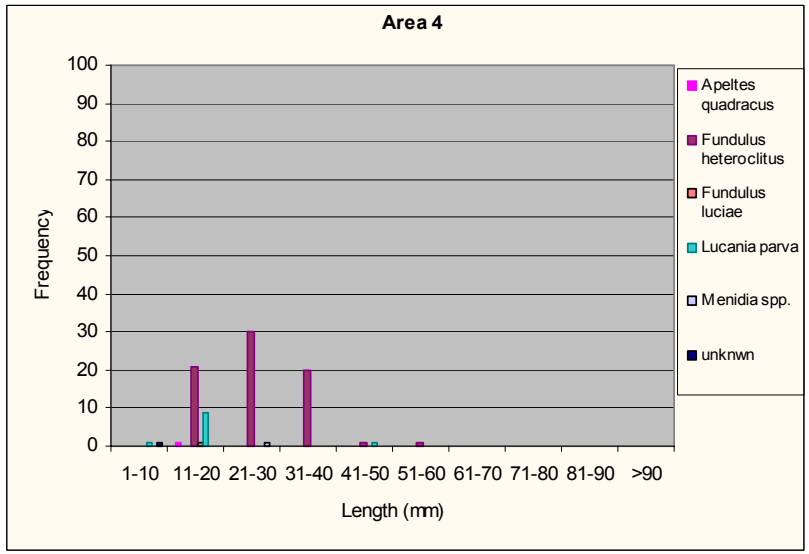
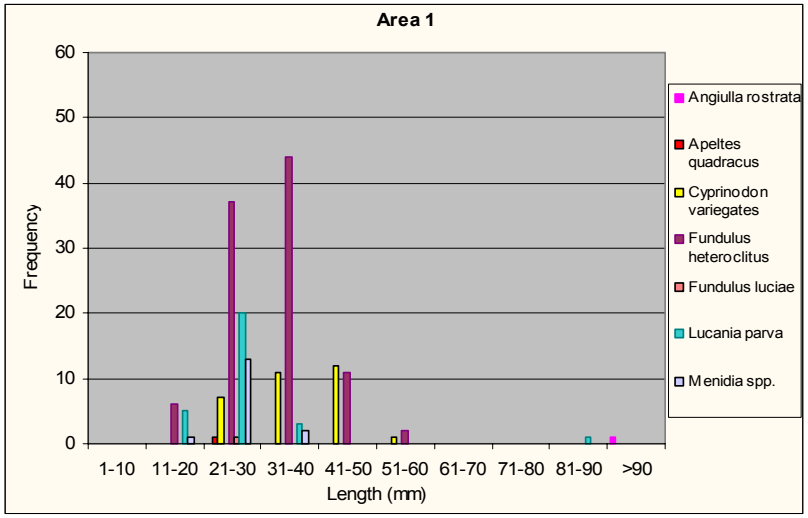
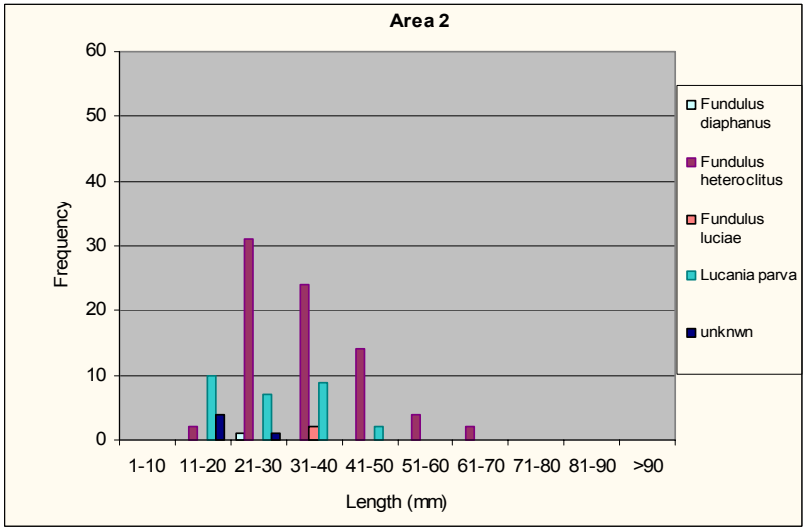
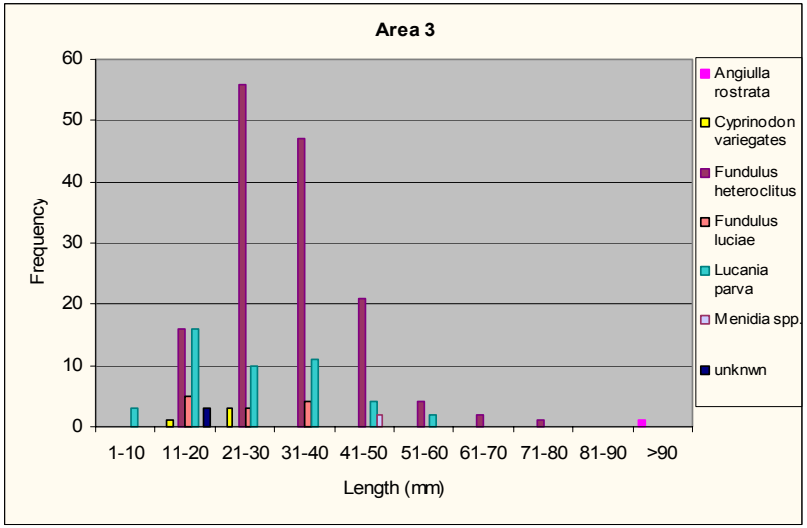


Figure 62. Nekton Length Frequency Distribution 2005







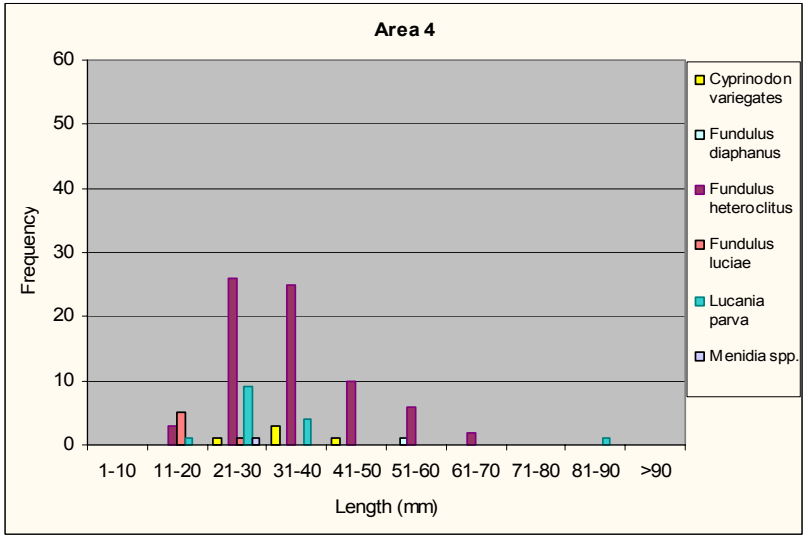
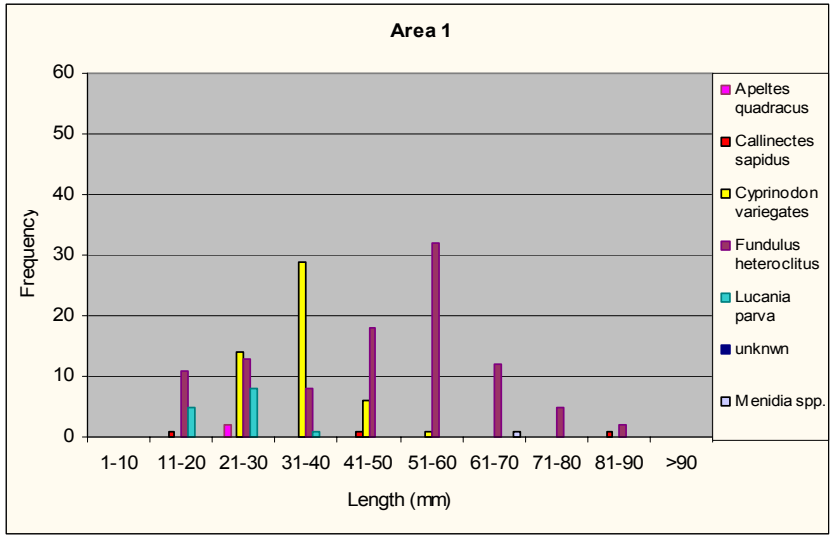
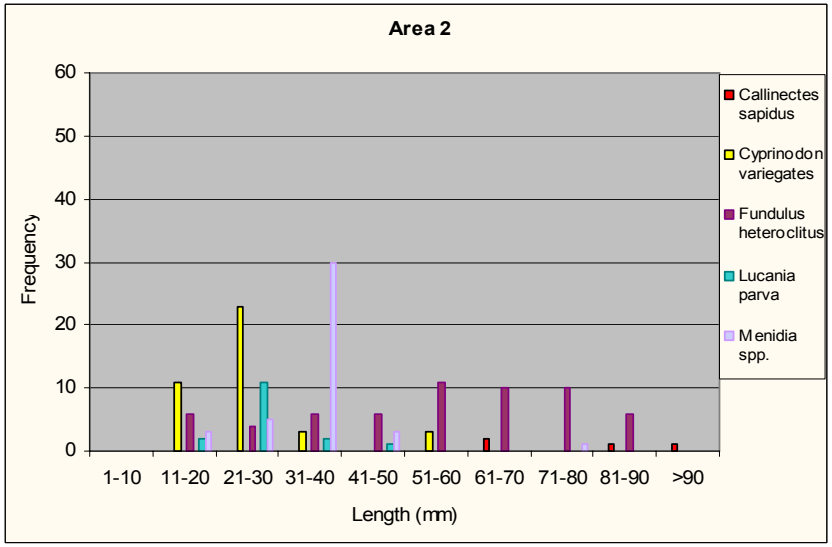
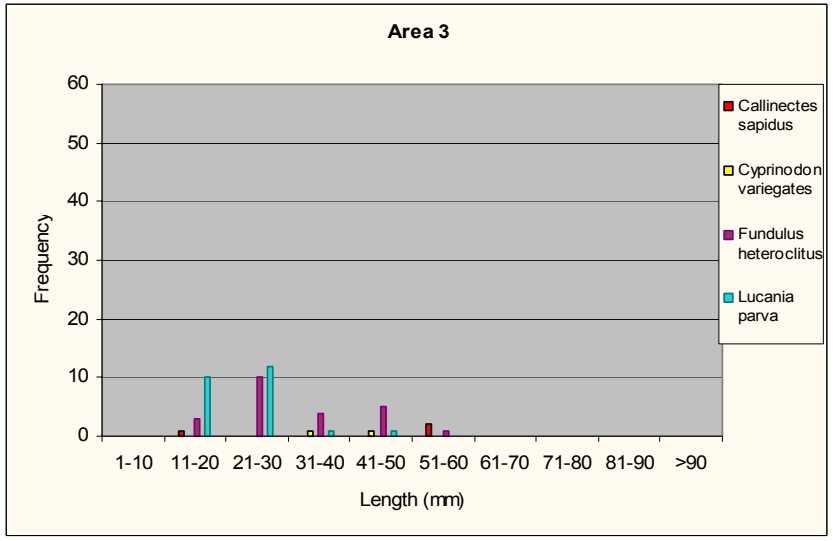


Figure 63. Nekton Length Frequency Distribution 2006







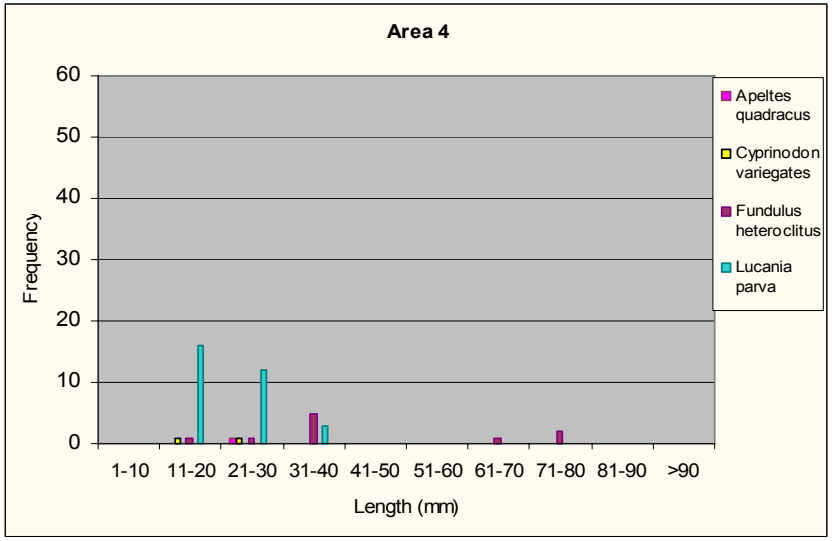
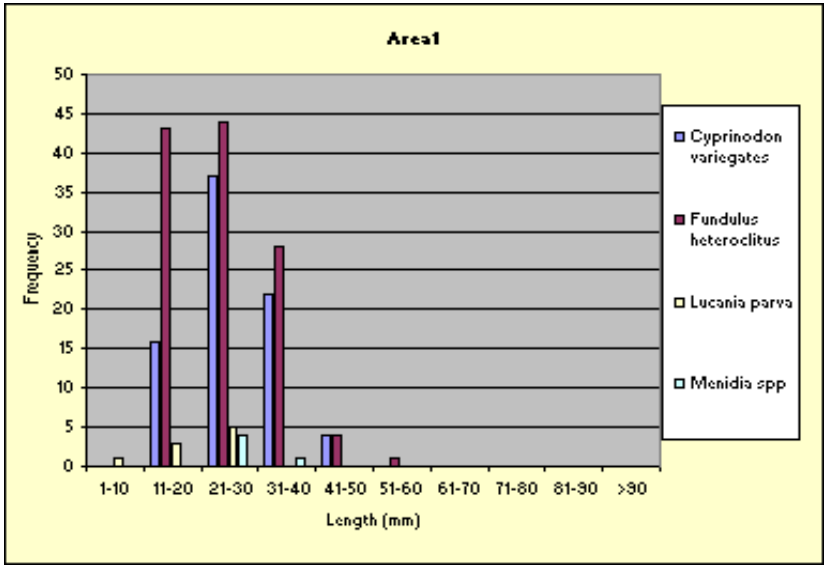
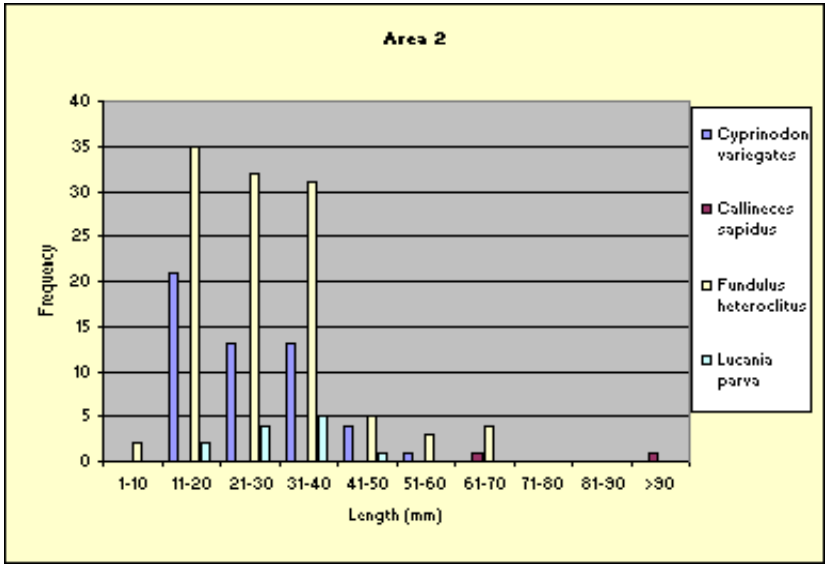
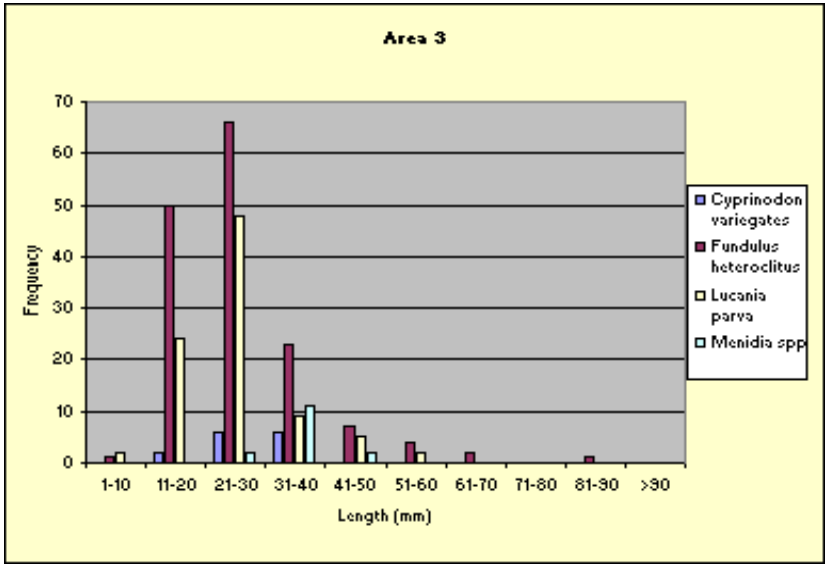
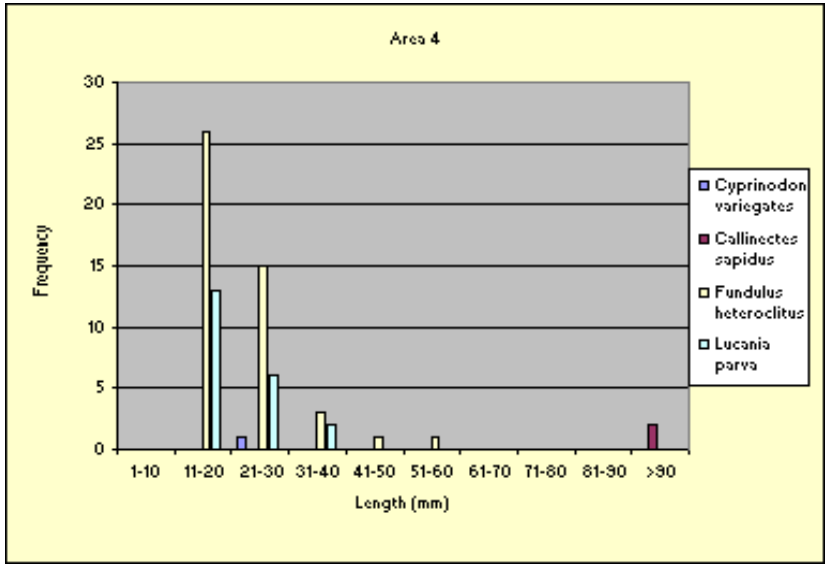


Figure 64. Nekton Length Frequency Distribution 2007









In addition to the quantitative analysis of the nekton changes, the sampling crew added the following subjective observations:

- An immediate fish presence was observed in Area 1 ponds once they were fully inundated, approximately one to two tidal cycles post creation. A slower fish response was observed for the Area 2 ponds.

- A *Prionotus carolinus* (Northern sea robin) was observed in the northern tidal channel of Area 1, two months post alterations.

- Ponds were observed "bubbling" with fish when the sampling crew would come within approximately 15 feet of a pond in Area 1 post alterations; this phenomenon earned these kinds of structures a name of "champagne" pools in New Jersey.

- *Callinectes sapidus* (blue claw crabs) were repeatedly observed in the sills of Area 1 throughout 2005 through 2007.

Overall, the nekton sampling data imply that the project met a goal of increasing the amount of suitable fish habitat in Areas 1 and 2. The diversity of fish across Area 1 increased notably, and the number of fish increased tremendously (from a depauperate marsh to one that teems with fish). The changes in Area 2 were also notable, if not on quite the same scale. Although there was some variability in the nekton data for control sites and pre-project samples in Area 2, the weight of the data is strongly supportive of improved fish habitat due to the marsh alterations. Although there were some shifts in species composition associated with the changes to the marshes, with the exception of declines in rainwater killifish, most other fish had absolute increases in abundance.

It should be noted that the gear and techniques used for sampling may not be optimal. Samplers noted that many times greater numbers of fish were observed in all areas than were captured by nets. Fish in ditches were extremely wary, and it was difficult to establish the nets there and have the fish repopulate the ditch (qualitatively) to the same density as observed prior to the nets being set up. The throw traps did not capture fish well in new ponds. This is thought to be the case because of the uneven bottom of the pond allows fish to escape underneath the trap. Fyke

nets worked much better in the spring 2006, but NYSDEC has not approved a change in sampling techniques, and so their use was not continued. Although these issues only affect the absolute and not relative catch for each sampling station, it is clear that the sampling efforts were not very efficient.

However, it should be noted that the total area of open water across the treatment areas was approximately doubled because of the project. Table 63 provides very broad estimates for the numbers of the persistent fish species, estimated for each Area, and for the entire sample area. In this very broad depiction of abundance, the total number of nekton, especially sheepshead minnows and mummichogs, are clearly increased post-treatment. Rainwater killifish numbers may have decreased somewhat over the entire study area, and grass shrimp numbers fluctuate across areas and years (but appear to be somewhat the same from pre-treatment to post-treatment). Since the overall size of the collected fish has increased somewhat, it is plausible to suggest that the biomass of fish produced across the marsh has been increased by this project.

Table 63. Estimated total abundances (in thousands)

Class	Years	Area 1	Area 2	Area 3	Area 4	Total
C. variegates	2003	0	1	0	0	1
	2004	0	0	0	0	0
	2005	12	0	0	1	12
	2006	66	14	0	0	80
	2007	26	35	1	0	60
F. heteroclitus	2003	2	27	11	7	47
	2004	1	37	8	18	63
	2005	30	10	16	8	63
	2006	92	121	2	1	217
	2007	72	104	18	5	198
L. parva	2003	11	6	8	2	27
	2004	2	23	3	1	29
	2005	8	3	5	3	19
	2006	4	1	2	4	12
	2007	2	1	13	4	20
Palaemonetes spp.	2003	0	25	17	32	74
	2004	0	36	5	23	63
	2005	22	18	9	4	53
	2006	40	53	8	1	102
	2007	9	4	7	1	21

5.2.4.2 Birds

5.2.4.2.1 General Observations

Most standard bird monitoring analyses report the birds seen in terms of area covered by the survey; in terms of this site, therefore, the number of birds observed at the same number of stations in Areas 1 and 2 would be reported differently, because Area 1 has a smaller overall area of vegetated marsh than is found in Area 2. This may not be a meaningful way of measuring birds when the spaces being considered are part of a larger marsh area, as the delineation of the area was artificial, in that they do not create distinct environmental areas, especially when considering mobile fauna such as birds. It may be important to note the number of observation points used over the areas. These varied, and might be expected to influence the number of birds seen in each area. The sampling design was created to address the configuration of the areas, and so although Area 1 is not the largest area, it is the least compact. Area 4 was the most regular in shape, and it was believed that four observation points would suffice to adequately cover all of the marsh at that area. Area 3 was considerably smaller than the other areas, and so had the fewest number of sampling points. Table 64 details the sampling intensity for each Area.

Table 64. Total number of point counts per area.

Area	# of Stationary Points	# of Walking Points	Total Point Count	Area (ha)
Area 1	5	4	9	16.0
Area 2	5	4	9	18.9
Area 3	3	2	5	10.7
Area 4	4	3	7	18.5

Unfortunately, some critical errors were made in the first two years of the bird sampling. Most importantly, the sampling protocol regarding sampling effort was not strictly adhered to, and in 2004 and 2006 winter sampling was not accomplished.

Samplers in 2004 overenthusiastically visited Area 1, but did not give the same degree of attention to the other Areas (although they were monitored) (see Table 65). Therefore, and because there are indications in the literature that quantifications of mobile organisms based on relatively short duration visits when other factors may affect observed numbers, this report will focus on the species of birds observed over the monitoring, and mostly discuss summer bird

species (this were better documented in terms of both pre-treatment and post-treatment conditions).

Table 65. Bird Survey Effort

Season	Dates	Area 1	Area 2	Area 3	Area 4
2004					
Winter	January 1 – March 31	-	-	-	-
Summer	June 1 – August 31	2	1	1	2
2005					
Winter	January 1 – March 31	3	3	3	3
Summer	June 1 – August 31	26	6	9	7
2006					
Winter	January 1 – March 31	-	-	-	-
Summer	June 1 – August 31	3	3	3	3
2007					
Winter	January 1 – March 31	3	3	3	3
Summer	June 1 – August 31	3	3	3	3
	Total Surveys	**40**	**19**	**22**	**21**

A total of 52 identified species of birds and 4 generally identified birds (identified to type) were observed (Table 66). Only 8 species were only seen in winter. The species diversity seen in each Area varied from year to year (Table 67). It is possible that the data suggests species diversity increased in the treatment areas following construction, although there is not enough comparable data to stress the point. The most commonly encountered species in all four areas were the marsh wren and red-winged blackbird.

An effort was made to incorporate some of the quantitative data in a meaningful way. Characteristic marsh species that were seen in more than one area, usually in multiple years, were identified (Table 68). The counts of each bird were converted into a percentage of all birds observed across the Area, in an attempt to minimize the effects of the unequal sampling efforts in 2004 and 2005. These created "characteristic assemblages" for each Area for each summer season, which were weighted by the relative frequency of observations of individual birds. A PCA of these data was created, using the 13 species as the variables defining each Area each year. The first two axes of the PCA accounted for 45.3 percent of the data variance: not good exceptionally in terms of general models of the variance, but is understandable given that there were 13 variables considered; the next three axes accounted for just over 30 percent of the variance, which suggests the first two axes are dominant in terms of generally explaining the data sets. The data were plotted in terms of the components and the first two axes (Figure 65 and

Figure 66). These plots show that the first year after treatment seemed to generate bird assemblages that were different from those seen before the treatment. In the case of Area 1, the bird assemblages returned to the patterns generally seen for 2004 and also for Area 3 and Area 4, generally. Area 2 assemblages were somewhat different than those seen for the other Areas, but those post-treatment were different than those pre-treatment.

Table 66. Species list of birds observed on Areas 1-4 at Wertheim National Wildlife Refuge during summer 2004 (May 20 - July 5), winter 2005 (January 10 - March 10) surveys, summer 2005 (June 1 - August 31), summer 2006 (June 14 – July 7), winter 2007 (March 13-14), and summer 2007 (July 2 – August 14).

Common Name	**Latin Name**	**Season Observed**
American black duck	*Anas rubripes*	W[2]
American bittern	*Botarus lentiginosus*	S[2]
American crow	*Corvus brachyrhyncos*	W, S[2,3,4]
American goldfinch	*Carduelis tristis*	S[2,4]
American robin	*Turdus migratorius*	S[4]
American tree sparrow	*Spizella arborea*	S[3,4],W[2]
American wigeon	*Anas Americana*	W[2]
Barn swallow	*Hirundo rustica*	S
Belted kingfisher	*Megaceryle alcyon*	S[2]
Black-capped chickadee	*Poecile atricapilla*	W[2]
Black-crowned night heron	*Nycticorax nycticorax*	S[1]
Black Skimmer	*Rynchops niger*	S[3]
Boat-tail grackle	*Quiscalus major*	S[2]
Canada goose	*Branta canadensis*	S[1], W[2]
Common yellowthroat	*Geothlypis trichas*	S[1,2]
Unknown crow		S[2]
Dunlin	*Calidris alpina*	S[4]
European starling	*Sturnus vulgaris*	W[2], S[2]
Fish crow	*Corvus ossifragus*	S[2,3]
Gadwall	*Anas strepera*	S[1]
Great blue heron	*Ardea herodias*	W[2], S[2,4]
Gray catbird	*Dumetella carolinensis*	S[2]
Great egret	*Casmerodius albus*	S[2,3,4]
Green heron	*Butorides striatus*	S[2]
Greater yellowlegs	*Tringa melanoleuca*	S[2]
Green-winged teal	*Anas crecca*	W[4]
Herring gull	*Larus argentatus*	S[2,3]
Hooded merganser	*Lophodytes cucullatus*	W[2]
Killdeer	*Charadrius vociferus*	S
Least sandpiper	*Calidris minutilla*	S[2,3,4]
Least tern	*Sterna albifrons*	S[2]
Lesser yellowlegs	*Tringa flavipes*	S[2,3,4]
Mallard	*Anas platyrhynchos*	S

Common Name	Latin Name	Season Observed
Marsh wren	*Cistothorus palustris*	S, W
Mourning dove	*Zenaida macroura*	S[4]
Northern harrier	*Circus cyaneus*	W[2,4]
Osprey	*Pandion haliaetus*	S
Palm warbler	*Dendroica palmarum*	S[2]
Pied-billed grebe	*Podilymbus podiceps*	W, S[2]
Unknown peep		S[2]
Pectoral sandpiper	*Calidris melanotos*	S[2]
Red-winged blackbird	*Agelaius phoeniceus*	S, W
Rough-legged hawk	*Buteo lagopus*	W[2]
Savannah sparrow	*Passerculus sandwichensis*	W[2]
Short-billed dowitcher	*Limnodromus griseus*	S[2]
Short-eared owl	*Asio flammeus*	W[2]
Semipalmated plover	*Charadrius wilsonia*	S[2,4]
Seaside sparrow	*Ammospiza maritima*	S
Snowy egret	*Egretta thula*	S[2,3,4]
Solitary sandpiper	*Tringa solitaria*	S[2]
Song sparrow	*Melospiza melodia*	S, W[2]
Swamp sparrow	*Melospiza georgiana*	W[2]
Unknown sparrow		S
Spotted sandpiper	*Actitis macularia*	S[2]
Saltmarsh sharp-tailed sparrow	*Ammospiza caudacuta*	S
Tree swallow	*Iridoprocne bicolor*	S[1,3,4]
Virginia rail	*Rallus limicola*	S[2]
Willet	*Catoptrophorus semipalmatus*	S
Unknown yellowlegs		S[2]
Yellow warbler	*Dendroica petechia*	S[1]

[1] = Observed during 2004 survey; [2] = Observed during 2005 survey, [3] = Observed during 2006 survey
[4] = Observed during 2007, W=winter; S=summer (if no designation, seen all four summers or both winters)

Table 67. Bird Species Diversity Observed in Summer Monitoring

Area	Summer 2004	Summer 2005	Summer 2006	Summer 2007
1	11	33	12	17
2	7	13	12	18
3	8	10	6	13
4	15	18	8	9

Table 68. Characteristic marsh birds observed across Wertheim National Wildlife Refuge

Year	Area	COYE	GRBH	GREG	KILL	LESA	LEYE	MAWR	RWBL	SAND	SESP	SNEG	SSTS	WILL
2004	1	X		X	X			X	X				X	X
	2							X	X		X		X	X
	3	X						X	X		X		X	X
	4	X		X				X	X		X		X	X
2005	1	X	X	X	X	X	X	X	X		X	X	X	X
	2			X		X	X	X	X		X		X	X
	3	X				X	X	X	X		X		X	X
	4	X				X		X	X		X		X	X
2006	1			X	X	X		X	X			X	X	X
	2			X	X	X		X	X			X	X	X
	3			X				X	X				X	X
	4							X	X				X	X
2007	1		X	X		X	X	X	X		X	X	X	X
	2		X	X	X	X	X	X	X	X	X	X	X	X
	3			X		X	X	X	X	X		X	X	X
	4					X		X	X		X		X	

COYE: common yellowthroat; GRBH: great blue heron; GREG: great egret; KILL: killdeer; LESA: least sandpiper; LEYE: lesser yellowlegs; MAWR: marsh wren; RWBL: red-winged blackbird; SAND: sanderling; SESP: seaside sparrow; SNEG: snowy egret; SSTS: salt marsh sharp-tailed sparrow; WILL: willet

Figure 65. PCA of Characteristic Bird Species (data plotted by year)

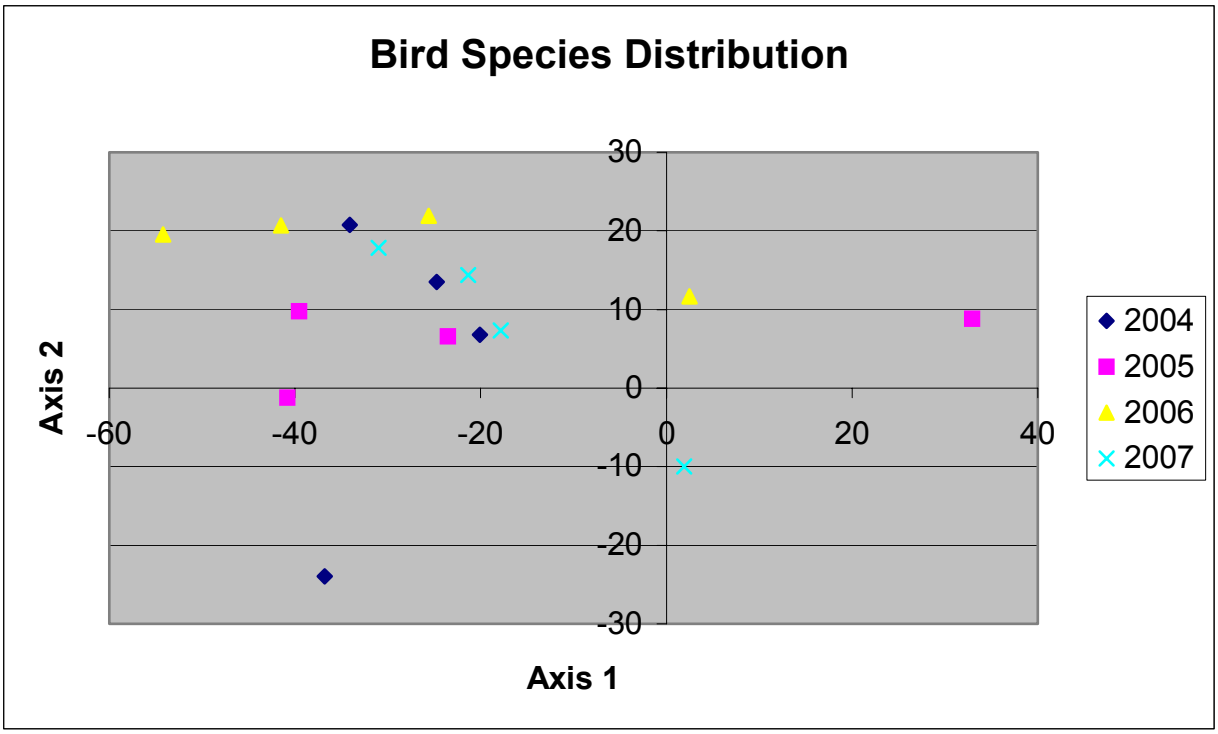
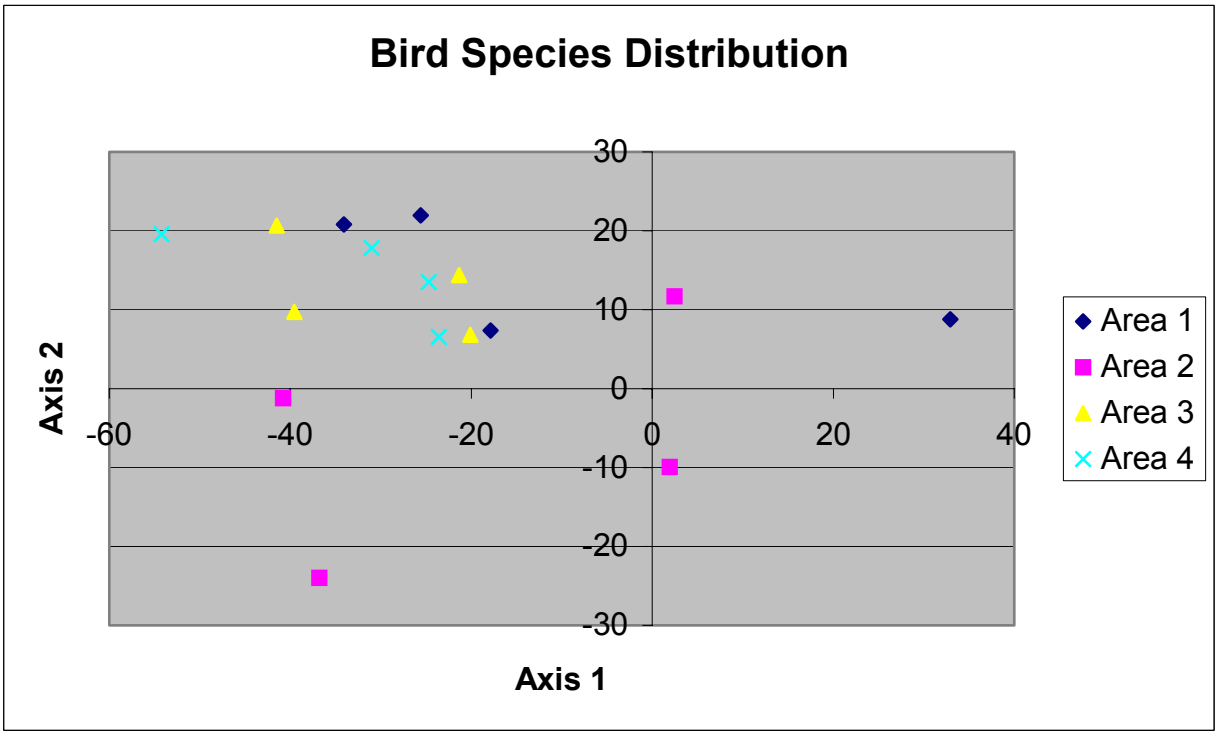


Figure 66. PCA of Characteristic Bird Species (data plotted by Area)



Observations reported by samplers during times other than the formal bird surveys support the contention that there was a shift in bird species post-treatment compared to pre-treatment and the control sites. Predominantly, shore birds exploited new habit in the muddy and lightly vegetated areas that were created post-construction. These birds foraged extensively, and, when these areas were more heavily vegetated in 2006 (the second season post-construction) there use of the Area diminished. There were also more water birds generally across the treatment areas, foraging and resting in the ponds, particularly.

5.2.4.2.2 Rare, Threatened, and Endangered Species

Seven species of special concern were observed during the monitoring program:

- Short-eared owl (*Asio flammeus*) – During the winter 2005 surveys, a total of three short-eared owls were observed during the surveys (two in Area 2 and one in Area 3). However, during the 2007 winter survey none where observed and because these were the only two surveys conducted during the winter months, this report can not analyze with any certainty the impacts that may have resulted from the project.

- Pied-billed grebe (*Podilymbus podiceps*) – This is a periodic winter inhabitant to Wertheim; one was observed during the 2005 winter survey. It was observed in control Area 4 and therefore no impact was expected as a result of project actions.

- Bald eagle (*Haliaeetus leucocephalus*) – Although, no bald eagles were recorded during the bird surveys, an immature eagle was observed in the general vicinity during construction times in the early spring of both 2005 and 2006.

- Northern harrier (*Circus cyaneus*) – This species was found in all four areas during the 2005 winter surveys and in Areas 1 and 2 during the 2007 winter surveys. Unfortunately, these were the only surveys conducted during the winter months and therefore, this report can not analyze with any certainty the impacts that may have resulted from the project.

- Osprey (*Pandion haliaetus*) – There were two established osprey nest located within proximity to the project area (one in the southern section of Area 1 and one in the impoundment located near Areas 2 and 3). Both of these nests were occupied during

breeding and fledgling periods and therefore no impacts were associated with the project. Also, as part of the project in early spring of 2006 an additional nesting pole was installed on the upland side of the northern section of Area 1. During the summer of 2006 a partial nest was observed at this location.

- Black skimmer (*Rynchops niger*) – During pre-construction monitoring, no black skimmers were observed utilizing any of the four project areas. However, during the 2006 summer surveys a back skimmer was observed skimming the surface water of the newly created ponds in both Area 1 and Area 2.

- Seaside sparrow (*Ammodramus maritimus*) – During the 2004 and 2005 summer surveys, seaside sparrow were observed utilizing all four project areas. However, during the 2006 summer surveys no seaside sparrows were observed in any of the four project areas. This discrepancy in observations is believed to be a consequence of changing observers, as the constant presence of the seaside sparrow in all four areas during the surveys of the prior two years makes it less likely that no seaside sparrows utilized the areas in 2006. A greater effort was made to distinguish seaside sparrows in 2007, and they were observed in Area 1, Area 2, and Area 4 in 2007.