MILL BROOK SALT MARSH
YEAR 5 POST-RESTORATION MONITORING
& PROJECT SUMMARY REPORT

MILL BROOK, SCARBOROUGH, MAINE

June 2010

Prepared for:

United States Fish & Wildlife Service – Gulf of Maine Program
Friends of Scarborough Marsh

Prepared by:

TETRA TECH

451 Presumpscot Street
Portland, ME 04103

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1.0 INTRODUCTION

The Scarborough Marsh Planning Team (SMPT) has conducted salt marsh restoration activities along Mill Brook, in the Scarborough Marsh Wildlife Management Area, in Scarborough, Maine (Figure 1). SMPT comprises Friends of Scarborough Marsh (FSM), United States Fish and Wildlife Service (USFWS), Maine Department of Inland Fisheries and Wildlife (MDIFW), United States Department of Agriculture – Natural Resources Conservation Service (NRCS), Conservation Law Foundation, and Ducks Unlimited, Inc.

1.1 PROJECT GOALS

The primary goals of SMPT's restoration efforts at the Mill Brook Salt Marsh Restoration Monitoring Project (Project) site were to:

- Increase the amount of pool habitat on the marsh surface to pre-ditch conditions;
- Reduce pooling of freshwater on the marsh; and,
- Eliminate the invasive plant *Phragmites australis* (*Phragmites*) populations from several sections of the marsh that were formerly dominated by *Spartina patens*, and minimize the potential for *Phragmites* to re-populate the marsh.

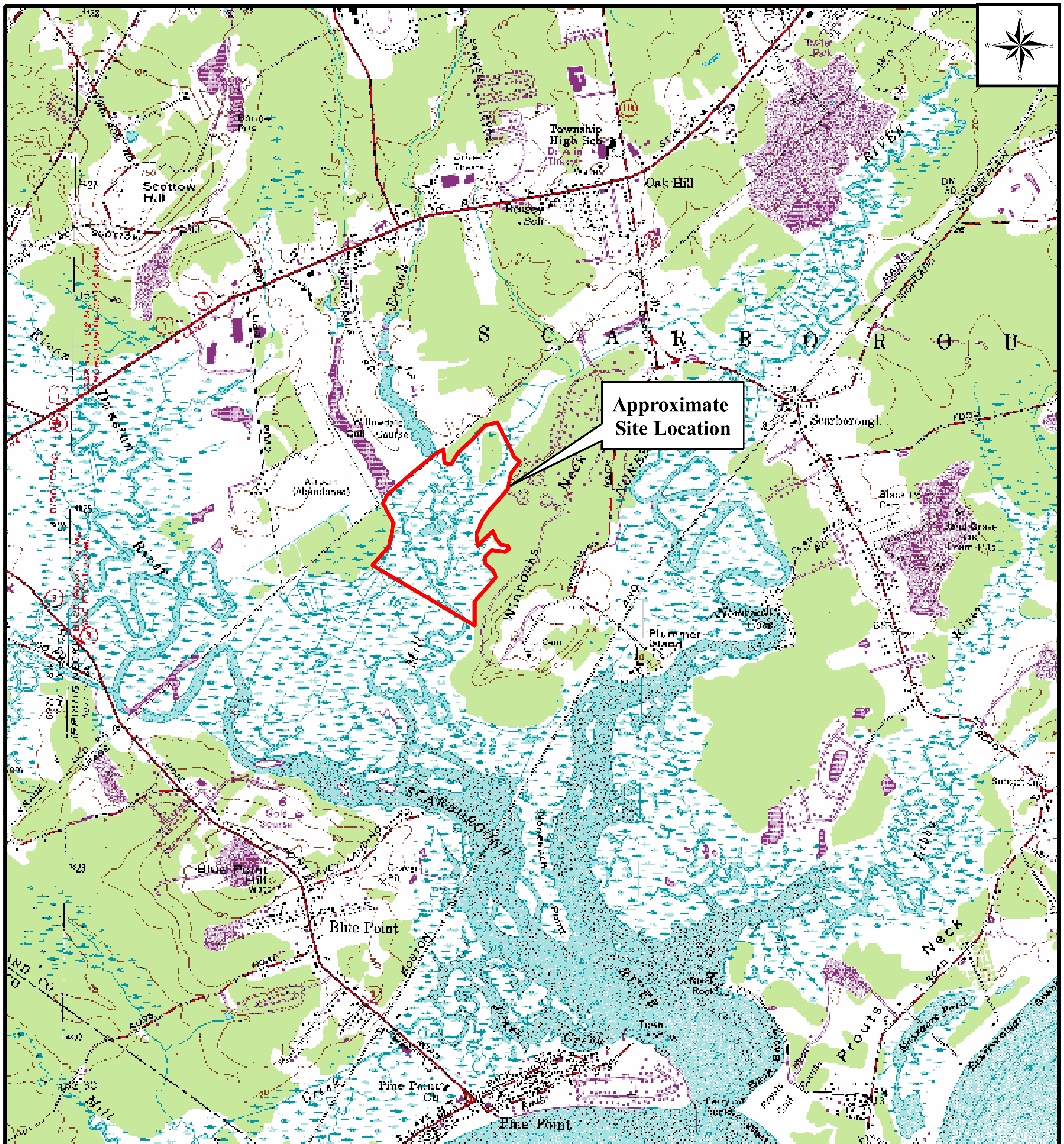
To accomplish these goals, restoration activity at Mill Brook included the following components:

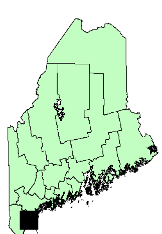
- Plugging man-made ditches to restore hydrology to the marsh surface;
- Excavating a new ditch and clearing out two existing ditches to minimize freshwater pooling in the northern portion of the marsh;
- Removing one short berm that currently impedes water flow to that area of the marsh; and,
- Controlling *Phragmites* in various areas of the marsh via the application of an herbicide (i.e., Rodeo).

Restoring natural salt marsh conditions and improving hydrological conditions will allow native salt marsh dependant species (i.e., fish, invertebrates, waterbirds, shorebirds, wading birds, waterfowl) to be reestablished and/or to increase in number.

1.2 ADDITIONAL WATER QUALITY ANALYSIS

Following completion of initial pre-restoration monitoring activities in 2003, the USFWS identified eight additional sampling locations for water quality analysis. The water quality analysis was conducted to help understand the composition of runoff as it enters along the upland edge of the marsh, after filtration by the marsh, and as it moves downstream and mixes with tidal water. The additional water quality analysis was designed to answer the following questions:





Source: USGS 7.5' Series Topographic Quadrangle
Prouts Neck 1957 Photorevised 1978;
Old Orchard Beach 1956 Photorevised 1970.

450 225 0 450 900 Meters

1,700 850 0 1,700 3,400 Feet

Figure 1. Site Location Map for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

Client: Friends of Scarborough Marsh & U.S. Fish & Wildlife Service

Prepared By: TETRA TECH, INC.

Date: 12/09

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1. Potential toxic effect of the runoff constituents: Is the runoff from up-gradient residential areas and Willowdale Golf Course likely to have an adverse effect on ecological receptors?

2. Potential filtration function being performed by the marsh: Is the upper marsh boundary currently providing an important filtration function for the runoff; a function that would be lost if the runoff were allowed to discharge directly to tidal creeks rather than pool along the upland boundary of the marsh surface?

1.3 MONITORING EFFORT

To assist in this effort, Tetra Tech, Inc. (formerly Northern Ecological Associates, Inc.) was contracted by the FSM to conduct pre- and post-restoration monitoring of an approximately 14.0-acre portion of the Scarborough Marsh Wildlife Management Area along Mill Brook. Monitoring activities were designed following the USFWS's *Salt Marsh Restoration Monitoring Plan for Ditch-Plugging Efforts in New England Marshes* (*Monitoring Plan*) (USFWS 2001) and the United States Geological Survey's *Monitoring Nekton in Shallow Estuarine Habitats* (Raposa and Roman 2001).

This Project Summary Report presents data gathered as part of pre- and post-restoration activities for the Project and includes a brief discussion of monitoring methodology (Section 2.0), a results and discussion section for pre- and post-restoration analyses (Section 3.0), and a management implication and recommendations section (Section 4.0). Also included are, a cover type map of the project area (Appendix A), completed site evaluation data forms (Appendix B), photographic documentation (Appendix C), water level data (Appendix D), statistical analysis results (Appendix E), field notes (Appendix F), and a list of wildlife species observed during monitoring activities (Appendix G).

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2.0 METHODS

Tetra Tech biologists conducted pre-restoration monitoring in 2003 and 2004, and post-restoration monitoring in 2006 (Year 2) and 2009 (Year 5) (FSM 2003, 2004, and 2006). Monitoring methods were selected based on the *Monitoring Plan* (USFWS 2001) and the United States Geological Survey's *Monitoring Nekton in Shallow Estuarine Habitats* (Raposa and Roman 2001), and modified as described below to account for site- and Project-specific conditions. Tetra Tech biologists identified three monitoring pool/panne complexes to monitor: Control Pool, Experimental Pool 1, and Experimental Pool 2, as shown in Figure 2.

Monitoring activities included preparing a cover type map; completing a site evaluation, which included a site assessment, vegetation monitoring, nekton sampling, and mosquito sampling; photographic documentation of site conditions; water level monitoring; and, nutrient load analysis. Additional water quality and fecal coliform sampling was added in 2004 to complete the pre-restoration sampling work. Table 1 provides the timeline and frequency for the monitoring activities performed in the Project area.

Table 1. Monitoring Activities Performed for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

Monitoring Activities		Pre-Restoration 2003	Pre-Restoration 2004	Post-Restoration Year 2 2006	Post-Restoration Year 5 2009
Cover Type Mapping		X			X
Site Evaluation	**Site Assessment**	X		X	X
	Vegetation Monitoring	X			X
	Nekton Sampling	X		X	X
	Mosquito Sampling	X		X[1]	X
	Photo Documentation	X		X	X
Water Level Monitoring		X		X	
Nutrient Load Analysis		X			
Additional Water Quality Analysis*			X		

* Includes analysis for sediment, calcium, magnesium, hardness, 13 U.S. Environmental Protection Agency Priority Pollutants, and fecal coliform bacteria.

The following sections provide a summary of the techniques used during monitoring activities at Mill Brook.

[1] Two additional mosquito sampling events were conducted in July and September 2007 to supplement the data collected during Year 2 post-restoration monitoring; the sampler conducting monitoring for one of the events in 2006 was unaware of the post-restoration sampling locations in the Experimental Pools, and the desired tidal conditions for sampling were not present again until too late in the season to capture these data in the same year.

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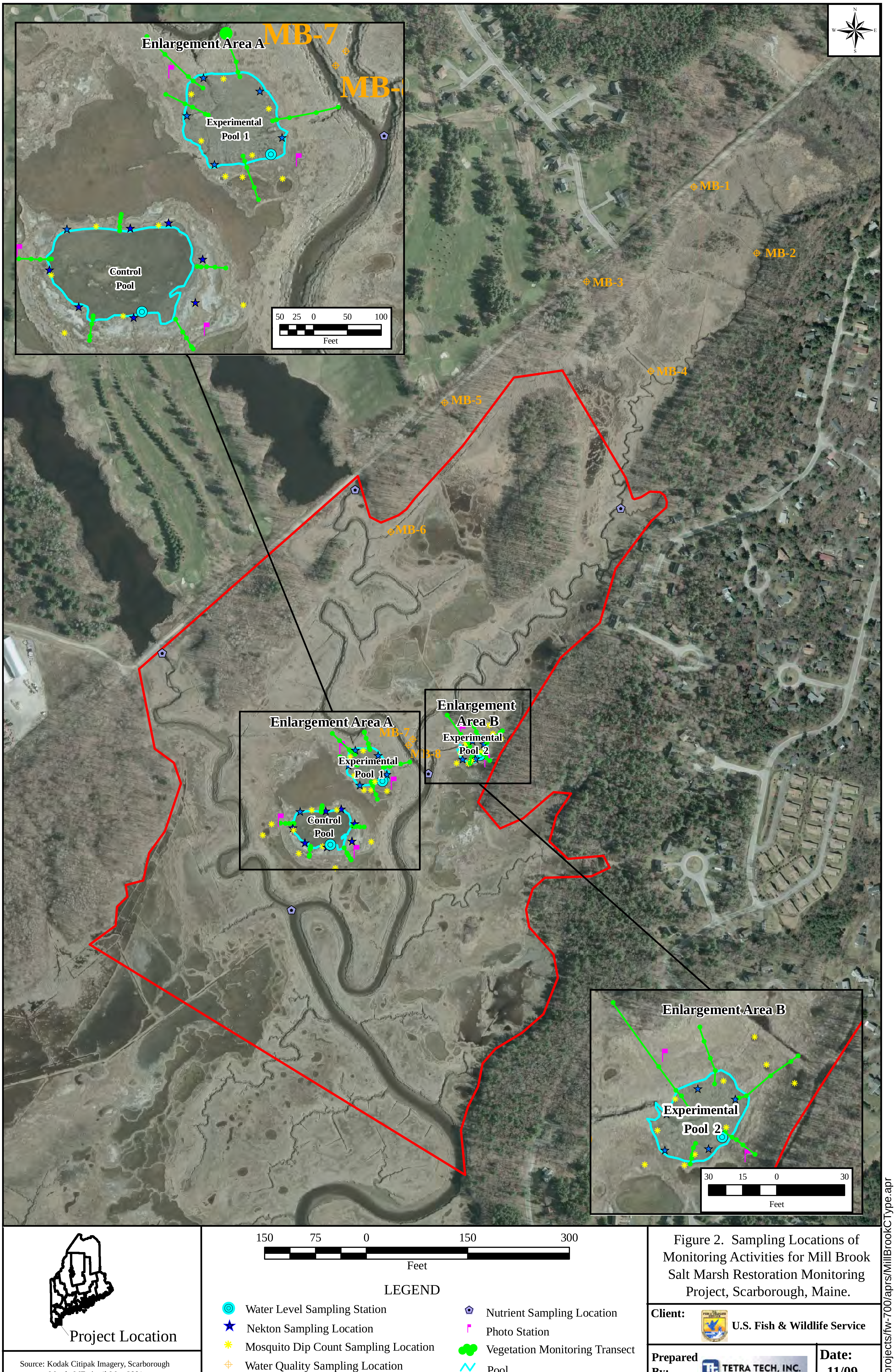

Figure 2. Sampling Locations of Monitoring Activities for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

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2.1 COVER TYPE MAP

The pre-restoration cover type map was generated for the Project area based on a review of digital ortho-quads, aerial photographs, and observations made during site visits in July through October 2003. Changes to cover type classification and boundaries on the pre-restoration cover type map were approximated based on a visual assessment of the site conditions during a site visit in September 2009 to generate the post-restoration cover type map.

Each unique community greater than 50 m^2 was delineated and mapped using ARCView/ARC/INFO® GIS software (Environmental Systems Research Institute, Inc. [ESRI] 1982, 1996). A more rigorous mapping effort was conducted in areas within 75 m around the three panne/pool complexes selected for intensive monitoring. In these areas, unique communities greater than 10 m^2 were delineated and mapped; additional level of detail was included, where noted, however the minimum mapping unit is 10 m^2. To assist in cover type mapping, where necessary, the boundaries of cover types were recorded using a Trimble Pro-Mark IV Global Positioning System (GPS).

The dominant vegetated wetland communities and invasive plants such as *Phragmites australis* were differentiated and mapped. Significant site features were also recorded on the cover type map, including pools, pannes, tidal creeks, and upland forest.

2.2 SITE EVALUATION

Pre- and post-restoration site conditions were established by performing a site evaluation in 2003 pre-restoration, and Year 2 (2006) and Year 5 (2009) post-restoration. Site evaluations included completion of a variety of tasks, as outlined in Table 1. In general, the site evaluations were focused on the areas surrounding and including the Control Pool, and Experimental Pool #1 and #2, and included completing a site assessment, nekton sampling, and mosquito sampling; and, photographic documentation of pre- and post-restoration site conditions. Vegetation monitoring was conducted pre-restoration and in Year 5 post-restoration. The annual site evaluations were based on the procedures presented in the *Monitoring Plan* (USFWS 2001) and the United States Geological Survey's *Monitoring Nekton in Shallow Estuarine Habitats* (Raposa and Roman 2001), and modified according to specific site conditions. Figure 2 shows the approximate site evaluation sampling locations overlaid onto an aerial photograph of the marsh.

2.2.1 Site Assessment

The site assessment was conducted pre-restoration in August 2003, and in August 2006 (Year 2) and September 2009 (Year 5) post-restoration, to qualitatively assess the overall site conditions. The assessment included notation and/or observation of existing weather conditions and tidal cycle; extent of natural pools and pannes; presence of undesirable and desirable species; presence of nekton, macro-invertebrates, birds, and mammals; observation of recreational activities; and, evidence of site disturbance.

2.2.2 Vegetation Monitoring

Vegetation monitoring was conducted to characterize the major plant communities within the three monitoring areas at Mill Brook through quantitative and qualitative field measurements and observations. Pre-restoration vegetation monitoring was conducted in July and August 2003, and post-restoration vegetation monitoring was conducted in August 2009 (Year 5). A general site reconnaissance was conducted within a 75 m radius surrounding each monitoring area to develop a comprehensive species list for each unique wetland community type.

Five transects were established in each of the three monitoring areas, for a total of 15 transects, and five sampling plots were located along each transect. These fixed 1 m^2 quadrat sampling plots were used to quantify species composition and note overall plant condition in each major plant community located along a gradient from the panne/pool complex toward an adjacent upland edge. Each transect extended from the panne/pool complex outward approximately 50 m into the surrounding marsh. Wooden stakes were placed and a sub-meter accuracy GPS was used to mark and record each sampling plot location during pre-restoration vegetation monitoring; a GPS was used to navigate to and locate the sampling plot locations during post-restoration monitoring. Observers recorded plant species, approximate percent cover, and vigor for each plot, on transect data forms.

2.2.3 Nekton Sampling

Nekton sampling was conducted within each of the three monitoring areas to determine the presence/absence and relative abundance of fish and invertebrate species in the pool/panne complexes. Pre-restoration nekton sampling was conducted in August and September 2003 and post-restoration nekton sampling was conducted in August and September 2006 (Year 2), and August and October 2009 (Year 5).

Sampling methodology was in accordance with the United States Geological Survey's *Monitoring Nekton in Shallow Estuarine Habitats* (Raposa and Roman 2001) and involved use of a throw trap. The throw trap consisted of a three-dimensional aluminum frame that measured 1 m^2 and 0.5 m high. The outer surfaces of the trap were covered with a 3-millimeter mesh screen attached to the frame bars with small cable ties, and the top and bottom were left open. Nekton was removed from the trap using a 1 m by 0.5 m dip net that fit snugly within the throw trap. The dip-netting procedure was performed three times at each sampling location.

During pre-restoration data collection, nekton could not be assessed in either of the Experimental Pools because the water drained completely from these panne/pool complexes during low tide. During post-restoration monitoring however, all three of the study areas contained water and were sampled for this parameter. Nekton sampling locations were selected randomly along the perimeter of the Experimental and Control pools at eight locations in the Control Pool and five locations in each Experimental Pool. The approximate sampling locations were recorded using a GPS unit and transferred into a GIS for overlay onto an aerial photograph of the marsh (Figure 2).

2.2.4 Mosquito Sampling

Mosquito sampling was conducted to address the public interest in determining whether marsh restoration activities appear to be increasing suitable breeding habitat for mosquitoes. Pre-restoration mosquito sampling was conducted on three separate occasions during low tide conditions in August and September 2003. Post-restoration mosquito sampling was conducted in July, August, and September 2006 (Year 2)[2], July and September 2007 (Year 3), and July, August, and September 2009 (Year 5).

Mosquito sampling was conducted by using a triangular Wildco© Indestructible Dip Net. The dip net consists of an 800 x 900 micron (µm) multifilament nylon netting. Dip net sampling was conducted by sweeping the dip net at random transects of the pannes/pools. Sampling was conducted at 10 locations in or around the Control Pool and Experimental Pool 2, and at eight locations in or around Experimental Pool 1[3] Each location was swept three times to determine the presence and/or absence of mosquito larvae and relative abundance (i.e., None, Few, Common, or Many). The sampling locations were recorded using a GPS unit and transferred into a GIS for overlay onto an aerial photograph of the marsh (Figure 2).

2.2.5 Photographic Documentation

Photographic stations were established at locations around each of the three monitoring areas in order to visually document marsh surface conditions and enable comparisons between pre-restoration and post-restoration marsh surface conditions. Pre-restoration photographs were taken in August 2003, and post-restoration photographs were taken in August 2006 (Year 2) and August 2009 (Year 5).

Photographic stations were established during the 2003 pre-restoration field season at six locations across the site (Figure 2). Panoramic photographs were taken at low tide during a spring tide cycle at each photo station. The photographer noted the date and approximate compass direction of each photo. Photographic station locations were recorded using a GPS unit and transferred into a GIS for overlay onto an aerial photograph of the marsh (Figure 2).

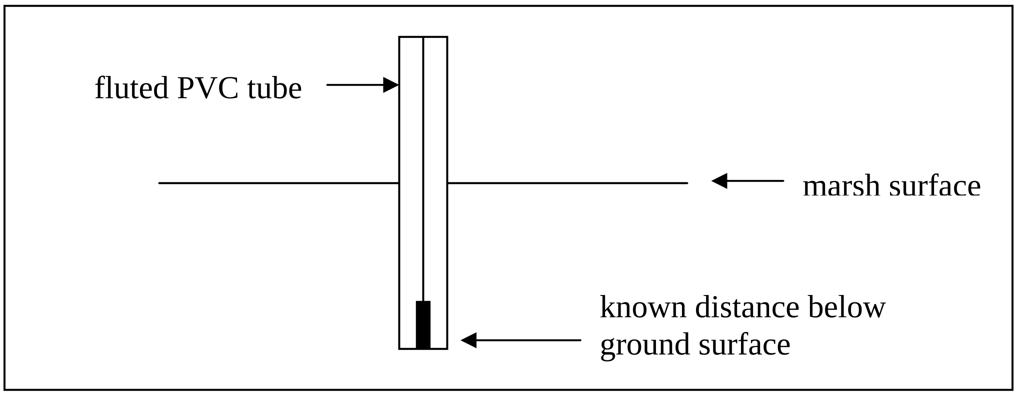
2.3 WATER LEVEL MONITORING

Water level (i.e., tidal signal) monitoring was conducted to determine the depth of flooding and duration of inundation in the three monitoring pools (i.e., Control Pool, Experimental Pool #1, and Experimental Pool #2), and allow a basic evaluation of change between pre-restoration and Year 2 (i.e., 2006) post-restoration conditions. Data were collected continuously over a minimum 4-week period consisting of one full lunar cycle of two spring and two neap tides. Water level was measured using Global Water Model WL15 pressure transducer/data loggers (Global Water 2001). Water level monitoring data loggers were placed so that the pressure-

[2] As previously mentioned, two additional rounds of mosquito sampling were conducted in July and September 2007 to supplement the data collected during Year 2 post-restoration monitoring.
[3] There were five sample locations within Experimental Pool 1, and only three pools identified in the vicinity of Experimental Pool 1 that could be sampled for mosquitoes.

sensitive probe tip was located at a known distance below the marsh surface within a fluted PVC pipe to capture data on the height of the water column above the pressure-sensitive probe tip and the duration of inundation, as shown in Figure 3.

Figure 3. Surface and Ground Water Sampling Data Recorder Set-up for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine..



Pre-construction water level monitoring was conducted during July and August, 2003. Post construction water level monitoring was conducted during July through September, 2006 (Year 2). The water level monitoring station at Experimental Pool #2 had to be reestablished because the PVC pipe had been destroyed; the replacement station was installed at a new location closer to the edge of the pool to accommodate safety concerns at the old location, which under post-restoration conditions was located in deep muck and permanent water. No water level monitoring was conducted during Year 5 post-restoration monitoring. Sampling station locations were recorded using a GPS unit and transferred into GIS for overlay onto Figure 2.

2.4 WATER QUALITY

2.4.1 Nutrient Load Analysis

Water samples were collected in order to characterize the nutrient load in runoff from developed upland areas along the northwest perimeter of the marsh. Surface water samples were collected twice during low tidal periods in August and September 2003. Sampling was conducted at five fixed locations along the marsh perimeter and significant channel intersections in order to characterize the nutrient load in runoff from developed upland areas along the northwest perimeter of the marsh (Figure 2). Water samples were collected in sterilized sample bottles for laboratory analysis. Samples were analyzed by Katahdin Analytical Services, in Westbrook, Maine, and analyzed for nitrate/nitrites, ammonia, total Kjeldahl nitrogen (TKN), total phosphorus, and total suspended solids.

2.4.2 Additional Water Quality Analysis

Following completion of initial pre-restoration water quality activities in 2003, the USFWS identified eight sampling locations for additional water quality analysis in order to understand the potential toxic effect of the runoff constituents and the potential filtration function being performed by the marsh (Figure 2). Three of these sampling locations (i.e., MB-1, MB-3, and MB-5) are located at culverts that drain under the Old Eastern Road, and contain runoff from residential areas and the Willowdale Golf Course. The remaining five sampling locations are located down-gradient from sampling locations MB-1, MB-3, and MB-5.

The water quality analysis was designed to evaluate the composition of runoff from upland areas along the northwest perimeter of the marsh, after filtration by the marsh, and as it moves downstream, through Mill Brook, mixing with tidal water. Water samples were analyzed for sediment, calcium, magnesium, hardness; the 13 United States Environmental Protection Agency (USEPA) Priority Pollutants (i.e., Sb, As, Be, Cd, Cr, Tl, Zn, Cu, Pb, Hg, Ni, Se, and Ag); and, fecal coliform bacteria. Analysis of water samples was divided into a general water quality analysis and fecal coliform analysis.

Water Quality Analysis

Water samples were collected at eight sample locations (Figure 2) on August 3, August 12, and September 16, 2004. Dry weather conditions were observed leading up to the August 3 and September 16 sampling events. The August 12 sampling event was following a >0.5 inch rain event in the watershed. All water samples were collected during an outgoing tide; samples collected during the August 12 event were collected approximately 1–3 hours after high tide, and samples collected during the August 3 and September 16 events were collected during an outgoing low tide.

Water samples were collected in sterilized sample bottles for laboratory analysis by Katahdin Analytical Services, in Westbrook, Maine, and analyzed for total suspended solids, calcium, magnesium, the USEPA Priority Pollutants, and hardness. Results were analyzed with the assistance of Woodard & Curran, of Portland, Maine.

Fecal Coliform Analysis

Water samples were collected in sterile Whirl-Pak bags for fecal coliform analysis on August 3, August 12, and September 16, 2004. Water samples were collected and analyzed within 24 hours by the Maine Department of Marine Resources (DMR), Shellfish Sanitation Program Laboratory, in West Boothbay Harbor, Maine. These results were analyzed with the assistance of the DMR, Shellfish Sanitation Program staff.

2.5 ADDITIONAL PROJECT INFORMATION

Field notes were recorded during field sampling activities, and list of species observed during field sampling activities was maintained during each year of monitoring. Species observations collected during monitoring activities are anecdotal observations, and are intended to provide additional information, and do not represent qualitative data collection. Additionally, these data are collected by individuals with a range of expertise in the identification of birds and wildlife, and therefore represent only a partial list of the species that may actually be using the Project area.

3.0 RESULTS AND DISCUSSION

This section describes the results collected during pre- and post-restoration monitoring, and discusses these results and potential causes contributing to the changes observed. In order to evaluate environmental impacts over time, but incorporate some sense of whether any changes are due to natural variability or due to the restoration activities, the Before-After, Control-Impact (BACI) study design was used. Data were collected at two Experimental Pools (Experimental Pool #1 and #2) and one Control Pool, and were collected before and after the restoration activities were implemented. Statistical analysis also was performed on the vegetation, nekton, and mosquito data sets, as described in the following sections, in order to reveal trends and determine the statistical significance of any observable changes.

Statistics were used to evaluate the data in several ways. In each case, the data was not assumed to be normal. For comparisons of two independent groups that are nonparametric, the Wilcoxon Rank Sum test (also known as the Mann-Whitney U test), 2-sample test with normal approximation, was used. The Kruskal-Wallis nonparametric one-way analysis of variance (ANOVA), Chi-square approximation, was used when the data were compared in groups of more than two. Additionally, the Tukey-Kramer HSD (honestly significant difference) test was used to compare group means. Tukey-Kramer HSD uses an adjusted *t test* to perform a modified comparison of means to control for error, and protects from falsely declaring two means significantly different (Sall and Lehman 1996).

3.1 COVER TYPE MAP

During pre-restoration monitoring, three primary vegetated wetland communities were differentiated and mapped. Unique wetland communities included *Spartina alterniflora*-dominated herbaceous saltmarsh, *Spartina patens*-dominated herbaceous saltmarsh, and *Juncus gerardii*-dominated herbaceous saltmarsh. A *Spartina alterniflora/Spartina patens* mixed community was identified as the dominant community. Some small areas of *Phragmites australis*, an invasive plant community, also were identified and mapped. The pool/channel community type includes the Control Pool, and Experimental Pool #1 and #2, although the Experimental Pools drained to mudflat at lowtide.

The post-restoration cover type map focused on changes that were in the vicinity of the monitoring efforts around the Control Pool and Experimental Pools, which is shown in detail on the Year 5 post-restoration cover type map (Appendix A). In addition to the unique wetland communities identified during pre-restoration activities, three small community types were identified during post-restoration monitoring: a *Typha* species community, a mixed vegetation community, and a panne community. Each of these new communities made up 0.2% or less of the area, and represented an overall decrease, or conversion, from the *Spartina alterniflora* or *Spartina alterniflora/Spartina patens* communities in the vicinity of the monitoring activities.

The *Typha* species community is located along the western boundary of the area of detail, and is located upgradient from ditch plug activities on the western side of the channel. The development of this community may be the result of pooling freshwater along the wetland boundary that is no longer able to drain from the marsh with the construction of the ditch plug near to these communities.

The panne community is located west of pool that is located between the Control Pool and Experimental Pool #1, and east of ditch plug activities where the new *Phragmites* communities have become established. It is possible that with the increase in groundwater levels resulting from ditch plugging activities, the *Spartina alterniflora* community experienced reduced aerobic restoration by the roots, and subsequently died off, creating panne habitat. However, this theory has not been confirmed.

The mixed community is a very small polygon located in the area where ditch plugging activities occurred for Experimental Pool #1, and had no clear dominant species. It is possible that the material placed for creation of the ditch plug in this location had a more diverse seed bank, and provided opportunity for less dominant species to take hold on the marsh in this location.

The cover type maps indicated that the pool/channel community around the Experimental Pools increased slightly from pre-restoration to post-restoration conditions. However, the true increase in permanent pool habitat is greater than what is reflected in Table 1, since the pre-restoration cover type did not differentiate between the pool and low tide mudflat habitat conditions present in the Experimental Pools at the time of pre-restoration activities. The Experimental Pools now provide permanent pool habitat as a result of the restoration work. Pre-restoration and Year 5 post-restoration cover type maps are included in Appendix A.

Table 2. Approximate Percent Area Change of Community Types Pre-Restoration Compared to Year 5 Post-Restoration Monitoring for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

Community Type	**Pre-Restoration (percent)**		**Post- Restoration (percent)**		**Change (percent)**
	Acres	Percentage	Acres	Percentage	
Spartina alterniflora	14.9	11.9%	13.9	11.1%	-0.8%
Spartina alterniflora /Spartina patens	65	51.9%	64.5	51.5%	-0.3%
Spartina patens	2.2	1.8%	2.7	2.2%	+0.4%
Juncus gerardii	0.9	0.8%	1.3	1.0%	+0.2%
Typha species	--	0%	0.3	0.2%	+0.2%
Mixed Community	--	0%	<0.1	<0.1%	+<0.1%
Phragmites australis	<0.1	<0.1%	0.1	0.1%	+0.1%
Pool/channel	26.9	21.5%	27.0	21.6%	+0.1%
Panne	--	0%	0.2	0.2%	+0.2%
Upland Forest	15.2	12.2%	15.2	12.2%	0%
Total of All Cover Types	**125.1**	**100%**	**125.1**	**100%**	

3.2 SITE EVALUATION

The site evaluations were used to compare observations of pre-restoration conditions with post-restoration conditions on the marsh surface. The site evaluation included completing a site assessment, vegetation monitoring, nekton sampling, and mosquito sampling (Appendix B), and photographic documentation of pre- and post-restoration site conditions (Appendix C).

3.2.1 Site Assessment

Site assessment observations, comparing pre-restoration and post-restoration conditions are summarized below. See Appendix B for the completed site assessment forms.

- Pre-restoration site assessment revealed poor hydrologic conditions in the two pools identified for ditch plugging restoration work, including inadequate water retention in the pools and lack of nekton habitat. No undesirable plant species were present in the vicinity of the monitoring areas, however some *Phragmites australis* was present along the marsh margins outside of the monitoring area and was noted in the cover type map. Desirable plant species that were present in the monitoring area include *Spartina patens*, *Spartina alterniflora*, and *Juncus gerardii*.
- During the Year 2 site assessment, the pools and ditch plugs were evaluated for growth of desirable species, plant health/vigor, obvious loss of aerial coverage or plant density, and evidence of water flow or leakage. In general, all the ditch plugs around the Experimental Pools were structurally sound, and had revegetated with desirable species. However, the plywood used in creating the ditch plug was exposed at each of the ditch plugs, by as much as 6-inches. There were some new minor drainage channels that had formed around the ditch plugs, but these were not anticipated to compromise the stability or soundness of the ditch plugs.
- Based on the final site assessment conducted in Year 5 post-restoration, the ditch plugs (Ditch Plugs #1, 1A, 2, and 12) were no longer discernable from the surrounding marsh, and there was no obvious evidence of the plywood used in creating the ditch plugs. The ditch plugs had revegetated with desirable species, and no invasive species were present. As noted during the Year 2 site assessment, the minor drainage channels that had formed around the ditch plugs were still present, but these did not appear to be compromising the stability, function, or soundness of the ditch plugs.
- The pools excavated to provide material to create the ditch plug were difficult to discern from natural pools, but where possible or believed to be present, the excavated pools appeared to be stable, support fish populations, had intact edges and were retaining water, and had apparent water quality that was typical of a salt marsh pool. Both of the Experimental Pools, which are now permanent pools, appeared to have increased in aerial extent from pre-restoration high tide conditions. The Experimental Pools appeared to have stable edges, were observed to support fish and nekton, and appeared to have adequate water quality.
- Natural pools and pannes appear to be stable, with typical conditions and species present. There appeared to be some additional panne habitat west of Experimental Pool #1 in the area east of Ditch Plugs #3A and 3B that may be associated with increased groundwater levels behind those ditch plugs.

- Undesirable species presence has increased slightly from pre-restoration conditions:
  - *Phragmites* was observed, as noted on the cover type map, in association with the Ditch Plugs #3A and 3B.
  - *Typha* was also observed at the upper edge of the marsh in the vicinity of Ditch Plug #31, as noted on the cover type map.
- Desirable species appear healthy and vigorous, and not decreasing in cover, with the exception of the minor addition of undesirable species, as noted on the cover type map.

3.2.2 Vegetation Monitoring

Control Pool – Pre-restoration (i.e., 2003) conditions of the vegetative community in the vicinity of the Control Pool were variable. The plot closest to the center of the pool for each transect was originally placed in pool/panne habitat, and these plots were dominated by bare ground (55–100%). Vegetative communities moving outward from the pool center, between 10 and 30 m, varied in composition but two species, saltwater cordgrass (*Spartina alterniflora*) (10–55%) and salt hay grass (*Spartina patens*) (2–95%), and a variety of other species to a lesser degree.

In Year 5 (i.e., 2009) post-restoration, the bare ground coverage in the first two plots of the Control Pool transects increased, with only two of the first two plots along the transect having less than 42% bare ground coverage. Overall the amount of bare ground appeared to have increased post-restoration in the vicinity of the Control Pool, compared to pre-restoration conditions.

Experimental Pool 1 – Pre-restoration conditions of the vegetative community in Experimental Pool #1 varied with distance from the pool. Similar to the Control Pool, the plots closest to the pool center were predominantly bare ground (55–95%), and vegetative communities moving outward from the pool between 10 and 30 meters from the first plot were composed of salt hay grass (5–100%) and saltwater cordgrass (1–90%). Detritus coverage ranged from 5–75% in these areas. The vegetative communities furthest from the pool (30–50 m) were composed of black grass (10–99%), salt grass (*Distichlis spicata*) (3–45%), and saltwater cordgrass (5–85%).

In Year 5 Post-restoration vegetative monitoring, the bare ground coverage increased in Experimental Pool #1 in the vegetation plots up to approximately 30 meters from the first plot along each transect as compared to pre-restoration conditions. This appears to be the result of the pool increasing in size with the restoration of permanent pool habitat. The vegetative coverage moving further from the pool center was dominated by a mix of saltwater cordgrass (35–80%) and salt hay grass (1–95%), and salt grass (5–99%) was also commonly present in the areas furthest from the pool center.

Experimental Pool 2 – Pre-restoration conditions of the vegetative community in Experimental Pool #2 varied with distance from the pool. Similar to the Control Pool, the plots closest to the pool center were predominantly bare ground (60–98%). Vegetative communities between 10 m and 30 m from the first plot were covered with varying percentages of saltwater cordgrass (1–80%) and salt hay grass (5–99%). The furthest plots, greater than 30 meters from the pool center were made up of a more diverse species compositions, which included black grass (35–80%), salt grass (5–30%), and salt hay grass (5–90%). Detritus was also present in each of these plots and varied in coverage (10–35%).

In Year 5 Post-restoration vegetative monitoring, the extent of Experimental Pool #2 observably expanded, resulting in an increase in bare ground (i.e., in this case non-vegetated pool habitat) in the plots located up to 30 meters from the first plot. In vegetation plots located further from the pool center, vegetative coverage was dominated by a mix of saltwater cordgrass (2–81%) and salt hay grass (1–75%).

Statistical Analysis

Vegetation data were collected pre-restoration and in Year 5 post-restoration at five plots positioned along five transects located around each the Control Pool and Experimental Pools #1 and #2. Plots established pre-restoration were relocated post-restoration using sub-meter accuracy GPS. A total of 25 vegetation plots were monitored around each of the pools. Data included the following:

- Control Pool – 25 pre-restoration data points, 25 post-restoration data points
- Experimental Pool 1 – 25 pre-restoration data points, 25 post-restoration data points
- Experimental Pool 2 – 25 pre-restoration data points, 25 post-restoration data points

The plot position related to the pool center was noted, with 1 for the plot located closest to the pool center, and 5 for the plot located furthest from the pool center. Data on species and percent cover were collected at each vegetation plot location. The following comparisons were conducted for (1) number of species and (2) percent vegetative cover:

- Compare (1) and (2) by plot position.
- Compare (1) and (2) by study area and year. (i.e., Control, Experimental #1, Experimental #2, for pre- and post-restoration)
- Compare (1) and (2) for Control to Control in each year.
- Compare (1) and (2) for Experimental Pool #1 to itself in each year.
- Compare (1) and (2) for Experimental Pool #2 to itself in each year.
- Compare (1) and (2) for each study area to the others in pre-restoration (i.e., 2003).
- Compare (1) and (2) for each study area to the others in Year 5 post-restoration (i.e., 2009).

Based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, the number of species and the percent vegetative cover comparison by plot positions were significantly different (probability <0.0001). The Tukey-Kramer HSD adjusted *t test* comparison indicate that there was a significant difference between the number of species and percent vegetative cover at plot position 1, and no significant difference between each of the other plot positions.

Comparisons of the number of species by study area and year, revealed a significant difference in number of species in vegetation plots (p=0.0002). The Tukey-Kramer HSD adjusted *t test* comparison between study area and year indicates that number of species in vegetation plots pre-restoration at the Experimental Pool #2 was significantly higher than in any of the Control plots or than post-restoration conditions in vegetation plots at Experimental Pools #1 or #2, and indicate that number of species in vegetation plots pre-restoration at the Experimental Pool #1 was significantly higher than in post-restoration conditions in vegetation plots at Experimental Pools #1 or #2. There was no significant change in the number of species in vegetation plots at the Control Pool pre-restoration compared to post-restoration, indicating that the significant differences observed at the Experimental Pools are attributable to restoration activities. Results of statistical analysis are summarized in Table 3 and presented in Appendix E.

Data on percent vegetative cover by study area and year revealed a similar trend, with a significant difference in the percent vegetative cover in vegetation plots (p=0.0005). The Tukey-Kramer HSD adjusted *t test* comparison between study area and year indicates that percent vegetative cover in plots pre-restoration at both Experimental Pools was significantly higher than in any of the Control plots or than post-restoration conditions in vegetation plots both Experimental Pools. There was no significant change in the number of species in vegetation plots at the Control Pool pre-restoration compared to post-restoration, indicating that the significant differences observed at the Experimental Pools are attributable to restoration activities. Also of note, restoration activities appear to have had some influence on a decrease in percent vegetative cover in the Control Pool plots, however these differences were not significant. Results of statistical analysis are summarized in Table 4 and presented in Appendix E.

Interpretation

Results for comparisons of number of species and percent vegetative cover by study area and year indicate that there was a higher diversity of species and more dense vegetative cover at both the Experimental Pools during pre-restoration, and that the post-restoration response is a decrease in diversity (i.e., number of species) and overall vegetative cover (i.e., percent cover) in the marsh surrounding these pools. Although the data on number of species indicate that species diversity remains higher post-restoration at the Experimental Pools as compared to the Control Pool, there is not a significant difference between these. Based on this and the results on change in percent vegetative cover, it appears that the marsh is trending towards conditions that are more similar to conditions in the vicinity of the Control Pool, or presumably more natural marsh conditions, and that these changes are attributable to restoration activities.

Table 3. Mean Number of Species in Vegetation Plots for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Pre = 2003		Yr 5 Post = 2009		Probability
	#	Mean	#	Mean	
Control	25	2.12 abd	25	1.76 abd	0.3371
Experimental Pool #1	25	2.96 abc	25	1.64 ad	0.0187*
Experimental Pool #2	25	3.60 bc	25	1.60 ad	0.0002*
Probability	0.0115*		0.9569		0.0002*

Note: Different letters indicate significant differences in mean number of species observed.
* indicates a significant difference.

Table 4. Mean Percent Cover in Vegetation Plots for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Pre = 2003		Yr 5 Post = 2009		Probability
	#	Mean	#	Mean	
Control	25	59.08 abc	25	36.32 ac	0.0556
Experimental Pool #1	25	75.44 abc	25	47.92 ab	0.0115*
Experimental Pool #2	25	73.36 abc	25	45.92 ab	0.0088*
Probability	0.1128		0.8063		0.0005*

Note: Different letters indicate significant differences in mean percent vegetative cover observed.
* indicates a significant difference.

3.2.3 Nekton Sampling

Control Pool – Nekton monitoring results for the Control Pool indicate that number of nekton species were relatively consistent (i.e., between 2 and 4 species) at each monitoring point pre-restoration (i.e., 2003) and in Year 5 (i.e., 2009) post-restoration, and were generally lower (i.e., between 0 and 1, with one monitoring point with 3 and one monitoring point with 4 species) during Year 2 (i.e., 2006) post-restoration.

Fish abundance for the Control Pool pre-restoration was very high during the August sampling event, but no fish were caught during the September sampling event. During the Year 2 post-restoration sampling events, only three adult mummichog and four larval fish were caught in the Control Pool. For the Year 5 post-restoration sampling events, the results for the August sampling event were similar to the event from August during pre-restoration sampling, and the results for the October sampling event were similar to the 2006 sampling results for the Control Pool. The results for the Control Pool indicate that fish abundance can be highly variable. Nekton sampling data forms are presented in Appendix B.

Experimental Pool #1 and #2 – During pre-restoration nekton sampling, the Experimental Pool #1 and #2 completely drained during low tide, and therefore could not support fish throughout a full tide cycle. During post-restoration monitoring, both Experimental Pool #1 and #2 provided permanent pool habitat throughout the tidal cycle, and fish and invertebrates were collected from each pool. Post restoration nekton sampling revealed that number of species were higher than pre-restoration during both Year 2 and 5 post-restoration. However, number of species observed during Year 2 post-restoration monitoring (i.e., between 0 and 2 species, with two monitoring points with 3 species) was generally lower than during Year 5 post-restoration (i.e., between 1 and 3 species, with one monitoring point with 0 species and one monitoring point with 4 species).

Post restoration nekton sampling also revealed that fish abundance had steadily increased in Experimental Pool 2 from pre-restoration to Year 5 post-restoration. Fish species diversity also increased with the presence of two new fish species, the Atlantic silverside (*Menidia menidia*) and a stickleback species (*Gasterosteidae* spp.), that were captured in Experimental Pool 2 during post-restoration nekton sampling. Larval fish were also collected during Year 2 post-restoration sampling events in Experimental Pool 1 and the Control Pool, which may possibly be attributed to sustaining fish populations in the pools.

Statistical Analysis

Nekton data were collected pre-restoration and in Year 2 and Year 5 post-restoration at eight locations in the Control Pool and five locations in each Experimental Pool #1 and #2. Data were collected during two different sampling events during each monitoring year. Data included the following:

- Control Pool – 16 pre-restoration data points, 32 post-restoration data points
- Experimental Pool 1 – 10 pre-restoration data points, 20 post-restoration data points
- Experimental Pool 2 – 10 pre-restoration data points, 20 post-restoration data points

The following comparisons were conducted for (1) number of nekton species (i.e., includes fish and invertebrates) and (2) fish abundance:

- Compare (1) and (2) by study area and year (i.e., Control, Experimental #1, Experimental #2, for pre- and post-restoration).
- Compare (1) and (2) by study area and year with pooled Experimental Pool data.
- Compare (1) and (2) by study area and year with pooled Experimental Pool data and with pre-restoration Experimental Pool data removed.
- Compare (1) and (2) for Control to Control in each year.
- Compare (1) and (2) for Experimental Pool #1 to itself in each year.
- Compare (1) and (2) for Experimental Pool #2 to itself in each year.
- Compare (1) and (2) for each study area to the others in pre-restoration (i.e., 2003).
- Compare (1) and (2) for each study area to the others in Year 2 post-restoration (i.e., 2006).
- Compare (1) and (2) for each study area to the others in Year 5 post-restoration (i.e., 2009).

Based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, the comparisons of the number of nekton species identified by study area and year, revealed a significant difference ($p<0.0001$). The most interesting results from the Tukey-Kramer HSD adjusted *t test* comparison between study area and year indicate that there was a significant difference between the pre-restoration data for both the Experimental Pools and all other data except for Experimental Pool #1 Year 2 (i.e., 2006), and that the number of nekton species for the Control Pool pre-restoration did not significantly differ from the Year 5 (i.e., 2009) post-restoration data for the Control Pool or either Experimental Pool, or Experimental Pool #2 Year 2. Also, it appears that data for Year 2 was relatively low for all study areas compared to the Control Pool pre-restoration and to all sites Year 5 post-restoration. The mean number of nekton species by location and year is summarized in Table 5 and presented in Appendix E.

Table 5. Mean Number of Nekton Species for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Pre = 2003		Yr 2 Post = 2006		Yr 5 Post = 2009		Probability
	#	Mean	#	Mean	#	Mean	
Control	16	2.4375 acfg	16	1.375 befg	16	2.6875 acg	0.0008*
Experimental Pool #1	10	0[1] de	10	1.1 bdefg	10	2.2 abcefg	0.0002* (0.0317*)
Experimental Pool #2	10	0[1] de	10	1.4 abefg	10	2.0 abcefg	0.0001* (0.3228)
Probability	<0.0001*		0.7235		0.2798		<0.0001*

Note: [1]Pool did not hold water at low tide; no sample collected.
Probability in ( ) represents probability without pre-restoration sampling event.
Different letters indicate significant differences in mean number of nekton species observed.
* indicates a significant difference.

Statistical comparisons were assessed between study areas (i.e., Control, Experimental #1, Experimental #2) and year (i.e., pre-restoration, Year 2, and Year 5) based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation. There were significant differences in the number of nekton species at the Control Pool Year 2 compared to either pre-restoration or Year 5 post-restoration (p=0.0008), at Experimental Pool #1 between all years (p=0.0002), and at Experimental Pool #2 pre-restoration compared to both post-restoration sampling events (p=0.0001). Also, the number of nekton species pre-restoration were significantly different between the Control Pool and both the Experimental Pool #1 and #2 (p<0.0001), and there was no significant difference between any site in Year 2 (p=0.7235) or Year 5 (p=0.2798) post-restoration. These data were supported by the results from the Tukey-Kramer HSD adjusted *t test*.

Results for fish abundance based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, revealed a significant difference in the abundance of fish by study area and year (p=0.0025). In particular, the abundance of fish in the Control Pool pre-restoration was significantly different than in the Control Pool in Year 2 post-restoration, however neither data set had significantly different fish abundance than any other location or year. The mean fish abundance by location and year is summarized in Table 6 and presented in Appendix E.

Additional specific comparisons were evaluated by location (i.e., Control Pool, Experimental Pool #1, and Experimental Pool #2) and year (i.e., pre-restoration, Year 2, and Year 5). The results using Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximations are included in Table 6, below. However, to protect from falsely declaring significance, only the Tukey-Kramer HSD adjusted *t test* results are discussed here. The comparison between monitoring years reveal significant differences in fish abundances for the Control Pool pre-restoration and Year 2 post-restoration (p=0.0269), and Experimental Pool #2 Year 5 post-restoration and both pre-restoration and Year 2 post-restoration (p=0.0363). There were no significant differences between fish abundances at any site in comparisons of data by year (i.e., pre-restoration, Year 2, and Year 5).

Table 6. Mean Fish Abundance for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Pre = 2003		Yr 2 Post = 2006		Yr 5 Post = 2009		Probability
	#	Mean	#	Mean	#	Mean	
Control	16	5.5625 a	16	0.375 b	16	1.875 ab	0.0269*
Experimental Pool #1	10	0[1] ab	10	3.0 ab	10	0.2 ab	0.0065* (0.0438*)
Experimental Pool #2	10	0[1] ab	10	1.0 ab	10	3.8 ab	0.0363* (0.4076)
Probability	0.0055*		0.0194*		0.1692		0.0025*

Note: [1]Pool did not hold water at low tide; no sample collected.
Probability in ( ) represents probability without pre-restoration sampling event.
Different letters indicate significant differences in mean fish abundance observed.
* indicates a significant difference.

Interpretation
Data on number of nekton species indicate that the Experimental Pools have recovered post-restoration in terms of providing nekton habitat, and are approaching the number of species captured in the Control Pool pre-restoration and in Year 5 post-restoration. The statistically significant difference between the number of species captured in the Control Pool pre-restoration and in Year 5 post-restoration as compared to in Year 2 post-restoration indicate that some other factors may have resulted in a reduced presence of nekton in the pools in 2006. Although, the variability in the nekton data for the Control Pool do decrease the strength of these results, it is clear that some recovery of nekton has occurred as a result of restoration activities, since the pre-restoration conditions did not support any nekton at low tide in either Experimental Pool #1 or 2, and post-restoration conditions do provide nekton habitat.

Results for fish abundances indicate that fish abundance is variable, and no clear patterns present themselves between years or study areas. However, it is clear that fish abundance at the Experimental Pools has increased post-restoration compared to pre-restoration, since the pre-restoration conditions did not support any fish at low tide in either Experimental Pool #1 or 2, and post-restoration conditions do provide some habitat for fish.

3.2.4 Mosquito Sampling

Control Pool – In the Control Pool for pre-restoration (i.e., 2003) and Year 2 (i.e., 2006) and Year 5 (i.e., 2009) post-restoration, mosquito dip net results were relatively similar, with the majoring (>50%) of stations having no (i.e., None) mosquito larvae, a few containing Few (1–20) individuals, and a few containing Common (20–40) or Many (>40) individuals at a dip net station. Year 3 (i.e., 2007) post-restoration mosquito sampling results were markedly different from the other years, with 50% of the stations having Many mosquito larvae, and the remainder having Few or Common, with no stations reporting “None” for mosquito larvae. Mosquito dip count data forms and figures summarizing data are presented in Appendix B.

Experimental Pool #1 – Pre-restoration and Year 2 and Year 5 post-restoration mosquito dip net sweeps in Experimental Pool #1 showed a similar pattern to the Control Pool, with no mosquito larvae collected at the majority (>81.25%) of stations and a small number (<12.5%) of stations having Few, Common, or Many mosquito larvae. Again, Year 3 post-restoration results were substantially different from the other years, with 50% of sites having Many mosquito larvae.

Experimental Pool #2 –. Pre-restoration and Year 2 and Year 5 post-restoration mosquito dip net sweeps in Experimental Pool #2 also showed a similar pattern to the Control Pool and Experimental Pool #1, with no mosquito larvae collected at the majority (>77.5%) of stations and a small number (<17.5%) of stations having Few, Common, or Many mosquito larvae. Again, Year 3 post-restoration results were substantially different from the other years, with 35% of sites having Few or Many mosquito larvae, and 15% of sites having None or Common mosquito larvae.

Statistical Analysis
Mosquito data were collected at 10 sites around or in the Control Pool, on four different days pre-restoration, and collected data at eight sites around or in Experimental Pool #1 and 10 sites around or in Experimental Pool# 2 for a total of nine separate events post-restoration (3 in 2006, 2 in 2007, 4 in 2009). Data included the following:

- Control Pool – 40 pre-restoration data points, 90 post-restoration data points
- Experimental Pool 1 – 32 pre-restoration data points, 67 post-restoration data points
- Experimental Pool 2 – 40 pre-restoration data points, 85 post-restoration data points

Mosquito data were considered to be categorical, ordinal (i.e., ranked) variables, in which the categories were ordered based on a numerical scale. A numeric score was assigned to each category based on the number of mosquito larvae observed at each sweep site: 0 for 0 mosquito larvae; 1 for few (1–20) mosquito larvae; 2 for common (21–40) mosquito larvae; and, 3 for many (>40) mosquito larvae.

The following comparisons were conducted:

- Compare Control to Control in each year.
- Compare Experimental Pool #1 to itself in each year.
- Compare Experimental Pool #2 to itself in each year.
- Compare each study area (i.e., Control, Experimental Pool #1, Experimental Pool #2) to the others in pre-restoration (i.e., 2003).
- Compare each study area to the others in Year 2 post-restoration (i.e., 2006).
- Compare each study area to the others in Year 3 post-restoration (i.e., 2007).
- Compare each study area to the others in Year 5 post-restoration (i.e., 2009).

Based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, the mosquito data for the Control Pool were significantly different ($p<0.0001$). The Tukey-Kramer

HSD adjusted *t test* comparison between years for the Control Pool indicate that there was a significant difference between the Year 3 (i.e., 2007) data and each other year, and between Year 2 (i.e., 2006) and Year 5 (i.e., 2009) (p=0.0070). The mean number of mosquito larvae, by category (i.e., None, Few, Common, or Many) are summarized in Table 7 and presented in Appendix E.

For both the Experimental Pool study areas, the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, revealed a significant difference in the mosquito data between years (p<0.0001). Clarifying this further, for both the Experimental Pool study areas, the Tukey-Kramer HSD adjusted *t test* comparison between years indicates that there was a significant difference between the Year 3 (i.e., 2007) data and each other year, but no significant difference between the mosquito data for any other years.

For the comparisons between study areas in each year, based on the Kruskal-Wallis nonparametric one-way ANOVA, Chi-square approximation, the mosquito data were not significantly different between the study areas in pre-restoration (i.e., 2003) (p=0.2058), Year 2 post-restoration (i.e., 2006) (p=0.1831), or Year 3 post-restoration (i.e., 2007) (p=0.3804). However, in Year 5 post-restoration (i.e., 2009), the mosquito data for the Control Pool was significantly different from both the Experimental Pool sites (p=0.0045), which was supported by the results from the Tukey-Kramer HSD adjusted *t test*.

Table 7. Mean Categorical Number of Mosquito Larvae Observed for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Pre = 2003		Yr 2 Post = 2006		Yr 3 Post = 2007		Yr 5 Post = 2009		Probability
	#	Mean	#	Mean	#	Mean	#	Mean	
Control	40	0.475 acde	30	0.2 ace	20	2.2 b	40	0.775 ad	<0.0001*
Experimental Pool #1	32	0.09375 e	19	0.0 e	16	1.875 b	32	0.28125 e	<0.0001*
Experimental Pool #2	40	0.55 de	25	0.12 e	20	1.7 b	40	0.175 e	<0.0001*
Probability	0.2058		0.1831		0.3804		0.0045*		<0.0001*

Note: Mean categorical number of mosquito larvae, where 0 is for 0 mosquito larvae; 1 is for few (1–20) mosquito larvae; 2 is for common (21–40) mosquito larvae; and, 3 is for many (>40) mosquito larvae. Different letters indicate significant differences in mean number of mosquito larvae observed. * indicates a significant difference.

Interpretation

The variability and statistically significant differences in the number of mosquito larvae observed between years at the Control Pool reduce the ability to attribute any differences observed in the data for the Experimental Pools. However, data on number of mosquito larvae indicate that 2007 was a significantly more productive year for mosquito larvae, because there was significantly higher numbers of mosquito larvae observed in and around the Control and Experimental Pool study areas in 2007 compared to each of the other years. However, the number of mosquito larvae in and around the study areas for 2007 were not significantly different between the study areas. Also, the number of mosquito larvae in and around the Control and Experimental Pool sites was significantly higher at the Control site in 2009 than in either of the Experimental Pools, and in general during post-restoration monitoring, the number of mosquito larvae at the Control Pool was higher (not always significantly) than at the Experimental Pool sites. It is possible that the proximity of the Experimental Pools compared to the Control Pool to a regular hydrology source for frequent tidal flushing and access for predatory fish that may prey on mosquito larvae would result in fewer mosquito larvae in the Experimental Pools as compared to the Control Pool, however this theory is not currently supported by enough data to be deterministic.

Mosquito larvae sampling was conducted in the main pool in each study area and around each pool in shallow pool habitat, where available for mosquito dip net sampling. Despite the potential for differences between presence and abundance of mosquito larvae in the main pool, which may support predatory fish, and the shallow pools around the main pool, these data were evaluated together for the statistical analysis. Additional statistical analyses, if conducted, may reveal trends in the presence and abundance of mosquito larvae in the main pools as compared to the adjacent shallow pools that were not revealed during this investigation.

3.2.5 Photographic Documentation

Control Pool – A comparison of the pre-restoration (i.e., 2003) photographs with the Year 2 (i.e., 2006) and Year 5 (i.e., 2009) post-restoration photographs for the Control Pool appear to indicate that there have been no substantial changes in marsh conditions or presence of pool or panne habitat for much of the area surrounding the Control Pool, with a few exceptions. For the Control Pool, photos #6, 7, and 14 show areas where some marsh vegetation has died, leaving barren panne habitat. Photo #13 does not show any appreciable change in water level in the Control Pool from pre-to post-restoration conditions (Figure 4).

Experimental Pool #1 and #2 – An examination of the photos for Experimental Pool #1 and Experimental Pool #2 also indicates that much of the marsh area surrounding the pool remains relatively unchanged from pre-restoration conditions. However, for Experimental Pool #1, photos #20 and 21 show some areas where barren vegetation observed in Year 2 post-restoration has revegetated by Year 5 post-restoration. Substantial changes in water level during an outgoing low tide were observed in Experimental Pool #1 in both Year 2 and Year 5 post-restoration as compared to pre-restoration, as shown in photos #27 and 28, and Figure 4, below. Additionally, substantial changes were observed in Experimental Pool 2, and can be seen in comparing the pre-restoration photos with the Year 2 and Year 5 post-restoration photograph logs for site conditions during an out-going low tide. Specifically, photos #29, 35, 37, and 38 appear to show an increase in pool size illustrated by the advancement of the pool margins over time (Figure 4). There is also an apparent decrease in the extent of vegetation observed pre-restoration in the area where permanent pool habitat has been established post-restoration. Photographic documentation of the photo stations is presented in Appendix C.

Figure 4. Comparison Photos Pre-Restoration and Year 5 Post-Restoration for Control Pool and Experimental Pool #1 and #2.

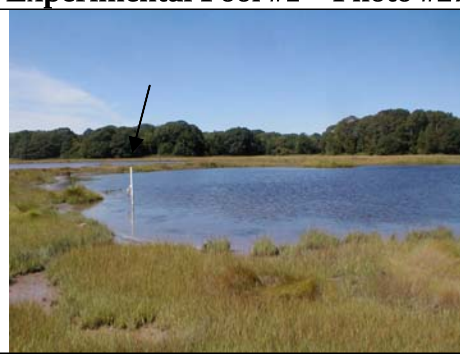
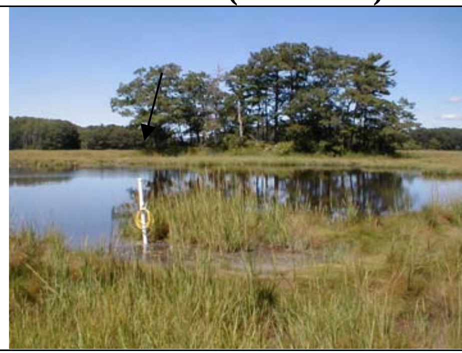
Pre-Restoration (2003)	**Year 2 Post-Restoration (2006)**	**Year 5 Post-Restoration (2009)**
	Control Pool – Photo #13	
		
	Experimental Pool #1 – Photo #27	
		
	Photo #28	
		
	Experimental Pool #2 – Photo #29	
		

Figure 4. Comparison Photos Pre-Restoration and Year 5 Post-Restoration for Control Pool and Experimental Pool #1 and #2 (continued).

Pre-Restoration (2003)	Year 2 Post-Restoration (2006)	Year 5 Post-Restoration (2009)
Experimental Pool #2 (continued) – Photo #35		
		
	Photo #37	
		
	Photo #38	
		

Note: Arrows point to location of water level monitoring station.

3.3 WATER LEVEL MONITORING

Control Pool – Pre-restoration water level data for the Control Pool were irregular, and do not seem to follow a traditional pattern of high and low tides. The pre-restoration and post-restoration data appear to indicate that water levels were more consistent and remained higher during the post-restoration monitoring in 2006 compared to the water levels during the pre-restoration monitoring at the Control Pool. Figures summarizing the water level data are included in Appendix D.

Experimental Pool #1 – Post-restoration water levels for Experimental Pool #1 appear to be similar to pre-restoration water levels. The exception to this is that during the third quarter of the neap tide cycle, when the tidal range is less and high tides frequently do not reach the high marsh, whereas during pre-restoration the water level in the pool would drop to below the ground surface, during post-restoration, the groundwater level did not drop below the ground surface.

Experimental Pool #2 – Post-restoration water levels for Experimental Pool #2 appear to be higher than during pre-restoration. However, it is important to note that water level data for Experimental Pool #2 are not directly comparable for pre- and post-restoration, because the water monitoring station had to be relocated for the 2006 monitoring event.

With consideration of the BACI-P experimental design at Mill Brook, the changes in water levels observed at the Control Pool (i.e., specifically more consistent and higher water level) suggest that the effects observed for Experimental Pool #1 and #2 may not be due to restoration activities, but may be due to natural variability in the Project area. However, it is possible that the Control Pool may have experienced some effects associated with the restoration activities that were not anticipated and resulted in changes to the water levels in the Control Pool similar to those observed at the Experimental Pools that were associated with ditch plugging activities.

Based on the water level monitoring data alone, the cause of changes in water levels at the Control Pool and Experimental Pool #1 and #2 are inconclusive. However, based on examination of water level data in conjunction with photographic documentation, it is clear that the water levels in Experimental Pool #1 and #2 have increased post-restoration, and the areas that formerly drained at low tide now hold water throughout the tidal cycle.

3.4 WATER QUALITY

3.4.1 Nutrient Load Analysis

The results of the nutrient load analysis were presented in Appendix B of the 2003 Pre-Restoration Monitoring Report, and are summarized in Table 8. For all sampling locations, the amount of nitrate/nitrite, ammonia, and total phosphorous in water samples ranged from undetectable to 0.01 mg/L above the adjusted practical quantitation limit. Total suspended solids ranged from 8 mg/L to 68 mg/L, and total Kjeldahl nitrogen ranged from 0.5 mg/L to 0.81 mg/L. Based on the results of the nutrient load data, the USFWS recommended that alternate water quality analysis be conducted to provide more comprehensive and specific water quality data.

Table 8. Nutrient Load Analysis Results for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

Parameter	Results										Adjusted Practical Quantitation Limit
	8/1/03					9/12/03					
Station (NL#):	1	2	3	4	5	1	2	3	4	5	
Nitrate + Nitrite	0.05	0.05	U	U	U	U	U	0.06	0.06	U	0.050 mg/L
Nitrogen-Ammonia	U	U	U	U	U	0.1	U	U	U	0.2	0.10 mg/L
Phosphorous, Total	0.1	0.1	0.2	U	0.1	U	U	U	U	0.1	0.10 mg/L
Total Suspended Solids (TSS)	68	19	47	4	22	18	10	20	8	29	4.0 mg/L
Total Kjeldahl Nitrogen	0.7	0.6	0.7	0.81	0.6	0.5	0.6	0.5	0.7	0.6	0.25 mg/L

Notes: U = undetectable, below adjusted practical quantitation limit.
Shading indicates actual values.

The results of the additional water quality analysis are provided in the following section, Section 3.4.2.

3.4.2 Additional Water Quality Analysis

Water Quality Analysis

Results of the water quality analysis were included in Appendix B of the 2004 Pre-Restoration Monitoring Report, and are summarized in Table 9. The questions posed in the Introduction were explored in detail in the 2004 Pre-Restoration Monitoring Report, and are not presented fully in this report. The results of the water quality analysis were based on the data collected during the three sampling events, and are summarized briefly below.

1. Is runoff likely to have a potential adverse effect?

Response: Potentially yes, particularly in the stream of MB-5 during storm events. Both acute and chronic water quality criteria for zinc were exceeded in MB-5 on August 3. Criteria for lead were also slightly exceeded in the dry-weather sample on September 16, 2004.

2. Is the marsh providing an important filtration function that should be preserved?

Response: Yes. The stream channel of MB-5 drains a golf course and appears to carry a significant silt load, with zinc concentrations over WQC, during storms. Silt is also present in the streambed of MB-3, suggesting a silt load on some occasions.

Table 9. Water quality results (mg/L) for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

Parameter (mg/L)	MB-1			MB-2			MB-3			MB-4		
	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004
Antimony	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Arsenic	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	0.011	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Beryllium	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Cadmium	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Calcium	3.53	4.18	3.35	156.	77.2	47.3	44.9	11.2	42.8	168.	12.6	34.1
Chromium	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150
Copper	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Lead	< 0.005	< 0.005	0.009	< 0.005	< 0.005	0.011	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Magnesium	1.76	3.15	1.57	437.	212.	116.	9.52	3.22	6.79	418.	12.0	36.2
Nickel	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400
Selenium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Silver	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150
Thallium	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Zinc	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Mercury	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Hardness	16.1	23.4	14.8	2190.	1070.	595.	151.	41.1	135.	2140.	80.9	234.
Solids-Nonfilterable Residue	8.4	4	26.	4	9.6	18.	4	22.	9.6	4.4	4	4

Table 9. Water quality results (mg/L) for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine (continued).

Parameter (mg/L)	MB-5			MB-6			MB-7			MB-8		
	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004	8/3/2004	8/12/2004	9/16/2004
Antimony	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Arsenic	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Beryllium	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Cadmium	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Calcium	19.1	8.35	14.4	225.	132.	104.	217.	152.	73.6	253.	223.	113.
Chromium	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150
Copper	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Lead	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Magnesium	10.1	3.20	6.95	700.	407.	324.	675.	469.	199.	805.	660.	330.
Nickel	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400	< 0.0400
Selenium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Silver	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150	< 0.0150
Thallium	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Zinc	0.106	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Mercury	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Hardness	89.1	34.0	64.4	3460.	2010.	1590.	3320.	2310.	1000.	3950.	3270	1640.
Solids-Nonfilterable Residue	280	6.0	7.6	4	18.	85.	39.	20.	17.	26.	27.	16.

Note: Shading indicates actual values.

Fecal Coliform Analysis

Results of the fecal coliform bacteria analysis were included in Appendix B of the 2004 Pre-Restoration Monitoring Report, and are summarized in Table 10. Sample locations MB-1 and MB-3 are located down-gradient from residential areas, and may provide sources of fecal coliform in runoff. MB-5 is located down-gradient of the Willowdale Golf Course. A high presence of Canada geese and a lack of a significant buffer around golf course water bodies may provide a potentially significant source of fecal coliform. Also, a review of aerial photography of the surrounding area shows additional residential development to the east of Mill Brook, providing alternative potential sources of fecal coliform to the marsh.

The questions posed in the Introduction were explored in detail in the 2004 Pre-Restoration Monitoring Report, and are not presented fully in this report. The results of the fecal coliform analysis were based on the data collected during the three sampling events, and are summarized briefly below.

1. Is runoff likely to have a potential adverse effect?

Response: Potentially, yes, particularly as part of runoff following rain events. Higher than background fecal coliform bacteria levels were found at MB-1, MB-3, and MB-5 in the wet-weather sample on September 16.

2. Is the marsh providing an important filtration function that should be preserved?

Response: Yes. Fecal coliform bacteria levels at MB-2 were not greater than background during any of the sampling events, even when >1,100 fecal coliform bacteria were found at MB-1 in the wet-weather sample on September 16.

3.4.3 Water Quality Analysis Summary

Based on the results of the nutrient load analysis and the additional water quality analysis, the SMPT determined that the originally proposed ditch creation and enhancement would not be conducted. Therefore, no post-restoration nutrient load or additional water quality monitoring would be necessary. As a result no conclusions are drawn regarding the potential effects of restoration activities on water quality in the study areas.

Table 10. Fecal Coliform Results for Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.

	Number of Fecal Coliform by Date		
Station	**3-Aug**	**12-Aug**	**16-Sep**
MB-1	91	>1,100	93
MB-2	93	23	23
MB-3	130	>1,100	43
MB-4	43	>1,100	1,100
MB-5	43	240	93
MB-6	43	>1,100	93
MB-7	93	460	460
MB-8	93	43	460
Preceding weather conditions	Dry	Wet	Dry
Tide conditions	Outgoing low tide	Outgoing, 1 hr past high tide	Outgoing extreme low tide

Note: Shading indicates number of fecal coliform greater than background levels.

3.5 ADDITIONAL PROJECT INFORMATION

A copy of all field notes collected during field sampling activities is provided in Appendix F. In addition, Appendix G contains a cumulative list of species observed during field sampling activities. All the monitoring data to date are provided with this report on compact disc.

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4.0 MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

4.1 MANAGEMENT IMPLICATIONS

The management implications based on the results pre- and post-restoration monitoring activities at Mill Brook, are restated below:

Cover Type Mapping

- Cover type changes observed from pre-restoration to Year 5 post-restoration include the observation of four small communities that appear to have developed following restoration (i.e., ditch plugging) activities, including development of additional undesirable species (i.e., *Typha* and *Phragmites*), as described below.
  - A small *Typha* community was observed along the upper border of the marsh upgradient from ditch plug activities on the western side of the channel that may be the result of pooling freshwater along the wetland boundary that is no longer able to drain from the marsh with the construction of the ditch plug near to these communities.
  - A small panne community was noted west of pool that is located between the Control Pool and Experimental Pool #1, and may be the result of increased groundwater levels upgradient of ditch plugging activities resulting in reduced aerobic restoration by the roots of the *Spartina alterniflora* community, and subsequently causing die off, creating panne habitat.
  - Two small *Phragmites* communities have become established in the west of the primary monitoring activities around Experimental Pool #1, where ditch plugging activities occurred.
  - A small mixed species community was observed in the area where ditch plugging activities occurred for Experimental Pool #1, and may be the result of ditch plugging activities creating an opportunity for less dominant species to take hold on the marsh in this location.
- Additionally, the pool/channel community around the Experimental Pools was observed to have expanded post-restoration compared to pre-restoration, due to restoration activities, although the true increase in permanent pool habitat is greater than what is reflected, since the pre-restoration cover type map did not differentiate between the pool and low tide mudflat habitat conditions present in the Experimental Pools at the time of pre-restoration activities.

Site Assessment

- The site assessment supported the findings noted on the cover type map, including that both of the Experimental Pools, which are now permanent pools, appeared to have increased in aerial extent from pre-restoration high tide conditions, and appeared to have stable edges, were observed to support fish and nekton, and appeared to have adequate water quality.

Additional notations included observations of undesirable species, specifically *Typha* and *Phragmites*, as noted above.

Vegetation Monitoring

- Vegetation monitoring results for comparisons of number of species and percent vegetative cover by study area and year indicate that there was a higher diversity of species and more dense vegetative cover at both the Experimental Pools during pre-restoration, and that the post-restoration response is a decrease in diversity (i.e., number of species) and overall vegetative cover (i.e., percent cover) in the marsh surrounding these pools. Although the data on number of species indicate that species diversity remains higher post-restoration at the Experimental Pools as compared to the Control Pool, there is not a significant difference between these. Based on this and the results on change in percent vegetative cover, it appears that the marsh is trending towards conditions that are more similar to conditions in the vicinity of the Control Pool, or presumably more natural marsh conditions, and that these changes are attributable to restoration activities.

Nekton Sampling

- Nekton sampling results indicate that the Experimental Pools have recovered post-restoration in terms of providing nekton habitat, and are approaching the number of species captured in the Control Pool pre-restoration and in Year 5 post-restoration. The statistically significant difference between the number of species captured in the Control Pool pre-restoration and in Year 5 post-restoration as compared to in Year 2 post-restoration indicate that some other factors may have resulted in a reduced presence of nekton in the pools in 2006. Although, the variability seen in the nekton data for the Control Pool do decrease the strength of these results, it is clear that some recovery of nekton has occurred as a result of restoration activities, since the pre-restoration conditions did not support any nekton at low tide in either Experimental Pool #1 or 2, and post-restoration conditions do provide nekton habitat.
- Results for fish abundances indicate that fish abundance is variable, and no clear patterns present themselves between years or study areas. However, it is clear that fish abundance at the Experimental Pools has increased post-restoration compared to pre-restoration, since the pre-restoration conditions did not support any fish at low tide in either Experimental Pool #1 or 2, and post-restoration conditions do provide some habitat for fish.

Mosquito Sampling

- The variability and statistically significant differences in the number of mosquito larvae observed between years at the Control Pool reduce the ability to attribute any differences observed in the data for the Experimental Pools. However, data on number of mosquito larvae indicate that 2007 was a significantly more productive year for mosquito larvae, because there was significantly higher numbers of mosquito larvae observed in and around the Control and Experimental Pool study areas in 2007 compared to each of the other years. However, the number of mosquito larvae in and around the study areas for 2007 were not significantly different between the study areas. Also, the number of mosquito larvae in and around the Control and Experimental Pool sites was significantly higher at the Control site in

2009 than in either of the Experimental Pools, and in general during post-restoration monitoring, the number of mosquito larvae at the Control Pool was higher (not always significantly) than at the Experimental Pool sites. It is possible that the proximity of the Experimental Pools compared to the Control Pool to a regular hydrology source for frequent tidal flushing and access for predatory fish that may prey on mosquito larvae would result in fewer mosquito larvae in the Experimental Pools as compared to the Control Pool, however this theory is not currently supported by enough data to be deterministic.

- Mosquito larvae sampling was conducted in the main pool in each study area and around each pool in shallow pool habitat, where available for mosquito dip net sampling. Despite the potential for differences between presence and abundance of mosquito larvae in the main pool, which may support predatory fish, and the shallow pools around the main pool, these data were evaluated together for the statistical analysis. Additional statistical analyses, if conducted, may reveal trends in the presence and abundance of mosquito larvae in the main pools as compared to the adjacent shallow pools that were not revealed during this investigation.

Photographic Documentation

- Photographic documentation did not reveal any substantial changes in marsh conditions or presence of pool or panne habitat for much of the area surrounding the Control Pool, with the exception of some areas where marsh vegetation has died, leaving barren panne habitat. Additionally, no appreciable change in water level was observed in the Control Pool from pre-to post-restoration conditions.
- Photographic documentation revealed substantial changes in water level during low tide conditions in Experimental Pools #1 and #2 post-restoration as compared to pre-restoration. Additionally, photographic documentation appears to indicate an increase in pool size, and a corresponding decrease in extent of vegetation, at Experimental Pool #2, in particular, as a result of restoration activities.
- Photographic documentation illustrates that this salt marsh system is dynamic and responds quickly to hydrologic changes.

Water Level Monitoring

- Based on the water level monitoring data alone, the cause of changes in water levels at the Control Pool and Experimental Pool #1 and #2 are inconclusive, and may be due to natural variability in water level, and not due to restoration activities.
- It also is possible that restoration activities may have had some effects on water levels at the Control Pool that were not anticipated, and resulted in changes to the water levels in the Control Pool similar to those observed at the Experimental Pools that were associated with ditch plugging activities.
- Based on an examination of water level data in conjunction with photographic documentation, it is clear that the water levels in Experimental Pool #1 and #2 have increased post-restoration, and the areas that formerly drained at low tide now hold water throughout the tidal cycle.

Water Quality

- No post-restoration monitoring of water quality, including nutrient load or additional water quality analysis, was conducted. As a result no conclusions are drawn regarding the potential effects of restoration activities on water quality in the study areas.

4.2 MANAGEMENT RECOMMENDATIONS

The primary Project goals were to:

- Increase the amount of pool habitat on the marsh surface to pre-ditch conditions;
- Eliminate the invasive plant *Phragmites* populations from several sections of the marsh that were formerly dominated by *Spartina patens*, and minimize the potential for *Phragmites* to re-populate the marsh.[4]

Overall, the results of cover type mapping, site assessment, vegetation monitoring, nekton sampling, photographic documentation, and water level monitoring activities at Mill Brook indicate that salt marsh restoration activities have successfully resulted in an increase in the extent of pool habitat on the marsh, re-creating pre-ditch pool conditions at Experimental Pool #1 and #2. However, additional populations of *Phragmites*, and a new population of *Typha*, have been identified since implementation of restoration activities. Based on these findings, it is recommended that monitoring of undesirable species be conducted, and if undesirable communities, particularly *Phragmites*, continue to expand, treatment could be considered to control further spread of *Phragmites* in the Project area.

[4] The original goal to reduce pooling of freshwater on the marsh was eliminated with the elimination of the originally proposed ditch creation and enhancement.

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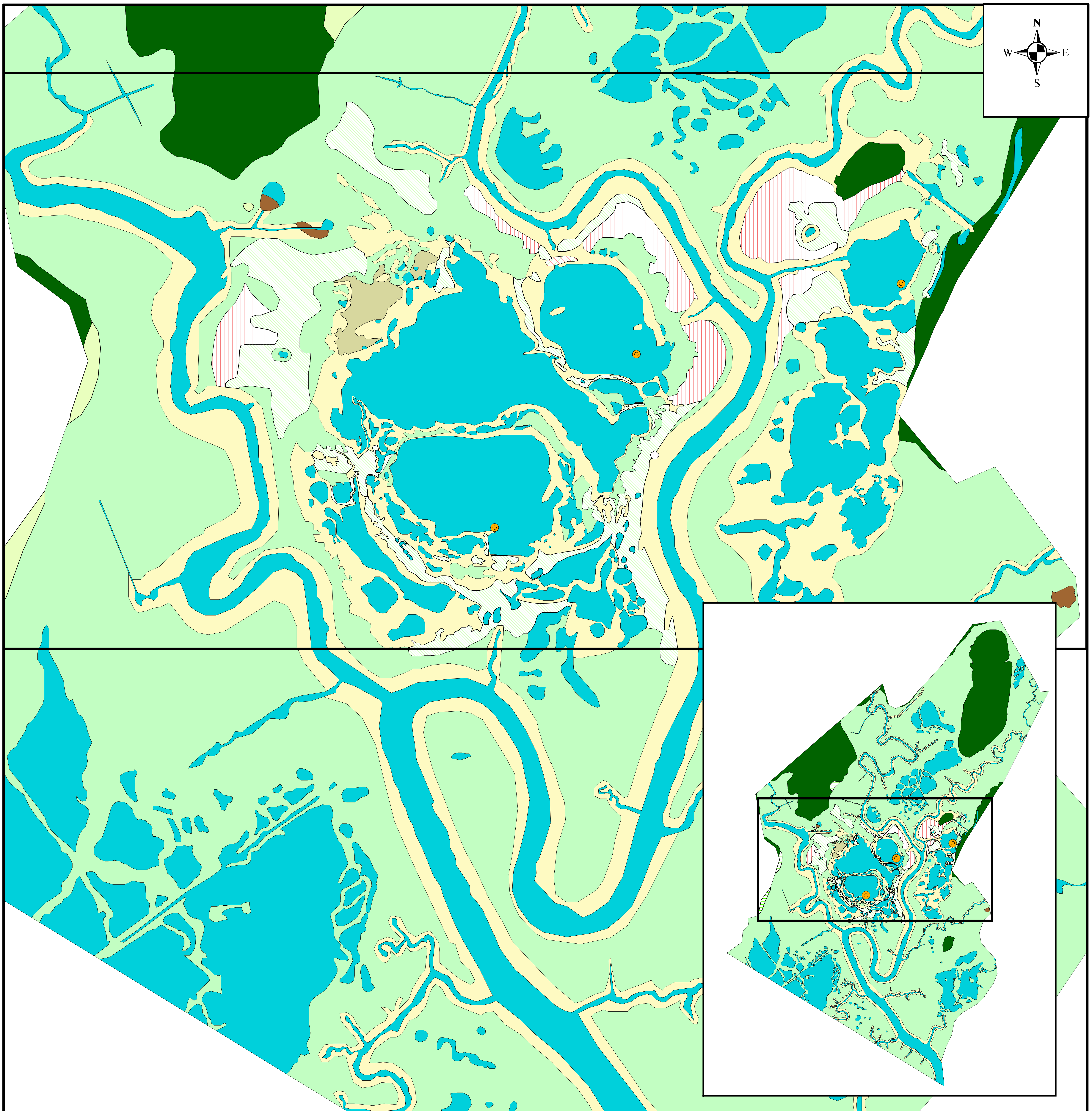
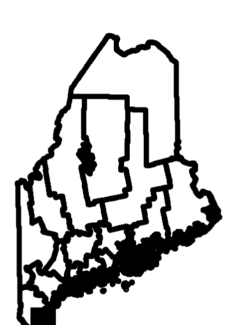
APPENDIX A

Cover Type Map





425 212.5 0 425 850 Feet

140 70 0 140 280 Meters

COVER TYPES	ACRES
Spartina alterniflora	13.86
Spartina alterniflora/Spartina patens	64.45
Spartina patens	2.66
Juncus gerardii	1.34
Typha species	0.32
Mixed Community	0.02
Phragmites australis	0.06
Pool/Channel	26.98
Panne	0.24
Upland Forest	15.17
Monitoring Well	
TOTAL	125.09

Year 5 post-Restoration Cover Type Map for Mill Brook Salt Marsh Restoration Monitoring Project Scarborough, Maine.

Client: U.S. Fish & Wildlife Service

Prepared By: TETRA TECH, INC.

Date: 11/09

z:/projects/fw-700/aprs/MillBrookCType.apr

APPENDIX B

Completed Site Evaluation Data Forms

- **Site Assessment**
- **Vegetation Monitoring**
- **Nekton Sampling**
- **Mosquito Sampling**

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Mill Brook Restoration Monitoring Site Assessment

Site Name: Mill Brook	**Date:** 9-11-09	**Time:** 0930	**Time of last high tide:** 0405
Evaluator(s): S. Watts	**Tide:** High Mid Low **and** incoming outgoing		
Cloud Cover(%): 0, 1 – 25, 25–50, 50–57, > 75%	**Precipitation:** none, drizzle, steady rain		
Temperature (°F): 60	**Wind:** calm **intermittent breeze** steady breeze gusting		
Rain events within past 3-days (avg. over 72 hours): none <25 %, 25-50%, 51-75%, >75			

REF # **ACCEPTABLE CONDITIONS** **UN-ACCEPTABLE CONDITIONS**

1) Ditch Plugs:

Acceptable		Un-acceptable	
✓	Desirable species present	____	Desirable species absent; undesirable species present
✓	Plant health/vigor good	____	Plants in poor health, showing signs of stress
✓	No obvious loss of aerial coverage or density	____	Obvious loss of aerial coverage, plant density
✓	No evidence of water flows, leaks	____	Evidence of water flows, leaks

2) Excavated Pools/Altered Tidal Creeks:

Acceptable		Un-acceptable	
✓	Pools retaining adequate water	____	In-sufficient water retained in pools
✓	Water quality adequate	____	Water quality poor (*i.e.,* anaerobic conditions)
✓	Presence of nekton	____	Evidence of nekton die-off
✓	Presence of macro-invertebrates	____	Evidence of macro-invertebrate die-off
✓	Mosquito larvae none - few	____	Mosquito larvae common - many
✓	Pool edges intact, stable	____	Pool edges sloughing, undercut, unstable
✓	Typical aquatic veg. species present	____	Devoid of aquatic veg. or invasive species present

3) Natural Pools:

Acceptable		Un-acceptable	
✓	Pools retaining adequate water	____	In-sufficient water retained in pools
✓	Water quality adequate	____	Water quality poor (*i.e.,* anerobic conditions)
✓	Presence of nekton	____	Evidence of nekton die-off
✓	Presence of macro-invertebrates	____	Evidence of macro-invertebrate die-off
✓	Mosquito larvae none - few	____	Mosquito larvae common – many

* Note the pool number beside the appropriate unacceptable condition if encountered, and describe the problem on back

4) Pannes:

Acceptable		Un-acceptable	
✓	Size, aerial coverage not increasing	✓	Size, aerial coverage increasing
✓	Typical veg. species present	____	Presence of invasive species

* Note the panne number beside the appropriate unacceptable condition if encountered, and describe the problem on back

5) Undesirable Species: (*Phragmites, Typha, Lythrum, Polygonum cuspidatum, and shrubs on high marsh surface)*

Acceptable		Un-acceptable	
____	No undesirable species present	✓	Undesirable species found on site
____	Undesirable species coverage not increasing	____	Undesirable species coverage increasing

* Identify the location of undesirable species on the cover type map

6) Desirable Species: (*Spartina, Juncus, Distichlis, Salicacia, Scirpus, Solidago, Ruppia) note others when encountered*

Acceptable		Un-acceptable	
✓	Plant health, vigor good	____	Plants in poor health, showing signs of stress
✓	No obvious loss of aerial coverage or density	____	Obvious loss of aerial coverage, plant density
NA	Shrubs, if present, are declining in health	____	Shrubs, if present, are healthy or increasing in % cover

Observations (identify if any of the following observations are made)

Ref. #	Species Group	√ if None	Note Species, Activity, Number, Habitat Use, etc. (identify approximate location on cover type map)
7	Passerines or passerine nests		See species list
8	Wading birds or wading bird nests		"
9	Water birds or water bird nests		"
10	Raptors or raptor nests		"
11	Small mammals	✓	
12	Large mammals		Deer
13	Amphibians	✓	
14	Reptiles	✓	
15	Recreational activities		Hunting
16	Site disturbance	✓	
17	Mosquito adult/larvae in pools		Few
18	Macro-invertebrates in pools		Water boatman, PDB, spiders
19	Fish in pools		mummichog, stickleback

Site Assessment (additional comments)

Be sure to record the location of features exhibiting un-acceptable conditions on the cover type map

Ref. #	Comments
1	Ditch Plugs - in excellent condition, no longer discernable from surrounding marsh. Veg w/ desirable S.M. species. No invasives present on D.P. Some water flow around DP in sm channels, but is not compromising stability or fxn of DP.
2	Excavated Pools - It is difficult to discern which pools are excavated but where possible, pools appear to to stable, support ∝ no mosq., edges intact and retaining water. WQ typical w/ some green algae/epibentic algal mats.
3	Natural Pools - appear healthy, sustained, good WQ
	Created Pools - edges stable, intact. Have increased in size from original size (appear). Support ∝ + nekton. WQ appears adequate. Algal mats typical.
4	Pannes - Mostly not increasing in size. One area near large pool between Exp and Control noted increase in panne area on covertype map. Otherwise pannes do not appear to be increasing.
5	Undesirable Species - note presence of Typha along marsh fringe, distant from Exp sites, and Phragmites along ditch along west side of site, near excavated pool/plugged ditch. This should be monitored and/or treated.
6	Desirable Species - healthy, vigorous, well established and not decreasing in cover.

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Control	**Weather:**
Transect ID: 1	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	35%	
Bare	42	
algae	15	
Detritus	7%	
SAEU	<1	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPPA	75	High
Detritus	~~25~~ 20	
Bare	5	

Plot ID: 4 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	50	
SAEU	4	
Bare	39	
Detritus	7	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Control	**Weather:**
Transect ID: 2	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare		

Plot ID: 2

Species Code	% Cover	Veg. Vigor
Bare	71	High
algae	15	↓
SPAL	10	↓
SPPA	3	↓
SAEU	<1	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPPA	15	High
SPAL	1	↓
Bare	78	↓
Detritus	5	↓
SAEU	<1	

Plot ID: 4 Pool/Panne

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	~~30~~ 25	High
Bare	75	↓

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts	**Date:** 9/30/09
Panne/Pool Complex: control	**Weather:**
Transect ID: 3	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	73	High
Bare	20	
algae	7	

Plot ID: 3 - Pool

Species Code	% Cover	Veg. Vigor
Bare	87	High
SPAL	10	
algae	3	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPPA	2	
Detritus	5	
Bare	93	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPPA	99	High
Detritus	1	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Control	**Weather:**
Transect ID: 4	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare		

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	20	
SPPA	60	
~~[illegible]~~		
SAEU	1	
Bare	7	
Detritus	10	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPPA	78	
SPAL	7	
Detitrus	10	
Bare	5	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
BaRe	70	
SPAL	20	
Algae	10	

Plot ID: 5 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	-

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	Date: 9/30/09		
Panne/Pool Complex: control	Weather:		
Transect ID: 5	Tide:	Flood	Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 5 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 4 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPAL	30	
SPPA	50	
SAEU	2	
PLMA	1	
Bare	7	
Detritus	10	

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	85	H, SL
Bare	14	
SAEU	1	

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	96	
algae	3	
SPAL	1	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers:	**Date:**
Panne/Pool Complex: Experimental 9	**Weather:**
Transect ID: 1	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 2 - Edge of Pool - land

Species Code	% Cover	Veg. Vigor
SPAL	25	High
SPPA	73	
SALI	1	
DISP	1	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPAL	53	High
SPPA	35	
Bare	10	
JUGE	2	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
DISP	99	High
SPPA	1	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	35	
DISP	45	
SPPA	18	
Bare	2	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:**
Panne/Pool Complex: Experimental 1	**Weather:**
Transect ID: 2	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	75	High
SPPA	1	↓
DISP	5	↓
Detritus	4	↓
Bare	15	↓

Plot ID: 4

Species Code	% Cover	Veg. Vigor
Juge	45	
DISP	45	
SPAL	5	
Detritus	5	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
Juge	1	High
SPAL	3	↓
SPPA	95	↓
Detritus	1	↓

Plot ID: 2 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts	**Date:**
Panne/Pool Complex: Experimental 1	**Weather:**
Transect ID: 3	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	58	High
SPPA	30	
Detritus	10	
Bare	2	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
DISP	15	High
JUGE	70	
SALI	15	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPAL	45	
SPPA	1~~8~~ 20	
Bare	30	
Detritus	5	

Plot ID: 2 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	–

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	–

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	Date: 9/30/09
Panne/Pool Complex: Experimental 1	Weather:
Transect ID: 4	Tide: Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 3 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 4 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	80	High
SAEU	1	
PLMA	<1	
SPPA	10	
Bare	8	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: S Watts T Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Experimental 1	**Weather:** overcast 60's
Transect ID: 5	**Tide:** 9:15 Flood out Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPal	80	High
Saev	1%	↓
Bare	19%	↓

Plot ID: 1 - pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 3 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPal	80	
SPPA	5	
Bare	15	

Plot ID: 2 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Experimental 2	**Weather:**
Transect ID: 1	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	65	
Detritus	10	
Bare	25	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPPA	49	
SPAL	35	
Bare	4	
Detritus	12	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPPA	22	
SPAL	60	
Bare	12	
Detritus	6	

Plot ID: 5-

Species Code	% Cover	Veg. Vigor
SPAL	5	
SCRO	2	
Bare	92	
SPPA	1	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Experimental 2	**Weather:**
Transect ID: 2	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2 Pool

Species Code	% Cover	Veg. Vigor
SPAL	2	
Bare	98	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPAL	71	
SPPA	9	
SCRO	3	
Bare	12	
Detritus	5	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPPA	100	

Plot ID: 5

Species Code	% Cover	Veg. Vigor
SPAL	45	
SPPA	2	
Detritus	40	
Bare	13	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/04
Panne/Pool Complex: Experimental 2	**Weather:**
Transect ID: 3	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 5

Species Code	% Cover	Veg. Vigor
DISP	78	
SPPA	10	
Juge	1	
Grass sp.	1	
Detritus	10	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPPA	75	
SPAL	10	
Detritus	15	

Plot ID: 3 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2 Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Caudet	**Date:** 9/30/09
Panne/Pool Complex: Experimental 2	**Weather:**
Transect ID: 4	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 5

Species Code	% Cover	Veg. Vigor
Juge	90	
Disp	9	
SULI ?	1	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPAL	81	
Detritus	12	
Bare	7	

Plot ID: 3 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 2 Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID: 1 - Pool

Species Code	% Cover	Veg. Vigor
Bare	100	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

Mill Brook Salt Marsh Restoration Project
Vegetation Monitoring Form

Observers: Watts Gaudet	**Date:** 9/30/09
Panne/Pool Complex: Experimental 2	**Weather:**
Transect ID: 5	**Tide:** Flood Ebb

QUANTITATIVE ASSESSMENT

Plot ID: 1 – Pool

Species Code	% Cover	Veg. Vigor
Bare	100	—

Plot ID: 2

Species Code	% Cover	Veg. Vigor
SPAL	81	
Bare	12	
Detritus	7	

Plot ID: 3

Species Code	% Cover	Veg. Vigor
SPAL	44	
SPPA	40	
Detritus	10	
Bare	2	

Plot ID: 4

Species Code	% Cover	Veg. Vigor
SPAL	15	
algae	10	
Pool – Bare	75	

Plot ID: 5 - Pool

Species Code	% Cover	Veg. Vigor
BaRe	100	

Plot ID:

Species Code	% Cover	Veg. Vigor

COMMENTS:

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Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: CONTROL	**Observer(s):** LR + TG	**Date:** 8/4/09
Start Time: 2:50 pm	**End Time:** 4:17	**Air Temp (°F):** ~ 78°
Tide (circle one): Flood **Ebb**	**Weather:** Sunny Breezy	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	Banded Killifish (Juvenile)	1	amphipod water boatmen midge	Yes / **No**
NC-2	Banded killifish (Juvenile)	5	water boatmen	Yes / **No**
NC-3	Banded Killifish (juvenile)	17	water boatmen amphipod	Yes / **No**
NC-4	Banded Killifish (juvenile)	1	water boatmen amphipod midge	Yes / **No**
NC-5	None	–	water boatmen midge	Yes / **No**
NC-6	Banded Killifish (juvenile)	1	water boatmen	Yes / **No**
NC-7	none	–	water boatmen	Yes / **No**
NC-8	Banded Killifish (juvenile)	3	water boatmen midge amphipod	**Yes** / No

Comments: NC-8 – grass and algae present, very small amount

Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: Exp. #1	**Observer(s):** LP + TG	**Date:** 8/4/09
Start Time: 4:20	**End Time:** 4:59	**Air Temp (°F):** ~78°
Tide (circle one): Flood Ebb	**Weather:** Sunny Breezy	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	Banded killifish (Juvenile)	1	water boatmen; shrimp-large transparent	Yes No
NC-2	Silverside (Menidia menidia)	1	Water boatmen; midge	Yes No
NC-3	none	—	waters boatmen	Yes No
NC-4	None	—	Water boatmen; amphipods	Yes No — minor SAV and Filamentous algae
NC-5	none	—	water boatmen; amphipods	Yes No
~~NC-6~~ N/A				Yes No
~~NC-7~~ N/A				Yes No
~~NC-8~~ N/A				Yes No

Comments: 5 stations

Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: Exp. #2	**Observer(s):** LR + TG	**Date:** 8/4/09
Start Time: 5:05	**End Time:** 6:15	**Air Temp (°F):** ~70°F
Tide (circle one): Flood Ebb	**Weather:** Sunny Breezy	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	none	—	Water boatmen	Yes No
NC-2	Banded Killifish	10	water boatmen	Yes No
	mummichog-adult	2		
NC-3	Silversides	2	water boatmen	Yes No
	Banded Killifish	2		
NC-4	Banded Killifish	6	water boatmen	Yes No
NC-5	none	—	water boatmen	Yes No
NC-6 N/A				Yes No
NC-7 N/A				Yes No
NC-8 N/A				Yes No

Comments: 5 stations

Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: Control	**Observer(s):** Rivard Gaudett Sweitzer	**Date:** 10/8/09
Start Time: 9:07 am	**End Time:** 9:50	**Air Temp (°F):** 53°F
Tide (circle one): Flood ↳ incoming Ebb	**Weather:** Sunny mild light Breeze	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	none	—	midge amphipods water boatmen	Yes ~~No~~ No
NC-2	fundulus ~~YOY~~ too small to ID <30mm	1	amphipod Water boatmen midge	Yes No
NC-3	none	—	water boatmen amphipod midge	Yes No
NC-4	none	—	amphipod Midge	Yes No
NC-5	Banded Killifish	1	amphipod midge	Yes No
NC-6	None		midge amphipod	Yes No
NC-7	none		midge amphipod	~~Yes~~ No
NC-8	none		midge amphipod	Yes No

Comments:

Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: EXP 1	Observer(s): LR TG	Date: 10/8/09
Start Time: 10:40	End Time: 11:05	Air Temp (°F): 53°F
Tide (circle one): Flood Ebb	Weather: Sunny mild	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	none	—	amphipod midge	Yes No
NC-2	none	—	amphipod water boatmen midge	Yes No
NC-3	none	—	midge amphipod water boatmen	Yes No
NC-4	none	—	midge water boatmen amphipod	Yes No
NC-5	none.	—		Yes No
NC-6				Yes No
NC-7				Yes No
NC-8				Yes No

Comments:

Mill Brook Salt Marsh Restoration Project
Nekton Sampling Throw Trap Data Form

Station: ExP 2	**Observer(s):** LR TC	**Date:** 10/8/09
Start Time: 10:00 am	**End Time:** 10:30	**Air Temp (°F):** 53
Tide (circle one): Flood Ebb	**Weather:** Sunny mild	

Pool / Panne ID	Fish Species	Abundance	Invertebrate Species	Algae Present?
NC-1	none	—	water boatmen (many) Snails worm sp	Yes No
NC-2	none	—	water boatmen	Yes No
NC-3	Banded Killifish	1	water boatmen midge amphipod	Yes No
NC-4	none	—	water boatmen	~~Yes~~ No
NC-5	Banded Killifish	15		~~Yes~~ No
~~NC-6~~ N/A				Yes No
~~NC-7~~ N/A				Yes No
~~NC-8~~ N/A				Yes No

Comments:

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 9/7/07	Observer: Brian Rod	Temp (°F): Air: 75°
Start Time: 1400	End Time: 1530	Tide: ~~1530~~ Neap
Weather: Sunny/clear, moderate breeze		

Pool/Panne ID	Individuals Present (Yes or No)	Average Number of Individuals (Few 1 - 20, Common 21 - 40, Many >40)	
MC-1		M NF	
MC-2		Deep F MF	
MC-3		M FF	
MC-4		F MF	
MC-5		M NF	
MC-6		F NF	
MC-7		M NF	
MC-8		C FF	
MC-9		F NF	
MC-10		F NF	
M X1-1		C ~~NF~~ FF	~ small pool, deep & algae covered
M X1-2		M NF	
M X1-3	N	N CF	
M X1-4		F FF	Clockwise from WLR
M X1-5		F NF	
MX1-6		F FF	
MX1-7	N	N NF	just N of ditch plug
MX1-8	N	N NF	
M X2-1		C FF small pool	
M X2-2	N	N CF	
M X2-3		F NF	Algae on surface obscure view
M X2-4		C NF	
M X2-5		M NF	algae on surface
MX2-6	N	N NF	~ Clockwise from WLR start pt
MX2-7		F FF	~~Big~~ pool b/w 1+2
MX2-8	N	N MF	NW side of pool
MX2-9		F MF	algae
MX2-10		F ~~NF~~ FF	thick algae many/common adults on surface

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

FF = few fish
NF = No fish

Comments:

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 7/18/07	**Observer:** Brian Rod	**Temp (°F):** ~70°F
Start Time: 1530	**End Time:** 1745	**Tide:**
Weather: Overcast with a few short sprinkles		

Pool/Panne ID	Individuals Present (<u>Y</u>es or <u>N</u>o)	Average Number of Individuals (<u>F</u>ew 1 - 20, <u>C</u>ommon 21 - 40, <u>M</u>any >40)
MC-1	Y	F M NF
MC-2	~~N~~? Y	Kinda deep + muddy / F
MC-3	Y	M NF
MC-4	Y	M NF
MC-5	Y	M NF
MC-6	Y	C NF
MC-7	Y	M NF
MC-8	Y	C NF
MC-9	Y	C ~3F
~~MC-10~~	~~Y~~	~~M NF~~
M X1-1	Y	M NF
M X1-2	Y	M NF
M X1-3	Y	F-C NF
M X1-4	Y	M NF
M X1-5	Y	M NF
MX1-6	Y	M NF
MX1-7	Y	M NF
~~MX1-8~~	~~Y~~	~~M NF~~
M X2-1	Y	M NF
M X2-2	Y	FM FF
M X2-3	Y	M NF
M X2-4	Y	M NF
M X2-5	Y	F
MX2-6	Y	C
MX2-7	Y	F
MX2-8	Y	F - by ditch
MX2-9	Y	M
MX2-10	Y	M

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

N/S = Not Sampled
NF = No Fish
MF = many fish

pretty deep

Started to rain at 4:20
~~So did not go to Exp Pool 2~~
Stopped 2 then till 4:30

Pool FF

crabs

Went to Exp Pool 2 last

Comments:

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 7/28/09	**Observer:** S. Watts + L. Rivard	**Temp (°F):** 80's
Start Time: ~12 PM	**End Time:**	**Tide:** incoming ~ 1 hour after low
Weather: Breezy, sunny		

Pool/Panne ID	Individuals Present (Yes or No)	Average Number of Individuals (Few 1 - 20, Common 21 - 40, Many >40)	
MC-1	Y	(live) F (hatched) *amph. fish. w.b.m	
MC-2	N	Ø spider, w.b.m, amph.	
MC-3	Y	F (hatched) fish w.b.m, ~~amph~~	
MC-4	N	Ø fish (9-spine), glass shrimp, snail	
MC-5	Y	F (live + hatched) spider, w.b.m. amph., water beetle	
MC-6	Y	C	w.b.m. amph. mosq. husks in algal m
MC-7	Y	* M (shells - hatched)	mummichog, w.b.m., mosq. carapace
MC-8	N	Ø fish amph.	w.b.m.
MC-9	Y	* M (shells-hatched)	w.b.m., amph,
MC-10	Y	* M (shells-hatched)	w.b.m, amph.
M X1-1	N	Ø	w.b.m., spider
M X1-2	Y	F	spider, w.b.m. amph.
M X1-3	N	Ø	snails, w.b.m. amph.
M X1-4	N	Ø	w.b.m, mummichog spider
M X1-5	N	Ø	w.b.m,
MX1-6	N	Ø	w.b.m. fish
MX1-7	N	Ø	w.b.m. fish
MX1-8			snail, w.b.m.
M X2-1	Y	F	w.b.m., pred. beetle larvae
M X2-2	Y	F	water strider, spider, snails, w.b.m,
M X2-3	Y	F	w.b.m., pred. diving beetle larvae, insect larv
M X2-4	N	Ø	** water boatmen, pred. diving beetle larvae
M X2-5	N	Ø	→ numerous water boatmen, amphipod leech, beetle
MX2-6	N	Ø	water boatmen, amphipod, spider, fish (.sn
MX2-7	N	Ø	* w.b.m
MX2-8	N	Ø	w.b.m, amph. *snails
MX2-9	N	Ø	fish, w.b.m., amph, empty snail shell
MX2-10	N	Ø	fish larvae, w.b.m. amph.

Forest edge

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

Comments: w.b.m. = water boatmen
amph. = amphipod

red dragonfly
Am. crow
white egret
Cormorant

Notes: ① appears many mosquito have all ready hatched as there were empty carapace fragments in the sweeps
② sweeps dominated by w.b.m.
* hatched/shells are stuck in algae (filamentous green algae) on downwind side.

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 8-10-09	**Observer:** L. Rivard	**Temp (°F):** 70's and rising; humid
Start Time: 0830	**End Time:** 12:05	**Tide:** outgoing, low → incoming Spring+3
Weather: clear, warm, no breeze (breeze picked up later @ ~ 8:45)		

Pool/Panne ID	Individuals Present (Yes or No)	Average Number of Individuals (Few 1 - 20, Common 21 - 40, Many >40)
MC-1	Y	F 2 cases+1 larvae: backswimmers, midge, amphipods
MC-2	N	backswimmers, amphipods, snails
MC-3	Y	F-1 larval case; backswimmers; amph
MC-4	N	many shrimp, fish observed amph
* MC-5	N	backswimmers, fish observed
MC-6	N	backswimmers
MC-7	N	backswimmers, amphipods. snails
MC-8	N	backswimmers, amphipods, midge
MC-9	Y	C (case) backswimmers, amphipods
MC-10	N	backswimmers, amphipods
M X1-1	Y	F (1 case) stickleback, killifish, backswimmers(1), amphipod
M X1-2	N	larval killifish, backswimmers
M X1-3	N	backswimmers; snails
* M X1-4	N	backswimmers
* M X1-5	N	backswimmers, snails, killifish
MX1-6	Y	F(case) midge, backswimmers, amphipods
MX1-7	Y	C (case) backswimmers
MX1-8	Y	M(cases) backswimmers, midge, amphipod, pred. diving beetle larv
M X2-1	N	many juv. killifish, pred. diving beetles + larvae
M X2-2	N	backswimmers; midge; juv fish observed + larval "maggot" w/ tail
M X2-3	N	backswimmers (100's); predacious diving beetle larvae; water beetle
* M X2-4	N	amphipods, sm. snails in algal mat; juv stickleback; juv killifish
* M X2-5	N	backswimmers; sm. snails
MX2-6	N	
MX2-7	N	backswimmers; adult mosquito; sm. snails; spider, water strider
MX2-8	N	backswimmers; sm snails.
MX2-9	N	backswimmers; sm snails
MX2-10	N	many sm. snails; stickleback

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

Comments:

* MX2-4 and MX2-5 - Not standing water, sampled larger adjacent pool located to south.
Many fish observed in Exp Pool #2
Control - majority of perimeter pools dry (i.e. no standing water)
MC-5 dry - sampled circular pool to west

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 8/25/09	**Observer:** SWATTS	**Temp (°F):** 80
Start Time: 0900	**End Time:** 1100	**Tide:** outgoing low
Weather: clear, sunny, very little wind		

Pool/Panne ID	Individuals Present (Yes or No)	Average Number of Individuals (Few 1 - 20, Common 21 - 40, Many >40)	Notes
MC-1	N	wb. mummi.	
MC-2	N	wb, ∝, pdb.	
MC-3	N	" " mummichog	
MC-4	N	wb, redworm, snails, amph	
MC-5	N	wb, snails, spider	
MC-6	N	" " "	wb spider, amph
MC-7	Y	F	wb., beetle, spider
MC-8	N		wb. spider, snails
MC-9	N		wb. f.clams, spider, ∝ obs.
MC-10	N		wb. pdb larvae, beetle, spiders
M X1-1	N		wb spider
M X1-2	N		wb "
M X1-3	N		wb, pdb, spiders
M X1-4	N		wb, pdb, spiders
M X1-5	N		wb, amph, spiders
MX1-6	N		wb.
MX1-7	Y		wb, worm, amph
MX1-8	N	F (carcao) N/A	wb, spider
M X2-1	N		wb, snails, spider
M X2-2	N		" " "
M X2-3	N		wb, snails
M X2-4	N		wb
M X2-5	N		wb, snails
MX2-6	N		wb snails
MX2-7	N		wb
MX2-8	N		wb, spider, larvae
MX2-9	N		wb spider
MX2-10	N		wb

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

Comments:
Found very few mosquitos or mosquito larvae in/on project site. Following spring high tide, would have expected more larvae and if not larvae then adults swarming around.
It's possible that recent storms/precipitation effected this...?

Mill Brook Salt Marsh Restoration Project
Mosquito Dip Count Survey Data Form

Date: 9/22/09	**Observer:** L. Rivard	**Temp (°F):** ~62° and ↑
Start Time: 0830	**End Time:** 1100	**Tide:** Low @ 0755 [illegible]
Weather: sunny, wind calm, light wispy cloudy layer		

	Pool/Panne ID	Individuals Present (Yes or No)	Average Number of Individuals (Few 1 - 20, Common 21 - 40, Many >40)
Main pool	MC-1	N	wb; snails
	MC-2	Y	adults + larvae F, snails; wb; shrimp; fly
	MC-3	Y	larvae M (in pond scum wb backed up along shore)
	MC-4	Y	larvae + adults (F); wb; snails
	MC-5	Y	larvae + adults (F); wb; shrimp; snails
adjacent pools	MC-6	N	spiders; snails; fish observed in pool
	MC-7	Y	F adults; wb; shrimp; snails
	MC-8	N	~~[illegible]~~ shrimp; snails; wb
	MC-9	Y	M larvae, F adults; wb
	MC-10	Y	F larvae; F adults; wb
main pool	M X1-1	N	wb
	M X1-2	N	wb
	M X1-3	N	wb
	M X1-4	N	spider; wb
	M X1-5	N	wb
adjacent pools	MX1-6	N	spiders; snails
	MX1-7	N	wb
	MX1-8	N	wb; snails
main pool	M X2-1	Y	adult (F); wb; snails, fly larvae; ? true bug (terrestrial)
	M X2-2	N	fly; wb; snails
	M X2-3	N	wb; snails; fly
	M X2-4	Y	adult (F) wb; snails
	M X2-5	N	snails (M)
adjacent pools	MX2-6	Y	adult (F)
	MX2-7	N	wb; spider
	MX2-8	N	wb; dragonfly nymph; fly (many alit on surface of pool)
	MX2-9	N	wb
	MX2-10	Y	F (adults); red worm

Key
M = Mosquito
C = Control
X1 = Experimental 1
X2 = Experimental 2
# = Location Number

Comments:

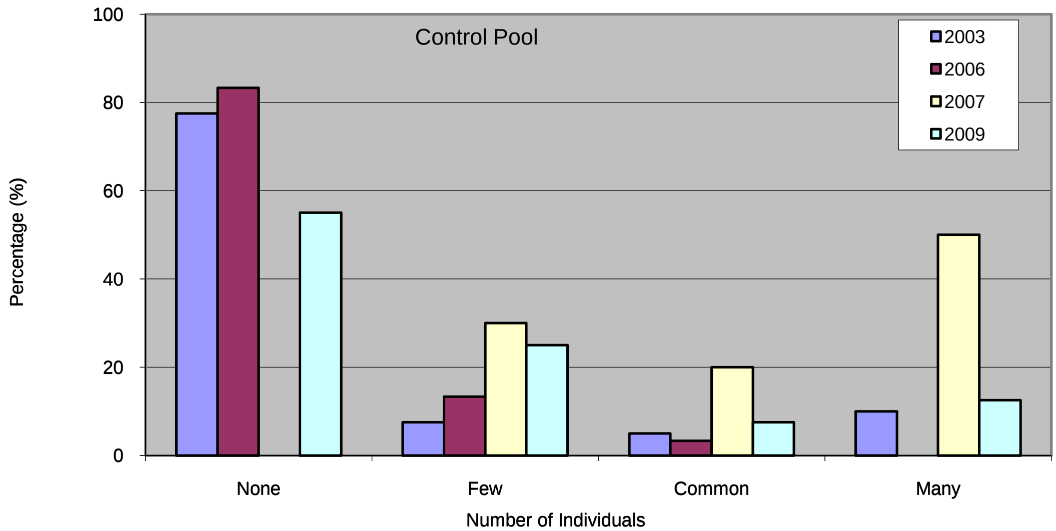
Near forest edge of Exp Pool # 2 Several airborne mosquitos pestering

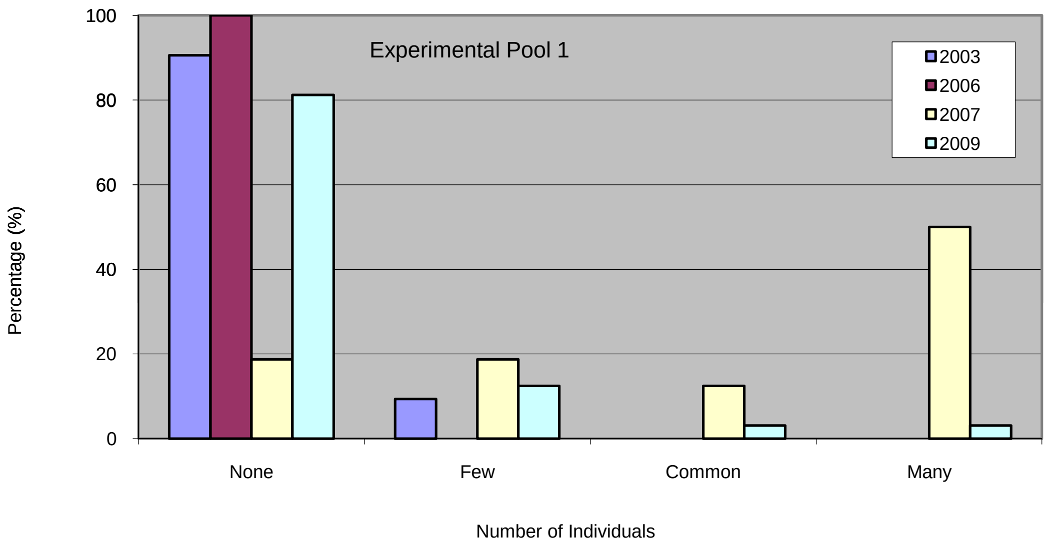
order is counterclockwise from WLR (1)

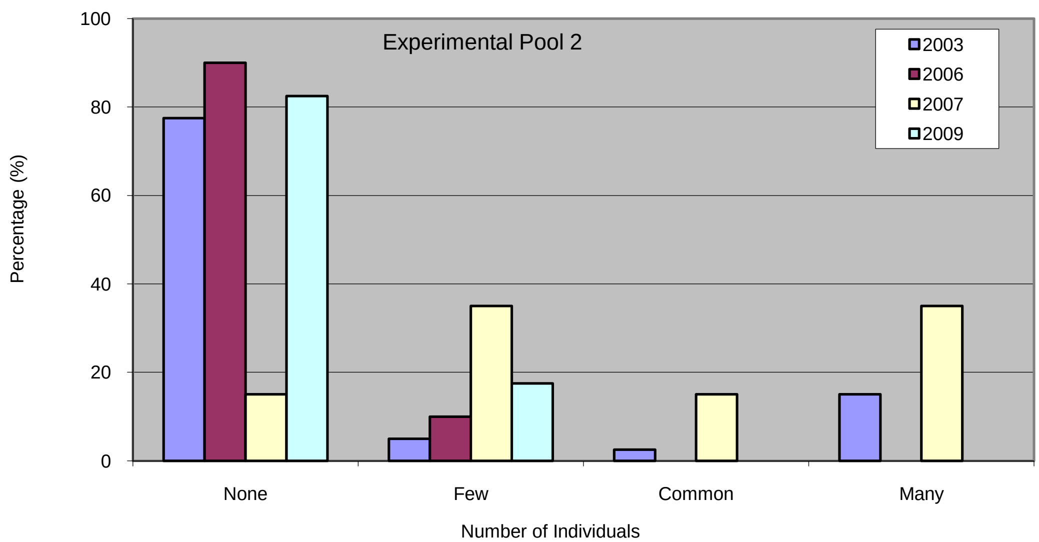
All larvae observed were of cases that had hatched out.

Wb = water boatman

Mosquito Sampling Results for the Mill Brook Salt Marsh Restoration Monitoring Project, Scarborough, Maine.







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APPENDIX C

Photographic Documentation

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NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Year 5 Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 1 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 1
Direction: 40

Comments:
Beginning of panoramic series from Photo Station 1 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 2
Direction: 80

Comments:
Panoramic series from Photo Station 1 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 1 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 3
Direction: 130

Comments:
Panoramic series from Photo Station 1 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 4
Direction: 190

Comments:
Panoramic series from Photo Station 1 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 1 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 5
Direction: 245

Comments:
Panoramic series from Photo Station 1 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 6
Direction: 290

Comments:
Panoramic series from Photo Station 1 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 1 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 7
Direction: 350

Comments:
End of Panoramic series from Photo Station 1 at Spring outgoing low tide.

PHOTO STATION 2 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 8
Direction: 45

Comments:
Beginning of panoramic series from Photo Station 2 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 2 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 9
Direction: 90

Comments:
Panoramic series from Photo Station 2 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 10
Direction: 140

Comments:
Panoramic series from Photo Station 2 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 2 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 11
Direction: 195

Comments:
Panoramic series from Photo Station 2 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 12
Direction: 250

Comments:
Panoramic series from Photo Station 2 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 2 – CONTROL POOL

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 13
Direction: 305

Comments:
Panoramic series from Photo Station 2 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 14
Direction: 355

Comments:
End of panoramic series from Photo Station 2 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 3 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 15
Direction: 40

Comments:
Beginning of panoramic series from Photo Station 3 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 16
Direction: 85

Comments:
Panoramic series from Photo Station 3 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 3 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 17
Direction: 140

Comments:
Panoramic series from Photo Station 3 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 18
Direction: 190

Comments:
Panoramic series from Photo Station 3 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 3 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 19
Direction: 245

Comments:
Panoramic series from Photo Station 3 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 20
Direction: 290

Comments:
Panoramic series from Photo Station 3 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 3 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 21
Direction: 350

Comments:
End of panoramic series from Photo Station 3 at Spring outgoing low tide.

PHOTO STATION 4 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 22
Direction: 50

Comments:
Beginning of panoramic series from Photo Station 4 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 4 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 23
Direction: 90

Comments:

Panoramic series from Photo Station 4 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 24
Direction: 135

Comments:

Panoramic series from Photo Station 4 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 4 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 25
Direction: 190

Comments:
Panoramic series from Photo Station 4 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 26
Direction: 230

Comments:
Panoramic series from Photo Station 4 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 4 – EXPERIMENTAL POOL #1

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 27
Direction: 295

Comments:
Panoramic series from Photo Station 4 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 28
Direction: 345

Comments:
End of panoramic series from Photo Station 4 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 5 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 29
Direction: 20

Comments:
Beginning of panoramic series from Photo Station 5 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 30
Direction: 55

Comments:
Panoramic series from Photo Station 5 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 5 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 31
Direction: 120

Comments:
Panoramic series from Photo Station 5 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 32
Direction: 160

Comments:
Panoramic series from Photo Station 5 at Spring outgoing low tide.

NORTHERN ECOLOGICAL ASSOCIATES, INC.

PHOTOGRAPHIC DOCUMENTATION
Post-Restoration Monitoring

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 5 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 33
Direction: 195

Comments:
Panoramic series from Photo Station 5 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 34
Direction: 220

Comments:
Panoramic series from Photo Station 5 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 5 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 35
Direction: 330

Comments:
End of panoramic series from Photo Station 5 at Spring outgoing low tide.

PHOTO STATION 6 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 36
Direction: 45

Comments:
Beginning of panoramic series from Photo Station 6 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 6 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 37
Direction: 100

Comments:
Panoramic series from Photo Station 6 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 38
Direction: 160

Comments:
Panoramic series from Photo Station 6 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 6 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 39
Direction: 212

Comments:
Panoramic series from Photo Station 6 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 40
Direction: 260

Comments:
Panoramic series from Photo Station 6 at Spring outgoing low tide.

Company: U.S. Fish and Wildlife Service & Friends of Scarborough Marsh
Project: Mill Brook Salt Marsh Restoration

PHOTO STATION 6 – EXPERIMENTAL POOL #2

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 41
Direction: 300

Comments:
Panoramic series from Photo Station 6 at Spring outgoing low tide.

Photographer: L. Rivard
Date: 08-07-09
Photo No.: 42
Direction: 350

Comments:
End of panoramic series from Photo Station 6 at Spring outgoing low tide.

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APPENDIX D

Water Level Data

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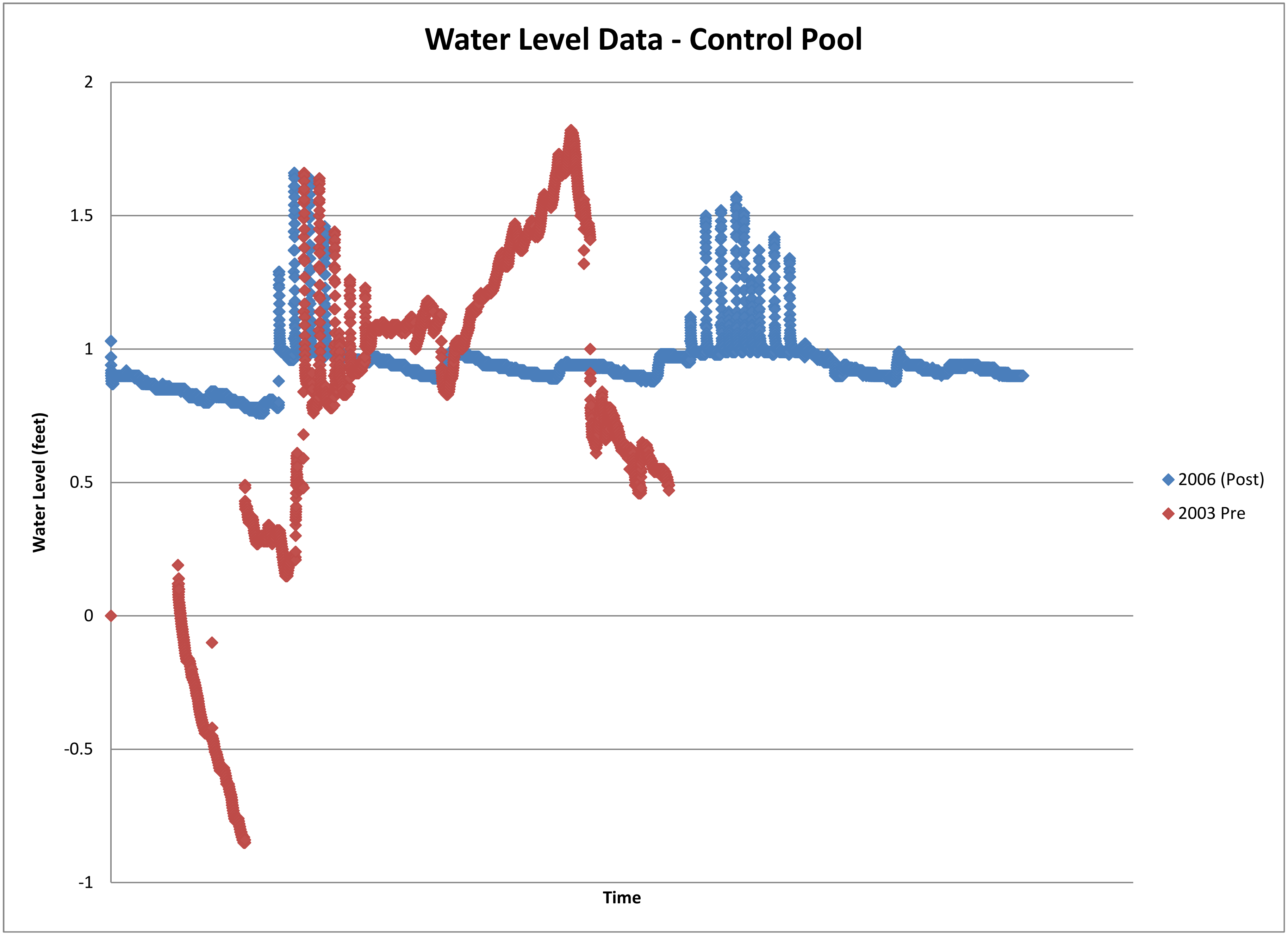
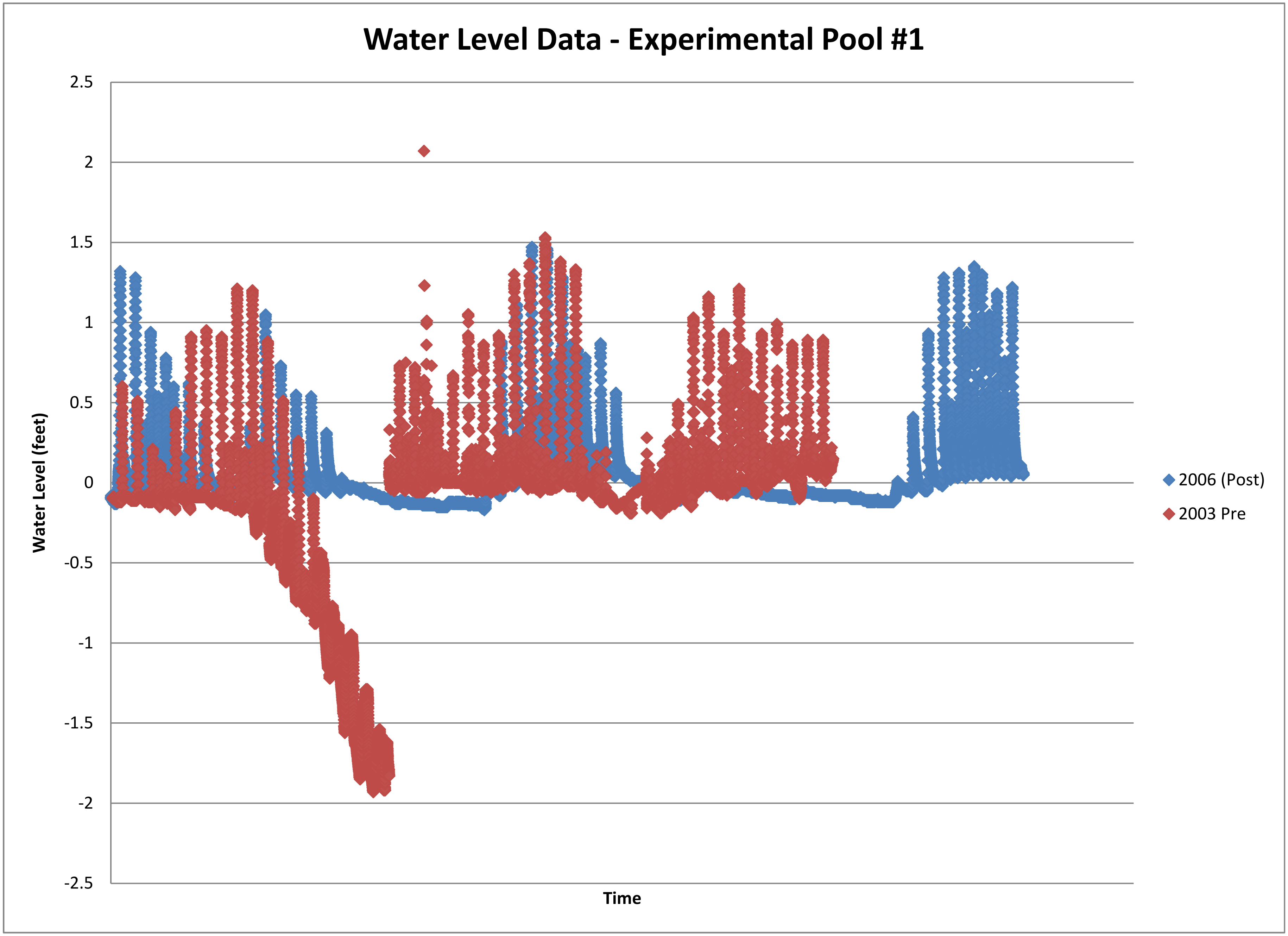
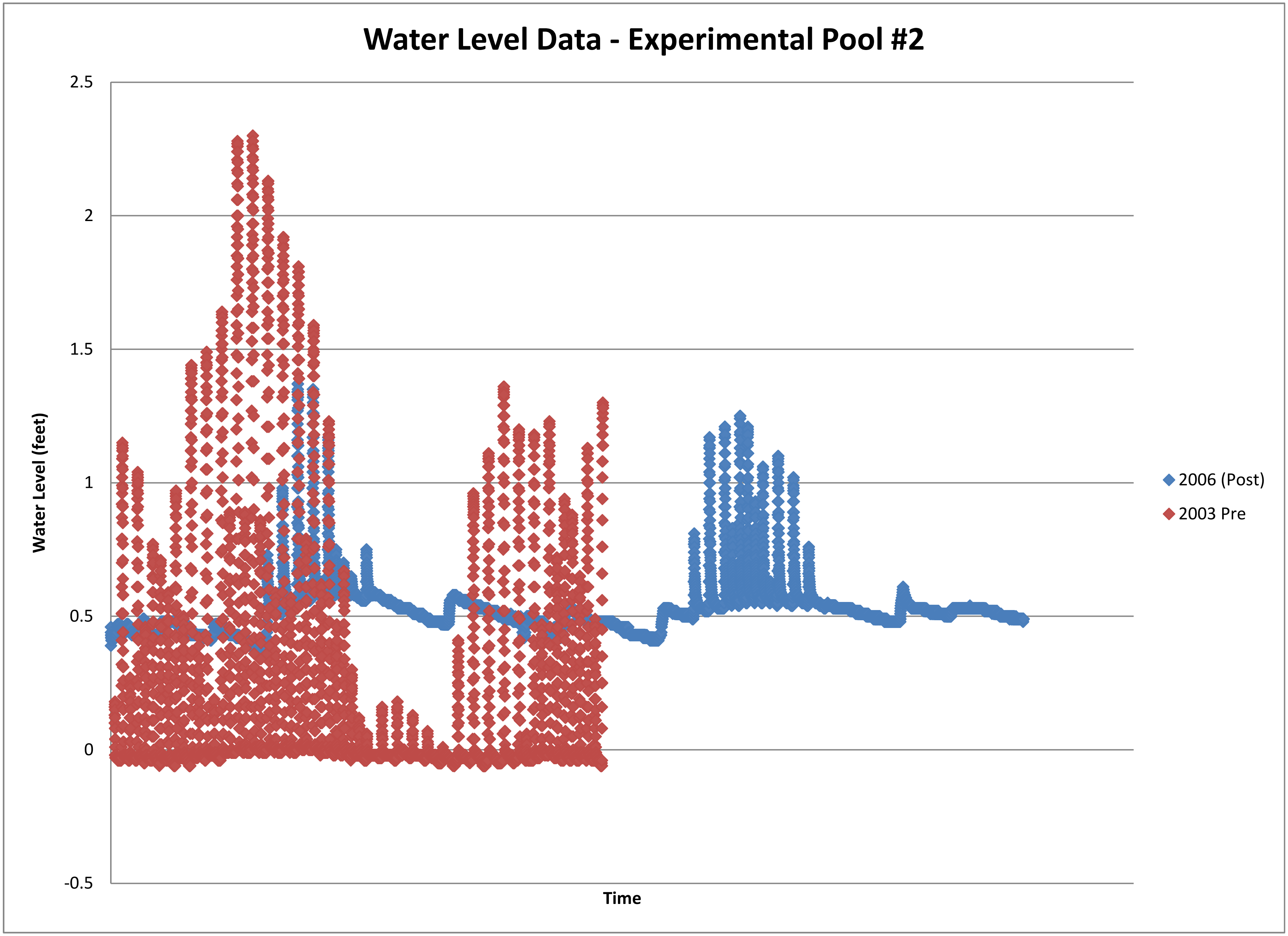


Water Level Data - Control Pool
2
1.5
1
0.5
0
-0.5
-1
Water Level (feet)
Time
2006 (Post)
2003 Pre


Water Level Data - Experimental Pool #1
Water Level (feet)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Time
2006 (Post)
2003 Pre


Water Level Data - Experimental Pool #2
2.5
2
1.5
1
0.5
0
-0.5
Water Level (feet)
Time
2006 (Post)
2003 Pre

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APPENDIX E

Statistical Analysis Results

- **Vegetation Monitoring**
- **Nekton Sampling**
- **Mosquito Sampling**

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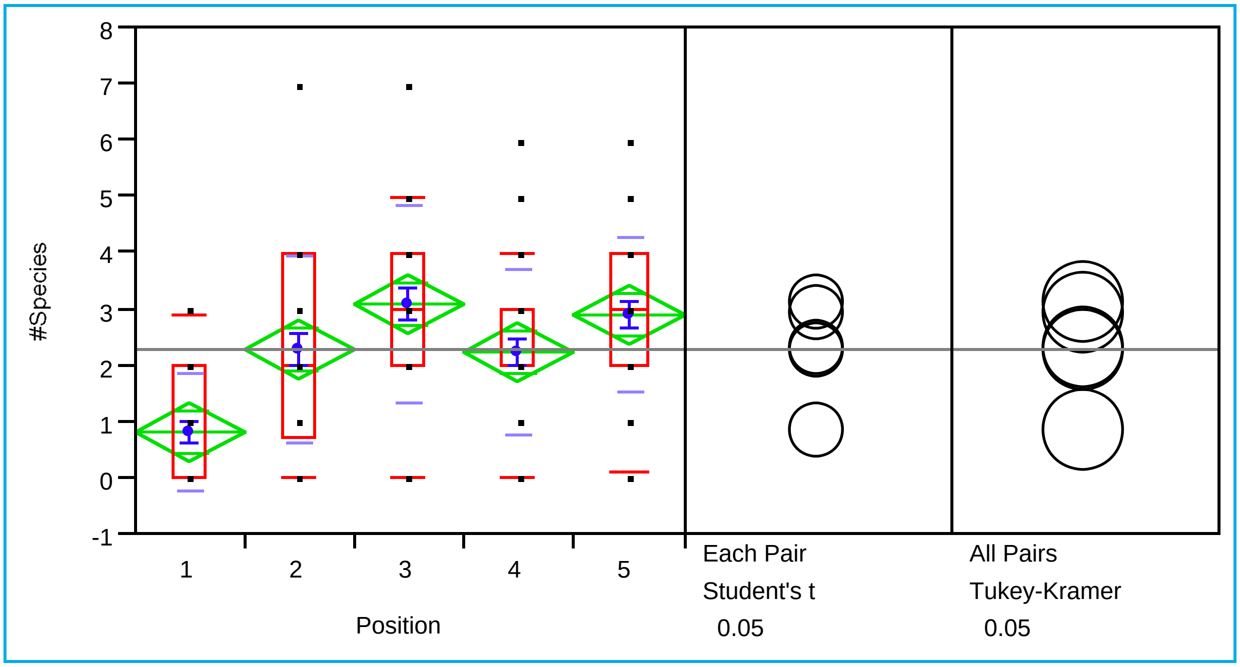
#Species By Position



Oneway Anova

Summary of Fit

RSquare	0.221722
RSquare Adj	0.200252
Root Mean Square Error	1.512553
Mean of Response	2.28
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	94.50667	23.6267	10.3272
Error	145	331.73333	2.2878	Prob>F
C Total	149	426.24000	2.8607	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
1	30	0.83333	0.27615
2	30	2.30000	0.27615
3	30	3.10000	0.27615
4	30	2.26667	0.27615
5	30	2.90000	0.27615

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
1	30	0.83333	1.08543	0.19817
2	30	2.30000	1.70496	0.31128
3	30	3.10000	1.78789	0.32642
4	30	2.26667	1.48401	0.27094
5	30	2.90000	1.39827	0.25529

Means Comparisons

Dif=Mean[i]-Mean[j]	3	5	2	4	1
3	0.00000	0.20000	0.80000	0.83333	2.26667
5	-0.20000	0.00000	0.60000	0.63333	2.06667
2	-0.80000	-0.60000	0.00000	0.03333	1.46667
4	-0.83333	-0.63333	-0.03333	0.00000	1.43333
1	-2.26667	-2.06667	-1.46667	-1.43333	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97648

Abs(Dif)-LSD	3	5	2	4	1
3	-0.77189	-0.57189	0.02811	0.06144	1.49477
5	-0.57189	-0.77189	-0.17189	-0.13856	1.29477
2	0.02811	-0.17189	-0.77189	-0.73856	0.69477
4	0.06144	-0.13856	-0.73856	-0.77189	0.66144
1	1.49477	1.29477	0.69477	0.66144	-0.77189

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.76241

Abs(Dif)-LSD	3	5	2	4	1
3	-1.07883	-0.87883	-0.27883	-0.24550	1.18784
5	-0.87883	-1.07883	-0.47883	-0.44550	0.98784
2	-0.27883	-0.47883	-1.07883	-1.04550	0.38784
4	-0.24550	-0.44550	-1.04550	-1.07883	0.35450
1	1.18784	0.98784	0.38784	0.35450	-1.07883

Positive values show pairs of means that are significantly different.

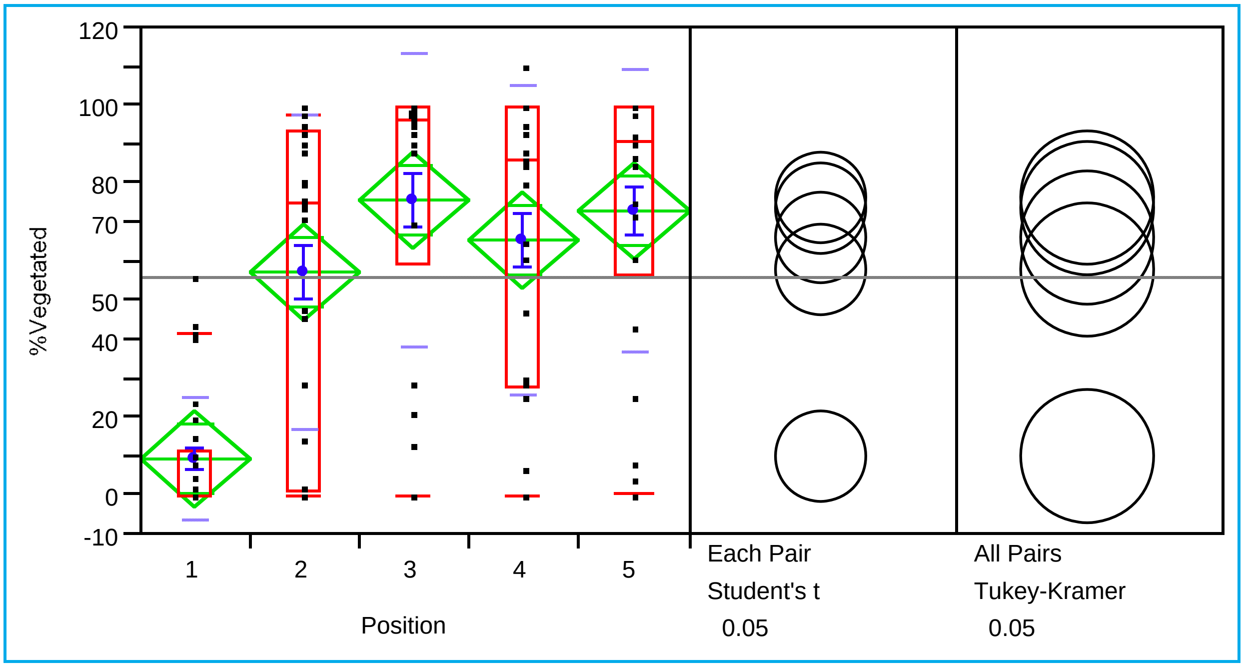
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	30	1152.5	38.4167	-5.352
2	30	2277.5	75.9167	0.058
3	30	2866.5	95.5500	2.892
4	30	2217	73.9000	-0.229
5	30	2811.5	93.7167	2.628

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
35.2170	4	<.0001

%Vegetated By Position



Oneway Anova

Summary of Fit

RSquare	0.326341
RSquare Adj	0.307758
Root Mean Square Error	35.48588
Mean of Response	56.34
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	88452.76	22113.2	17.5606
Error	145	182590.90	1259.2	Prob>F
C Total	149	271043.66	1819.1	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
1	30	9.5333	6.4788
2	30	57.2000	6.4788
3	30	75.6333	6.4788
4	30	65.8333	6.4788
5	30	73.5000	6.4788

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
1	30	9.5333	15.8696	2.8974
2	30	57.2000	40.3710	7.3707
3	30	75.6333	38.2474	6.9830
4	30	65.8333	39.9259	7.2894
5	30	73.5000	36.8461	6.7272

Means Comparisons

Dif=Mean[i]-Mean[j]	3	5	4	2	1
3	0.0000	2.1333	9.8000	18.4333	66.1000
5	-2.1333	0.0000	7.6667	16.3000	63.9667
4	-9.8000	-7.6667	0.0000	8.6333	56.3000
2	-18.4333	-16.3000	-8.6333	0.0000	47.6667
1	-66.1000	-63.9667	-56.3000	-47.6667	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97648

Abs(Dif)-LSD	3	5	4	2	1
3	-18.1093	-15.9760	-8.3093	0.3240	47.9907
5	-15.9760	-18.1093	-10.4426	-1.8093	45.8574
4	-8.3093	-10.4426	-18.1093	-9.4760	38.1907
2	0.3240	-1.8093	-9.4760	-18.1093	29.5574
1	47.9907	45.8574	38.1907	29.5574	-18.1093

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.76241

Abs(Dif)-LSD	3	5	4	2	1
3	-25.3103	-23.1770	-15.5103	-6.8770	40.7897
5	-23.1770	-25.3103	-17.6437	-9.0103	38.6563
4	-15.5103	-17.6437	-25.3103	-16.6770	30.9897
2	-6.8770	-9.0103	-16.6770	-25.3103	22.3563
1	40.7897	38.6563	30.9897	22.3563	-25.3103

Positive values show pairs of means that are significantly different.

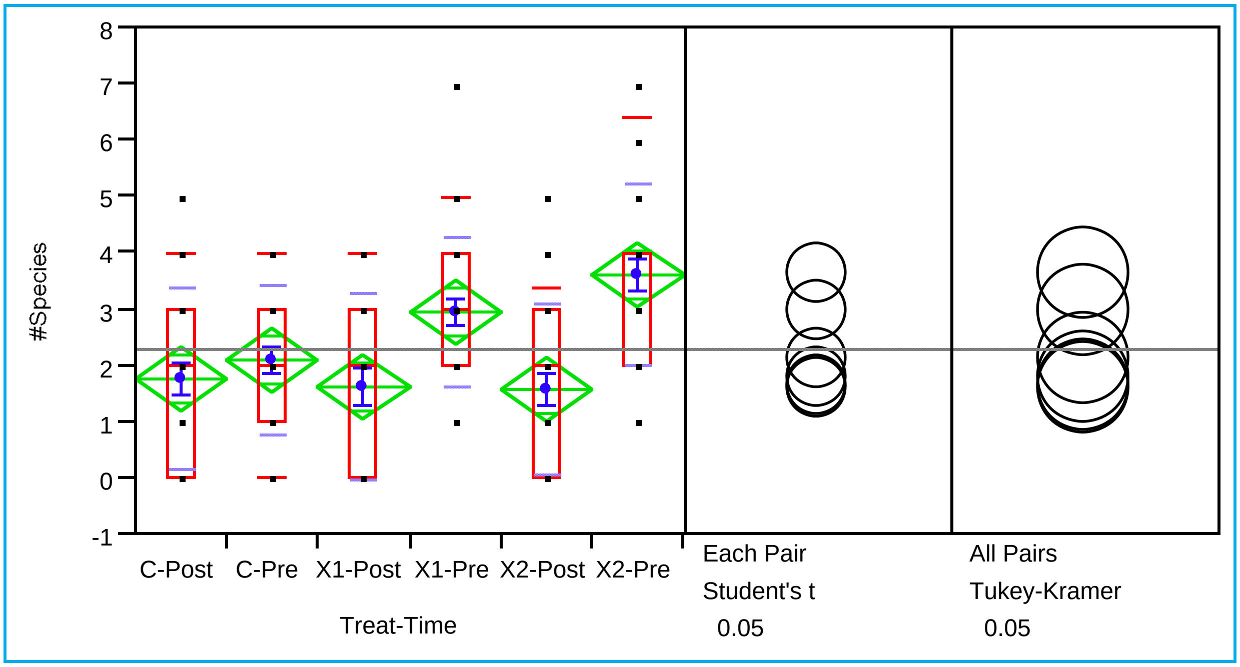
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	30	967.5	32.2500	-6.168
2	30	2118	70.6000	-0.697
3	30	2883.5	96.1167	2.939
4	30	2563.5	85.4500	1.417
5	30	2792.5	93.0833	2.506

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
44.4168	4	<.0001

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.197823
RSquare Adj	0.169969
Root Mean Square Error	1.540923
Mean of Response	2.28
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	84.32000	16.8640	7.1023
Error	144	341.92000	2.3744	Prob>F
C Total	149	426.24000	2.8607	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	1.76000	0.30818
C-Pre	25	2.12000	0.30818
X1-Post	25	1.64000	0.30818
X1-Pre	25	2.96000	0.30818
X2-Post	25	1.60000	0.30818
X2-Pre	25	3.60000	0.30818

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	1.76000	1.61452	0.32290
C-Pre	25	2.12000	1.36382	0.27276
X1-Post	25	1.64000	1.70489	0.34098
X1-Pre	25	2.96000	1.33791	0.26758
X2-Post	25	1.60000	1.55456	0.31091
X2-Pre	25	3.60000	1.63299	0.32660

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-Pre	X1-Pre	C-Pre	C-Post	X1-Post	X2-Post
X2-Pre	0.00000	0.64000	1.48000	1.84000	1.96000	2.00000
X1-Pre	-0.64000	0.00000	0.84000	1.20000	1.32000	1.36000
C-Pre	-1.48000	-0.84000	0.00000	0.36000	0.48000	0.52000
C-Post	-1.84000	-1.20000	-0.36000	0.00000	0.12000	0.16000
X1-Post	-1.96000	-1.32000	-0.48000	-0.12000	0.00000	0.04000
X2-Post	-2.00000	-1.36000	-0.52000	-0.16000	-0.04000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97659

Abs(Dif)-LSD	X2-Pre	X1-Pre	C-Pre	C-Post	X1-Post	X2-Post
X2-Pre	-0.86148	-0.22148	0.61852	0.97852	1.09852	1.13852
X1-Pre	-0.22148	-0.86148	-0.02148	0.33852	0.45852	0.49852
C-Pre	0.61852	-0.02148	-0.86148	-0.50148	-0.38148	-0.34148
C-Post	0.97852	0.33852	-0.50148	-0.86148	-0.74148	-0.70148
X1-Post	1.09852	0.45852	-0.38148	-0.74148	-0.86148	-0.82148
X2-Post	1.13852	0.49852	-0.34148	-0.70148	-0.82148	-0.86148

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.88849

Abs(Dif)-LSD	X2-Pre	X1-Pre	C-Pre	C-Post	X1-Post	X2-Post
X2-Pre	-1.25892	-0.61892	0.22108	0.58108	0.70108	0.74108
X1-Pre	-0.61892	-1.25892	-0.41892	-0.05892	0.06108	0.10108
C-Pre	0.22108	-0.41892	-1.25892	-0.89892	-0.77892	-0.73892
C-Post	0.58108	-0.05892	-0.89892	-1.25892	-1.13892	-1.09892
X1-Post	0.70108	0.06108	-0.77892	-1.13892	-1.25892	-1.21892
X2-Post	0.74108	0.10108	-0.73892	-1.09892	-1.21892	-1.25892

Positive values show pairs of means that are significantly different.

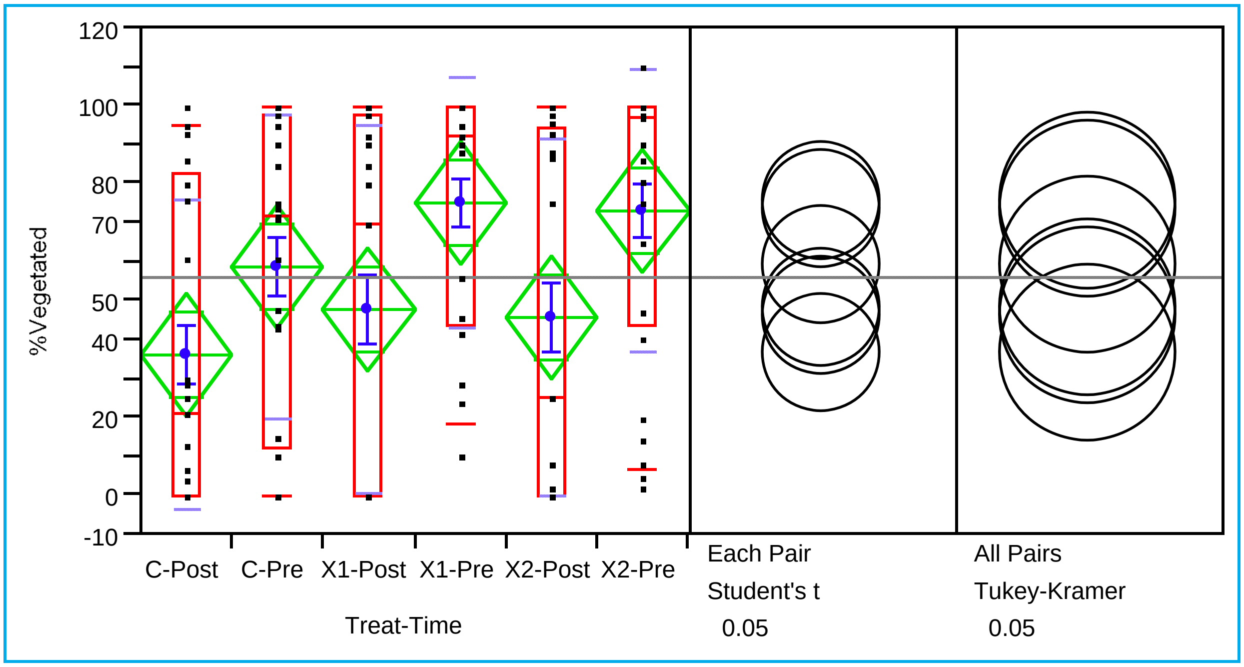
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	1565.5	62.620	-1.661
C-Pre	25	1820	72.800	-0.346
X1-Post	25	1545	61.800	-1.767
X1-Pre	25	2277.5	91.100	2.012
X2-Post	25	1482.5	59.300	-2.089
X2-Pre	25	2634.5	105.380	3.856

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
24.4520	5	0.0002

%Vegetated By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.114582
RSquare Adj	0.083839
Root Mean Square Error	40.82371
Mean of Response	56.34
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	31056.78	6211.36	3.7270
Error	144	239986.88	1666.58	Prob>F
C Total	149	271043.66	1819.08	0.0033

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	36.3200	8.1647
C-Pre	25	59.0800	8.1647
X1-Post	25	47.9200	8.1647
X1-Pre	25	75.4400	8.1647
X2-Post	25	45.9200	8.1647
X2-Pre	25	73.3600	8.1647

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	36.3200	40.1577	8.0315
C-Pre	25	59.0800	39.4556	7.8911
X1-Post	25	47.9200	47.4841	9.4968
X1-Pre	25	75.4400	32.7568	6.5514
X2-Post	25	45.9200	46.4901	9.2980
X2-Pre	25	73.3600	36.6195	7.3239

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-Pre	X2-Pre	C-Pre	X1-Post	X2-Post	C-Post
X1-Pre	0.0000	2.0800	16.3600	27.5200	29.5200	39.1200
X2-Pre	-2.0800	0.0000	14.2800	25.4400	27.4400	37.0400
C-Pre	-16.3600	-14.2800	0.0000	11.1600	13.1600	22.7600
X1-Post	-27.5200	-25.4400	-11.1600	0.0000	2.0000	11.6000
X2-Post	-29.5200	-27.4400	-13.1600	-2.0000	0.0000	9.6000
C-Post	-39.1200	-37.0400	-22.7600	-11.6000	-9.6000	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97659

Abs(Dif)-LSD	X1-Pre	X2-Pre	C-Pre	X1-Post	X2-Post	C-Post
X1-Pre	-22.8231	-20.7431	-6.4631	4.6969	6.6969	16.2969
X2-Pre	-20.7431	-22.8231	-8.5431	2.6169	4.6169	14.2169
C-Pre	-6.4631	-8.5431	-22.8231	-11.6631	-9.6631	-0.0631
X1-Post	4.6969	2.6169	-11.6631	-22.8231	-20.8231	-11.2231
X2-Post	6.6969	4.6169	-9.6631	-20.8231	-22.8231	-13.2231
C-Post	16.2969	14.2169	-0.0631	-11.2231	-13.2231	-22.8231

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.88849

Abs(Dif)-LSD	X1-Pre	X2-Pre	C-Pre	X1-Post	X2-Post	C-Post
X1-Pre	-33.3525	-31.2725	-16.9925	-5.8325	-3.8325	5.7675
X2-Pre	-31.2725	-33.3525	-19.0725	-7.9125	-5.9125	3.6875
C-Pre	-16.9925	-19.0725	-33.3525	-22.1925	-20.1925	-10.5925
X1-Post	-5.8325	-7.9125	-22.1925	-33.3525	-31.3525	-21.7525
X2-Post	-3.8325	-5.9125	-20.1925	-31.3525	-33.3525	-23.7525
C-Post	5.7675	3.6875	-10.5925	-21.7525	-23.7525	-33.3525

Positive values show pairs of means that are significantly different.

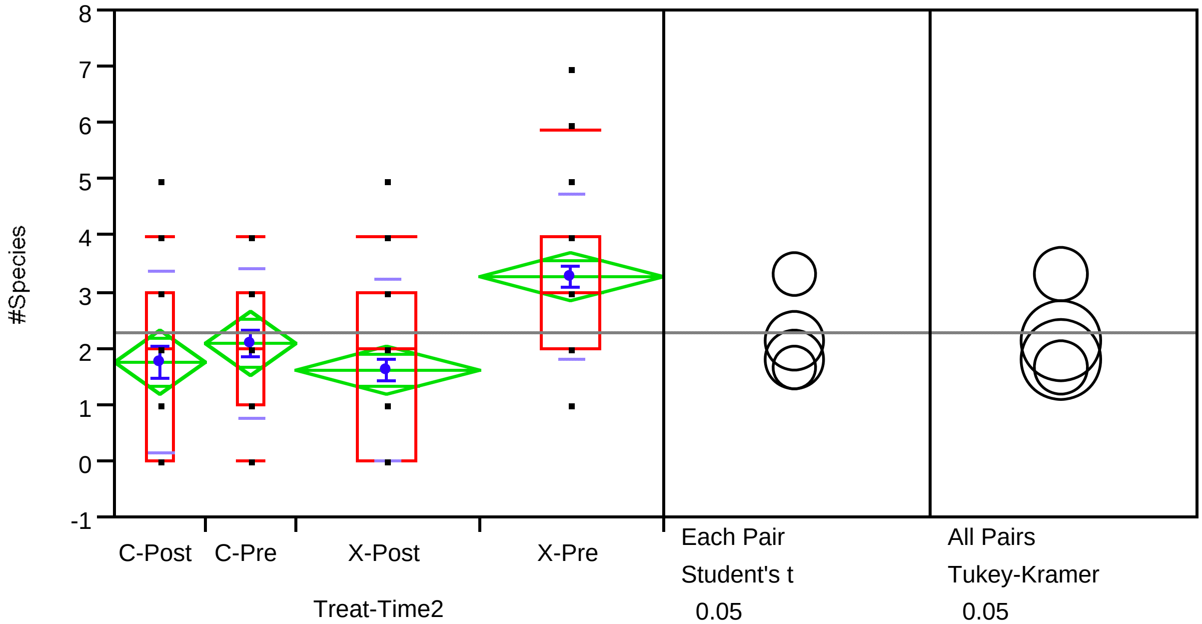
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	1361	54.4400	-2.685
C-Pre	25	1885.5	75.4200	-0.008
X1-Post	25	1619	64.7600	-1.368
X1-Pre	25	2452.5	98.1000	2.881
X2-Post	25	1599	63.9600	-1.470
X2-Pre	25	2408	96.3200	2.654

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
22.2031	5	0.0005

#Species By Treat-Time2



Oneway Anova

Summary of Fit

RSquare	0.185764
RSquare Adj	0.169033
Root Mean Square Error	1.541792
Mean of Response	2.28
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	79.18000	26.3933	11.1031
Error	146	347.06000	2.3771	Prob>F
C Total	149	426.24000	2.8607	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	1.76000	0.30836
C-Pre	25	2.12000	0.30836
X-Post	50	1.62000	0.21804
X-Pre	50	3.28000	0.21804

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	1.76000	1.61452	0.32290
C-Pre	25	2.12000	1.36382	0.27276
X-Post	50	1.62000	1.61485	0.22837
X-Pre	50	3.28000	1.51240	0.21389

Means Comparisons

Dif=Mean[i]-Mean[j]	X-Pre	C-Pre	C-Post	X-Post
X-Pre	0.00000	1.16000	1.52000	1.66000
C-Pre	-1.16000	0.00000	0.36000	0.50000
C-Post	-1.52000	-0.36000	0.00000	0.14000
X-Post	-1.66000	-0.50000	-0.14000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97636

Abs(Dif)-LSD	X-Pre	C-Pre	C-Post	X-Post
X-Pre	-0.60943	0.41361	0.77361	1.05057
C-Pre	0.41361	-0.86186	-0.50186	-0.24639
C-Post	0.77361	-0.50186	-0.86186	-0.60639
X-Post	1.05057	-0.24639	-0.60639	-0.60943

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.59888

Abs(Dif)-LSD	X-Pre	C-Pre	C-Post	X-Post
X-Pre	-0.80139	0.17851	0.53851	0.85861
C-Pre	0.17851	-1.13333	-0.77333	-0.48149
C-Post	0.53851	-0.77333	-1.13333	-0.84149
X-Post	0.85861	-0.48149	-0.84149	-0.80139

Positive values show pairs of means that are significantly different.

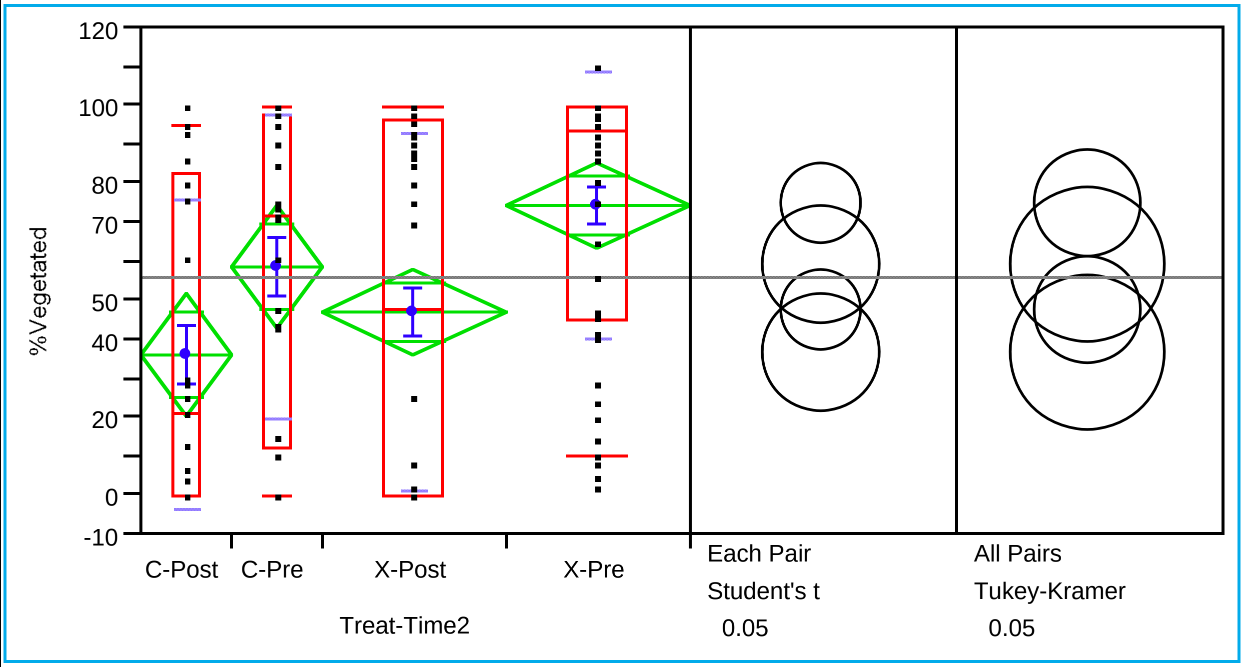
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	1565.5	62.6200	-1.661
C-Pre	25	1820	72.8000	-0.346
X-Post	50	3027.5	60.5500	-3.051
X-Pre	50	4912	98.2400	4.641

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
22.9916	3	<.0001

%Vegetated By Treat-Time2



Oneway Anova

Summary of Fit

RSquare	0.114198
RSquare Adj	0.095997
Root Mean Square Error	40.55193
Mean of Response	56.34
Observations (or Sum Wgts)	150

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	30952.70	10317.6	6.2741
Error	146	240090.96	1644.5	Prob>F
C Total	149	271043.66	1819.1	0.0005

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	36.3200	8.1104
C-Pre	25	59.0800	8.1104
X-Post	50	46.9200	5.7349
X-Pre	50	74.4000	5.7349

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	36.3200	40.1577	8.0315
C-Pre	25	59.0800	39.4556	7.8911
X-Post	50	46.9200	46.5187	6.5787
X-Pre	50	74.4000	34.4016	4.8651

Means Comparisons

Dif=Mean[i]-Mean[j]	X-Pre	C-Pre	X-Post	C-Post
X-Pre	0.0000	15.3200	27.4800	38.0800
C-Pre	-15.3200	0.0000	12.1600	22.7600
X-Post	-27.4800	-12.1600	0.0000	10.6000
C-Post	-38.0800	-22.7600	-10.6000	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.97636

Abs(Dif)-LSD	X-Pre	C-Pre	X-Post	C-Post
X-Pre	-16.0291	-4.3115	11.4509	18.4485
C-Pre	-4.3115	-22.6685	-7.4715	0.0915
X-Post	11.4509	-7.4715	-16.0291	-9.0315
C-Post	18.4485	0.0915	-9.0315	-22.6685

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.59888

Abs(Dif)-LSD	X-Pre	C-Pre	X-Post	C-Post
X-Pre	-21.0779	-10.4950	6.4021	12.2650
C-Pre	-10.4950	-29.8086	-13.6550	-7.0486
X-Post	6.4021	-13.6550	-21.0779	-15.2150
C-Post	12.2650	-7.0486	-15.2150	-29.8086

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

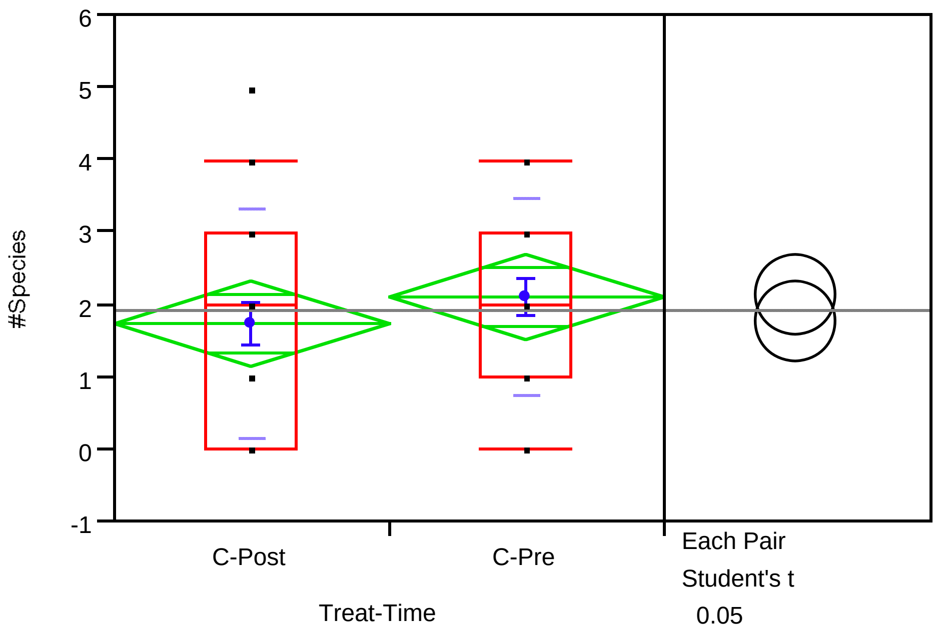
Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	1361	54.4400	-2.685
C-Pre	25	1885.5	75.4200	-0.008
X-Post	50	3218	64.3600	-2.246
X-Pre	50	4860.5	97.2100	4.378

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
22.1772	3	<.0001

Vegetation Sampling

#Species By Treat-Time



Quantiles

Level	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
C-Post	0	0	0	2	3	4	5
C-Pre	0	0	1	2	3	4	4

Oneway Anova

Summary of Fit

RSquare	0.014887
RSquare Adj	-0.00564
Root Mean Square Error	1.494434
Mean of Response	1.94
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-0.36000	-0.852	48	0.3986
Std Error	0.42269			
Lower 95%	-1.20987			
Upper 95%	0.48987			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.62000	1.62000	0.7254
Error	48	107.20000	2.23333	Prob>F
C Total	49	108.82000	2.22082	0.3986

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	1.76000	0.29889
C-Pre	25	2.12000	0.29889

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	1.76000	1.61452	0.32290
C-Pre	25	2.12000	1.36382	0.27276

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	C-Post
C-Pre	0.000000	0.360000
C-Post	-0.36	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	C-Pre	C-Post
C-Pre	-0.84987	-0.48987
C-Post	-0.48987	-0.84987

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	589.5	23.5800	-0.950
C-Pre	25	685.5	27.4200	0.950

2-Sample Test, Normal Approximation

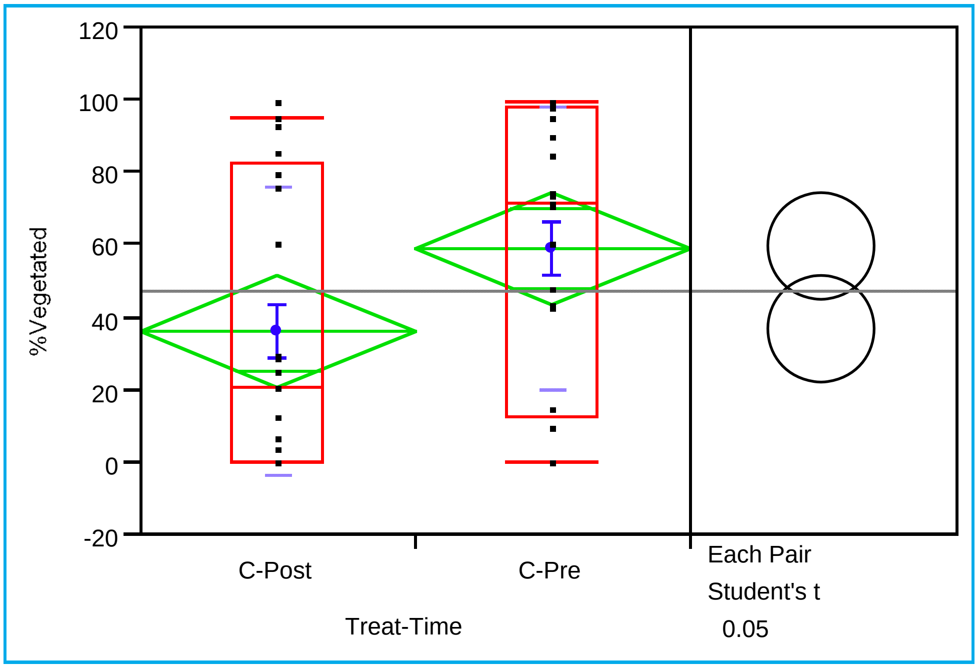
S	Z	Prob>|Z|
685.5	0.94995	0.3421

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
0.9215	1	0.3371

Vegetation Sampling

%Vegetated By Treat-Time



Quantiles

Level	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
C-Post	0	0	0	21	83	95	100
C-Pre	0	0	12.5	72	98	100	100

Oneway Anova

Summary of Fit

RSquare	0.078449
RSquare Adj	0.05925
Root Mean Square Error	39.80821
Mean of Response	47.7
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-22.7600	-2.021	48	0.0488
Std Error	11.2595			
Lower 95%	-45.3986			
Upper 95%	-0.1214			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	6475.220	6475.22	4.0861
Error	48	76065.280	1584.69	Prob>F
C Total	49	82540.500	1684.50	0.0488

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	36.3200	7.9616
C-Pre	25	59.0800	7.9616

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	36.3200	40.1577	8.0315
C-Pre	25	59.0800	39.4556	7.8911

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	C-Post
C-Pre	0.0000	22.7600
C-Post	-22.7600	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	C-Pre	C-Post
C-Pre	-22.6386	0.1214
C-Post	0.1214	-22.6386

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	540	21.6000	-1.904
C-Pre	25	735	29.4000	1.904

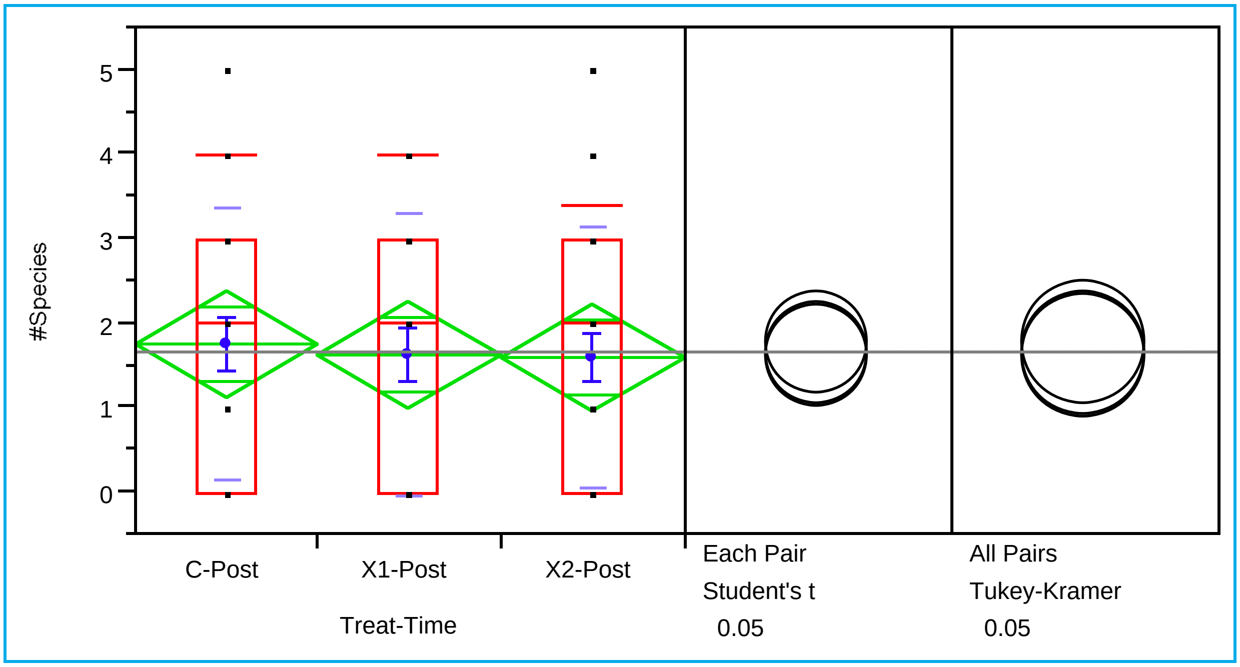
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
735	1.90438	0.0569

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
3.6642	1	0.0556

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.001818
RSquare Adj	-0.02591
Root Mean Square Error	1.625833
Mean of Response	1.666667
Observations (or Sum Wgts)	75

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.34667	0.17333	0.0656
Error	72	190.32000	2.64333	Prob>F
C Total	74	190.66667	2.57658	0.9366

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	1.76000	0.32517
X1-Post	25	1.64000	0.32517
X2-Post	25	1.60000	0.32517

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	1.76000	1.61452	0.32290
X1-Post	25	1.64000	1.70489	0.34098
X2-Post	25	1.60000	1.55456	0.31091

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Post	X1-Post	X2-Post
C-Post	0.000000	0.120000	0.160000
X1-Post	-0.12	0.000000	0.040000
X2-Post	-0.16	-0.04	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.99347

Abs(Dif)-LSD	C-Post	X1-Post	X2-Post
C-Post	-0.91671	-0.79671	-0.75671
X1-Post	-0.79671	-0.91671	-0.87671
X2-Post	-0.75671	-0.87671	-0.91671

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.39313

Abs(Dif)-LSD	C-Post	X1-Post	X2-Post
C-Post	-1.10050	-0.98050	-0.94050
X1-Post	-0.98050	-1.10050	-1.06050
X2-Post	-0.94050	-1.06050	-1.10050

Positive values show pairs of means that are significantly different.

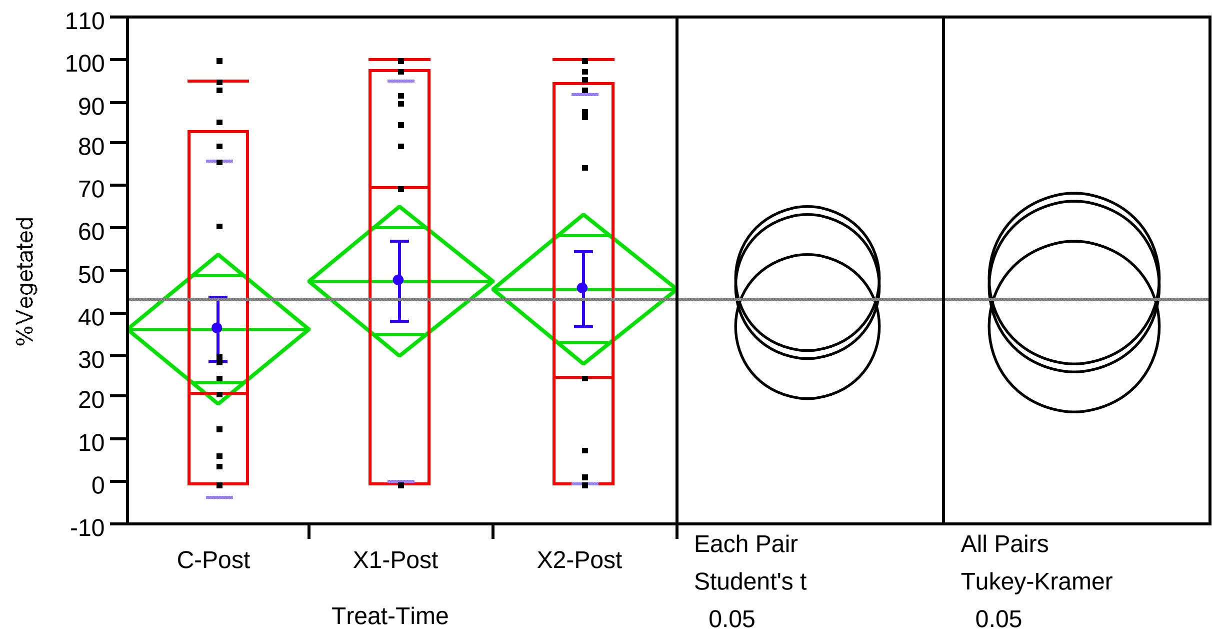
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	974.5	38.9800	0.282
X1-Post	25	943	37.7200	-0.076
X2-Post	25	932.5	37.3000	-0.200

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
0.0882	2	0.9569

%Vegetated By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.013114
RSquare Adj	-0.0143
Root Mean Square Error	44.82824
Mean of Response	43.38667
Observations (or Sum Wgts)	75

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1922.67	961.33	0.4784
Error	72	144689.12	2009.57	Prob>F
C Total	74	146611.79	1981.24	0.6217

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	25	36.3200	8.9656
X1-Post	25	47.9200	8.9656
X2-Post	25	45.9200	8.9656

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	25	36.3200	40.1577	8.0315
X1-Post	25	47.9200	47.4841	9.4968
X2-Post	25	45.9200	46.4901	9.2980

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-Post	X2-Post	C-Post
X1-Post	0.0000	2.0000	11.6000
X2-Post	-2.0000	0.0000	9.6000
C-Post	-11.6000	-9.6000	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.99347

Abs(Dif)-LSD	X1-Post	X2-Post	C-Post
X1-Post	-25.2759	-23.2759	-13.6759
X2-Post	-23.2759	-25.2759	-15.6759
C-Post	-13.6759	-15.6759	-25.2759

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.39313

Abs(Dif)-LSD	X1-Post	X2-Post	C-Post
X1-Post	-30.3434	-28.3434	-18.7434
X2-Post	-28.3434	-30.3434	-20.7434
C-Post	-18.7434	-20.7434	-30.3434

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

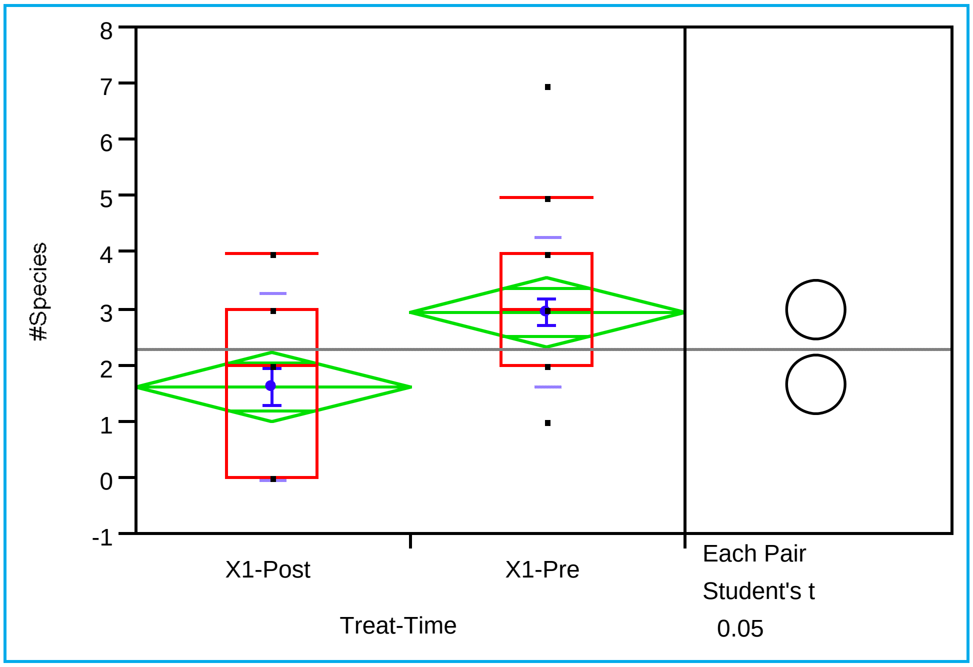
Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	25	894.5	35.7800	-0.642
X1-Post	25	970	38.8000	0.228
X2-Post	25	985.5	39.4200	0.409

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
0.4307	2	0.8063

Vegetation Sampling

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.161933
RSquare Adj	0.144473
Root Mean Square Error	1.532427
Mean of Response	2.3
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-1.32000	-3.045	48	0.0038
Std Error	0.43344			
Lower 95%	-2.19148			
Upper 95%	-0.44852			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	21.78000	21.7800	9.2747
Error	48	112.72000	2.3483	Prob>F
C Total	49	134.50000	2.7449	0.0038

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-Post	25	1.64000	0.30649
X1-Pre	25	2.96000	0.30649

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-Post	25	1.64000	1.70489	0.34098
X1-Pre	25	2.96000	1.33791	0.26758

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-Pre	X1-Post
X1-Pre	0.00000	1.32000
X1-Post	-1.32000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	X1-Pre	X1-Post
X1-Pre	-0.87148	0.448521
X1-Post	0.448521	-0.87148

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-Post	25	519.5	20.7800	-2.341
X1-Pre	25	755.5	30.2200	2.341

2-Sample Test, Normal Approximation

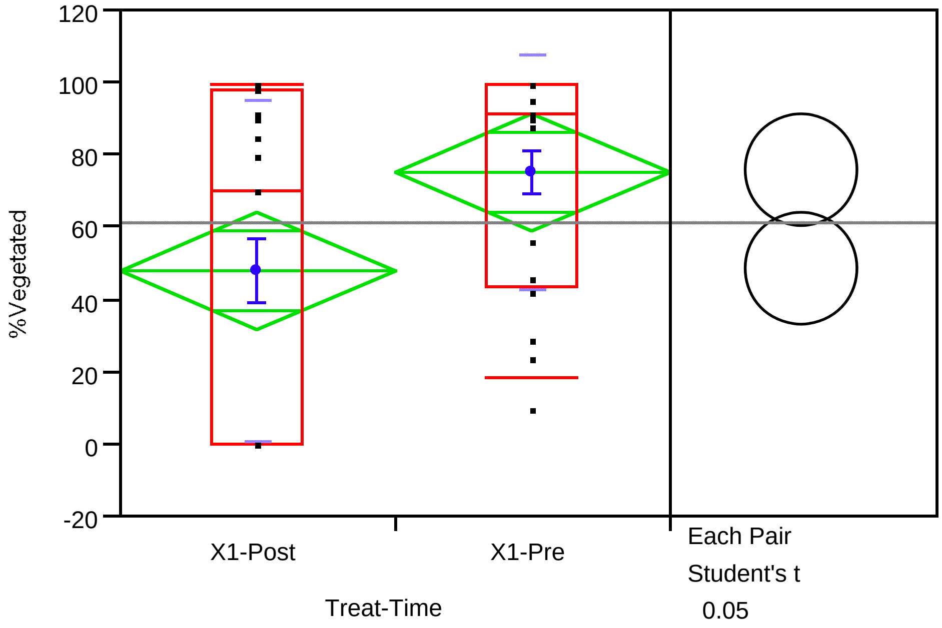
S	Z	Prob>|Z|
755.5	2.34147	0.0192

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
5.5293	1	0.0187

Vegetation Sampling

%Vegetated By Treat-Time



Quantiles

Level	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
X1-Post	0	0	0	70	98	100	100
X1-Pre	10	18.4	44	92	100	100	100

Oneway Anova

Summary of Fit

RSquare	0.105973
RSquare Adj	0.087348
Root Mean Square Error	40.79062
Mean of Response	61.68
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-27.5200	-2.385	48	0.0211
Std Error	11.5373			
Lower 95%	-50.7173			
Upper 95%	-4.3227			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	9466.880	9466.88	5.6897
Error	48	79866.000	1663.88	Prob>F
C Total	49	89332.880	1823.12	0.0211

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-Post	25	47.9200	8.1581
X1-Pre	25	75.4400	8.1581

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-Post	25	47.9200	47.4841	9.4968
X1-Pre	25	75.4400	32.7568	6.5514

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-Pre	X1-Post
X1-Pre	0.0000	27.5200
X1-Post	-27.5200	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	X1-Pre	X1-Post
X1-Pre	-23.1973	4.3227
X1-Post	4.3227	-23.1973

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-Post	25	510	20.4000	-2.517
X1-Pre	25	765	30.6000	2.517

2-Sample Test, Normal Approximation

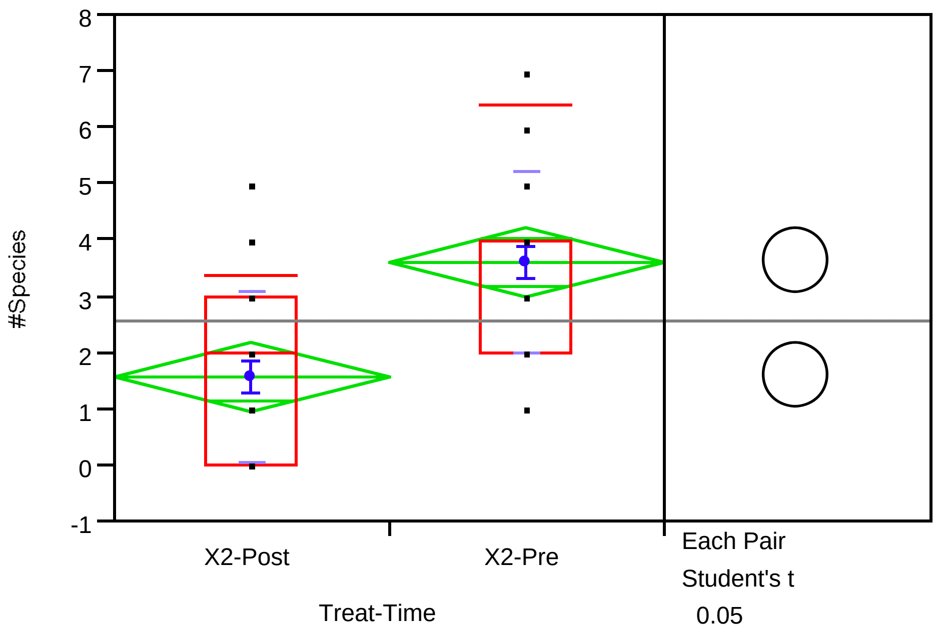
S	Z	Prob>|Z|
765	2.51680	0.0118

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
6.3843	1	0.0115

Vegetation Sampling

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.290698
RSquare Adj	0.275921
Root Mean Square Error	1.594261
Mean of Response	2.6
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-2.00000	-4.435	48	<.0001
Std Error	0.45092			
Lower 95%	-2.90664			
Upper 95%	-1.09336			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	50.00000	50.0000	19.6721
Error	48	122.00000	2.5417	Prob>F
C Total	49	172.00000	3.5102	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-Post	25	1.60000	0.31885
X2-Pre	25	3.60000	0.31885

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-Post	25	1.60000	1.55456	0.31091
X2-Pre	25	3.60000	1.63299	0.32660

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-Pre	X2-Post
X2-Pre	0.00000	2.00000
X2-Post	-2.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	X2-Pre	X2-Post
X2-Pre	-0.90664	1.09336
X2-Post	1.09336	-0.90664

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-Post	25	450.5	18.0200	-3.684
X2-Pre	25	824.5	32.9800	3.684

2-Sample Test, Normal Approximation

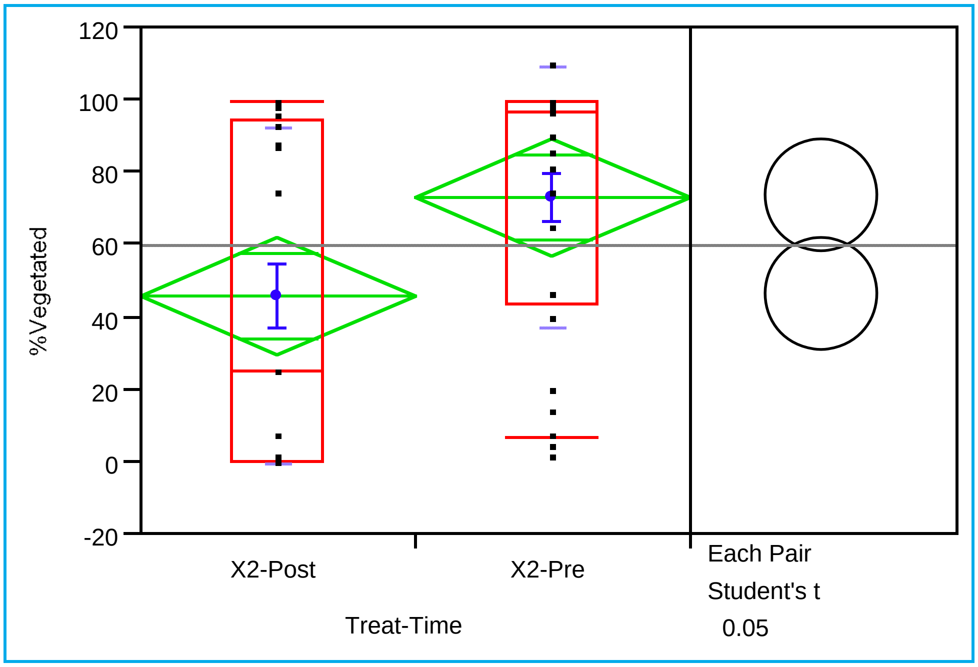
S	Z	Prob>|Z|
824.5	3.68396	0.0002

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
13.6444	1	0.0002

%Vegetated By Treat-Time

Vegetation Sampling



Oneway Anova

Summary of Fit

RSquare	0.100697
RSquare Adj	0.081962
Root Mean Square Error	41.84684
Mean of Response	59.64
Observations (or Sum Wgts)	50

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-27.4400	-2.318	48	0.0247
Std Error	11.8361			
Lower 95%	-51.2380			
Upper 95%	-3.6420			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	9411.920	9411.92	5.3747
Error	48	84055.600	1751.16	Prob>F
C Total	49	93467.520	1907.50	0.0247

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-Post	25	45.9200	8.3694
X2-Pre	25	73.3600	8.3694

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-Post	25	45.9200	46.4901	9.2980
X2-Pre	25	73.3600	36.6195	7.3239

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-Pre	X2-Post
X2-Pre	0.0000	27.4400
X2-Post	-27.4400	0.0000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01063

Abs(Dif)-LSD	X2-Pre	X2-Post
X2-Pre	-23.7980	3.6420
X2-Post	3.6420	-23.7980

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-Post	25	504	20.1600	-2.610
X2-Pre	25	771	30.8400	2.610

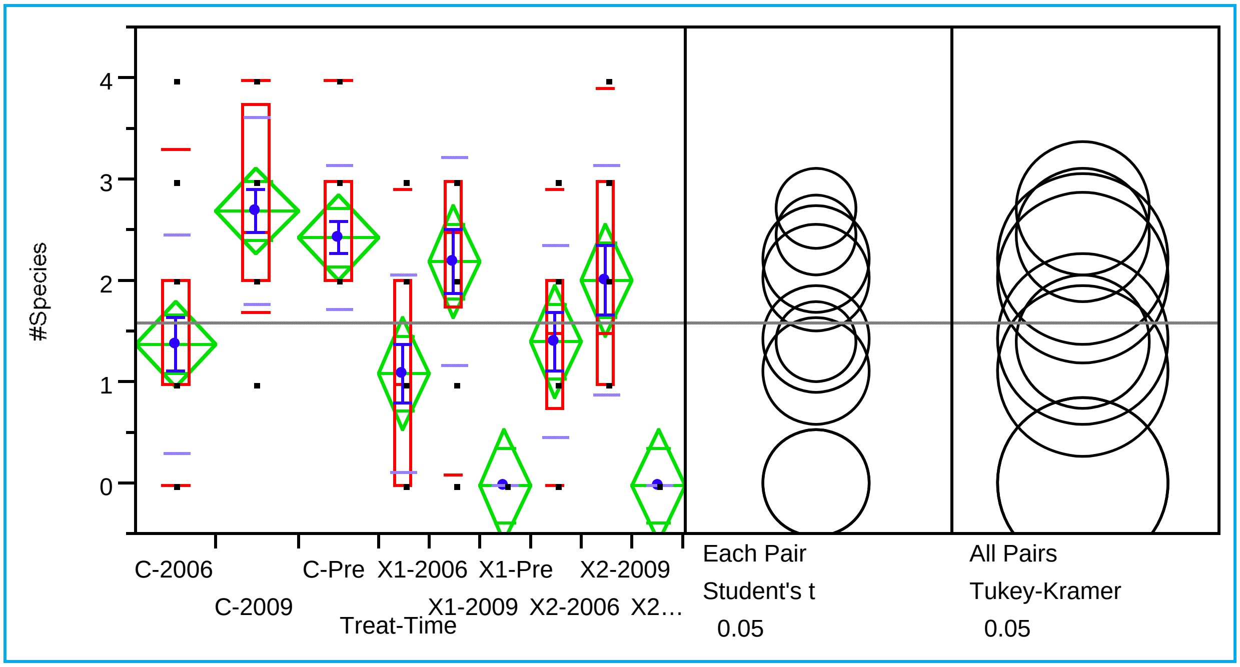
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
771	2.61007	0.0091

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
6.8638	1	0.0088

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.536256
RSquare Adj	0.498781
Root Mean Square Error	0.887768
Mean of Response	1.583333
Observations (or Sum Wgts)	108

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	90.22500	11.2781	14.3100
Error	99	78.02500	0.7881	Prob>F
C Total	107	168.25000	1.5724	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	1.37500	0.22194
C-2009	16	2.68750	0.22194
C-Pre	16	2.43750	0.22194
X1-2006	10	1.10000	0.28074
X1-2009	10	2.20000	0.28074
X1-Pre	10	0.00000	0.28074
X2-2006	10	1.40000	0.28074
X2-2009	10	2.00000	0.28074
X2-Pre	10	0.00000	0.28074

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	1.37500	1.08781	0.27195
C-2009	16	2.68750	0.94648	0.23662
C-Pre	16	2.43750	0.72744	0.18186
X1-2006	10	1.10000	0.99443	0.31447
X1-2009	10	2.20000	1.03280	0.32660
X1-Pre	10	0.00000	0.00000	0.00000
X2-2006	10	1.40000	0.96609	0.30551
X2-2009	10	2.00000	1.15470	0.36515
X2-Pre	10	0.00000	0.00000	0.00000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-2009	C-Pre	X1-2009	X2-2009	X2-2006	C-2006	X1-2006	X1-Pre	X2-Pre
C-2009	0.00000	0.25000	0.48750	0.68750	1.28750	1.31250	1.58750	2.68750	2.68750
C-Pre	-0.25000	0.00000	0.23750	0.43750	1.03750	1.06250	1.33750	2.43750	2.43750
X1-2009	-0.48750	-0.23750	0.00000	0.20000	0.80000	0.82500	1.10000	2.20000	2.20000
X2-2009	-0.68750	-0.43750	-0.20000	0.00000	0.60000	0.62500	0.90000	2.00000	2.00000
X2-2006	-1.28750	-1.03750	-0.80000	-0.60000	0.00000	0.02500	0.30000	1.40000	1.40000
C-2006	-1.31250	-1.06250	-0.82500	-0.62500	-0.02500	0.00000	0.27500	1.37500	1.37500
X1-2006	-1.58750	-1.33750	-1.10000	-0.90000	-0.30000	-0.27500	0.00000	1.10000	1.10000
X1-Pre	-2.68750	-2.43750	-2.20000	-2.00000	-1.40000	-1.37500	-1.10000	0.00000	0.00000
X2-Pre	-2.68750	-2.43750	-2.20000	-2.00000	-1.40000	-1.37500	-1.10000	0.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98423

Abs(Dif)-LSD	C-2009	C-Pre	X1-2009	X2-2009	X2-2006	C-2006	X1-2006	X1-Pre	X2-Pre
C-2009	-0.62280	-0.37280	-0.22260	-0.02260	0.57740	0.68970	0.87740	1.97740	1.97740
C-Pre	-0.37280	-0.62280	-0.47260	-0.27260	0.32740	0.43970	0.62740	1.72740	1.72740
X1-2009	-0.22260	-0.47260	-0.78778	-0.58778	0.01222	0.11490	0.31222	1.41222	1.41222
X2-2009	-0.02260	-0.27260	-0.58778	-0.78778	-0.18778	-0.08510	0.11222	1.21222	1.21222
X2-2006	0.57740	0.32740	0.01222	-0.18778	-0.78778	-0.68510	-0.48778	0.61222	0.61222
C-2006	0.68970	0.43970	0.11490	-0.08510	-0.68510	-0.62280	-0.43510	0.66490	0.66490
X1-2006	0.87740	0.62740	0.31222	0.11222	-0.48778	-0.43510	-0.78778	0.31222	0.31222
X1-Pre	1.97740	1.72740	1.41222	1.21222	0.61222	0.66490	0.31222	-0.78778	-0.78778
X2-Pre	1.97740	1.72740	1.41222	1.21222	0.61222	0.66490	0.31222	-0.78778	-0.78778

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
3.17152

Abs(Dif)-LSD	C-2009	C-Pre	X1-2009	X2-2009	X2-2006	C-2006	X1-2006	X1-Pre	X2-Pre
C-2009	-0.99545	-0.74545	-0.64749	-0.44749	0.15251	0.31705	0.45251	1.55251	1.55251
C-Pre	-0.74545	-0.99545	-0.89749	-0.69749	-0.09749	0.06705	0.20251	1.30251	1.30251
X1-2009	-0.64749	-0.89749	-1.25916	-1.05916	-0.45916	-0.30999	-0.15916	0.94084	0.94084
X2-2009	-0.44749	-0.69749	-1.05916	-1.25916	-0.65916	-0.50999	-0.35916	0.74084	0.74084
X2-2006	0.15251	-0.09749	-0.45916	-0.65916	-1.25916	-1.10999	-0.95916	0.14084	0.14084
C-2006	0.31705	0.06705	-0.30999	-0.50999	-1.10999	-0.99545	-0.85999	0.24001	0.24001
X1-2006	0.45251	0.20251	-0.15916	-0.35916	-0.95916	-0.85999	-1.25916	-0.15916	-0.15916
X1-Pre	1.55251	1.30251	0.94084	0.74084	0.14084	0.24001	-0.15916	-1.25916	-1.25916
X2-Pre	1.55251	1.30251	0.94084	0.74084	0.14084	0.24001	-0.15916	-1.25916	-1.25916

Positive values show pairs of means that are significantly different.

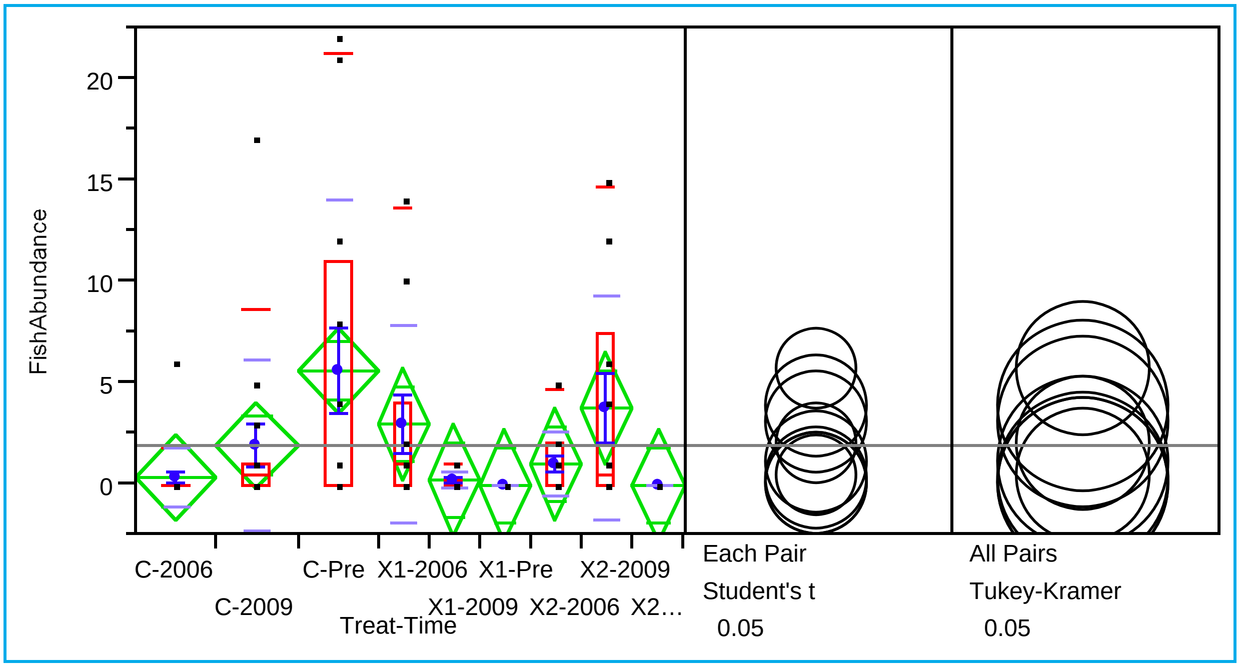
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	787	49.1875	-0.753
C-2009	16	1289.5	80.5938	3.715
C-Pre	16	1215	75.9375	3.051
X1-2006	10	429.5	42.9500	-1.256
X1-2009	10	712	71.2000	1.818
X1-Pre	10	150	15.0000	-4.307
X2-2006	10	507.5	50.7500	-0.404
X2-2009	10	645.5	64.5500	1.092
X2-Pre	10	150	15.0000	-4.307

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
59.6889	8	<.0001

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.175649
RSquare Adj	0.109035
Root Mean Square Error	4.404586
Mean of Response	1.898148
Observations (or Sum Wgts)	108

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	409.2421	51.1553	2.6368
Error	99	1920.6375	19.4004	Prob>F
C Total	107	2329.8796	21.7746	0.0116

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	0.37500	1.1011
C-2009	16	1.87500	1.1011
C-Pre	16	5.56250	1.1011
X1-2006	10	3.00000	1.3929
X1-2009	10	0.20000	1.3929
X1-Pre	10	0.00000	1.3929
X2-2006	10	1.00000	1.3929
X2-2009	10	3.80000	1.3929
X2-Pre	10	0.00000	1.3929

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	0.37500	1.50000	0.3750
C-2009	16	1.87500	4.25637	1.0641
C-Pre	16	5.56250	8.54766	2.1369
X1-2006	10	3.00000	4.89898	1.5492
X1-2009	10	0.20000	0.42164	0.1333
X1-Pre	10	0.00000	0.00000	0.0000
X2-2006	10	1.00000	1.63299	0.5164
X2-2009	10	3.80000	5.55378	1.7563
X2-Pre	10	0.00000	0.00000	0.0000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	X2-2009	X1-2006	C-2009	X2-2006	C-2006	X1-2009	X1-Pre	X2-Pre
C-Pre	0.00000	1.76250	2.56250	3.68750	4.56250	5.18750	5.36250	5.56250	5.56250
X2-2009	-1.76250	0.00000	0.80000	1.92500	2.80000	3.42500	3.60000	3.80000	3.80000
X1-2006	-2.56250	-0.80000	0.00000	1.12500	2.00000	2.62500	2.80000	3.00000	3.00000
C-2009	-3.68750	-1.92500	-1.12500	0.00000	0.87500	1.50000	1.67500	1.87500	1.87500
X2-2006	-4.56250	-2.80000	-2.00000	-0.87500	0.00000	0.62500	0.80000	1.00000	1.00000
C-2006	-5.18750	-3.42500	-2.62500	-1.50000	-0.62500	0.00000	0.17500	0.37500	0.37500
X1-2009	-5.36250	-3.60000	-2.80000	-1.67500	-0.80000	-0.17500	0.00000	0.20000	0.20000
X1-Pre	-5.56250	-3.80000	-3.00000	-1.87500	-1.00000	-0.37500	-0.20000	0.00000	0.00000
X2-Pre	-5.56250	-3.80000	-3.00000	-1.87500	-1.00000	-0.37500	-0.20000	0.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98423

Abs(Dif)-LSD	C-Pre	X2-2009	X1-2006	C-2009	X2-2006	C-2006	X1-2009	X1-Pre	X2-Pre
C-Pre	-3.08995	-1.76059	-0.96059	0.59755	1.03941	2.09755	1.83941	2.03941	2.03941
X2-2009	-1.76059	-3.90852	-3.10852	-1.59809	-1.10852	-0.09809	-0.30852	-0.10852	-0.10852
X1-2006	-0.96059	-3.10852	-3.90852	-2.39809	-1.90852	-0.89809	-1.10852	-0.90852	-0.90852
C-2009	0.59755	-1.59809	-2.39809	-3.08995	-2.64809	-1.58995	-1.84809	-1.64809	-1.64809
X2-2006	1.03941	-1.10852	-1.90852	-2.64809	-3.90852	-2.89809	-3.10852	-2.90852	-2.90852
C-2006	2.09755	-0.09809	-0.89809	-1.58995	-2.89809	-3.08995	-3.34809	-3.14809	-3.14809
X1-2009	1.83941	-0.30852	-1.10852	-1.84809	-3.10852	-3.34809	-3.90852	-3.70852	-3.70852
X1-Pre	2.03941	-0.10852	-0.90852	-1.64809	-2.90852	-3.14809	-3.70852	-3.90852	-3.90852
X2-Pre	2.03941	-0.10852	-0.90852	-1.64809	-2.90852	-3.14809	-3.70852	-3.90852	-3.90852

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
3.17152

Abs(Dif)-LSD	C-Pre	X2-2009	X1-2006	C-2009	X2-2006	C-2006	X1-2009	X1-Pre	X2-Pre
C-Pre	-4.93886	-3.86867	-3.06867	-1.25136	-1.06867	0.24864	-0.26867	-0.06867	-0.06867
X2-2009	-3.86867	-6.24722	-5.44722	-3.70617	-3.44722	-2.20617	-2.64722	-2.44722	-2.44722
X1-2006	-3.06867	-5.44722	-6.24722	-4.50617	-4.24722	-3.00617	-3.44722	-3.24722	-3.24722
C-2009	-1.25136	-3.70617	-4.50617	-4.93886	-4.75617	-3.43886	-3.95617	-3.75617	-3.75617
X2-2006	-1.06867	-3.44722	-4.24722	-4.75617	-6.24722	-5.00617	-5.44722	-5.24722	-5.24722
C-2006	0.24864	-2.20617	-3.00617	-3.43886	-5.00617	-4.93886	-5.45617	-5.25617	-5.25617
X1-2009	-0.26867	-2.64722	-3.44722	-3.95617	-5.44722	-5.45617	-6.24722	-6.04722	-6.04722
X1-Pre	-0.06867	-2.44722	-3.24722	-3.75617	-5.24722	-5.25617	-6.04722	-6.24722	-6.24722
X2-Pre	-0.06867	-2.44722	-3.24722	-3.75617	-5.24722	-5.25617	-6.04722	-6.24722	-6.24722

Positive values show pairs of means that are significantly different.

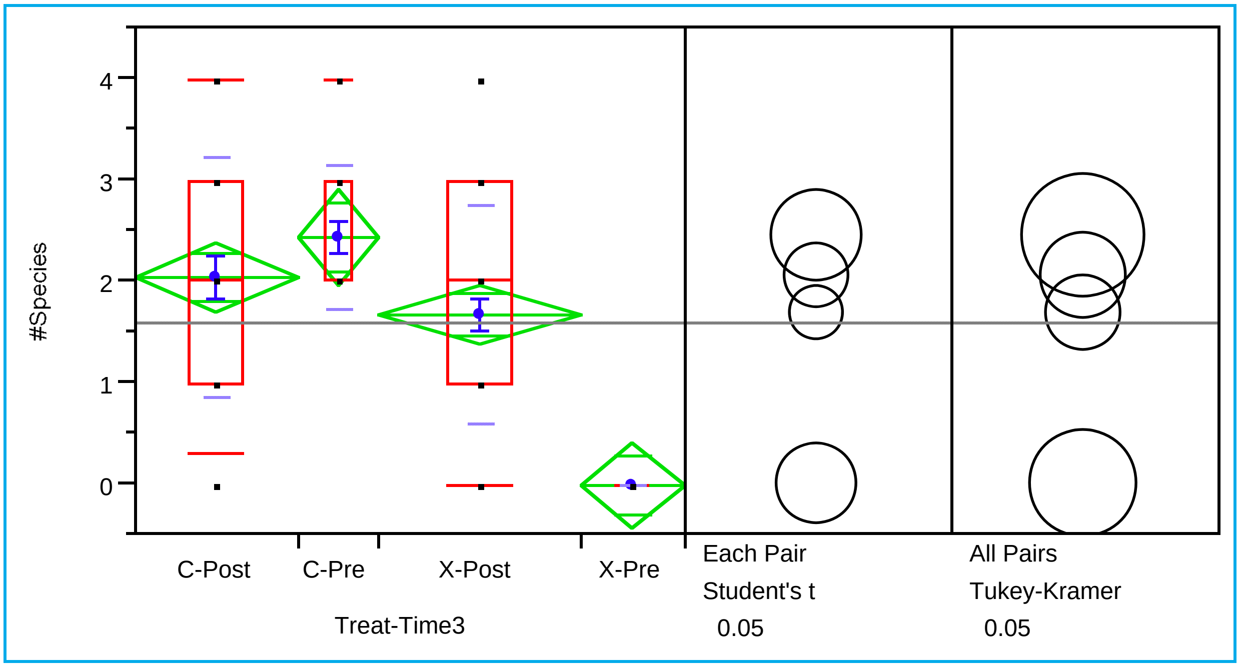
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	667.5	41.7188	-2.166
C-2009	16	1004	62.7500	1.396
C-Pre	16	1038.5	64.9063	1.762
X1-2006	10	697	69.7000	1.971
X1-2009	10	467	46.7000	-1.008
X1-Pre	10	380	38.0000	-2.140
X2-2006	10	584	58.4000	0.501
X2-2009	10	668	66.8000	1.594
X2-Pre	10	380	38.0000	-2.140

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
23.7513	8	0.0025

#Species By Treat-Time3



Oneway Anova

Summary of Fit

RSquare	0.407541
RSquare Adj	0.390451
Root Mean Square Error	0.979017
Mean of Response	1.583333
Observations (or Sum Wgts)	108

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	68.56875	22.8562	23.8465
Error	104	99.68125	0.9585	Prob>F
C Total	107	168.25000	1.5724	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	32	2.03125	0.17307
C-Pre	16	2.43750	0.24475
X-Post	40	1.67500	0.15480
X-Pre	20	0.00000	0.21891

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	32	2.03125	1.20441	0.21291
C-Pre	16	2.43750	0.72744	0.18186
X-Post	40	1.67500	1.09515	0.17316
X-Pre	20	0.00000	0.00000	0.00000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	C-Post	X-Post	X-Pre
C-Pre	0.00000	0.40625	0.76250	2.43750
C-Post	-0.40625	0.00000	0.35625	2.03125
X-Post	-0.76250	-0.35625	0.00000	1.67500
X-Pre	-2.43750	-2.03125	-1.67500	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98305

Abs(Dif)-LSD	C-Pre	C-Post	X-Post	X-Pre
C-Pre	-0.68640	-0.18819	0.18821	1.78632
C-Post	-0.18819	-0.48536	-0.10420	1.47785
X-Post	0.18821	-0.10420	-0.43412	1.14331
X-Pre	1.78632	1.47785	1.14331	-0.61394

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.61106

Abs(Dif)-LSD	C-Pre	C-Post	X-Post	X-Pre
C-Pre	-0.90378	-0.37645	0.00634	1.58010
C-Post	-0.37645	-0.63907	-0.25002	1.30260
X-Post	0.00634	-0.25002	-0.57160	0.97494
X-Pre	1.58010	1.30260	0.97494	-0.80836

Positive values show pairs of means that are significantly different.

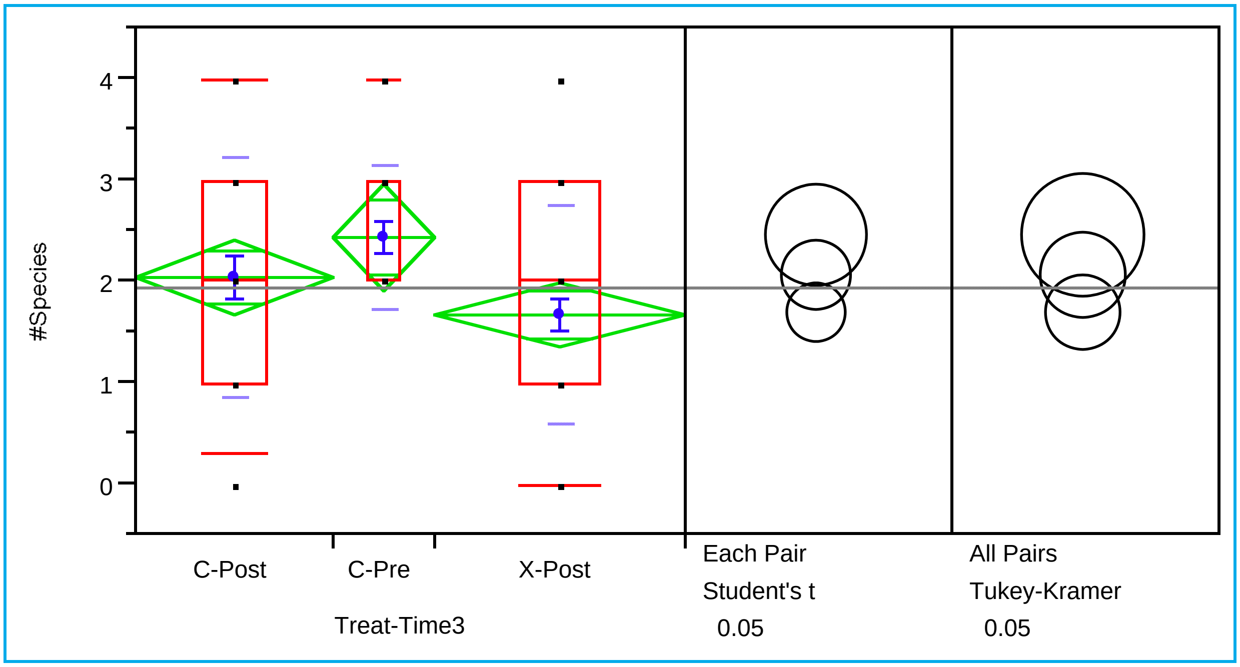
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	32	2076.5	64.8906	2.301
C-Pre	16	1215	75.9375	3.051
X-Post	40	2294.5	57.3625	0.747
X-Pre	20	300	15.0000	-6.432

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
45.8027	3	<.0001

#Species By Treat-Time3



Oneway Anova

Summary of Fit

RSquare	0.065919
RSquare Adj	0.043941
Root Mean Square Error	1.082922
Mean of Response	1.943182
Observations (or Sum Wgts)	88

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.03466	3.51733	2.9993
Error	85	99.68125	1.17272	Prob>F
C Total	87	106.71591	1.22662	0.0551

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	32	2.03125	0.19144
C-Pre	16	2.43750	0.27073
X-Post	40	1.67500	0.17123

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	32	2.03125	1.20441	0.21291
C-Pre	16	2.43750	0.72744	0.18186
X-Post	40	1.67500	1.09515	0.17316

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	C-Post	X-Post
C-Pre	0.000000	0.406250	0.762500
C-Post	-0.40625	0.000000	0.356250
X-Post	-0.7625	-0.35625	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98828

Abs(Dif)-LSD	C-Pre	C-Post	X-Post
C-Pre	-0.76125	-0.25301	0.125590
C-Post	-0.25301	-0.53829	-0.15441
X-Post	0.125590	-0.15441	-0.48146

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.38547

Abs(Dif)-LSD	C-Pre	C-Post	X-Post
C-Pre	-0.91333	-0.38471	-0.00164
C-Post	-0.38471	-0.64582	-0.25643
X-Post	-0.00164	-0.25643	-0.57764

Positive values show pairs of means that are significantly different.

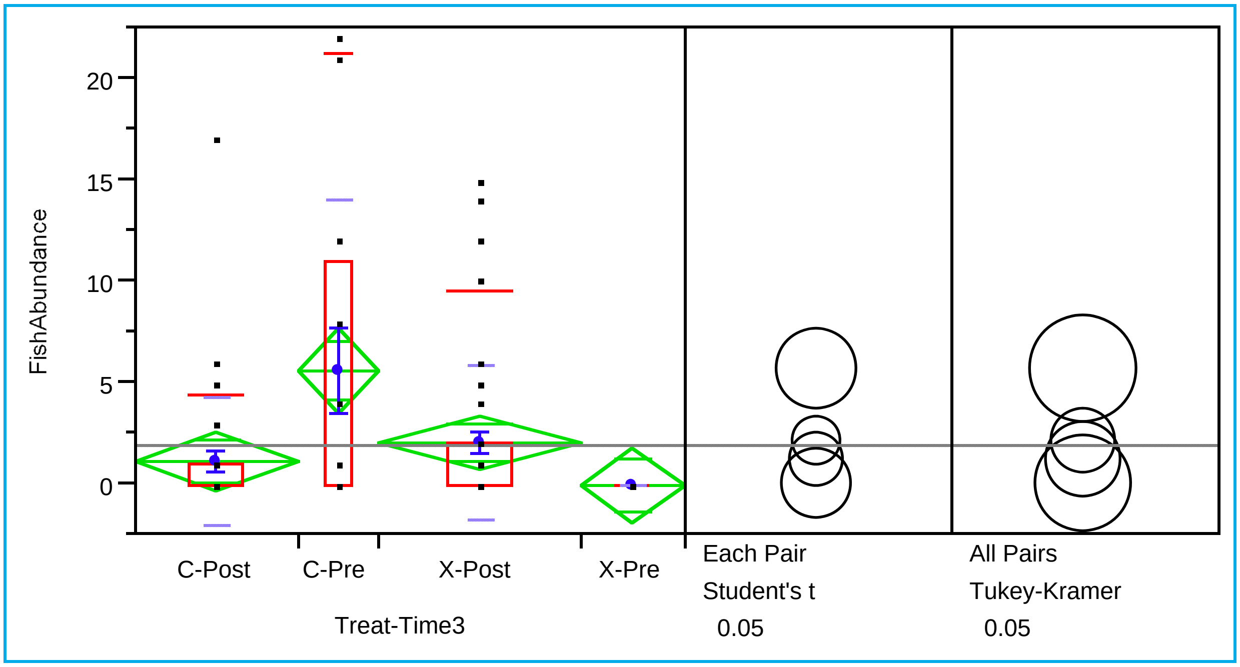
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	32	1466.5	45.8281	0.378
C-Pre	16	895	55.9375	2.049
X-Post	40	1554.5	38.8625	-1.957

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
5.6474	2	0.0594

FishAbundance By Treat-Time3



Oneway Anova

Summary of Fit

RSquare	0.131527
RSquare Adj	0.106475
Root Mean Square Error	4.41091
Mean of Response	1.898148
Observations (or Sum Wgts)	108

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	306.4421	102.147	5.2501
Error	104	2023.4375	19.456	Prob>F
C Total	107	2329.8796	21.775	0.0021

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	32	1.12500	0.7797
C-Pre	16	5.56250	1.1027
X-Post	40	2.00000	0.6974
X-Pre	20	0.00000	0.9863

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	32	1.12500	3.23040	0.5711
C-Pre	16	5.56250	8.54766	2.1369
X-Post	40	2.00000	3.93538	0.6222
X-Pre	20	0.00000	0.00000	0.0000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	X-Post	C-Post	X-Pre
C-Pre	0.00000	3.56250	4.43750	5.56250
X-Post	-3.56250	0.00000	0.87500	2.00000
C-Post	-4.43750	-0.87500	0.00000	1.12500
X-Pre	-5.56250	-2.00000	-1.12500	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98305

Abs(Dif)-LSD	C-Pre	X-Post	C-Post	X-Pre
C-Pre	-3.09255	0.97509	1.75927	2.62865
X-Post	0.97509	-1.95590	-1.19955	-0.39548
C-Post	1.75927	-1.19955	-2.18676	-1.36829
X-Pre	2.62865	-0.39548	-1.36829	-2.76606

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.61106

Abs(Dif)-LSD	C-Pre	X-Post	C-Post	X-Pre
C-Pre	-4.07193	0.15568	0.91110	1.69953
X-Post	0.15568	-2.57532	-1.85654	-1.15411
C-Post	0.91110	-1.85654	-2.87929	-2.15790
X-Pre	1.69953	-1.15411	-2.15790	-3.64205

Positive values show pairs of means that are significantly different.

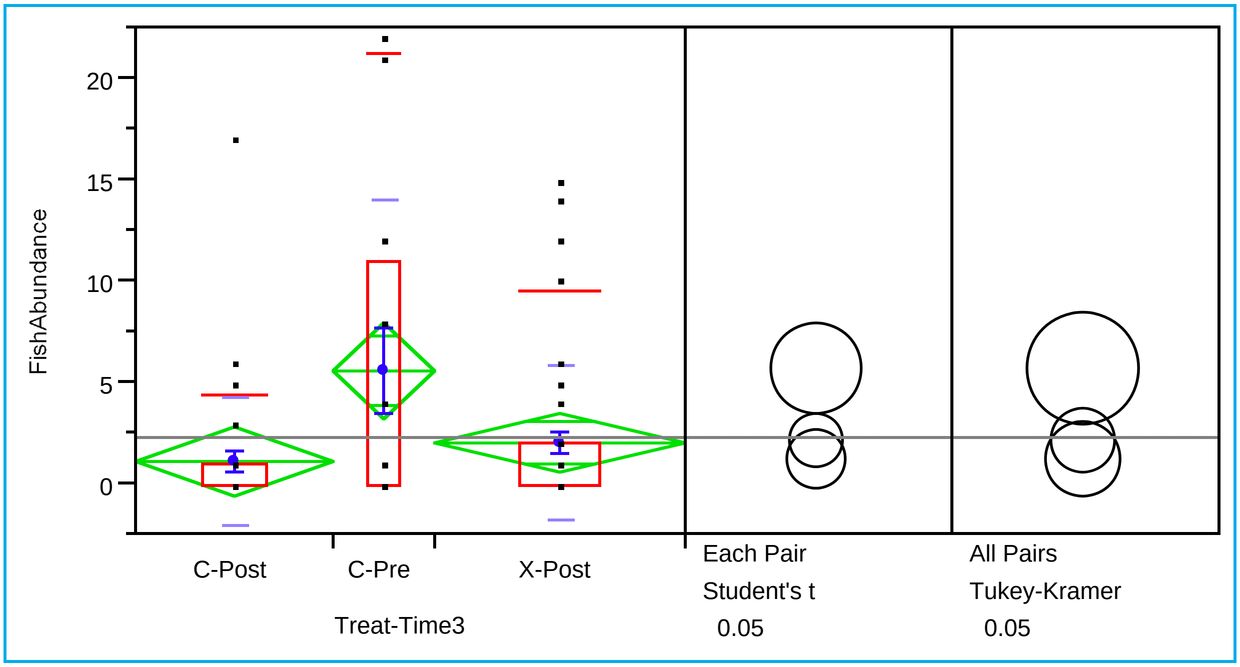
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	32	1671.5	52.2344	-0.595
C-Pre	16	1038.5	64.9063	1.762
X-Post	40	2416	60.4000	1.839
X-Pre	20	760	38.0000	-3.199

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
13.4149	3	0.0038

FishAbundance By Treat-Time3



Oneway Anova

Summary of Fit

RSquare	0.097261
RSquare Adj	0.07602
Root Mean Square Error	4.879052
Mean of Response	2.329545
Observations (or Sum Wgts)	88

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	218.0057	109.003	4.5790
Error	85	2023.4375	23.805	Prob>F
C Total	87	2241.4432	25.764	0.0129

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post	32	1.12500	0.8625
C-Pre	16	5.56250	1.2198
X-Post	40	2.00000	0.7714

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post	32	1.12500	3.23040	0.5711
C-Pre	16	5.56250	8.54766	2.1369
X-Post	40	2.00000	3.93538	0.6222

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	X-Post	C-Post
C-Pre	0.00000	3.56250	4.43750
X-Post	-3.56250	0.00000	0.87500
C-Post	-4.43750	-0.87500	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98828

Abs(Dif)-LSD	C-Pre	X-Post	C-Post
C-Pre	-3.42979	0.69293	1.46722
X-Post	0.69293	-2.16919	-1.42577
C-Post	1.46722	-1.42577	-2.42523

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.38547

Abs(Dif)-LSD	C-Pre	X-Post	C-Post
C-Pre	-4.11495	0.11969	0.87385
X-Post	0.11969	-2.60252	-1.88539
C-Post	0.87385	-1.88539	-2.90971

Positive values show pairs of means that are significantly different.

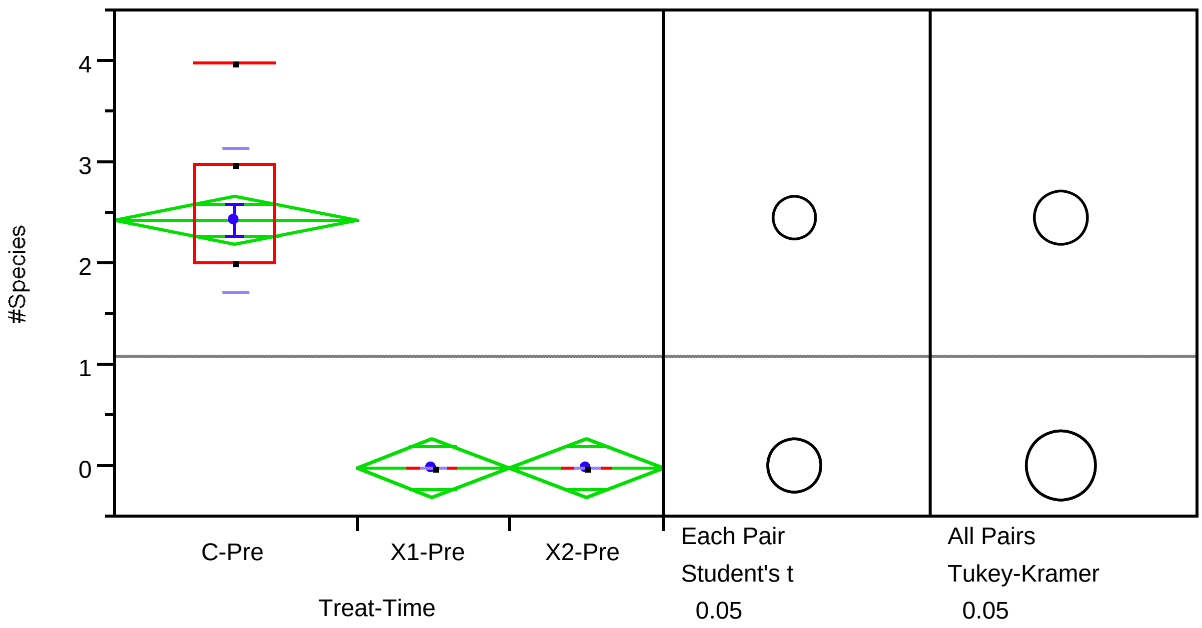
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post	32	1261.5	39.4219	-1.619
C-Pre	16	808.5	50.5313	1.197
X-Post	40	1846	46.1500	0.632

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
3.0839	2	0.2140

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.869342
RSquare Adj	0.861423
Root Mean Square Error	0.490439
Mean of Response	1.083333
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	52.812500	26.4063	109.7835
Error	33	7.937500	0.2405	Prob>F
C Total	35	60.750000	1.7357	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Pre	16	2.43750	0.12261
X1-Pre	10	0.00000	0.15509
X2-Pre	10	0.00000	0.15509

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Pre	16	2.43750	0.727438	0.18186
X1-Pre	10	0.00000	0.000000	0.00000
X2-Pre	10	0.00000	0.000000	0.00000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	X1-Pre	X2-Pre
C-Pre	0.00000	2.43750	2.43750
X1-Pre	-2.43750	0.00000	0.00000
X2-Pre	-2.43750	0.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	C-Pre	X1-Pre	X2-Pre
C-Pre	-0.35278	2.03527	2.03527
X1-Pre	2.03527	-0.44623	-0.44623
X2-Pre	2.03527	-0.44623	-0.44623

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	C-Pre	X1-Pre	X2-Pre
C-Pre	-0.42548	1.95238	1.95238
X1-Pre	1.95238	-0.53819	-0.53819
X2-Pre	1.95238	-0.53819	-0.53819

Positive values show pairs of means that are significantly different.

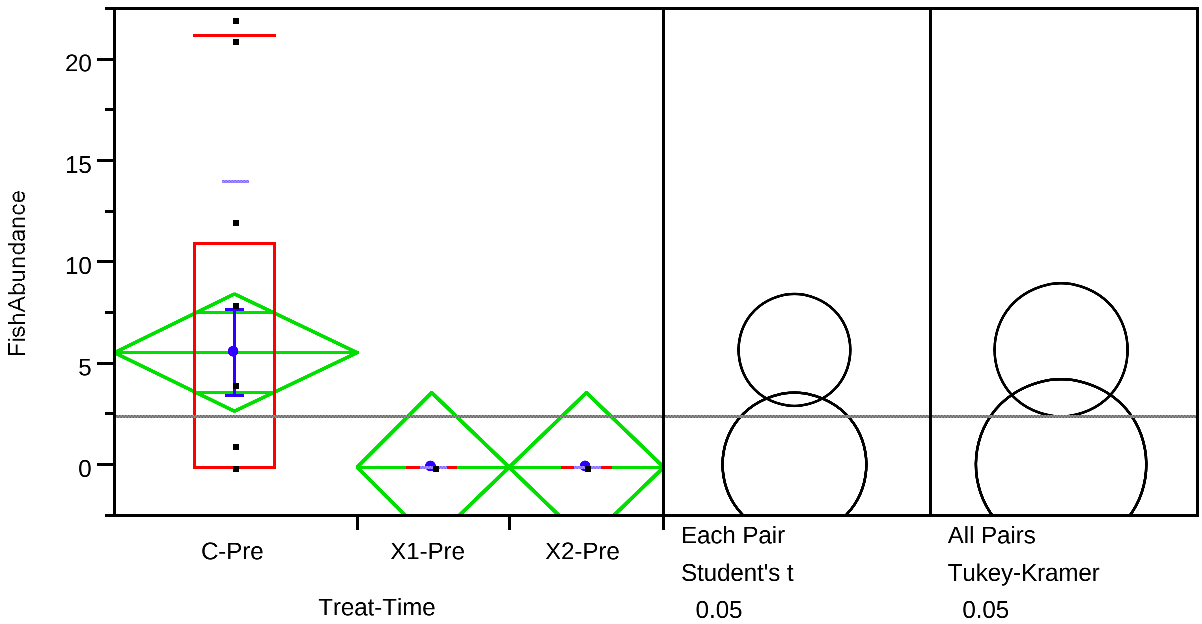
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Pre	16	456	28.5000	5.678
X1-Pre	10	105	10.5000	-3.139
X2-Pre	10	105	10.5000	-3.139

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
32.4377	2	<.0001

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.200613
RSquare Adj	0.152165
Root Mean Square Error	5.762832
Mean of Response	2.472222
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	275.0347	137.517	4.1408
Error	33	1095.9375	33.210	Prob>F
C Total	35	1370.9722	39.171	0.0249

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Pre	16	5.56250	1.4407
X1-Pre	10	0.00000	1.8224
X2-Pre	10	0.00000	1.8224

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Pre	16	5.56250	8.54766	2.1369
X1-Pre	10	0.00000	0.00000	0.0000
X2-Pre	10	0.00000	0.00000	0.0000

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	X1-Pre	X2-Pre
C-Pre	0.00000	5.56250	5.56250
X1-Pre	-5.56250	0.00000	0.00000
X2-Pre	-5.56250	0.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	C-Pre	X1-Pre	X2-Pre
C-Pre	-4.14523	0.83621	0.83621
X1-Pre	0.83621	-5.24335	-5.24335
X2-Pre	0.83621	-5.24335	-5.24335

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	C-Pre	X1-Pre	X2-Pre
C-Pre	-4.99953	-0.13784	-0.13784
X1-Pre	-0.13784	-6.32396	-6.32396
X2-Pre	-0.13784	-6.32396	-6.32396

Positive values show pairs of means that are significantly different.

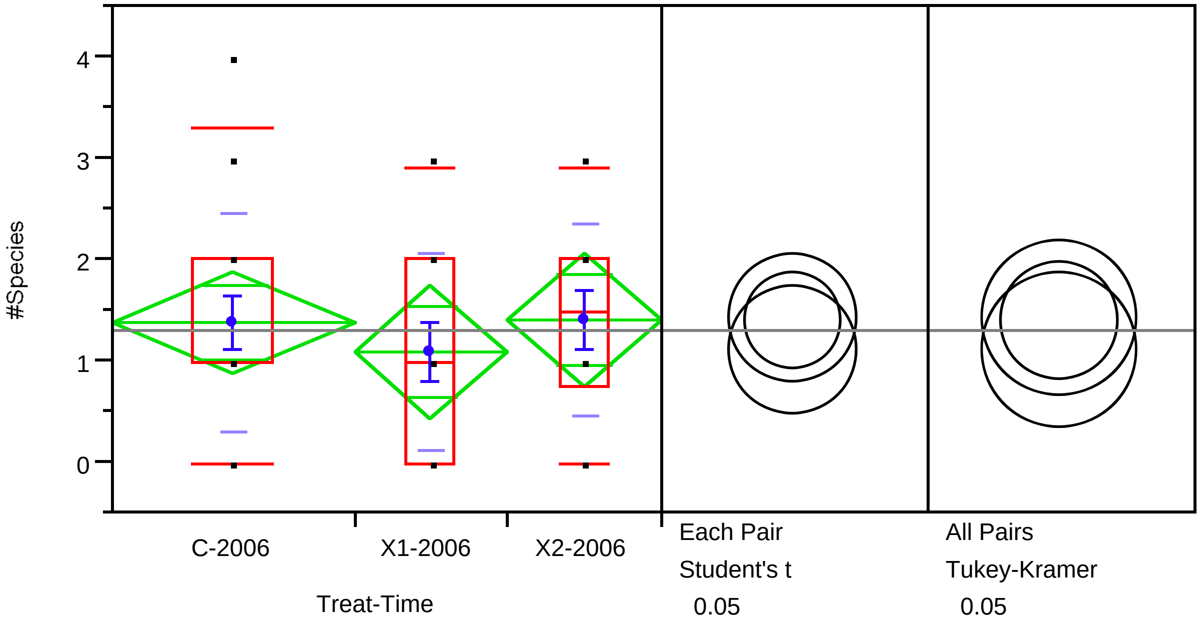
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Pre	16	366	22.8750	3.202
X1-Pre	10	150	15.0000	-1.764
X2-Pre	10	150	15.0000	-1.764

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
10.4037	2	0.0055

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.016524
RSquare Adj	-0.04308
Root Mean Square Error	1.030593
Mean of Response	1.305556
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.588889	0.29444	0.2772
Error	33	35.050000	1.06212	Prob>F
C Total	35	35.638889	1.01825	0.7596

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	1.37500	0.25765
X1-2006	10	1.10000	0.32590
X2-2006	10	1.40000	0.32590

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	1.37500	1.08781	0.27195
X1-2006	10	1.10000	0.99443	0.31447
X2-2006	10	1.40000	0.96609	0.30551

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2006	C-2006	X1-2006
X2-2006	0.000000	0.025000	0.300000
C-2006	-0.025	0.000000	0.275000
X1-2006	-0.3	-0.275	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	X2-2006	C-2006	X1-2006
X2-2006	-0.93769	-0.82022	-0.63769
C-2006	-0.82022	-0.74131	-0.57022
X1-2006	-0.63769	-0.57022	-0.93769

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	X2-2006	C-2006	X1-2006
X2-2006	-1.13094	-0.99442	-0.83094
C-2006	-0.99442	-0.89409	-0.74442
X1-2006	-0.83094	-0.74442	-1.13094

Positive values show pairs of means that are significantly different.

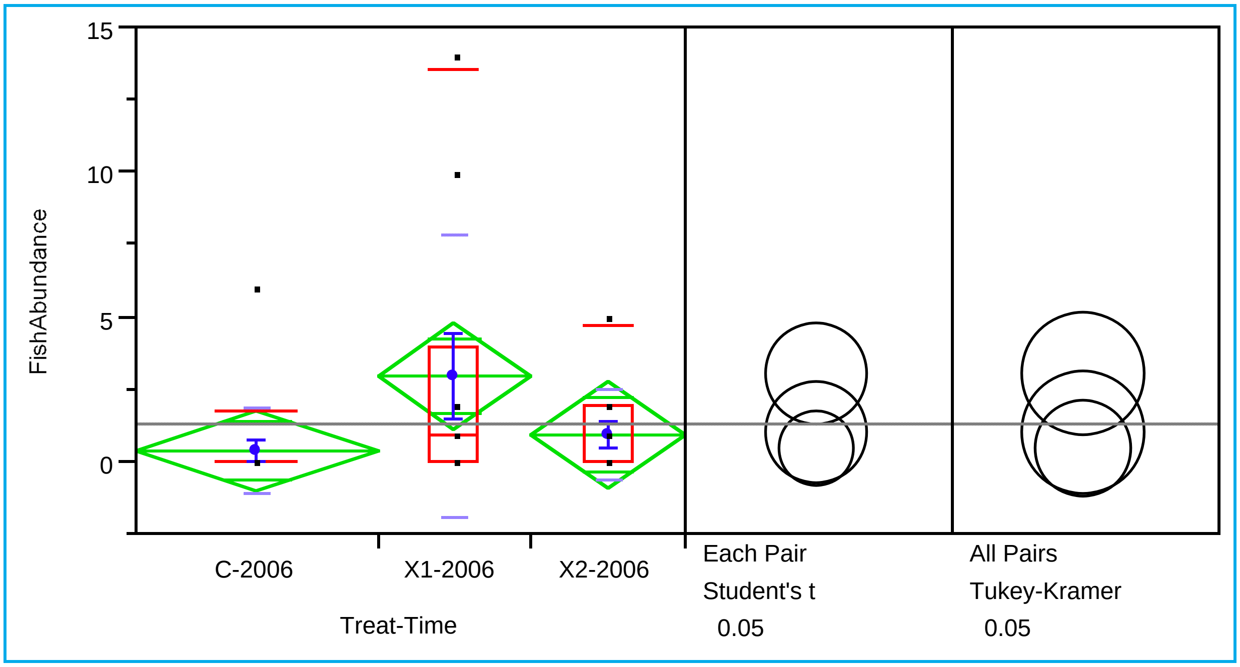
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	302	18.8750	0.184
X1-2006	10	164.5	16.4500	-0.741
X2-2006	10	199.5	19.9500	0.519

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
0.6473	2	0.7235

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.13704
RSquare Adj	0.08474
Root Mean Square Error	2.880183
Mean of Response	1.277778
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	43.47222	21.7361	2.6202
Error	33	273.75000	8.2955	Prob>F
C Total	35	317.22222	9.0635	0.0879

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	0.37500	0.72005
X1-2006	10	3.00000	0.91079
X2-2006	10	1.00000	0.91079

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	0.37500	1.50000	0.3750
X1-2006	10	3.00000	4.89898	1.5492
X2-2006	10	1.00000	1.63299	0.5164

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-2006	X2-2006	C-2006
X1-2006	0.00000	2.00000	2.62500
X2-2006	-2.00000	0.00000	0.62500
C-2006	-2.62500	-0.62500	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	X1-2006	X2-2006	C-2006
X1-2006	-2.62055	-0.62055	0.26286
X2-2006	-0.62055	-2.62055	-1.73714
C-2006	0.26286	-1.73714	-2.07173

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	X1-2006	X2-2006	C-2006
X1-2006	-3.16063	-1.16063	-0.22395
X2-2006	-1.16063	-3.16063	-2.22395
C-2006	-0.22395	-2.22395	-2.49870

Positive values show pairs of means that are significantly different.

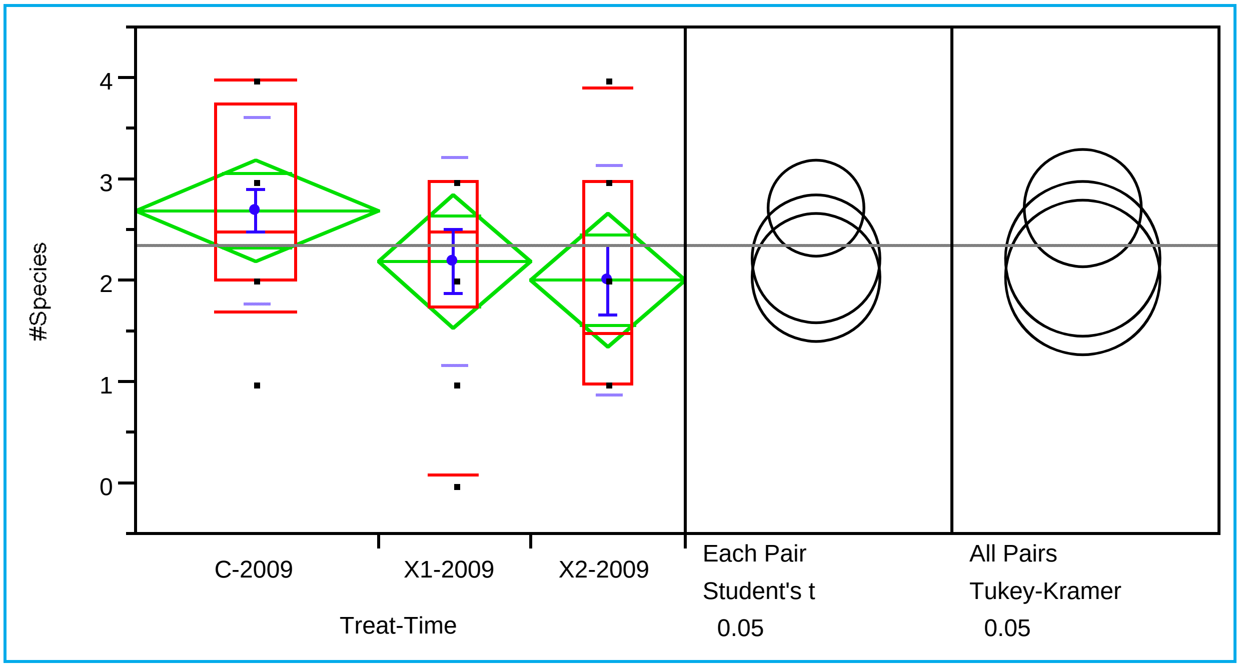
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	229	14.3125	-2.599
X1-2006	10	238	23.8000	2.276
X2-2006	10	199	19.9000	0.585

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
7.8887	2	0.0194

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.085315
RSquare Adj	0.02988
Root Mean Square Error	1.030409
Mean of Response	2.361111
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	3.268056	1.63403	1.5390
Error	33	35.037500	1.06174	Prob>F
C Total	35	38.305556	1.09444	0.2296

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2009	16	2.68750	0.25760
X1-2009	10	2.20000	0.32584
X2-2009	10	2.00000	0.32584

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2009	16	2.68750	0.94648	0.23662
X1-2009	10	2.20000	1.03280	0.32660
X2-2009	10	2.00000	1.15470	0.36515

Means Comparisons

Dif=Mean[i]-Mean[j]	C-2009	X1-2009	X2-2009
C-2009	0.000000	0.487500	0.687500
X1-2009	-0.4875	0.000000	0.200000
X2-2009	-0.6875	-0.2	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	C-2009	X1-2009	X2-2009
C-2009	-0.74118	-0.35757	-0.15757
X1-2009	-0.35757	-0.93752	-0.73752
X2-2009	-0.15757	-0.73752	-0.93752

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	C-2009	X1-2009	X2-2009
C-2009	-0.89393	-0.53174	-0.33174
X1-2009	-0.53174	-1.13074	-0.93074
X2-2009	-0.33174	-0.93074	-1.13074

Positive values show pairs of means that are significantly different.

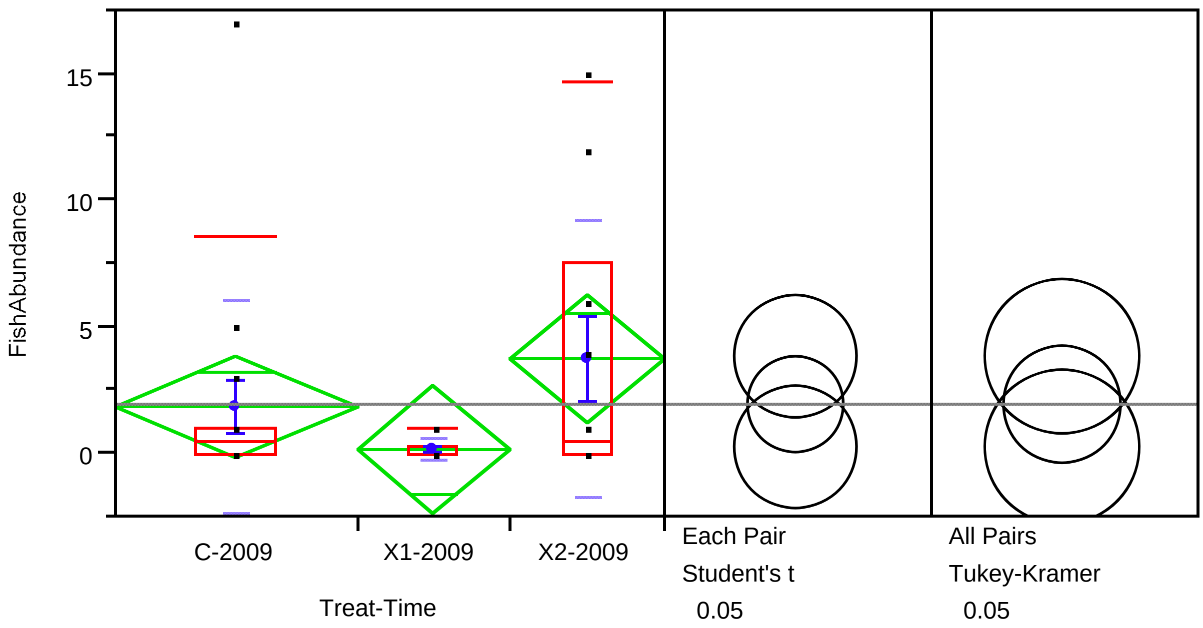
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2009	16	341	21.3125	1.473
X1-2009	10	175.5	17.5500	-0.330
X2-2009	10	149.5	14.9500	-1.285

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
2.5477	2	0.2798

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.105439
RSquare Adj	0.051223
Root Mean Square Error	4.086007
Mean of Response	1.944444
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	64.93889	32.4694	1.9448
Error	33	550.95000	16.6955	Prob>F
C Total	35	615.88889	17.5968	0.1591

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2009	16	1.87500	1.0215
X1-2009	10	0.20000	1.2921
X2-2009	10	3.80000	1.2921

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2009	16	1.87500	4.25637	1.0641
X1-2009	10	0.20000	0.42164	0.1333
X2-2009	10	3.80000	5.55378	1.7563

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2009	C-2009	X1-2009
X2-2009	0.00000	1.92500	3.60000
C-2009	-1.92500	0.00000	1.67500
X1-2009	-3.60000	-1.67500	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.03450

Abs(Dif)-LSD	X2-2009	C-2009	X1-2009
X2-2009	-3.71768	-1.42607	-0.11768
C-2009	-1.42607	-2.93909	-1.67607
X1-2009	-0.11768	-1.67607	-3.71768

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.45379

Abs(Dif)-LSD	X2-2009	C-2009	X1-2009
X2-2009	-4.48386	-2.11670	-0.88386
C-2009	-2.11670	-3.54480	-2.36670
X1-2009	-0.88386	-2.36670	-4.48386

Positive values show pairs of means that are significantly different.

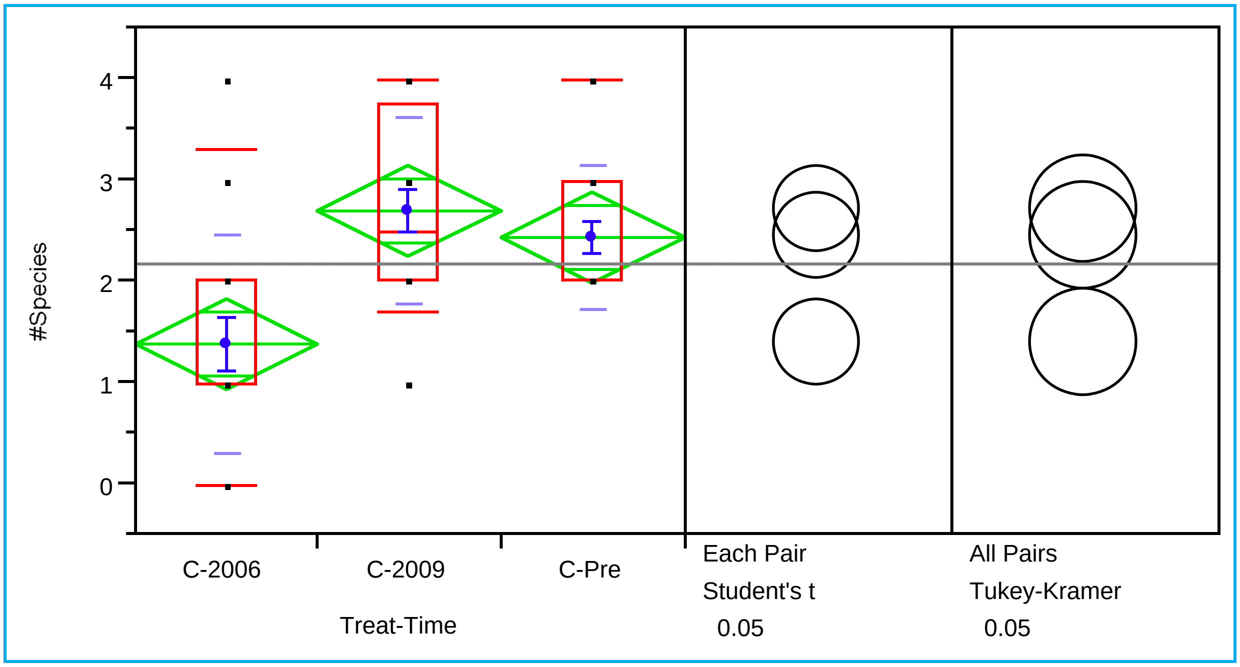
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2009	16	313.5	19.5938	0.609
X1-2009	10	139	13.9000	-1.807
X2-2009	10	213.5	21.3500	1.112

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
3.5531	2	0.1692

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.284299
RSquare Adj	0.25249
Root Mean Square Error	0.93244
Mean of Response	2.166667
Observations (or Sum Wgts)	48

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	15.541667	7.77083	8.9377
Error	45	39.125000	0.86944	Prob>F
C Total	47	54.666667	1.16312	0.0005

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	1.37500	0.23311
C-2009	16	2.68750	0.23311
C-Pre	16	2.43750	0.23311

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	1.37500	1.08781	0.27195
C-2009	16	2.68750	0.94648	0.23662
C-Pre	16	2.43750	0.72744	0.18186

Means Comparisons

Dif=Mean[i]-Mean[j]	C-2009	C-Pre	C-2006
C-2009	0.00000	0.25000	1.31250
C-Pre	-0.25000	0.00000	1.06250
C-2006	-1.31250	-1.06250	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01410

Abs(Dif)-LSD	C-2009	C-Pre	C-2006
C-2009	-0.66398	-0.41398	0.648518
C-Pre	-0.41398	-0.66398	0.398518
C-2006	0.648518	0.398518	-0.66398

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.42362

Abs(Dif)-LSD	C-2009	C-Pre	C-2006
C-2009	-0.79899	-0.54899	0.513513
C-Pre	-0.54899	-0.79899	0.263513
C-2006	0.513513	0.263513	-0.79899

Positive values show pairs of means that are significantly different.

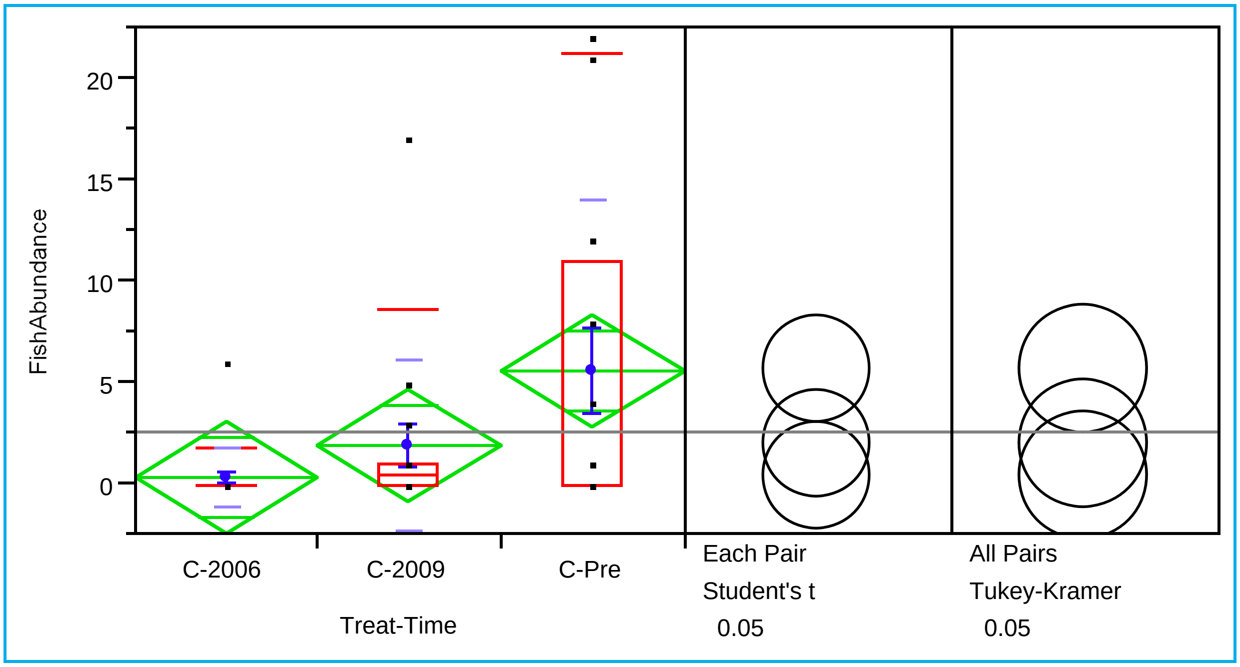
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	231	14.4375	-3.718
C-2009	16	495	30.9375	2.374
C-Pre	16	450	28.1250	1.332

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
14.2695	2	0.0008

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.139948
RSquare Adj	0.101723
Root Mean Square Error	5.580596
Mean of Response	2.604167
Observations (or Sum Wgts)	48

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	228.0417	114.021	3.6612
Error	45	1401.4375	31.143	Prob>F
C Total	47	1629.4792	34.670	0.0336

Means for Oneway Anova

Level	Number	Mean	Std Error
C-2006	16	0.37500	1.3951
C-2009	16	1.87500	1.3951
C-Pre	16	5.56250	1.3951

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-2006	16	0.37500	1.50000	0.3750
C-2009	16	1.87500	4.25637	1.0641
C-Pre	16	5.56250	8.54766	2.1369

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Pre	C-2009	C-2006
C-Pre	0.00000	3.68750	5.18750
C-2009	-3.68750	0.00000	1.50000
C-2006	-5.18750	-1.50000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.01410

Abs(Dif)-LSD	C-Pre	C-2009	C-2006
C-Pre	-3.97389	-0.28639	1.21361
C-2009	-0.28639	-3.97389	-2.47389
C-2006	1.21361	-2.47389	-3.97389

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.42362

Abs(Dif)-LSD	C-Pre	C-2009	C-2006
C-Pre	-4.78189	-1.09439	0.40561
C-2009	-1.09439	-4.78189	-3.28189
C-2006	0.40561	-3.28189	-4.78189

Positive values show pairs of means that are significantly different.

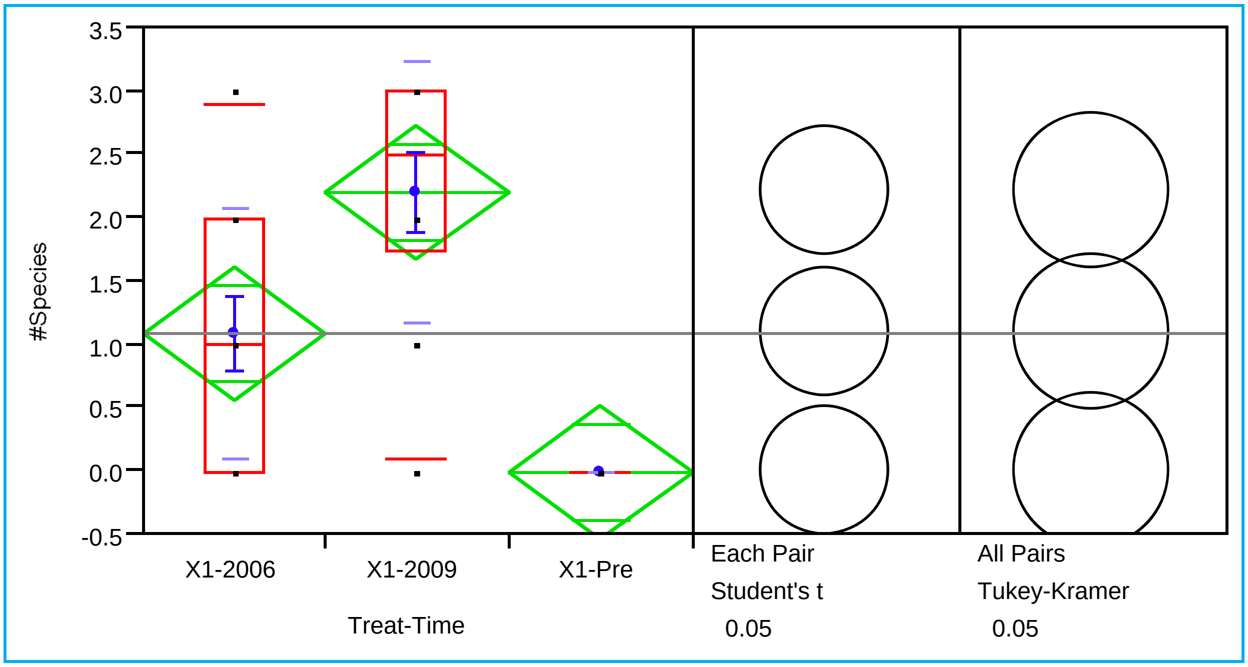
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-2006	16	289.5	18.0938	-2.663
C-2009	16	434.5	27.1563	1.096
C-Pre	16	452	28.2500	1.553

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
7.2290	2	0.0269

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.566745
RSquare Adj	0.534652
Root Mean Square Error	0.827759
Mean of Response	1.1
Observations (or Sum Wgts)	30

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	24.200000	12.1000	17.6595
Error	27	18.500000	0.6852	Prob>F
C Total	29	42.700000	1.4724	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-2006	10	1.10000	0.26176
X1-2009	10	2.20000	0.26176
X1-Pre	10	0.00000	0.26176

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-2006	10	1.10000	0.99443	0.31447
X1-2009	10	2.20000	1.03280	0.32660
X1-Pre	10	0.00000	0.00000	0.00000

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-2009	X1-2006	X1-Pre
X1-2009	0.00000	1.10000	2.20000
X1-2006	-1.10000	0.00000	1.10000
X1-Pre	-2.20000	-1.10000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.05181

Abs(Dif)-LSD	X1-2009	X1-2006	X1-Pre
X1-2009	-0.75955	0.34045	1.44045
X1-2006	0.34045	-0.75955	0.34045
X1-Pre	1.44045	0.34045	-0.75955

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.47942

Abs(Dif)-LSD	X1-2009	X1-2006	X1-Pre
X1-2009	-0.91784	0.18216	1.28216
X1-2006	0.18216	-0.91784	0.18216
X1-Pre	1.28216	0.18216	-0.91784

Positive values show pairs of means that are significantly different.

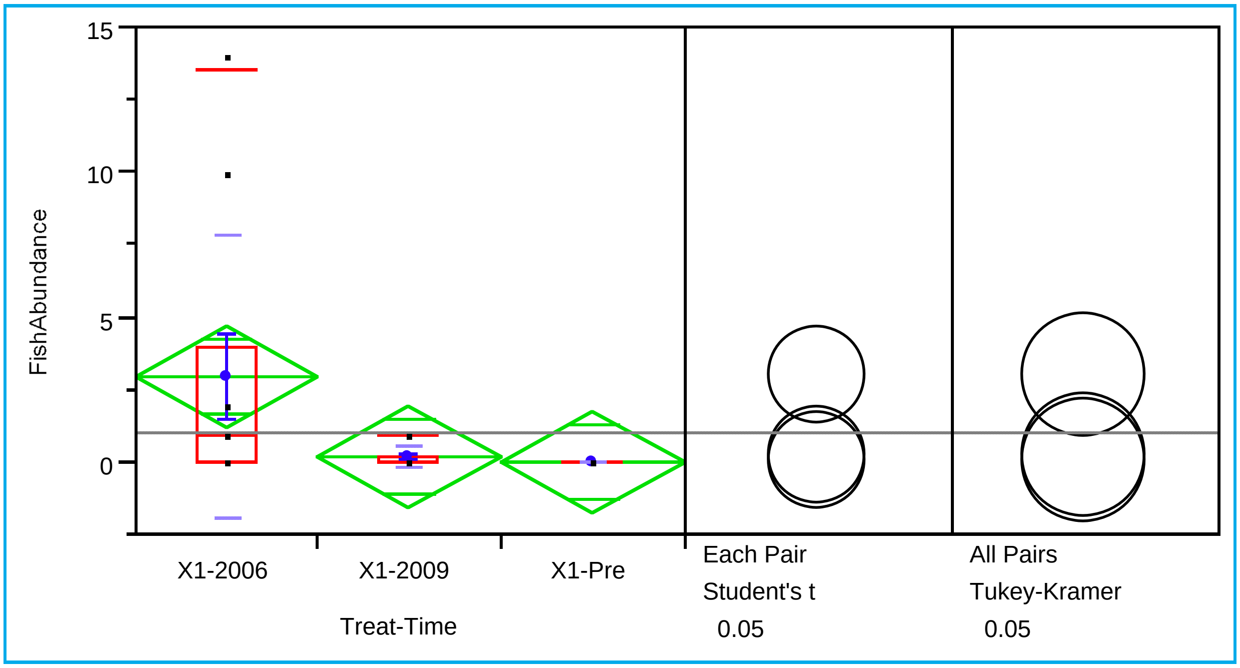
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-2006	10	162	16.2000	0.304
X1-2009	10	228	22.8000	3.396
X1-Pre	10	75	7.5000	-3.724

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
17.2289	2	0.0002

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.205453
RSquare Adj	0.146597
Root Mean Square Error	2.838883
Mean of Response	1.066667
Observations (or Sum Wgts)	30

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	56.26667	28.1333	3.4908
Error	27	217.60000	8.0593	Prob>F
C Total	29	273.86667	9.4437	0.0448

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-2006	10	3.00000	0.89773
X1-2009	10	0.20000	0.89773
X1-Pre	10	0.00000	0.89773

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-2006	10	3.00000	4.89898	1.5492
X1-2009	10	0.20000	0.42164	0.1333
X1-Pre	10	0.00000	0.00000	0.0000

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-2006	X1-2009	X1-Pre
X1-2006	0.00000	2.80000	3.00000
X1-2009	-2.80000	0.00000	0.20000
X1-Pre	-3.00000	-0.20000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.05181

Abs(Dif)-LSD	X1-2006	X1-2009	X1-Pre
X1-2006	-2.60496	0.19504	0.39504
X1-2009	0.19504	-2.60496	-2.40496
X1-Pre	0.39504	-2.40496	-2.60496

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.47942

Abs(Dif)-LSD	X1-2006	X1-2009	X1-Pre
X1-2006	-3.14784	-0.34784	-0.14784
X1-2009	-0.34784	-3.14784	-2.94784
X1-Pre	-0.14784	-2.94784	-3.14784

Positive values show pairs of means that are significantly different.

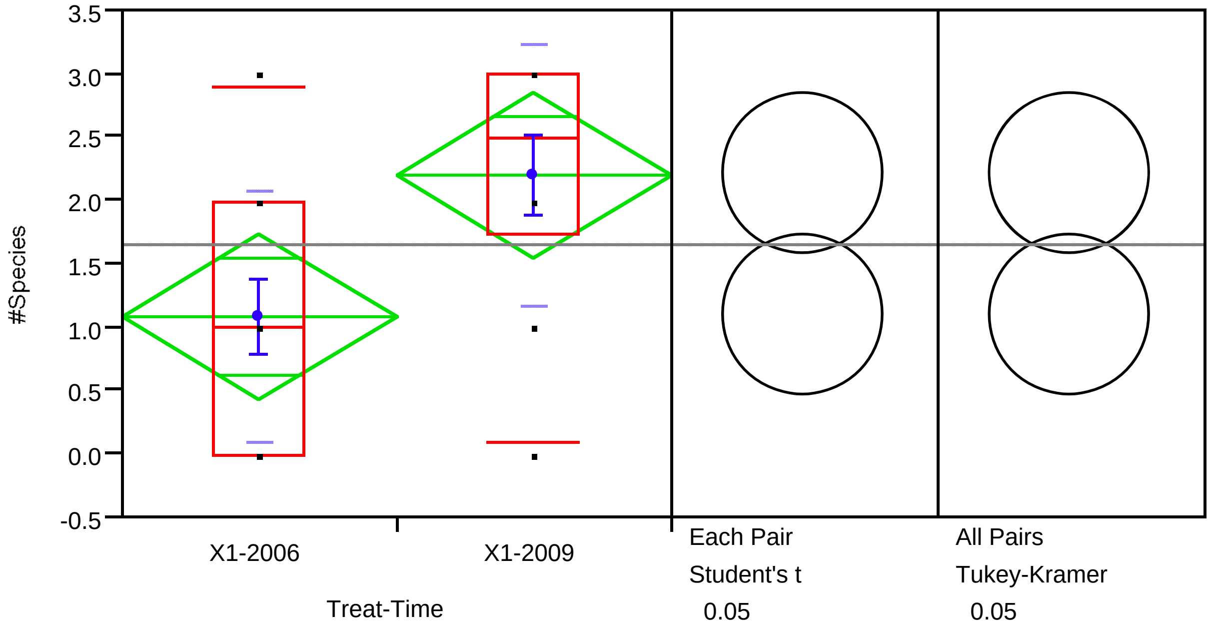
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-2006	10	209	20.9000	3.030
X1-2009	10	141	14.1000	-0.764
X1-Pre	10	115	11.5000	-2.237

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
10.0736	2	0.0065

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.246436
RSquare Adj	0.204571
Root Mean Square Error	1.013794
Mean of Response	1.65
Observations (or Sum Wgts)	20

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-1.10000	-2.426	18	0.0260
Std Error	0.45338			
Lower 95%	-2.05251			
Upper 95%	-0.14749			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	6.050000	6.05000	5.8865
Error	18	18.500000	1.02778	Prob>F
C Total	19	24.550000	1.29211	0.0260

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-2006	10	1.10000	0.32059
X1-2009	10	2.20000	0.32059

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-2006	10	1.10000	0.99443	0.31447
X1-2009	10	2.20000	1.03280	0.32660

Nekton Monitoring

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-2009	X1-2006
X1-2009	0.00000	1.10000
X1-2006	-1.10000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.10091

Abs(Dif)-LSD	X1-2009	X1-2006
X1-2009	-0.95251	0.147485
X1-2006	0.147485	-0.95251

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.10092

Abs(Dif)-LSD	X1-2009	X1-2006
X1-2009	-0.95252	0.147479
X1-2006	0.147479	-0.95252

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-2006	10	77	7.7000	-2.149
X1-2009	10	133	13.3000	2.149

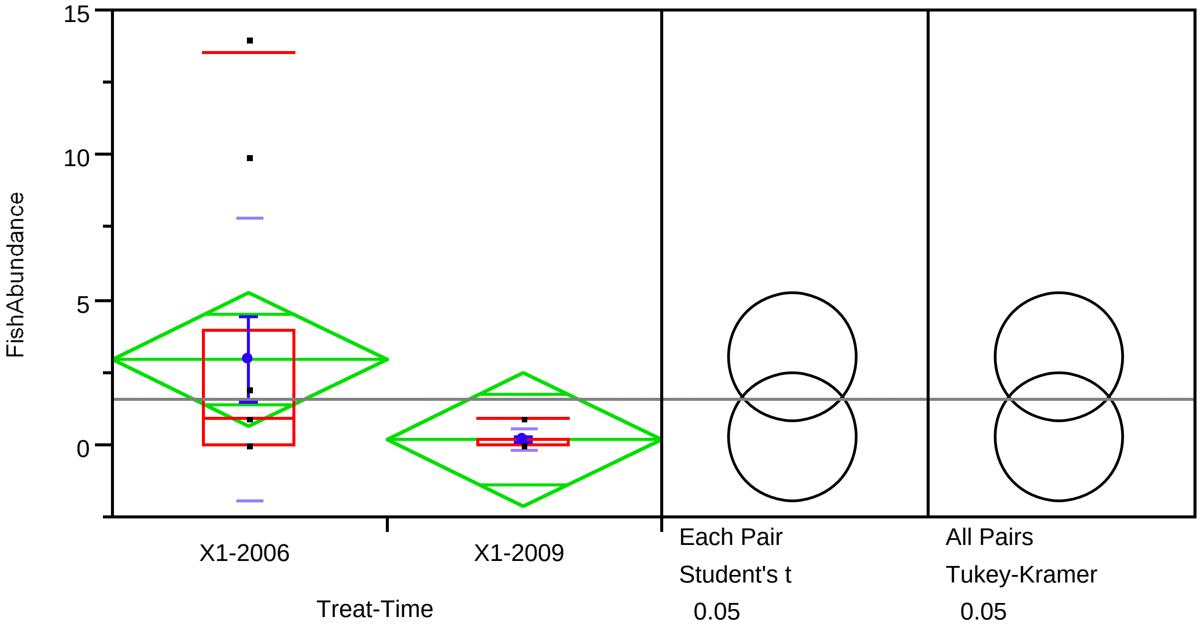
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
133	2.14860	0.0317

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
4.7859	1	0.0287

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.152648
RSquare Adj	0.105573
Root Mean Square Error	3.476908
Mean of Response	1.6
Observations (or Sum Wgts)	20

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	2.80000	1.801	18	0.0885
Std Error	1.55492			
Lower 95%	-0.46675			
Upper 95%	6.06675			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	39.20000	39.2000	3.2426
Error	18	217.60000	12.0889	Prob>F
C Total	19	256.80000	13.5158	0.0885

Means for Oneway Anova

Level	Number	Mean	Std Error
X1-2006	10	3.00000	1.0995
X1-2009	10	0.20000	1.0995

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X1-2006	10	3.00000	4.89898	1.5492
X1-2009	10	0.20000	0.42164	0.1333

Means Comparisons

Dif=Mean[i]-Mean[j]	X1-2006	X1-2009
X1-2006	0.00000	2.80000
X1-2009	-2.80000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.10091

Abs(Dif)-LSD	X1-2006	X1-2009
X1-2006	-3.26675	-0.46675
X1-2009	-0.46675	-3.26675

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.10092

Abs(Dif)-LSD	X1-2006	X1-2009
X1-2006	-3.26677	-0.46677
X1-2009	-0.46677	-3.26677

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X1-2006	10	129	12.9000	2.016
X1-2009	10	81	8.1000	-2.016

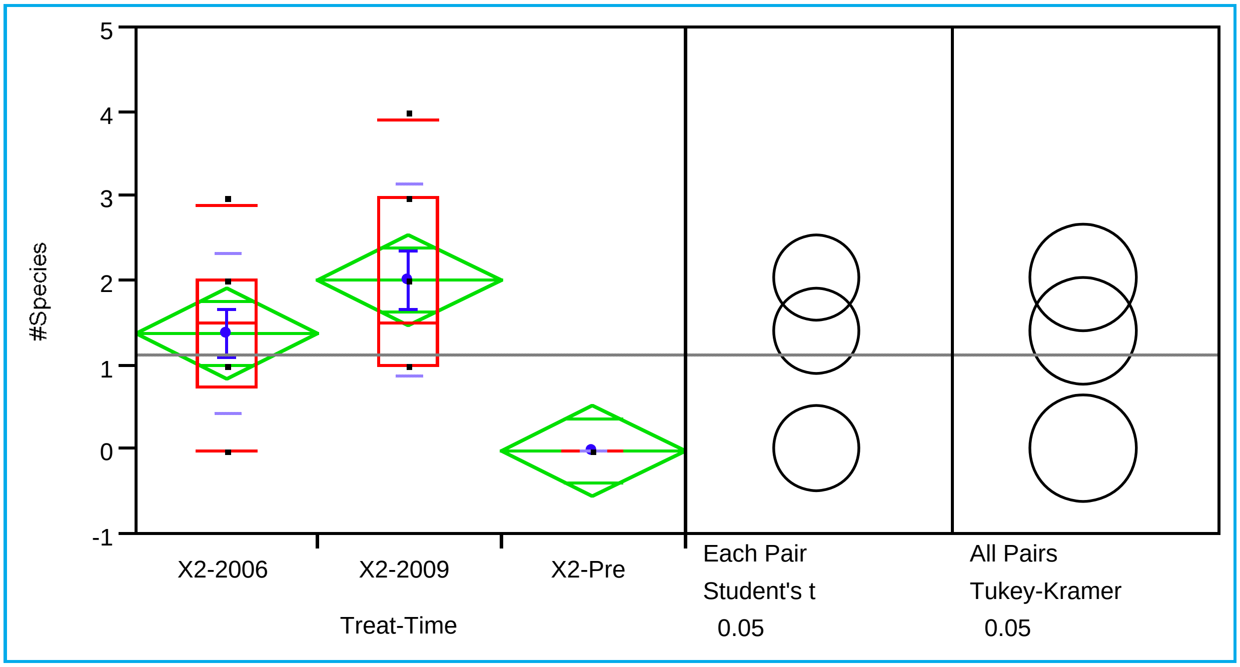
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
81	-2.01569	0.0438

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
4.2378	1	0.0395

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.508039
RSquare Adj	0.471597
Root Mean Square Error	0.869227
Mean of Response	1.133333
Observations (or Sum Wgts)	30

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	21.066667	10.5333	13.9412
Error	27	20.400000	0.7556	Prob>F
C Total	29	41.466667	1.4299	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-2006	10	1.40000	0.27487
X2-2009	10	2.00000	0.27487
X2-Pre	10	0.00000	0.27487

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-2006	10	1.40000	0.96609	0.30551
X2-2009	10	2.00000	1.15470	0.36515
X2-Pre	10	0.00000	0.00000	0.00000

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2009	X2-2006	X2-Pre
X2-2009	0.00000	0.60000	2.00000
X2-2006	-0.60000	0.00000	1.40000
X2-Pre	-2.00000	-1.40000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.05181

Abs(Dif)-LSD	X2-2009	X2-2006	X2-Pre
X2-2009	-0.79760	-0.19760	1.20240
X2-2006	-0.19760	-0.79760	0.60240
X2-Pre	1.20240	0.60240	-0.79760

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.47942

Abs(Dif)-LSD	X2-2009	X2-2006	X2-Pre
X2-2009	-0.96382	-0.36382	1.03618
X2-2006	-0.36382	-0.96382	0.43618
X2-Pre	1.03618	0.43618	-0.96382

Positive values show pairs of means that are significantly different.

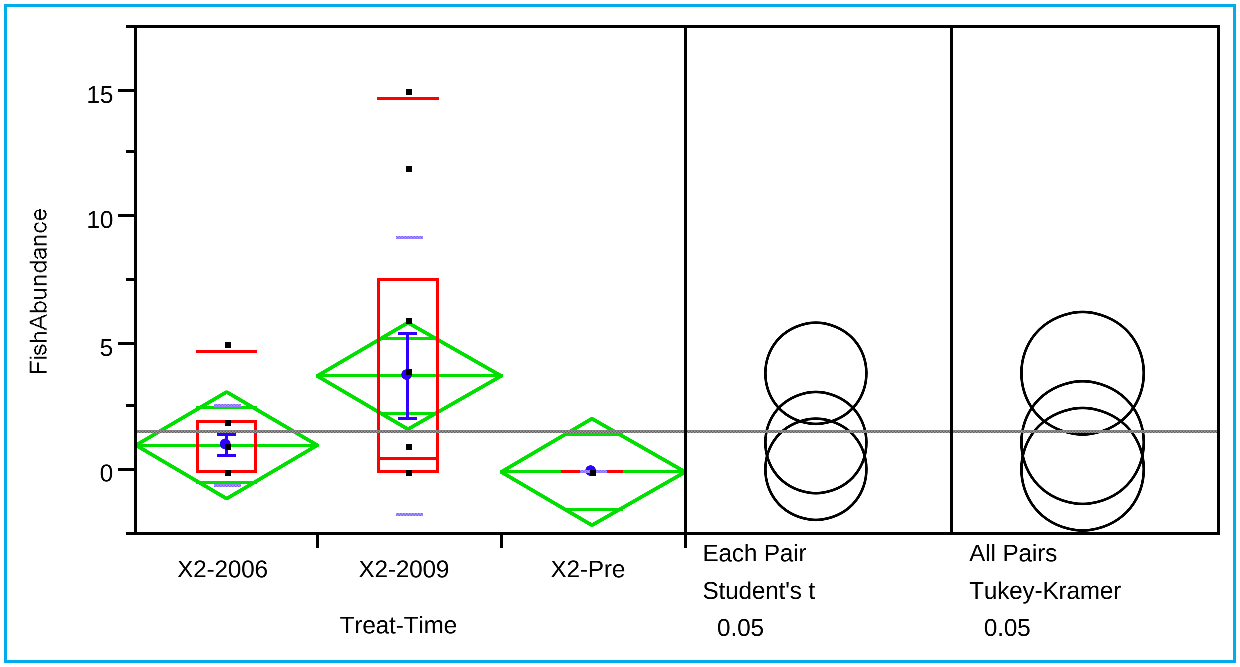
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-2006	10	182	18.2000	1.221
X2-2009	10	218	21.8000	2.881
X2-Pre	10	65	6.5000	-4.125

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
18.1266	2	0.0001

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.204641
RSquare Adj	0.145726
Root Mean Square Error	3.34221
Mean of Response	1.6
Observations (or Sum Wgts)	30

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	77.60000	38.8000	3.4735
Error	27	301.60000	11.1704	Prob>F
C Total	29	379.20000	13.0759	0.0455

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-2006	10	1.00000	1.0569
X2-2009	10	3.80000	1.0569
X2-Pre	10	0.00000	1.0569

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-2006	10	1.00000	1.63299	0.5164
X2-2009	10	3.80000	5.55378	1.7563
X2-Pre	10	0.00000	0.00000	0.0000

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2009	X2-2006	X2-Pre
X2-2009	0.00000	2.80000	3.80000
X2-2006	-2.80000	0.00000	1.00000
X2-Pre	-3.80000	-1.00000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.05181

Abs(Dif)-LSD	X2-2009	X2-2006	X2-Pre
X2-2009	-3.06681	-0.26681	0.73319
X2-2006	-0.26681	-3.06681	-2.06681
X2-Pre	0.73319	-2.06681	-3.06681

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.47942

Abs(Dif)-LSD	X2-2009	X2-2006	X2-Pre
X2-2009	-3.70594	-0.90594	0.09406
X2-2006	-0.90594	-3.70594	-2.70594
X2-Pre	0.09406	-2.70594	-3.70594

Positive values show pairs of means that are significantly different.

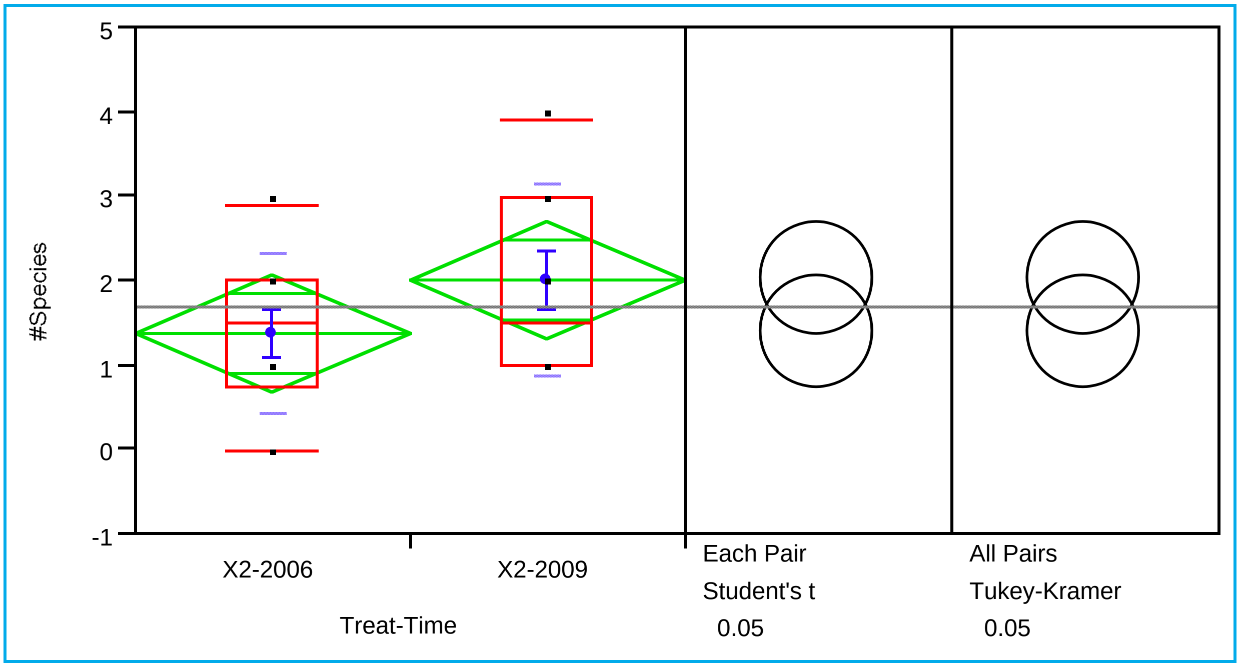
Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-2006	10	164.5	16.4500	0.489
X2-2009	10	190.5	19.0500	1.900
X2-Pre	10	110	11.0000	-2.415

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
6.6298	2	0.0363

#Species By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.081081
RSquare Adj	0.03003
Root Mean Square Error	1.064581
Mean of Response	1.7
Observations (or Sum Wgts)	20

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-0.60000	-1.260	18	0.2237
Std Error	0.47610			
Lower 95%	-1.60023			
Upper 95%	0.40023			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.800000	1.80000	1.5882
Error	18	20.400000	1.13333	Prob>F
C Total	19	22.200000	1.16842	0.2237

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-2006	10	1.40000	0.33665
X2-2009	10	2.00000	0.33665

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-2006	10	1.40000	0.96609	0.30551
X2-2009	10	2.00000	1.15470	0.36515

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2009	X2-2006
X2-2009	0.000000	0.600000
X2-2006	-0.6	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.10091

Abs(Dif)-LSD	X2-2009	X2-2006
X2-2009	-1.00023	-0.40023
X2-2006	-0.40023	-1.00023

Positive values show pairs of means that are significantly different.
Comparisons for all pairs using Tukey-Kramer HSD

q*
2.10092

Abs(Dif)-LSD	X2-2009	X2-2006
X2-2009	-1.00024	-0.40024
X2-2006	-0.40024	-1.00024

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-2006	10	92	9.2000	-0.989
X2-2009	10	118	11.8000	0.989

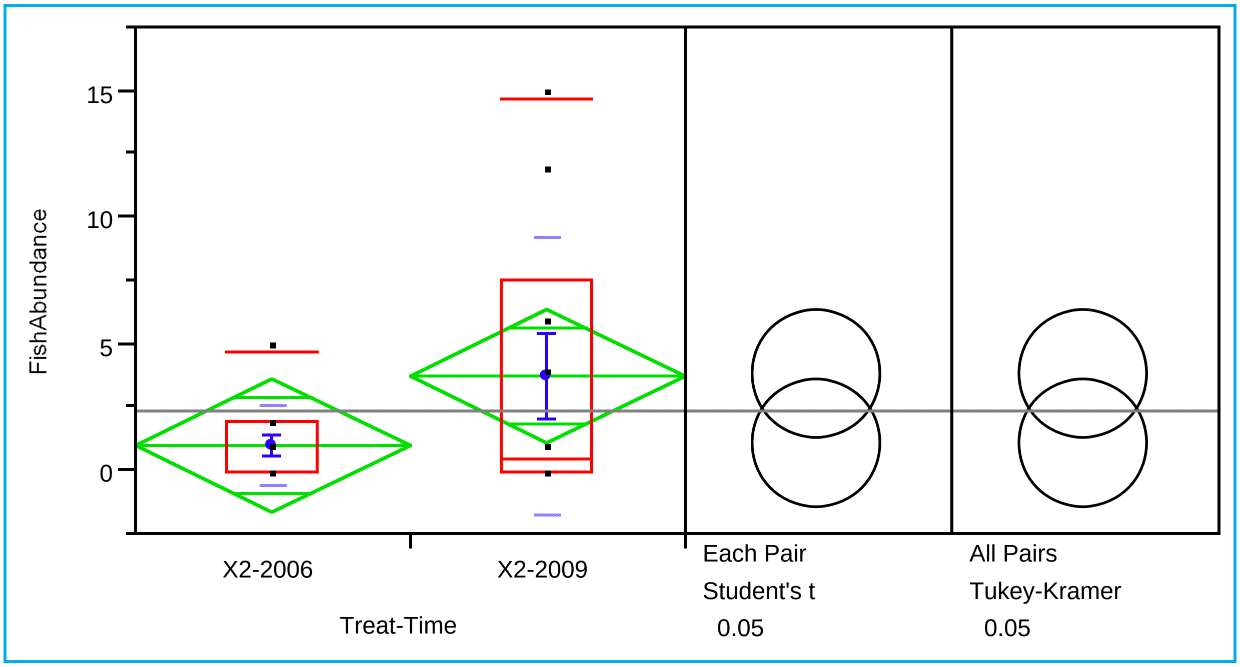
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
118	0.98862	0.3228

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
1.0571	1	0.3039

FishAbundance By Treat-Time



Oneway Anova

Summary of Fit

RSquare	0.115023
RSquare Adj	0.065858
Root Mean Square Error	4.093355
Mean of Response	2.4
Observations (or Sum Wgts)	20

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-2.80000	-1.530	18	0.1435
Std Error	1.83060			
Lower 95%	-6.64593			
Upper 95%	1.04593			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	39.20000	39.2000	2.3395
Error	18	301.60000	16.7556	Prob>F
C Total	19	340.80000	17.9368	0.1435

Means for Oneway Anova

Level	Number	Mean	Std Error
X2-2006	10	1.00000	1.2944
X2-2009	10	3.80000	1.2944

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
X2-2006	10	1.00000	1.63299	0.5164
X2-2009	10	3.80000	5.55378	1.7563

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-2009	X2-2006
X2-2009	0.00000	2.80000
X2-2006	-2.80000	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.10091

Abs(Dif)-LSD	X2-2009	X2-2006
X2-2009	-3.84593	-1.04593
X2-2006	-1.04593	-3.84593

Positive values show pairs of means that are significantly different.
Comparisons for all pairs using Tukey-Kramer HSD

q*
2.10092

Abs(Dif)-LSD	X2-2009	X2-2006
X2-2009	-3.84595	-1.04595
X2-2006	-1.04595	-3.84595

Positive values show pairs of means that are significantly different.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
X2-2006	10	94.5	9.4500	-0.828
X2-2009	10	115.5	11.5500	0.828

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
115.5	0.82820	0.4076

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
0.7562	1	0.3845

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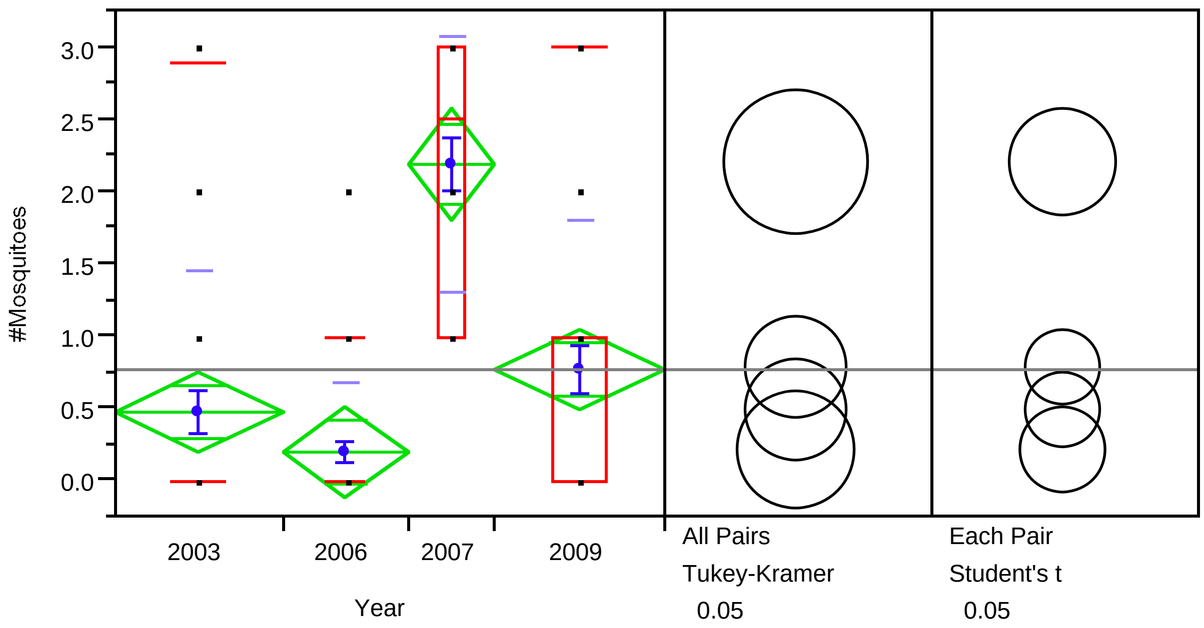
Mosquito Sampling

#Mosquitoes By Year



Oneway Anova

Summary of Fit

RSquare	0.344589
RSquare Adj	0.328984
Root Mean Square Error	0.903916
Mean of Response	0.769231
Observations (or Sum Wgts)	130

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	54.12692	18.0423	22.0819
Error	126	102.95000	0.8171	Prob>F
C Total	129	157.07692	1.2177	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
2003	40	0.47500	0.14292
2006	30	0.20000	0.16503
2007	20	2.20000	0.20212
2009	40	0.77500	0.14292

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
2003	40	0.47500	0.98677	0.15602
2006	30	0.20000	0.48423	0.08841
2007	20	2.20000	0.89443	0.20000
2009	40	0.77500	1.04973	0.16598

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
2003	40	2191.5	54.788	-2.453
2006	30	1454	48.467	-3.204
2007	20	2176	108.800	6.344
2009	40	2693.5	67.338	0.418

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
46.3077	3	<.0001

Means Comparisons

Dif=Mean[i]-Mean[j]	2007	2009	2003	2006
2007	0.00000	1.42500	1.72500	2.00000
2009	-1.42500	0.00000	0.30000	0.57500
2003	-1.72500	-0.30000	0.00000	0.27500
2006	-2.00000	-0.57500	-0.27500	0.00000

Alpha= 0.05

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.60366

Abs(Dif)-LSD	2007	2009	2003	2006
2007	-0.74424	0.78047	1.08047	1.32061
2009	0.78047	-0.52626	-0.22626	0.00658
2003	1.08047	-0.22626	-0.52626	-0.29342
2006	1.32061	0.00658	-0.29342	-0.60767

Positive values show pairs of means that are significantly different.

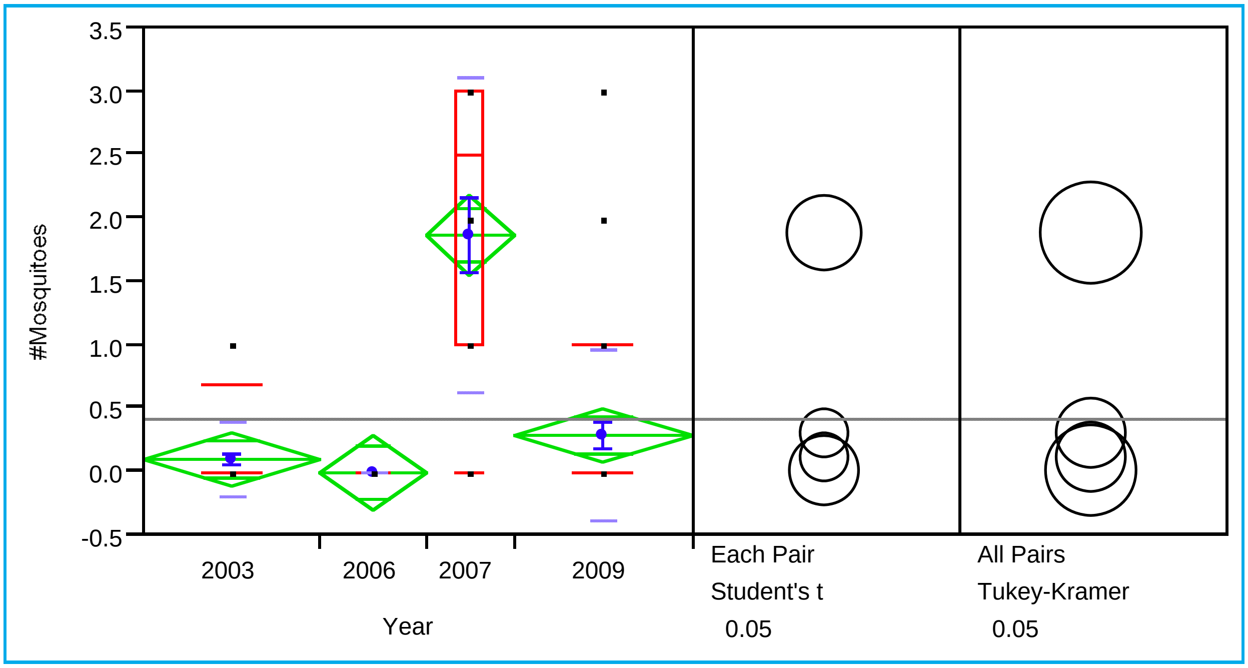
Comparisons for each pair using Student's t

t
1.97899

Abs(Dif)-LSD	2007	2009	2003	2006
2007	-0.56568	0.93511	1.23511	1.48361
2009	0.93511	-0.40000	-0.10000	0.14295
2003	1.23511	-0.10000	-0.40000	-0.15705
2006	1.48361	0.14295	-0.15705	-0.46188

Positive values show pairs of means that are significantly different.

#Mosquitoes By Year



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Mosquito
Sampling

Oneway Anova

Summary of Fit

RSquare	0.501867
RSquare Adj	0.486136
Root Mean Square Error	0.656446
Mean of Response	0.424242
Observations (or Sum Wgts)	99

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	41.244318	13.7481	31.9040
Error	95	40.937500	0.4309	Prob>F
C Total	98	82.181818	0.8386	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
2003	32	0.09375	0.11604
2006	19	0.00000	0.15060
2007	16	1.87500	0.16411
2009	32	0.28125	0.11604

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
2003	32	0.09375	0.29614	0.05235
2006	19	0.00000	0.00000	0.00000
2007	16	1.87500	1.25831	0.31458
2009	32	0.28125	0.68318	0.12077

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
2003	32	1380	43.1250	-2.261
2006	19	741	39.0000	-2.551
2007	16	1298.5	81.1563	6.518
2009	32	1530.5	47.8281	-0.711

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
44.8013	3	<.0001

Means Comparisons

Dif=Mean[i]-Mean[j]	2007	2009	2003	2006
2007	0.00000	1.59375	1.78125	1.87500
2009	-1.59375	0.00000	0.18750	0.28125
2003	-1.78125	-0.18750	0.00000	0.09375
2006	-1.87500	-0.28125	-0.09375	0.00000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98526

Abs(Dif)-LSD	2007	2009	2003	2006
2007	-0.46076	1.19472	1.38222	1.43280
2009	1.19472	-0.32580	-0.13830	-0.09619
2003	1.38222	-0.13830	-0.32580	-0.28369
2006	1.43280	-0.09619	-0.28369	-0.42282

Positive values show pairs of means that are significantly different.

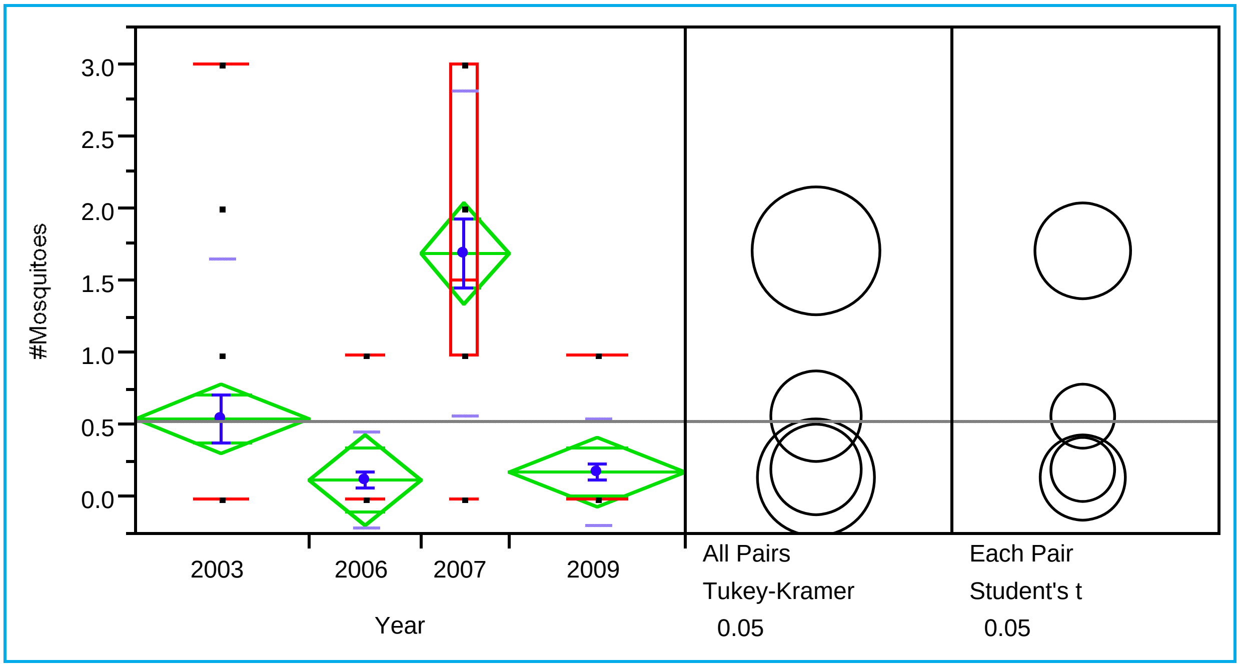
Comparisons for all pairs using Tukey-Kramer HSD

q*
2.61510

Abs(Dif)-LSD	2007	2009	2003	2006
2007	-0.60693	1.06813	1.25563	1.29252
2009	1.06813	-0.42917	-0.24167	-0.21594
2003	1.25563	-0.24167	-0.42917	-0.40344
2006	1.29252	-0.21594	-0.40344	-0.55696

Positive values show pairs of means that are significantly different.

#Mosquitoes By Year



M-X2_All_
Y by X.pdf

Mosquito
Sampling

Oneway Anova

Summary of Fit

RSquare	0.31273
RSquare Adj	0.295691
Root Mean Square Error	0.815729
Mean of Response	0.528
Observations (or Sum Wgts)	125

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	36.63700	12.2123	18.3530
Error	121	80.51500	0.6654	Prob>F
C Total	124	117.15200	0.9448	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
2003	40	0.55000	0.12898
2006	25	0.12000	0.16315
2007	20	1.70000	0.18240
2009	40	0.17500	0.12898

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
2003	40	0.55000	1.10824	0.17523
2006	25	0.12000	0.33166	0.06633
2007	20	1.70000	1.12858	0.25236
2009	40	0.17500	0.38481	0.06084

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
2003	40	2417.5	60.4375	-0.678
2006	25	1287	51.4800	-2.228
2007	20	1992.5	99.6250	6.189
2009	40	2178	54.4500	-2.269

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
40.0299	3	<.0001

Means Comparisons

Dif=Mean[i]-Mean[j]	2007	2003	2009	2006
2007	0.00000	1.15000	1.52500	1.58000
2003	-1.15000	0.00000	0.37500	0.43000
2009	-1.52500	-0.37500	0.00000	0.05500
2006	-1.58000	-0.43000	-0.05500	0.00000

Alpha= 0.05

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.60510

Abs(Dif)-LSD	2007	2003	2009	2006
2007	-0.672	0.568030	0.943030	0.942484
2003	0.568030	-0.47518	-0.10018	-0.11178
2009	0.943030	-0.10018	-0.47518	-0.48678
2006	0.942484	-0.11178	-0.48678	-0.60106

Positive values show pairs of means that are significantly different.

Comparisons for each pair using Student's t

t
1.97978

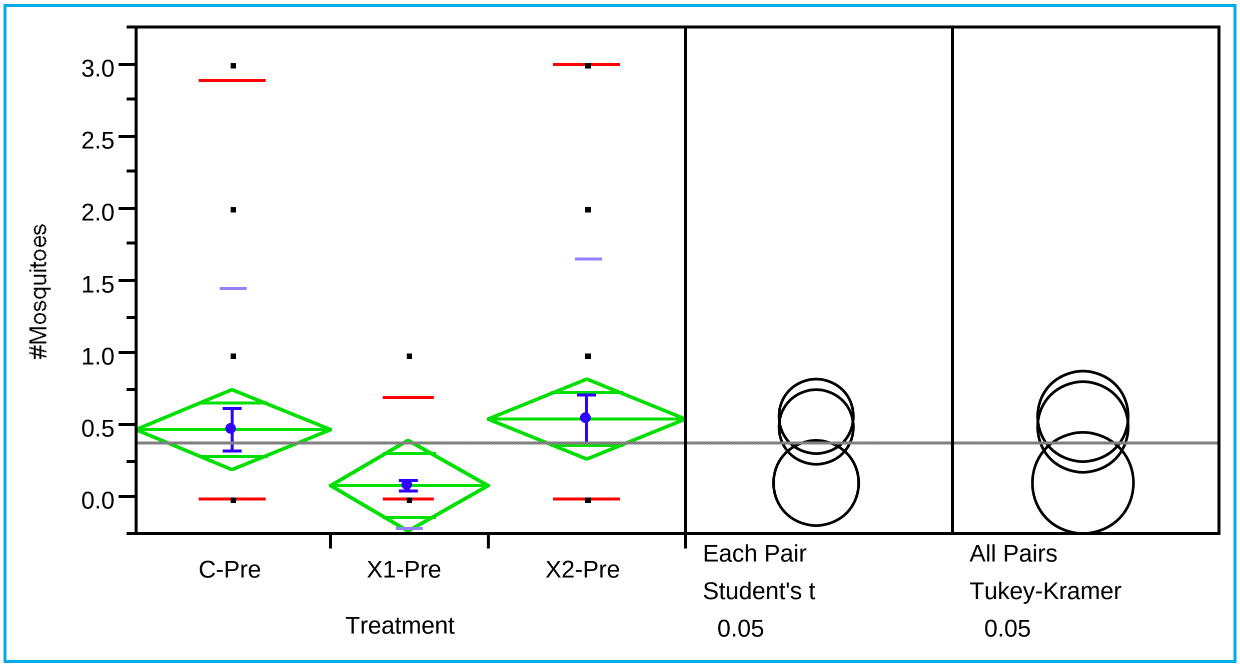
Abs(Dif)-LSD	2007	2003	2009	2006
2007	-0.51070	0.70772	1.08272	1.09551
2003	0.70772	-0.36112	0.01388	0.01826
2009	1.08272	0.01388	-0.36112	-0.35674
2006	1.09551	0.01826	-0.35674	-0.45678

Positive values show pairs of means that are significantly different.

M-Pre_All_
Y by X.pdf

Mosquito
Sampling

#Mosquitoes By Treatment



Oneway Anova

Summary of Fit

RSquare	0.044443
RSquare Adj	0.02691
Root Mean Square Error	0.901547
Mean of Response	0.392857
Observations (or Sum Wgts)	112

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	4.120536	2.06027	2.5348
Error	109	88.593750	0.81279	Prob>F
C Total	111	92.714286	0.83526	0.0839

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Pre	40	0.475000	0.14255
X1-Pre	32	0.093750	0.15937
X2-Pre	40	0.550000	0.14255

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Pre	40	0.475000	0.98677	0.15602
X1-Pre	32	0.093750	0.29614	0.05235
X2-Pre	40	0.550000	1.10824	0.17523

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Pre	40	2344.5	58.6125	0.750
X1-Pre	32	1620.5	50.6406	-1.771
X2-Pre	40	2363	59.0750	0.915

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
3.1615	2	0.2058

Means Comparisons

Dif=Mean[i]-Mean[j]	X2-Pre	C-Pre	X1-Pre
X2-Pre	0.000000	0.075000	0.456250
C-Pre	-0.075	0.000000	0.381250
X1-Pre	-0.45625	-0.38125	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98198

Abs(Dif)-LSD	X2-Pre	C-Pre	X1-Pre
X2-Pre	-0.39955	-0.32455	0.032462
C-Pre	-0.32455	-0.39955	-0.04254
X1-Pre	0.032462	-0.04254	-0.44671

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

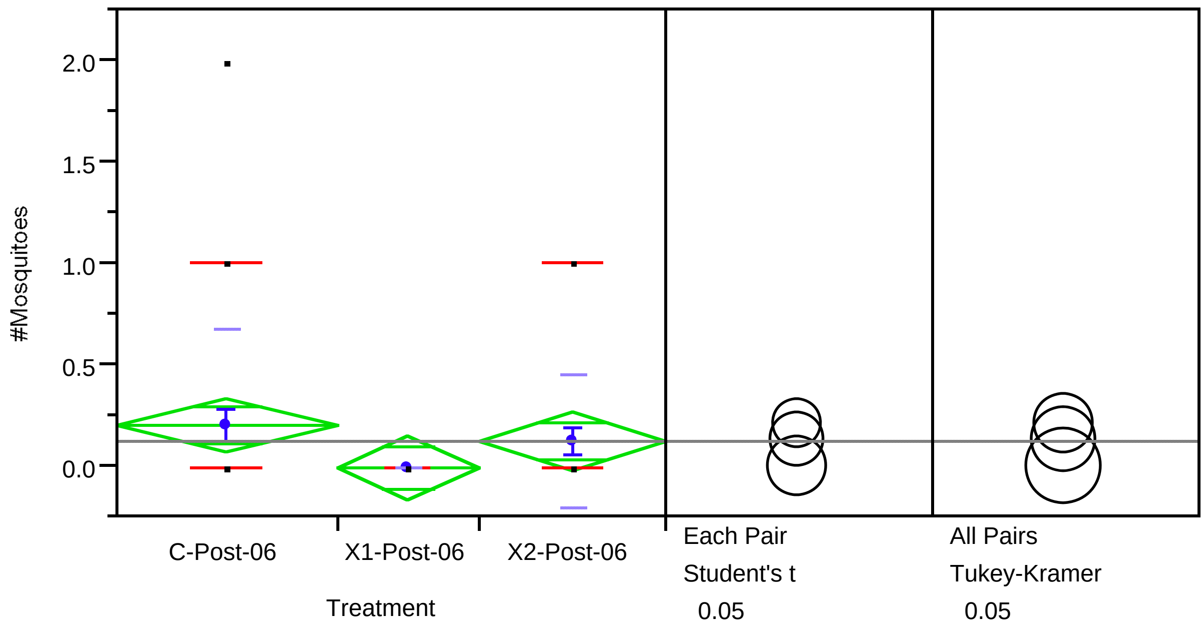
q*
2.37618

Abs(Dif)-LSD	X2-Pre	C-Pre	X1-Pre
X2-Pre	-0.47902	-0.40402	-0.05183
C-Pre	-0.40402	-0.47902	-0.12683
X1-Pre	-0.05183	-0.12683	-0.53556

Positive values show pairs of means that are significantly different.

M-2006_All_
Y by X.pdf

#Mosquitoes By Treatment



Oneway Anova

Summary of Fit

RSquare	0.046985
RSquare Adj	0.02014
Root Mean Square Error	0.364634
Mean of Response	0.121622
Observations (or Sum Wgts)	74

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.4654054	0.232703	1.7502
Error	71	9.4400000	0.132958	Prob>F
C Total	73	9.9054054	0.135690	0.1812

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post-06	30	0.200000	0.06657
X1-Post-06	19	0.000000	0.08365
X2-Post-06	25	0.120000	0.07293

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post-06	30	0.200000	0.484234	0.08841
X1-Post-06	19	0.000000	0.000000	0.00000
X2-Post-06	25	0.120000	0.331662	0.06633

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post-06	30	1191.5	39.7167	1.350
X1-Post-06	19	636.5	33.5000	-1.736
X2-Post-06	25	947	37.8800	0.191

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
3.3957	2	0.1831

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Post-06	X2-Post-06	X1-Post-06
C-Post-06	0.000000	0.080000	0.200000
X2-Post-06	-0.08	0.000000	0.120000
X1-Post-06	-0.2	-0.12	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.99395

Abs(Dif)-LSD	C-Post-06	X2-Post-06	X1-Post-06
C-Post-06	-0.18773	-0.11689	-0.01317
X2-Post-06	-0.11689	-0.20564	-0.10128
X1-Post-06	-0.01317	-0.10128	-0.23589

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.39384

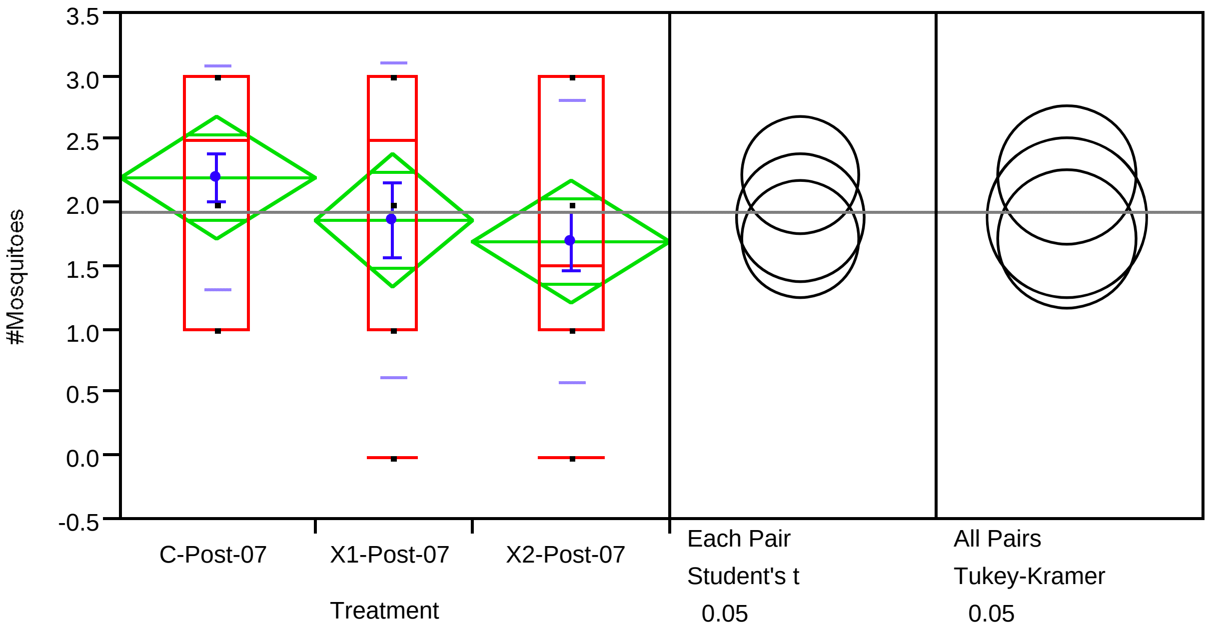
Abs(Dif)-LSD	C-Post-06	X2-Post-06	X1-Post-06
C-Post-06	-0.22538	-0.15638	-0.05593
X2-Post-06	-0.15638	-0.24689	-0.14566
X1-Post-06	-0.05593	-0.14566	-0.2832

Positive values show pairs of means that are significantly different.

M-2007_All_Y by X.pdf

Mosquito Sampling

#Mosquitoes By Treatment



Oneway Anova

Summary of Fit

RSquare	0.039022
RSquare Adj	0.002758
Root Mean Square Error	1.091563
Mean of Response	1.928571
Observations (or Sum Wgts)	56

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	2.564286	1.28214	1.0761
Error	53	63.150000	1.19151	Prob>F
C Total	55	65.714286	1.19481	0.3483

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post-07	20	2.20000	0.24408
X1-Post-07	16	1.87500	0.27289
X2-Post-07	20	1.70000	0.24408

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post-07	20	2.20000	0.89443	0.20000
X1-Post-07	16	1.87500	1.25831	0.31458
X2-Post-07	20	1.70000	1.12858	0.25236

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post-07	20	640	32.0000	1.267
X1-Post-07	16	450	28.1250	-0.106
X2-Post-07	20	506	25.3000	-1.158

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
1.9330	2	0.3804

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Post-07	X1-Post-07	X2-Post-07
C-Post-07	0.000000	0.325000	0.500000
X1-Post-07	-0.325	0.000000	0.175000
X2-Post-07	-0.5	-0.175	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
2.00574

Abs(Dif)-LSD	C-Post-07	X1-Post-07	X2-Post-07
C-Post-07	-0.69235	-0.40935	-0.19235
X1-Post-07	-0.40935	-0.77407	-0.55935
X2-Post-07	-0.19235	-0.55935	-0.69235

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.41127

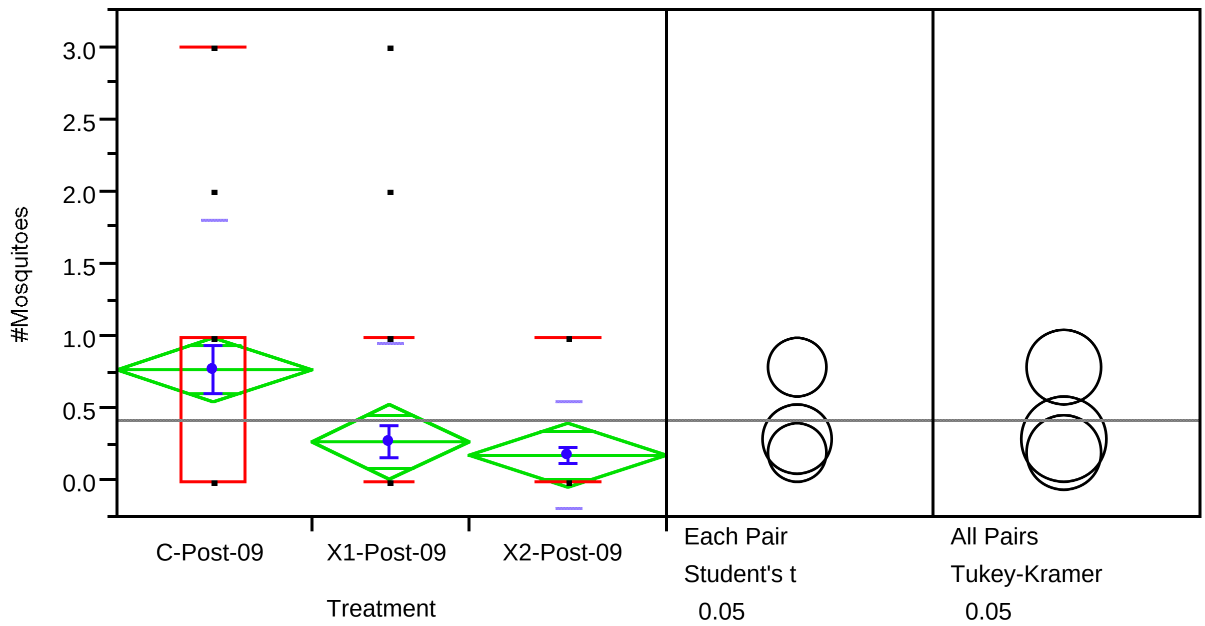
Abs(Dif)-LSD	C-Post-07	X1-Post-07	X2-Post-07
C-Post-07	-0.83233	-0.55782	-0.33233
X1-Post-07	-0.55782	-0.93057	-0.70782
X2-Post-07	-0.33233	-0.70782	-0.83233

Positive values show pairs of means that are significantly different.

M-2009_All_
Y by X.pdf

Mosquito
Sampling

#Mosquitoes By Treatment



Oneway Anova

Summary of Fit

RSquare	0.113053
RSquare Adj	0.096778
Root Mean Square Error	0.76157
Mean of Response	0.419643
Observations (or Sum Wgts)	112

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	8.058036	4.02902	6.9467
Error	109	63.218750	0.57999	Prob>F
C Total	111	71.276786	0.64213	0.0014

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post-09	40	0.775000	0.12041
X1-Post-09	32	0.281250	0.13463
X2-Post-09	40	0.175000	0.12041

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post-09	40	0.775000	1.04973	0.16598
X1-Post-09	32	0.281250	0.68318	0.12077
X2-Post-09	40	0.175000	0.38481	0.06084

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post-09	40	2683	67.0750	3.272
X1-Post-09	32	1648	51.5000	-1.310
X2-Post-09	40	1997	49.9250	-2.033

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
10.7961	2	0.0045

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Post-09	X1-Post-09	X2-Post-09
C-Post-09	0.000000	0.493750	0.600000
X1-Post-09	-0.49375	0.000000	0.106250
X2-Post-09	-0.6	-0.10625	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.98198

Abs(Dif)-LSD	C-Post-09	X1-Post-09	X2-Post-09
C-Post-09	-0.33752	0.135760	0.262484
X1-Post-09	0.135760	-0.37735	-0.25174
X2-Post-09	0.262484	-0.25174	-0.33752

Positive values show pairs of means that are significantly different.

Comparisons for all pairs using Tukey-Kramer HSD

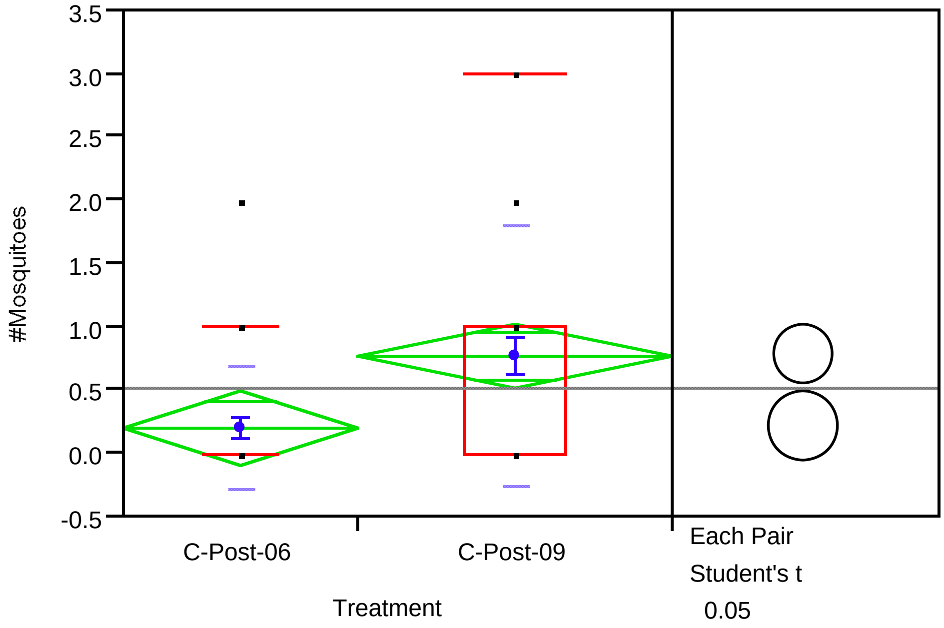
q*
2.37618

Abs(Dif)-LSD	C-Post-09	X1-Post-09	X2-Post-09
C-Post-09	-0.40464	0.064559	0.195355
X1-Post-09	0.064559	-0.45241	-0.32294
X2-Post-09	0.195355	-0.32294	-0.40464

Positive values show pairs of means that are significantly different.

Mosquito Sampling

#Mosquitoes By Treatment



Oneway Anova

Summary of Fit

RSquare	0.102229
RSquare Adj	0.089026
Root Mean Square Error	0.855561
Mean of Response	0.528571
Observations (or Sum Wgts)	70

t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-0.575	-2.783	68	0.0070
Std Error	0.206638			
Lower 95%	-0.98734			
Upper 95%	-0.16266			

Assuming equal variances

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.667857	5.66786	7.7431
Error	68	49.775000	0.73199	Prob>F
C Total	69	55.442857	0.80352	0.0070

Means for Oneway Anova

Level	Number	Mean	Std Error
C-Post-06	30	0.200000	0.15620
C-Post-09	40	0.775000	0.13528

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
C-Post-06	30	0.200000	0.48423	0.08841
C-Post-09	40	0.775000	1.04973	0.16598

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
C-Post-06	30	881.5	29.3833	-2.617
C-Post-09	40	1603.5	40.0875	2.617

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
881.5	-2.61664	0.0089

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
6.8843	1	0.0087

Means Comparisons

Dif=Mean[i]-Mean[j]	C-Post-09	C-Post-06
C-Post-09	0.000000	0.575000
C-Post-06	-0.575	0.000000

Alpha= 0.05

Comparisons for each pair using Student's t

t
1.99547

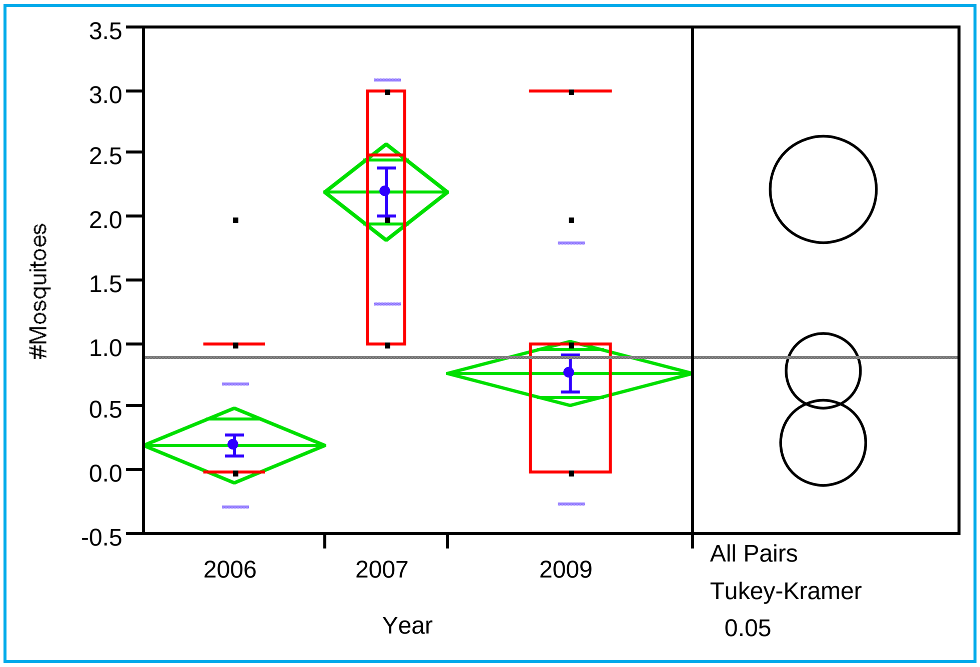
Abs(Dif)-LSD	C-Post-09	C-Post-06
C-Post-09	-0.38175	0.162660
C-Post-06	0.162660	-0.44081

Positive values show pairs of means that are significantly different.

M-Ctrl_AllPost_
Y by X.pdf

Mosquito Sampling

#Mosquitoes By Year



Oneway Anova

Summary of Fit

RSquare	0.430543
RSquare Adj	0.417452
Root Mean Square Error	0.864199
Mean of Response	0.9
Observations (or Sum Wgts)	90

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	49.12500	24.5625	32.8886
Error	87	64.97500	0.7468	Prob>F
C Total	89	114.10000	1.2820	<.0001

Means for Oneway Anova

Level	Number	Mean	Std Error
2006	30	0.20000	0.15778
2007	20	2.20000	0.19324
2009	40	0.77500	0.13664

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
2006	30	0.20000	0.48423	0.08841
2007	20	2.20000	0.89443	0.20000
2009	40	0.77500	1.04973	0.16598

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
2006	30	901.5	30.0500	-4.320
2007	20	1461	73.0500	5.825
2009	40	1732.5	43.3125	-0.770

1-way Test, Chi-Square Approximation

ChiSquare	DF	Prob>ChiSq
39.2388	2	<.0001

Means Comparisons

Dif=Mean[i]-Mean[j]	2007	2009	2006
2007	0.00000	1.42500	2.00000
2009	-1.42500	0.00000	0.57500
2006	-2.00000	-0.57500	0.00000

Alpha= 0.05

Comparisons for all pairs using Tukey-Kramer HSD

q*
2.38450

Abs(Dif)-LSD	2007	2009	2006
2007	-0.65164	0.86066	1.40513
2009	0.86066	-0.46078	0.07730
2006	1.40513	0.07730	-0.53206

Positive values show pairs of means that are significantly different.

APPENDIX F

Field Notes

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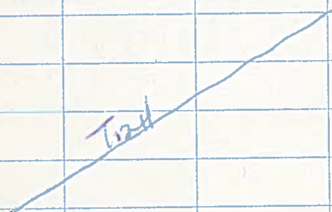
Location Mill Brook Date 7/18/07

Project / Client Mosquito Dip Net

Approach from E along path / res
neighborhood
Will see white PVC tubes
Also will see golf course & ponds
At low tide can walk across channel
but tide turns quickly
Dip netting - presence/absence

3 areas X1 X2 + C



Dipnet
Copy Fig 2
Data sheet on network
Directions in Book + on map
Google directions
[illegible]

Location Mill Brook Date 7/18/07

Project / Client Mosquito Dip Net

5 dips equally spaced in the pond
itself

Location

Date

Project / Client

Location MillBrook

Date 7/28/09

Project / Client S. WATTS + L. RIVARD

Rt 1 - Scarborough

TL ~~Ave~~ Lincoln Ave (Tim Horton's)

TL @ intersection

Park at Scarborough Public Works Station

Onsite @ 11:45 Mosquito Dip Net + Site Visit

end 2:45PM

Location Mill Brook Date 8-4-09

Project / Client LINDA RIVARD + Tyler Gaudet

ON SITE: 2:50PM

Sunny, Breezy ~ 76°

Nekton Sampling

Control Pool

Throw #1 ① juv. Fundulus sp.

sweep 1 - ~~Killi fish~~, amphipod, backswimmers

Sweep 2 backswimmers

Sweep 3 midge, backswimmers

NO SAV or Algae

Throw #2

sweep 1 - 1 juv. Fundulus backswimmers

sweep 2 2 juv. Fundulus "

sweep 3 1 juv. Fundulus "

NO SAV, No Algae

Throw #3

Sweep 1 11 juv. Fundulus, amphipod, backswimmers

Sweep 2 1 juv. Fundulus, " "

Sweep 3 5 juv. Fundulus " "

NO SAV NO ALGAE

Location Date

Project / Client

Throw #4

sweep 1 - backswimmers

sweep 2 backswimmers, amphipods, midges

Sweep 3 - 1 juv. Fundulus, backswimmers

NO SAV, No Algae

Throw #5

Sweep 1 - backswimmers, midge

Sweep 2 backswimmers

Sweep 3 - backswimmers

No Algae, NO SAV

Birds - Am. Crow, White egret

Bl. Duck,

Throw #6

Sweep 1 - Backswimmers

Sweep 2 - Backswimmers

Sweep 3 - 1 juv. Fundulus

V. MUDDY ~~NO FISH~~ NO VEG

Location ______ Date ______

Project / Client ______

Exp Pool #2 start - 0505PM

Throw 1

Sweep 1 - backswimmers

Sweep 2 - "

Sweep 3 - "

NO VEG NO FISH

THROW 2

Sweep 1 - 3 Killifish, backswimmers

Sweep 2 - 5 Killifish

Sweep 3 - 4 Killifish

total fish - 12 banded killifish

deeper water near center of pool no veg

Throw 3

Sweep 1 - backswimmers 2 silversides 1 killifish

Sweep 2 - 2 killifish

Sweep 3 - 0 fish

soft bottom, deep, no veg

Location ______ Date ______

Project / Client ______

Throw 4

Sweep 1 - 2 juv killifish few backswimmers

Sweep 2 - 2 ~~#~~ killifish few backswimmers

Sweep 3 - 2 killifish

near shore, no veg

Throw 5

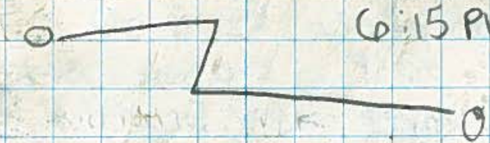
Sweep 1 - backswimmers few

Sweep 2 - backswimmers few

Sweep 3 - 0

near shore, no veg

Exp #2 end 0555 Leave site @ 6:15 PM



Notes: Exp Pool #2 much deeper w/ a much high abundance of fish collected, and of much larger size. Fish species dominated by banded killifish w/ few silversides and mummichog.

Species: mallard ♀ + ♂

Location Mill Brook Date 8/7/09

Project / Client L. Rivard

Onsite @ 7:15AM, Sunny, No Breeze
~ 68° and rising

8/7/09 Low Tide Photos

Species: White egret (group), GRBL Heron, Ducks (group)
Canada goose (flock)
Raptor heard vocalizing (Red Tail?)
Butterfly - Brown w/orange wing tips
at Exp Pool #2 @ 7:50
Photo Station 5+6

Exp. Pool #2 photo complete @ 8:15

Begin Photos @ Control Pool @ 8:25
Photo Station 1+2
Complete @ 8:50

Black egret → juv Great Blue Heron?
White egrets w/yellow legs (small) - Snowy Egret

Exp Pool #1 Photos Station 3+4
Begin: 8:55 End 9:25

Leave site @ 9:50

Location Mill Brook Date 8/10/09

Project / Client L. Rivard

Mosquito Dip Net Sampling
Onsite @ 8 AM
Clear, warm, No Breeze
Temps increasing + humid.
(became breezy @ about 9 AM)
Many flocks on birds (egrets, herons, ducks, sandpipers, geese) observed in large pools located on west side of brook channel.

At exp pool #2 @ 8:30 AM

outer pool # 5 dry.
Sampled nearby pool w/water

Finish @ exp pool # 2 @ 9:50

Control Pool 10:00AM - 11:20
Racoon tracks

Exp Pool #1 11:25 - 12:04

Leave site @ 12:25

Location Mill Brook Date 6/25/09

Project / Client FSM / USFWS

0830

MOSQUITO DIP NET SURVEY

Scarborough DPW personnel stopped me to see if I was w/ DIF&W. They have had some issues w/ DIF&W surveyors looking for bats and installing stakes in the pipeline ROW. I clarified our role and confirmed that parking in this location is OK.

Ducks (BL)
Sandpiper (flock)
HEGU
NO KINGFISHER (BELTED)
CAGO
AM CR
GREG
COEG
Tringa species ~yellowlegs or sandpiper

SAM 8/25/09

Location Mill Brook Date 9-11-09

Project / Client FSM / USFWS

0830

SITE ASSESSMENT & COVER TYPE

BIRDS

HEGU	TINY SANDPIPERS - SPOTTED	
GREG	BLDU	SM DUCKS
AMCR	AMGO	
BEKI	SNEG	
DCCO	GBHE	
LEYE	GLIB	
GRYE		

Note: at 1230 tide is still very low; seems to be incoming but creeping in.

Location Mill Brook Date 9/22/09

Project / Client L. Rivard Mosquito Dip Net Sampling

Onsite @ 0805. Sunny w/ light wispy cloud layer. Slight breeze. ~60's and climbing. Pools very full

High Tide 9.6 ft @ 0201 AM
Low Tide 0.1 ft @ 0755 AM

Begin sampling @ Exp Pool #2 @ 0830.
Complete @ 0920

Begin sampling @ Control Pool @ 0930
Complete @ 1025

GRBH
AMCR
Racoon tracks
Deer tracks
unid sandpiper
unid sparrow

Begin exp Pool #2 @ 1030
Complete @ 1100

~~Leav~~ Arrive @ vehicle @ 1108

Location Mill Brook Date 9-30-09

Project / Client S. Watts J. Garnet

Vegetation Monitoring

Exp #1
Transects ~~3~~, 5, 1, 2, 3, 4

Exp [Points 1, 2, 3 now bare / pool
320°, 344°, 84°, 167°

Exp 2 [~~342°, 380, 58°, 136°, 204°~~
328, 348, 66, 134, 202

CONT [12, 100, 158, 200, 284

Control 5, 4, 3, 2, 1

Location Scarborough Salt Marsh Date 10-8-09

Project / Client Mill Brook

Linda Rivard, T. Gaudet * J. Sweitzer (observer)

Sunny + mild ~55° ↑ No Clouds
Light Breeze

Nekton Sampling onsite @0850

~~Exp. Pool #2 (S)~~ Begin Sampling @0907
Control Pool

Throw #1 - 1 midge, amphipods
No veg 2 water boatmen, midge, amp.
3 " " "

wb = water boatmen

Throw #2
sweep 1 - amp, midge, wb
filamentous algae 2 - amp, wb
3 - 1 Fundulus y-o-y
No veg amp. midge

Throw #3 1 wb, amp. midge No veg
filamentous algae 2 wb, amp. midge
3 wb, amp. midge

Throw #4 1 amp. midge No veg
2 amp. midge
3 amp. midge

Location Date

Project / Client

Throw #5 1 - amp, midge
2 - 1 banded killifish
3 - amp. midge

Throw #6 1 - midge, amp.
2 - midge, amp.
3 - midge amp.

Throw #7 1 - midge
No veg 2 - midge, amp
3 - midge amp

Throw #8 1 midge, amp
No veg 2 midge, amp.
3 midge, amp.

Control end 09:50 AM

Location ______ Date ______

Project / Client ______

Start 10:00

Exp # 2 (1)
no veg (1) wb (many) snails
filamentous (2) wb
algae (3) worm, wb

(2) (1) wb
filamentous (2) wb
algae (3) wb
no veg

Throw 3 (1) wb, midge, amp.
filamentous (2) (1) banded killifish
algae (3) wb
no veg near inlet

Throw 4 (1) wb
(2) —
(3) —

Throw 5 (1) 4 banded killifish
near inlet #2 (2) 7 banded killifish
(3) 4 banded killifish

End Exp # 2 10:30

Location ______ Date ______

Project / Client ______

Exp # 1 Start 10:40
(1)
Throw # 1 – (1) amp. midge
(2) amp. midge
No veg (3) amp. midge

Throw # 2 (1) wb, midge, amp
(2) wb, midge
No veg (3) wb, midge

Throw # 3 (1) midge wb
(2) amp. wb
No veg (3) midge, wb, amp

Throw # 4 (1) midge, wb, amp
(2) amp. wb
No veg (3) midge

Throw # 5 (1) midge
muddy (2) midge amp.
No veg (3) amp

Exp # 1 – 11:05

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APPENDIX G

Species List

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Species Observed in the vicinity of the Mill Brook Project Area.

Common Name	Scientific Name	Visual Categories	Pre-Restoration	Year 2 post-Restoration	Year 5 post-Restoration
Birds					
American avocet	*Recurvirostra Americana*	Wading bird		X	
American crow	*Corvus brachyrhynchos*	Passerine	X		X
American goldfinch	*Carduelis tristis*	Passerine	X		X
American robin	*Turdus migratorius*	Passerine	X		
Belted kingfisher					X
Black capped chickadee	*Parus atricapillus*	Passerine	X		
Blue jay	*Cyanocitta cristata*	Passerine	X		X
Black duck	*Anas rubripes*	Dabbling duck		X	X
Canada goose	*Branta canadensis*	Water bird	X	X	X
Cattle egret	*Bubulcus ibis*	Wading bird	X		
Common yellowthroat	*Geothlypis trichas*	Passerine	X		
Double-crested cormorant	*Phalacrocorax auritus*	Water bird	X	X	X
Eastern kingbird	*Tyrannus tyrannus*	Passerine	X		
Eastern phoebe	*Sayornis phoebe*	Passerine	X		
Snowy egret	*Egretta thula*	Wading bird		X	X
Glossy ibis	*Plegadis falcinellus*	Wading bird		X	X
Gray catbird	*Dumetella carolinensis*	Passerine	X	X	
Great blue heron	*Ardea heroides*	Wading bird	X	X	X
Great egret	*Ardea alba*	Wading bird	X	X	X
Greater yellowlegs	*Tringa melanoleuca*	Wading bird	X		X
Hairy woodpecker	*Picoides villosus*	Non-passerine land bird	X		
Herring gull	*Larus argentatus*	Seabird	X	X	X
House wren	*Troglodytes aedon*	Passerine	X		
Least sandpiper	*Calidris minutilla*	Wading bird	X		
Lesser yellowlegs		Wading bird			X
Little blue heron	*Egretta caerulea*	Wading bird		X	X
Mallard	*Anas platyrhynchos*	Dabbling duck		X	X
Marsh wren	*Cistothorus palustris*	Passerine	X	X	

Common Name	Scientific Name	Visual Categories	Pre-Restoration	Year 2 post-Restoration	Year 5 post-Restoration
Northern harrier	*Circus cyaneus*	Bird of prey	X		X
Northern flicker	*Colaptes auratus*	Non-passerine land bird	X		
Plover species	*Charadrius* species	Wading bird		X	
Red-tailed hawk	*Buteo jamaicensis*	Bird of prey	X	X	X
Saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*	Passerine	X	X	X
Sandpiper species	*Calidris* species	Wading bird	X	X	X
Tree swallow	*Tachycineta bicolor*	Passerine	X		
Tufted titmouse	*Baeolophus bicolor*	Passerine	X		
Willet	*Catoptrophorus semipalmatus*	Wading bird	X		
Mammals					
Deer tracks		Large mammal			X
Eastern chipmunk	*Tamias striatus*	Small mammal	X		X
Beaver					X
Raccoon track/scat	*Procyon lotor*	Large mammal	X		X
Red squirrel	*Tamiasciurus hudsonicus*	Small mammal	X		

[1] **Note:** Data collected on bird and wildlife observed using the project area are anecdotal observations collected during field sampling activities onsite, and are intended to provide additional information, and do not represent qualitative data collection. Additionally, these data are collected by individuals with a range of expertise in the identification of birds and wildlife, and therefore represent only a partial list of the species that may actually be using the project area.