Riverine Wetland Summary Report

2012-2014

Submitted by:

Jacklyn Gautsch and Brandon Harland

Iowa Department of Natural Resources
Watershed Monitoring and Assessment Section

Present Address: 502 East 9th Street, Des Moines, IA 53019;
Emails: jackie.gautsch@dnr.iowa.gov & brandon.harland@dnr.iowa.gov

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Introduction

The condition of Iowa's riverine wetlands is poorly known. No historic baseline information about the physical conditions, vegetation communities, and wildlife use in these ecosystems exists in the state. The primary goals of this project were to assess the ecological condition of riverine wetlands in Iowa, and improve the quality and quantity of data available to resource managers.

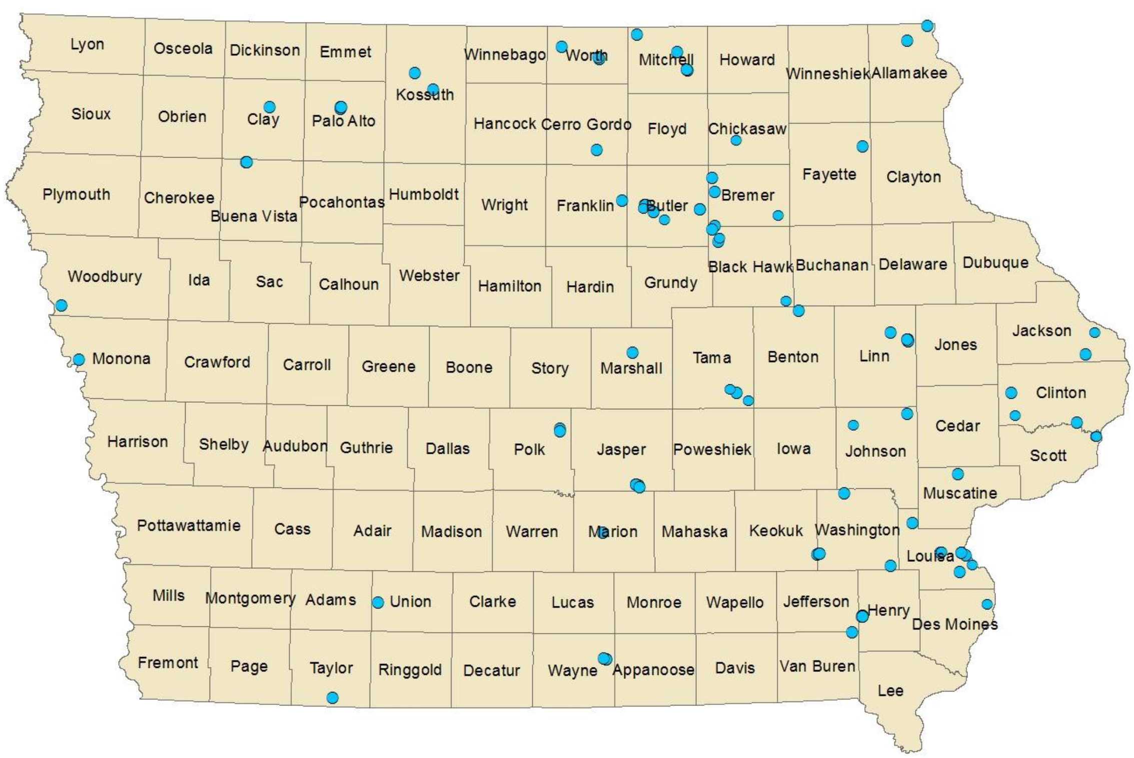
With the significant degree of hydrologic alteration by ditching, draining, damming, and channel straightening which has occurred in the state, many of Iowa's riverine wetlands have either been lost completely or now exist in a state much different from pre-settlement. These wetland systems provide valuable services such as temporary storage of surface water from overbank flow during flood events, dissipation of flood energy, nutrient removal or sequestration, and are important habitat for numerous plant and animal species. With the dredging and channelization of many rivers, the adjacent water table has been lowered and prevents many riverine wetlands from holding water during a significant portion of the year. Semi-annual flooding of these wetlands is a necessary ecological process, and the longer water is detained as it moves through the wetland, the greater the potential for the wetland to perform multiple functions and to support wetland biology (Brinson et. al. 1995). These wetlands also retain sediments from flood waters which improves downstream water quality as well as providing a source of nutrients to the wetland ecosystem. Riverine wetlands also serve to remove or sequester excess macronutrients, heavy metals, and pesticides by mineralizing them or providing the conditions for biological degradation. These components of wetland function are especially important in Iowa to alleviate land use nutrient loading and reduce the impacts of herbicides and pesticides in downstream ecosystems. Riverine wetlands are important sources of organic carbon (leaf litter, woody debris, carbon rich sediments and fine particles) which drives productivity in river ecosystems. They also provide key habitat for spawning and recruitment of some fish species such as northern pike, bluegill, and crappie which may have trouble finding suitable habitats in the main river channel. These wetland systems are also home to many species of water birds, reptiles, amphibians, and mammals.

Iowa's remaining riverine wetlands represent a valuable set of resources, and their continued monitoring and assessment is imperative to future management decisions.

Methods

Site Selection

Sites were selected randomly using the updated Iowa Wetland Mapping Inventory. Site selection criteria included location within 2 miles of a stream and semi-permanent or permanent wetland type. In 2012 25 sites were selected; 34 sites were selected in 2013; 28 sites were selected in 2014 (Table 1).



Of the sites sampled in 2012, 9 sites were selected as sites to be sampled all three years of the project. Two additional sites were added to this resample list in 2013 for a total of 11 resample sites. These sites were selected based on water quality, biological community, accessibility, and the presence of water throughout the sampling season. Weather greatly affected the ability to resample sites as 2012 was one of the driest on record in Iowa and both 2013 and 2014 experienced spring flooding.

Table 1. Wetland sites sampled in 2012 to 2014.

Site	County	2012	2013	2014	Site	County	2012	2013	2014
Wetland 0	Black Hawk		X		Wetland 3	Mitchell	X	X	X
Wetland 1	Worth	X			Wetland 34	Scott			X
Wetland 10a	Linn	X	X	X	Wetland 35	Black Hawk			X
Wetland 10c	Linn	X	X	X	Wetland 4	Butler	X	X	X
Wetland 11	Worth		X		Wetland 41	Scott			X
Wetland 11a	Clinton		X		Wetland 46	Chickasaw			X
Wetland 12	Louisa		X		Wetland 49	Des Moines			X
Wetland 12a	Monona		X		Wetland 4a	Jasper		X	
Wetland 12c	Wayne	X			Wetland 5	Linn			X
Wetland 13b	Jasper	X	X	X	Wetland 56	Black Hawk			X
Wetland 14	Kossuth		X		Wetland 59	Louisa			X
Wetland 14a	Henry	X	X	X	Wetland 5a	Butler	X	X	X
Wetland 14b	Henry	X	X		Wetland 5b	Butler		X	X
Wetland 15	Washington	X	X		Wetland 6	Cerro Gordo	X		
Wetland 15a	Buena Vista		X		Wetland 61	Butler			X
Wetland 15b	Marshall		X		Wetland 63	Clinton			X
Wetland 16	Bremer			X	Wetland 68	Tama			X
Wetland 16a	Allamakee		X	X	Wetland 6a	Johnson		X	
Wetland 16b	Washington	X			Wetland 7	Monona		X	
Wetland 17	Bremer		X		Wetland 70	Tama			X
Wetland 17a	Louisa	X	X	X	Wetland 71	Butler			X
Wetland 17b	Louisa	X			Wetland 73	Johnson			X
Wetland 17c	Washington		X		Wetland 7a	Palo Alto	X		
Wetland 19	Jackson			X	Wetland 7b	Palo Alto	X		
Wetland 1a	Muscatine		X		Wetland 7c	Palo Alto	X		
Wetland 2	Mitchell	X			Wetland 8	Kossuth	X		
Wetland 23	Tama			X	Wetland 8a	Bremer		X	
Wetland 24	Allamakee		X		Wetland 8b	Tama			X
Wetland 25	Benton		X		Wetland 9	Buena Vista	X		
Wetland 26	Black Hawk		X		Wetland 9a	Woodbury		X	
Wetland 2a	Clay		X		Wetland 9b	Woodbury		X	
Wetland 2b	Mitchell		X		Wetland 9c	Bremer		X	

Water Quality/Chemistry

Water samples were gathered from the open water zone of each wetland using a modified bucket scoop to obtain a representative sample from the water column (UHL 1997a). This was done to minimize the effects of sediment re-suspension that may have been caused by wading through these shallow waters. A grab sample was collected from wetlands holding water and not freely connected to the main river channel at the time of sampling. Samples were immediately placed on ice and shipped within 24 hours to the nearest State Hygienic Laboratory (SHL) location.

Water samples were analyzed for total suspended solids (TSS), total dissolved solids (TDS), chlorophyll a, chloride, total phosphorus (TP), ortho-phosphate (Ortho-P), ammonia nitrogen, total Kjeldahl nitrogen (TKN), nitrate+ nitrite nitrogen (N+N), 14 herbicides and 23 pesticides and their secondary compounds. Additional water quality data were collected using a YSI 556-MPS multi-parameter probe. The data included water temperature (Temp), dissolved oxygen (DO) and pH. Turbidity was calculated by taking the mean of three readings from a Hach 2100Q turbidimeter.

Biological Parameters

Aquatic invertebrate samples were collected in May and June with a 500µm mesh D-net by 10 one meter long sweeps. Samples were identified to the lowest taxonomic level possible, counted, and Index of Biotic Integrity (IBI) scores were calculated.

Fish were sampled at sites with adequate water levels (1m in depth) in August and September, using up to four modified fyke nets, two with ¾" mesh and two with ¼" mesh. Number and type of nets used in each wetland was dependent on surface area and basin morphology. At minimum, each wetland was sampled with two nets each with ¼" mesh. Gear was allowed to soak for 24 hours overnight and retrieved the following day. Fish were observed in several wetlands that did not meet the depth requirement for fish netting.

Vegetation surveys were conducted in July and August by identifying plants and estimating their cover at 1m^2 plots spaced every 10 meters apart along parallel transect lines running the length of the wetland. Plants were sampled using a long-handled, double-headed rake, which is 14 inches wide and has 14, 2-inch teeth on each side. Not all sites were surveyed due to declines in late summer water levels causing wetlands to become dry or colonized with terrestrial non-aquatic plants. On-site observations were used to delineate wetland boundaries based on vegetation types and water levels.

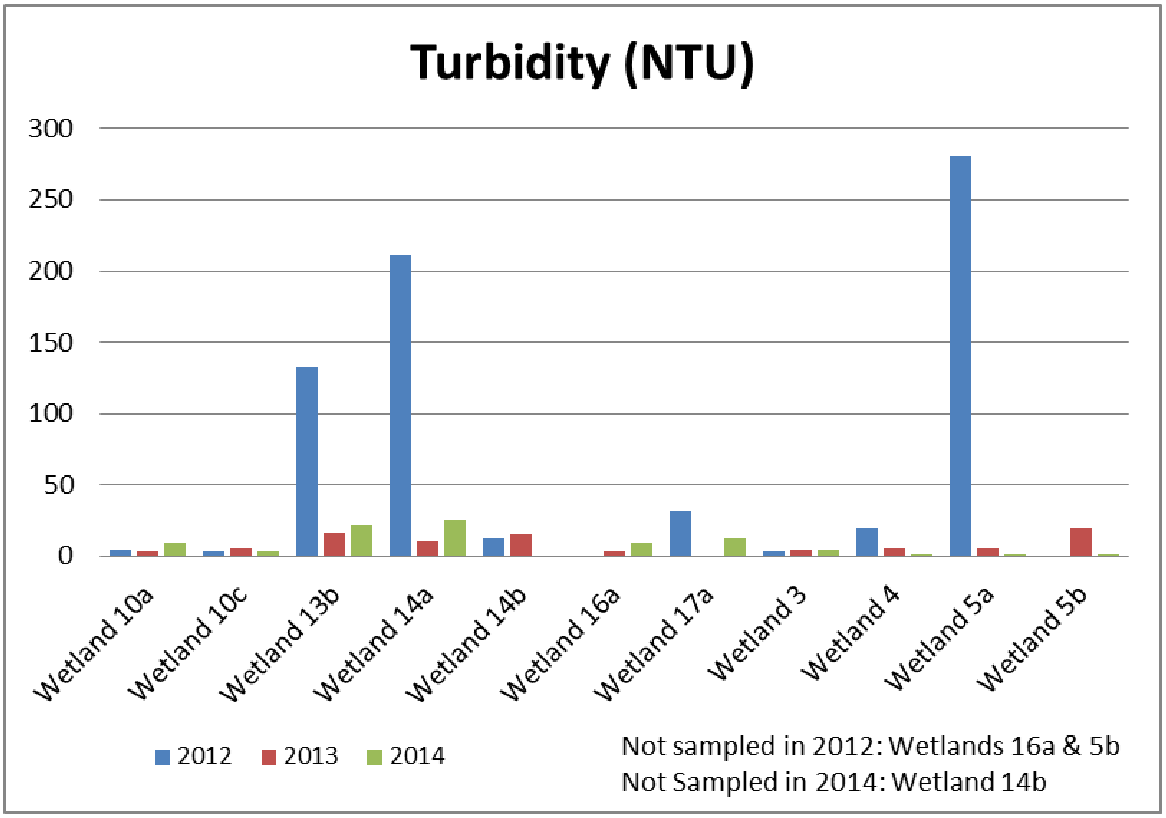

A turtle collected in 2014.

Waterfowl, amphibian, and other vertebrate use were recorded only by observations made while conducting other sampling efforts. Turtles were present as by-catch in fyke nets set for fish surveys.

Results

Turbidity in revisit sites was low for most sampling events (Figure 1). Sampling events in 2012 with higher turbidity levels are the result of very low water levels combined with heavy animal use for drinking water.

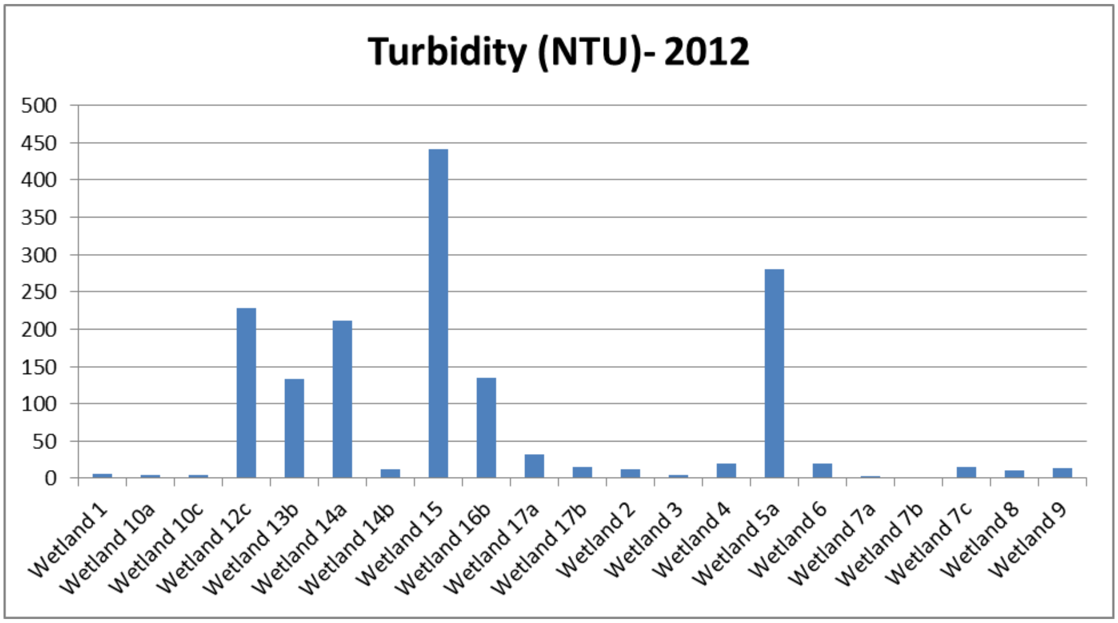
Figure 1. Turbidity for wetlands sampled multiple years.

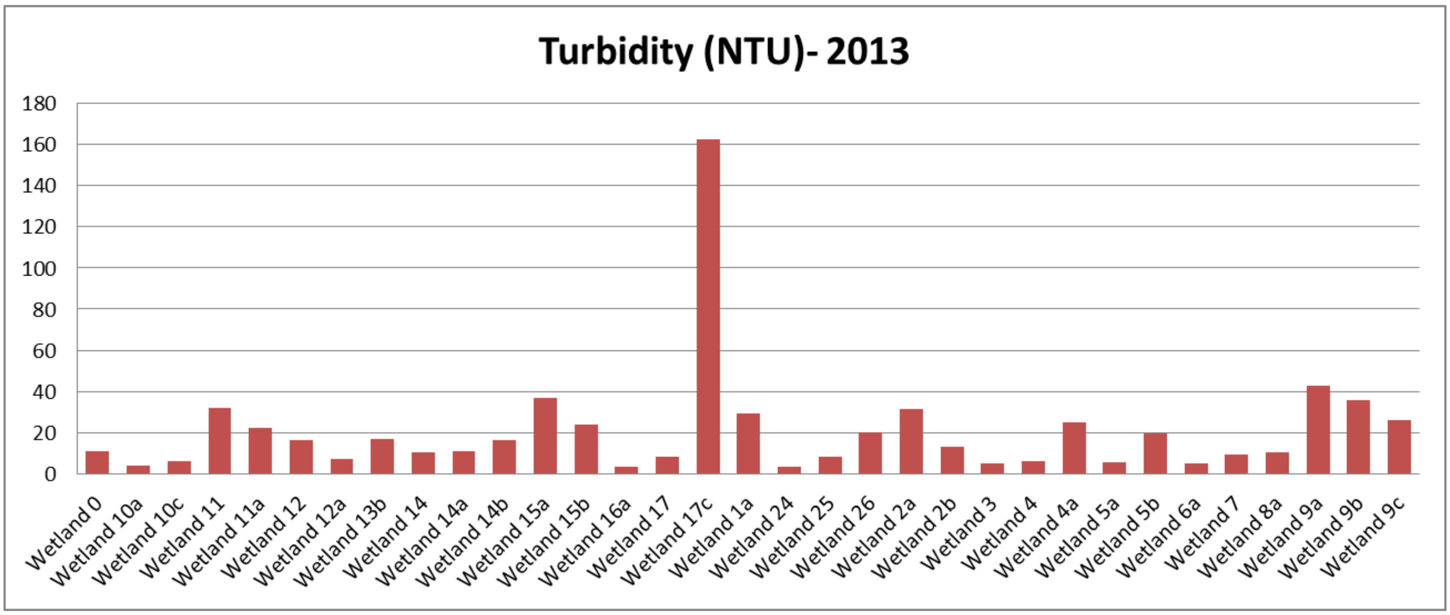


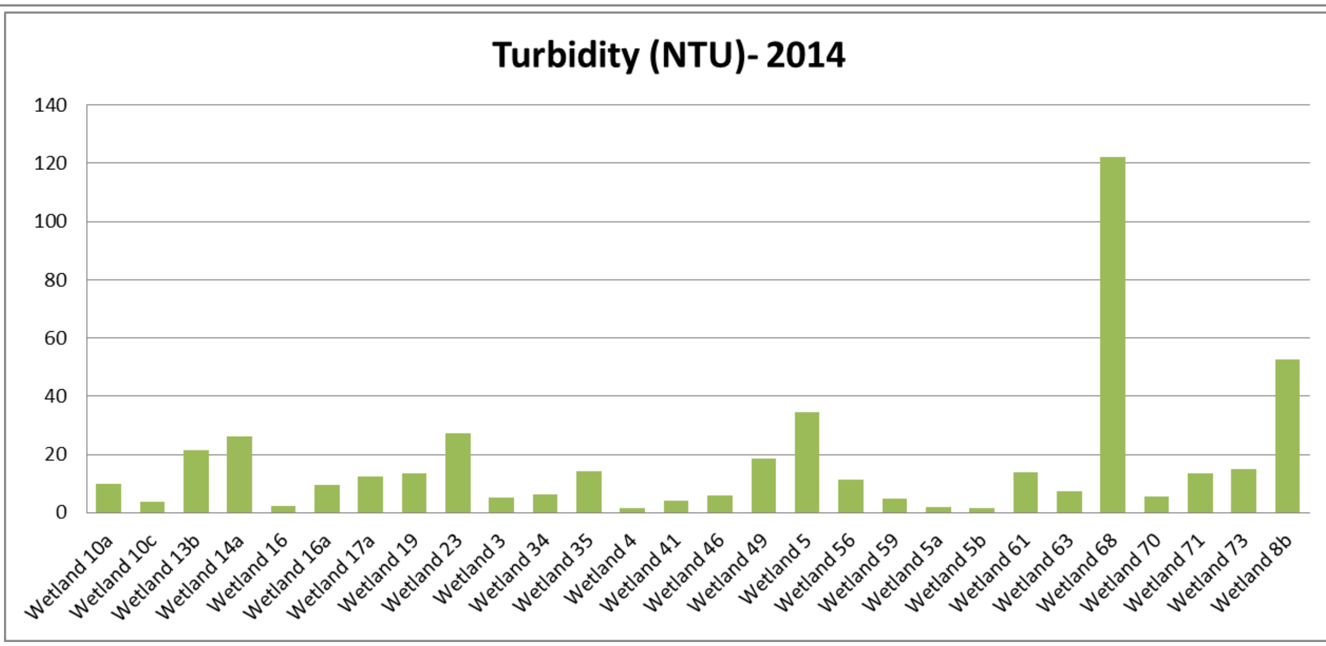
Turbidity ranged between 441 and 1.77 NTU in 2012, 162.8 to 3.29 NTU in 2013 and 122 to 1.50 NTU in 2014. In 2012, six of 21 sites had a turbidity of 100 NTU or greater (Figure 2). The wetlands with the highest turbidity in 2012 were basins with almost no remaining water which had received heavy animal use for drinking water. In 2013 and 2014 only one site each year that had a turbidity higher than 100 NTU; 162.8 NTU in Wetland 17c in Washington County in 2013 and 122 NTU in Wetland 68 in Tama County in 2014 (Figure 2). The average turbidity in 2012, 2013 and 2014 was 76.26 NTU, 20.69 NTU and 16.61 NTU, respectively.


Wetland 68 in Tama County, 2013

Figure 2. Turbidity for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







Total suspended solids (TSS) ranged from 610 to two mg/L in 2012, 190 to zero mg/L in 2013 and 700 to one mg/L in 2014 (Figure 4). In 2012 there were five sites with a TSS of greater than 100 mg/L. Wetland 4 in Mitchell County had the highest reading in 2012 of 610 mg/L. During 2013 the TSS dropped at this site to 10 mg/L and in 2014 to one mg/L (Figure 3). One wetland in 2013 had a TSS reading over 100 mg/L, 17c in Washington County (Figure 4). This wetland, where beaver activity was observed, was a chocolate brown color during sample collection. In 2014 one wetland had a TSS reading over 100 mg/L; Wetland 16a in Allamakee County. This wetland was also sampled in 2013 where the TSS dropped to 6 mg/L (Figure 3). The average TSS in 2012, 2013 and 2014 was 86.90 mg/L, 31.21 mg/L and 71.32 mg/L, respectively.

Figure 3. Total suspended solids (TSS) for wetlands sampled multiple years.

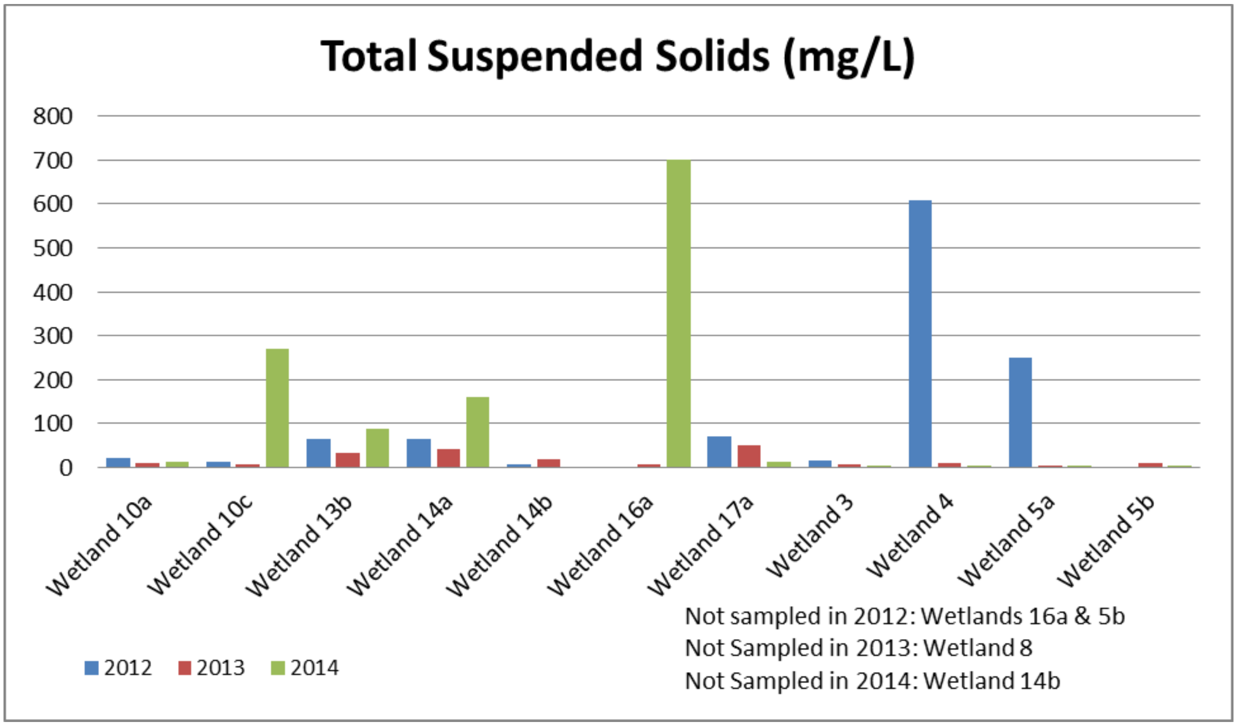
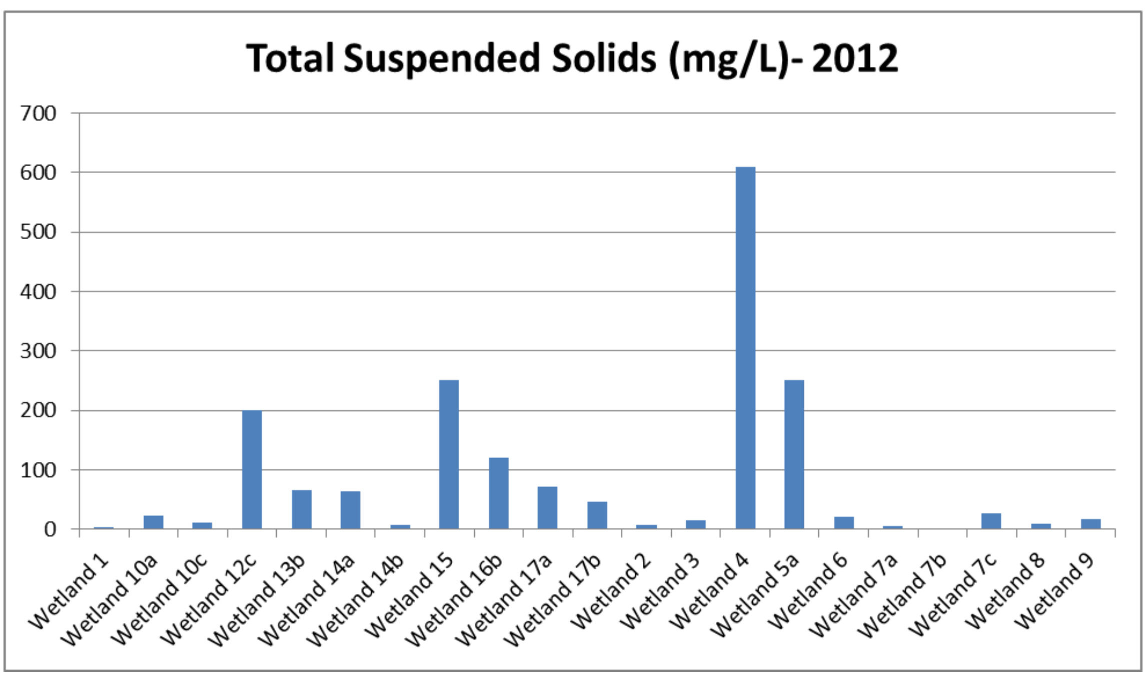
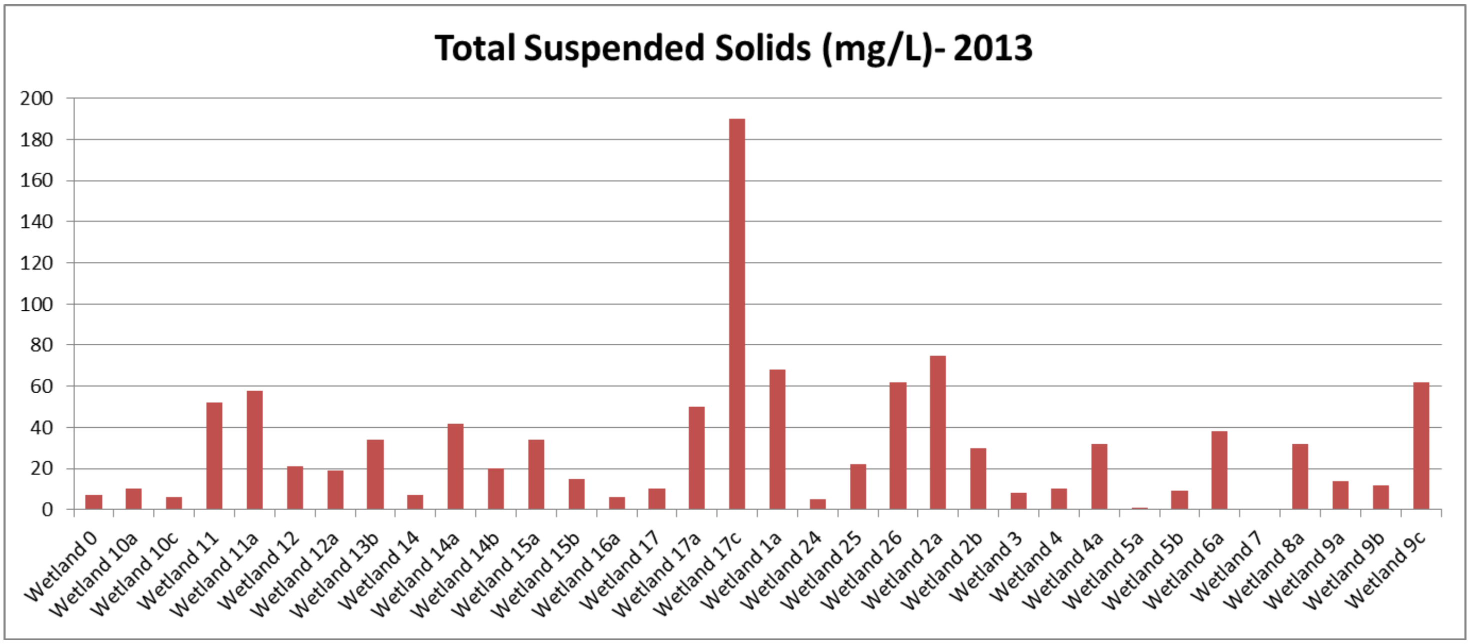
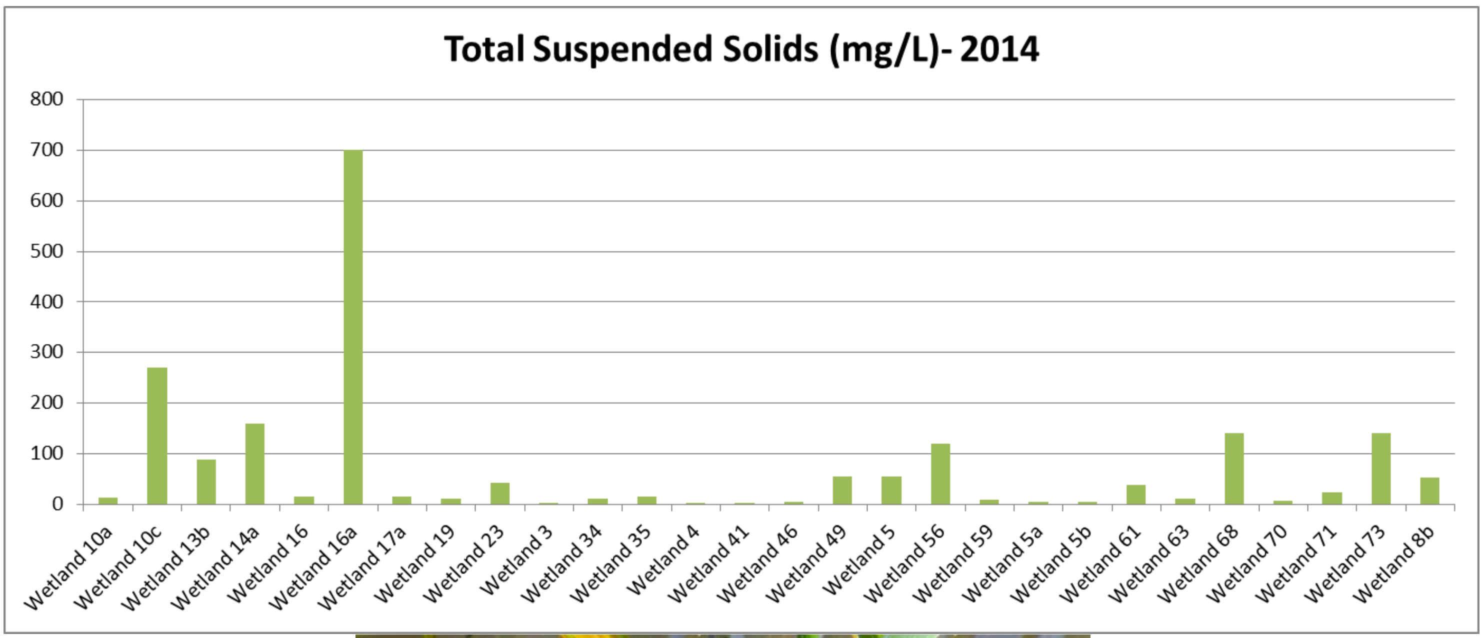


Figure 4. Total suspended solids (TSS) for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).




Total Suspended Solids (mg/L)- 2013
200
180
160
140
120
100
80
60
40
20
0
Wetland 0
Wetland 10a
Wetland 10c
Wetland 11
Wetland 11a
Wetland 12
Wetland 12a
Wetland 13b
Wetland 14
Wetland 14a
Wetland 14b
Wetland 15a
Wetland 15b
Wetland 16a
Wetland 17
Wetland 17a
Wetland 17c
Wetland 1a
Wetland 24
Wetland 25
Wetland 26
Wetland 2a
Wetland 2b
Wetland 3
Wetland 4
Wetland 4a
Wetland 5a
Wetland 5b
Wetland 6a
Wetland 7
Wetland 8a
Wetland 9a
Wetland 9b
Wetland 9c


Total Suspended Solids (mg/L)- 2014
800
700
600
500
400
300
200
100
0
Wetland 10a
Wetland 10c
Wetland 13b
Wetland 14a
Wetland 16
Wetland 16a
Wetland 17a
Wetland 19
Wetland 23
Wetland 3
Wetland 34
Wetland 35
Wetland 4
Wetland 41
Wetland 46
Wetland 49
Wetland 5
Wetland 56
Wetland 59
Wetland 5a
Wetland 5b
Wetland 61
Wetland 63
Wetland 68
Wetland 70
Wetland 71
Wetland 73
Wetland 8b


Amphibian eggs found in a
wetland in Bremer County

Total dissolved solids (TDS) ranged from 760 to 94 mg/L in 2012, 580 to 94 mg/L in 2013, and 320 to 86 mg/L in 2014 (Figures 5 and 6). The average TDS in 2012, 2013 and 2014 was 328 mg/L, 260 mg/L, and 216 mg/L, respectively.

Figure 5. Total dissolved solids (TDS) for all sites sampled in 2013.

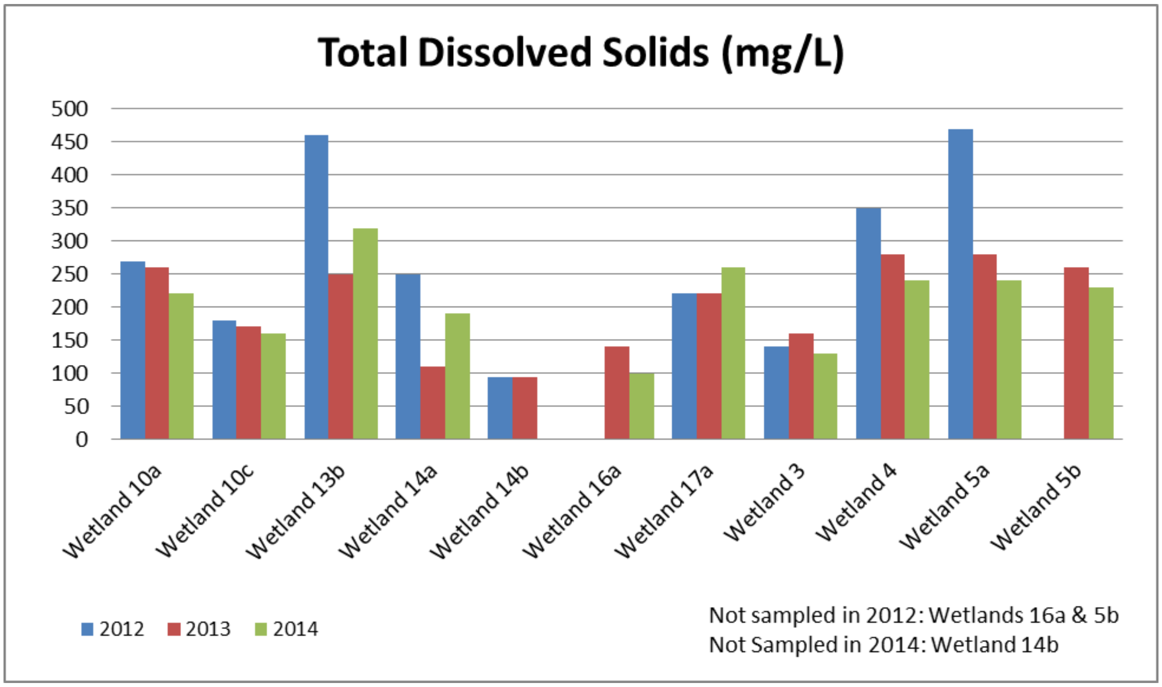
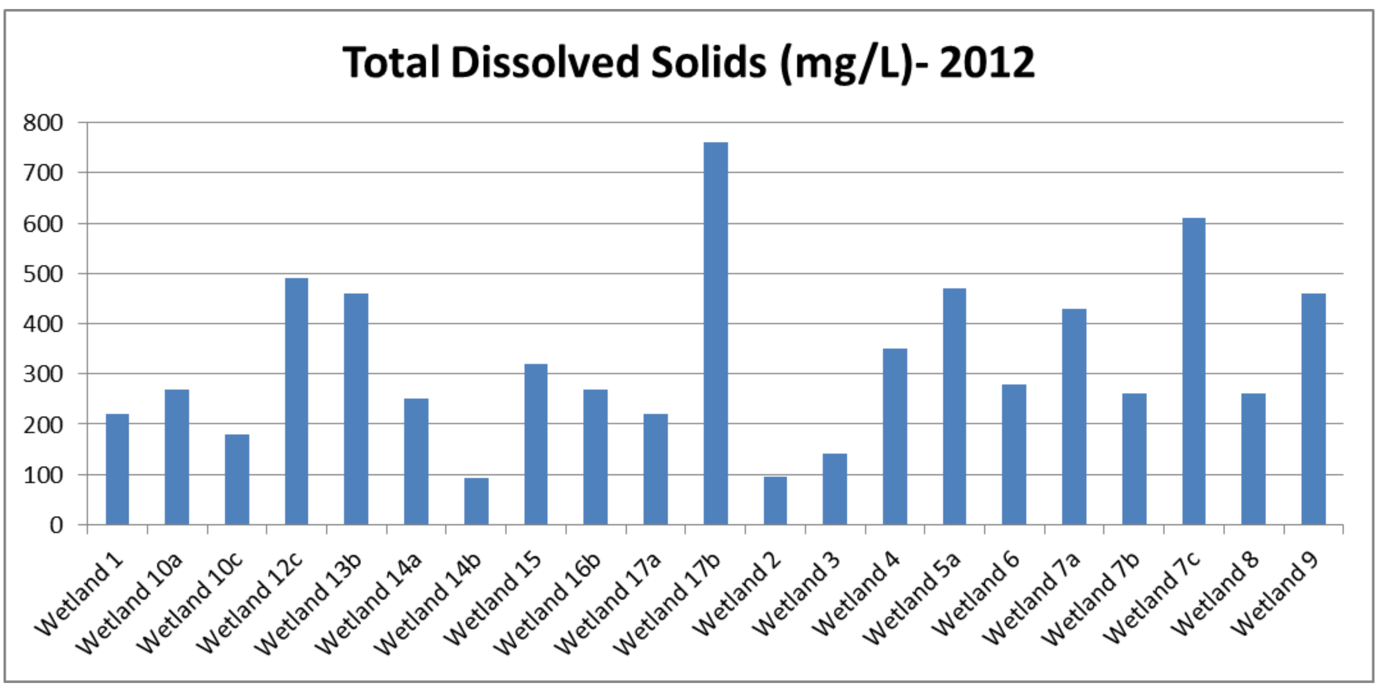
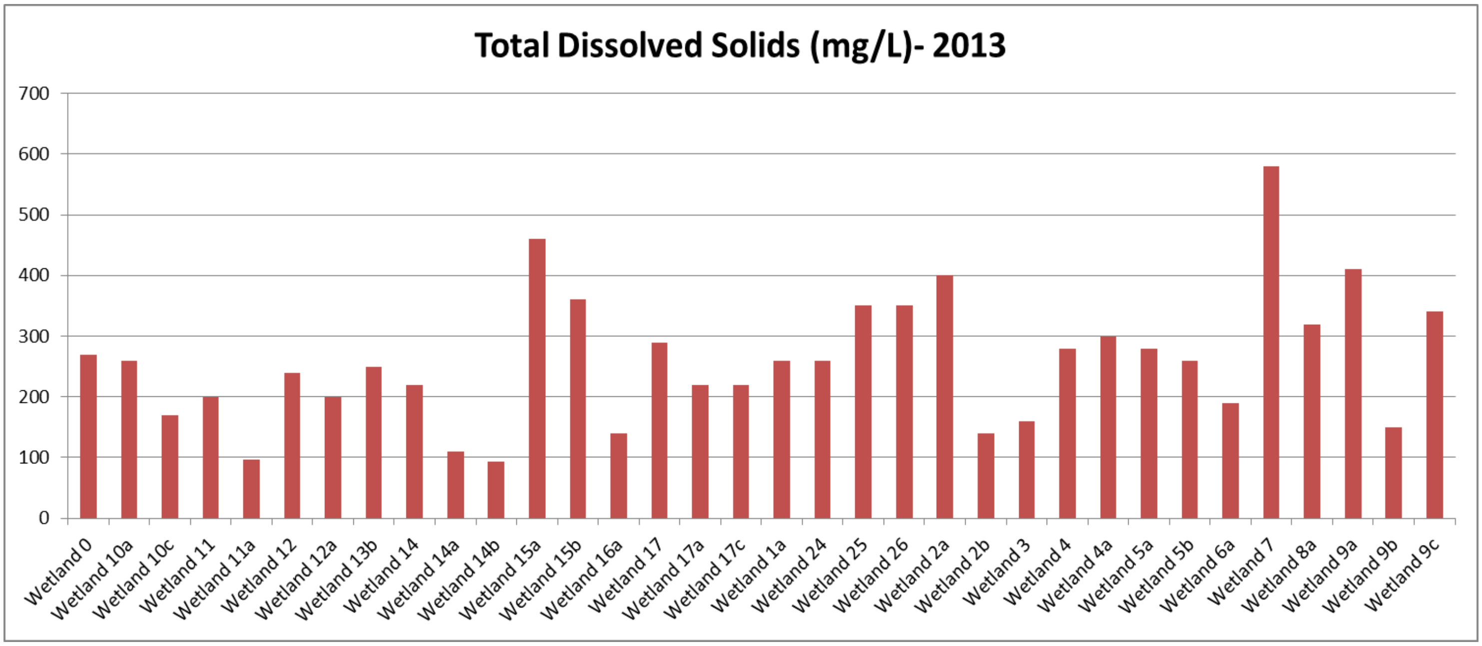
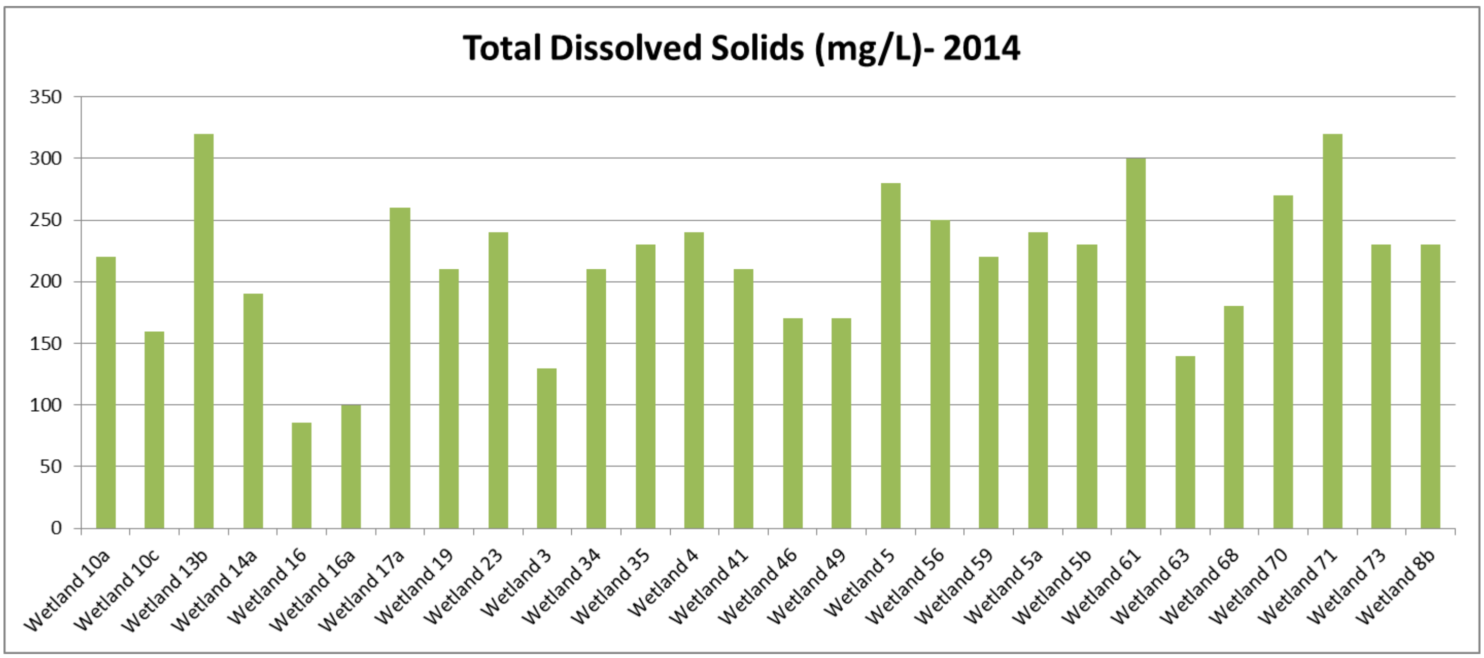


Figure 6. Total dissolved solids (TDS) for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







Chlorophyll a ranged from 1000 to three µg/L in 2012, 270 to zero µg/L in 2013, and 160 to zero µg/L in 2014 (Figure 8). In 2012 Wetland 5a had the highest Chlorophyll a value, which corresponded with high levels of turbidity, TSS, chloride, Total Kjeldahl Nitrogen and Total Phosphorus. Chlorophyll a levels dropped to nine µg/L and two µg/L in 2013 and 2014, respectively (Figure 7). The average in 2012, 2013, and 2014 was 92 µg/L, 40 µg/L, and 24 µg/L, respectively.

Figure 7. Chlorophyll a for all wetlands sampled multiple years.

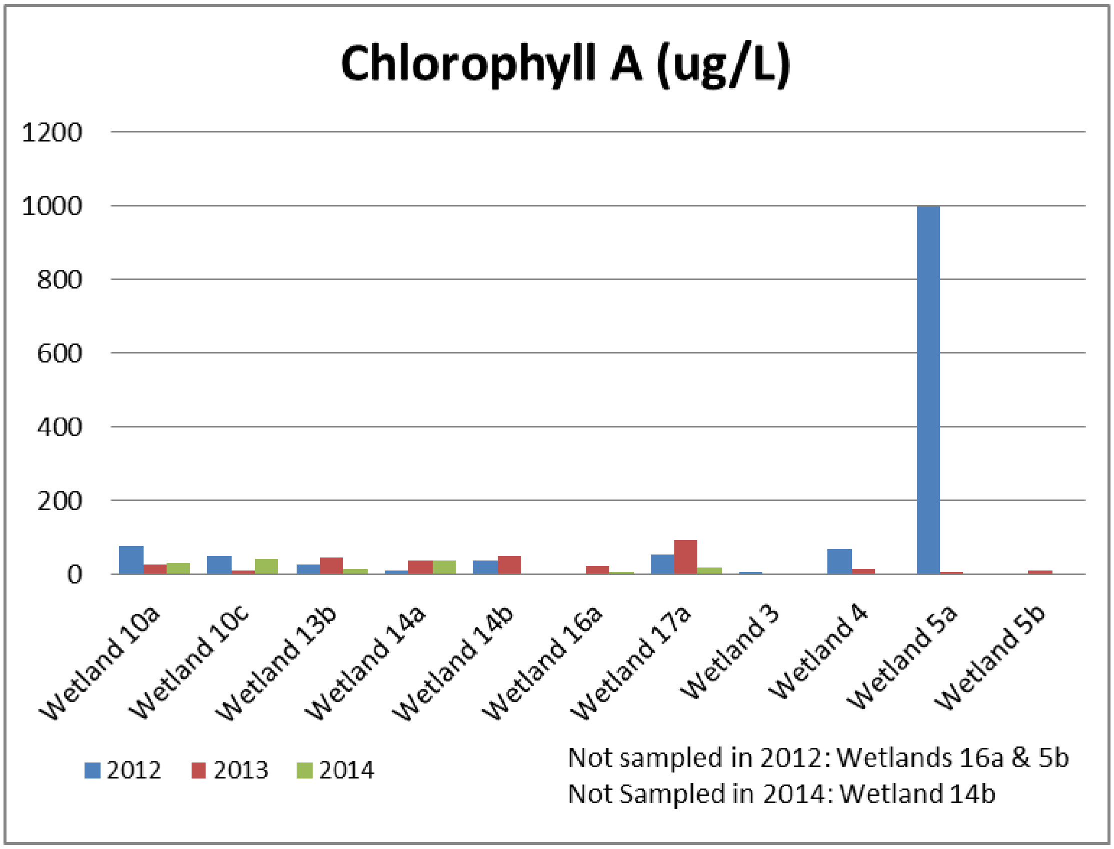
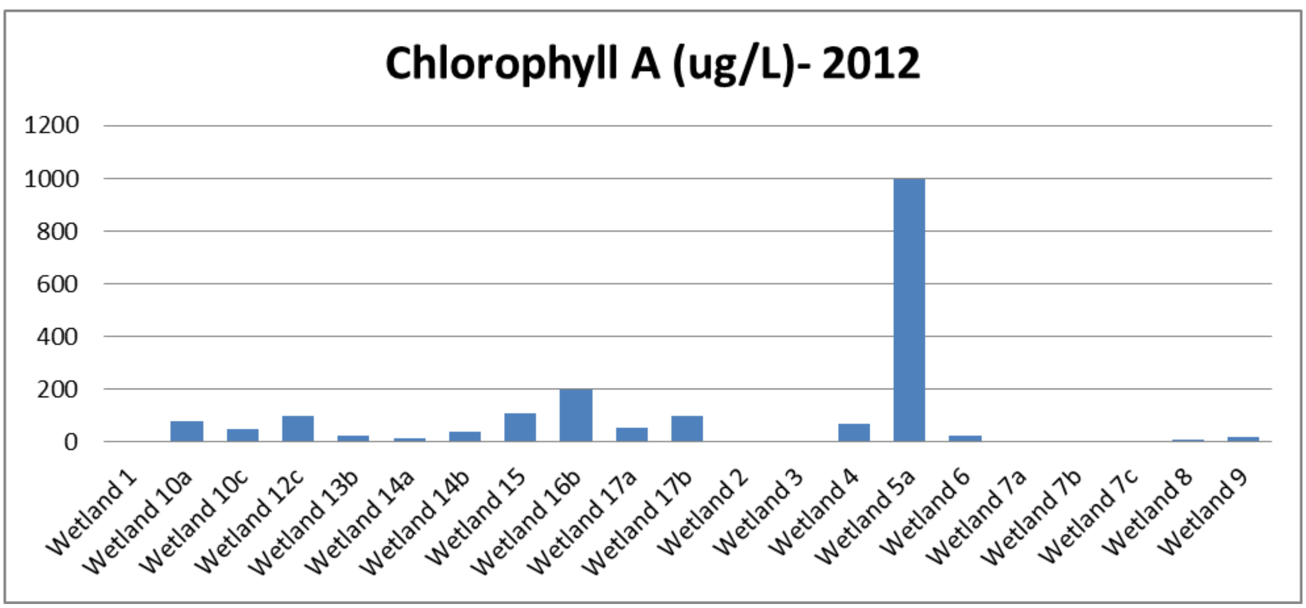
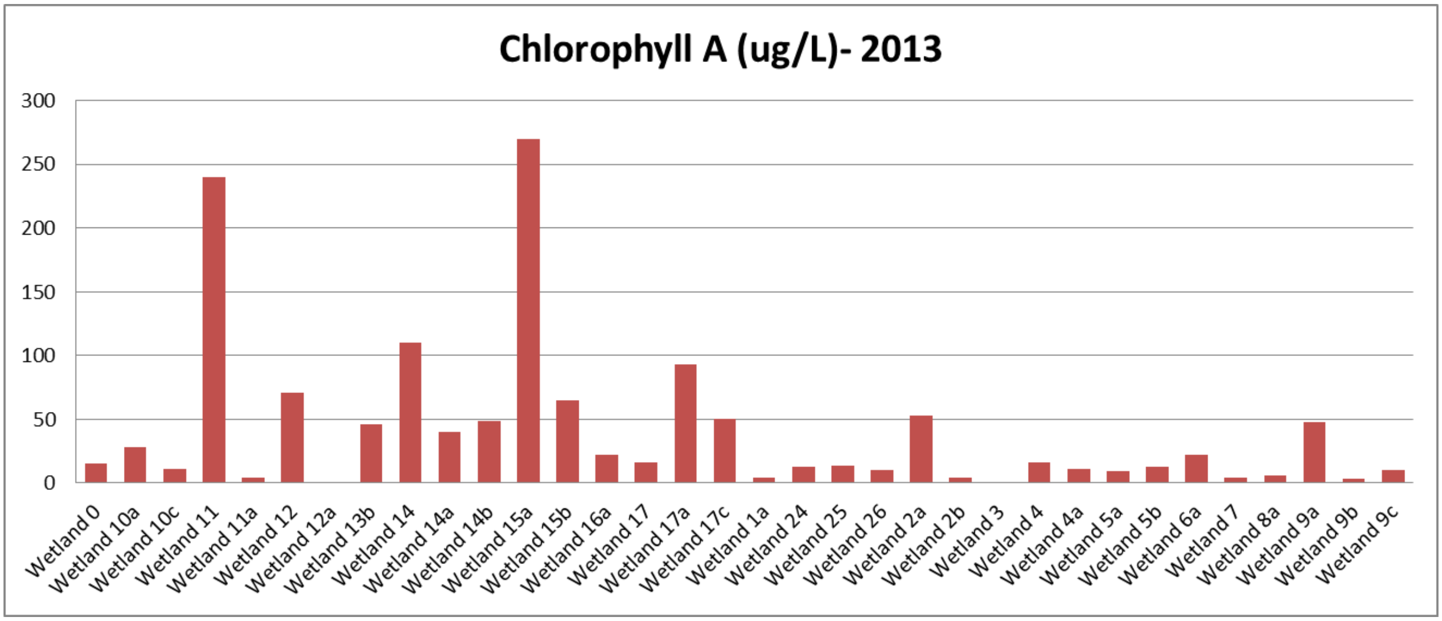
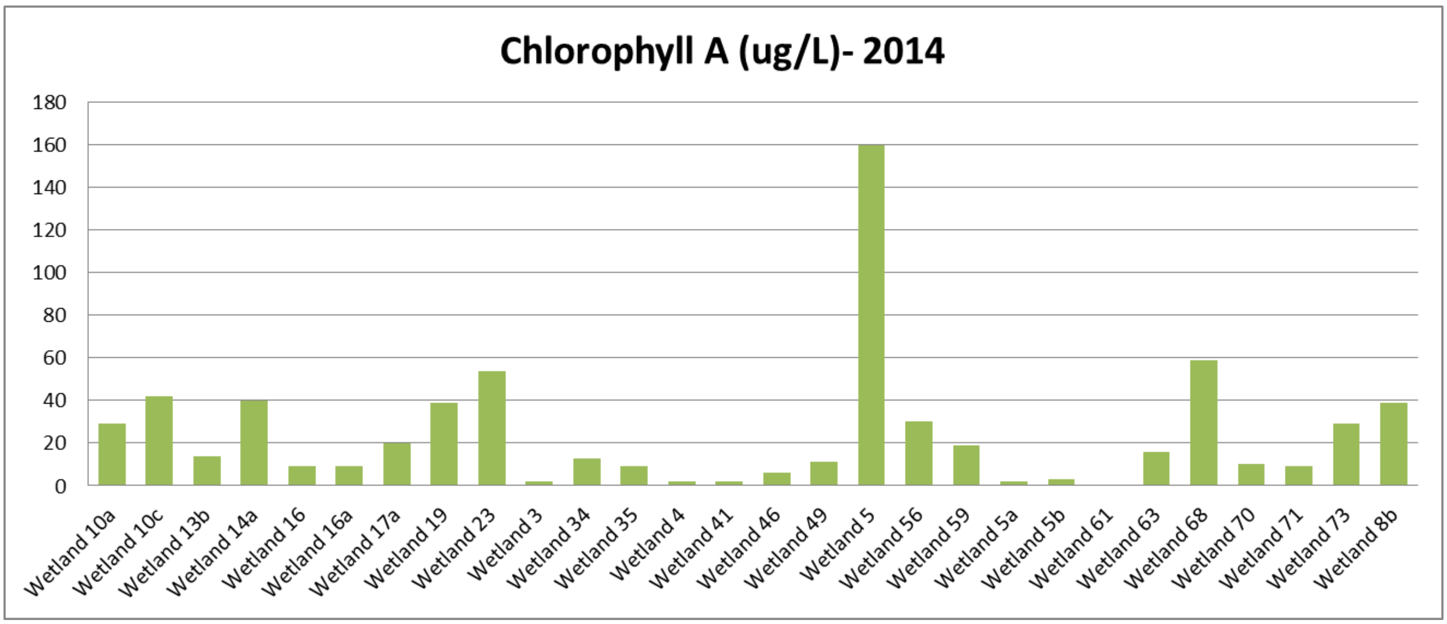


Figure 8. Chlorophyll a for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







Chloride ranged from 81 to zero mg/L in 2012, 28 to zero µg/L in 2013 and 25 to zero µg/L in 2014 (Figure 10). In 2012 Wetland 5a had the highest chloride value this corresponded with high levels of turbidity, TSS, chlorophyll a, total Kjeldahl nitrogen, and total phosphorus. Chloride levels dropped in 2013 to 17 µg/L and in 2014 to 15 µg/L (Figure 9). The average in 2012, 2013, and 2014 was 16.62 mg/L, 11.01 mg/L and 11.71 mg/L, respectively.

Figure 9. Chloride for all wetlands sampled multiple years.

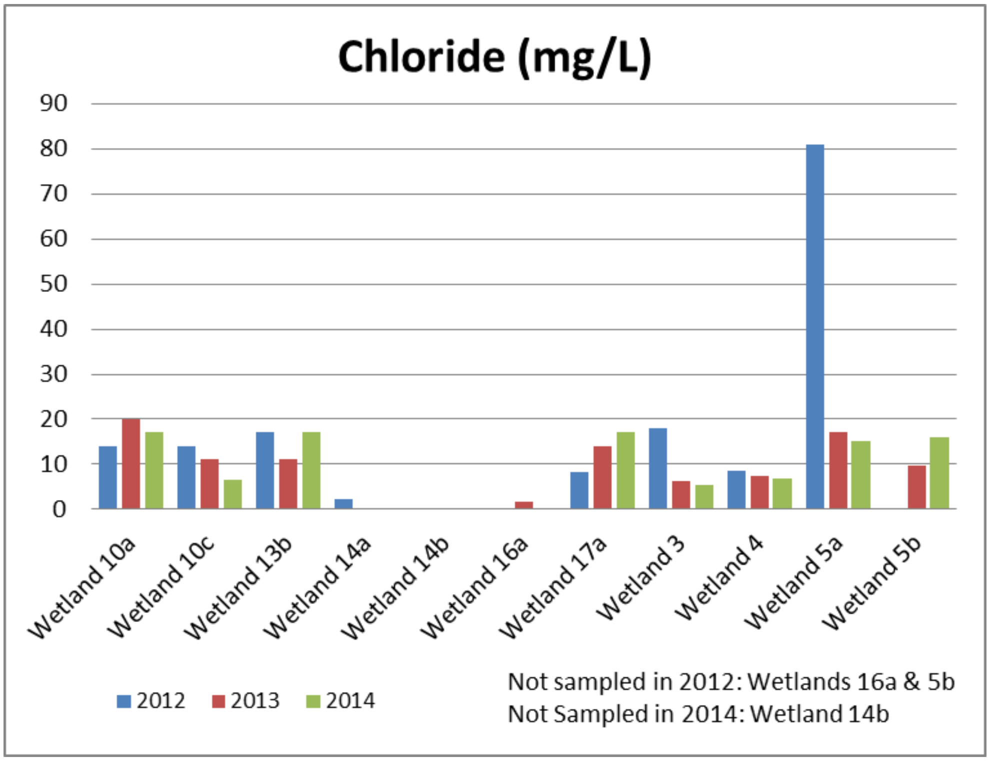
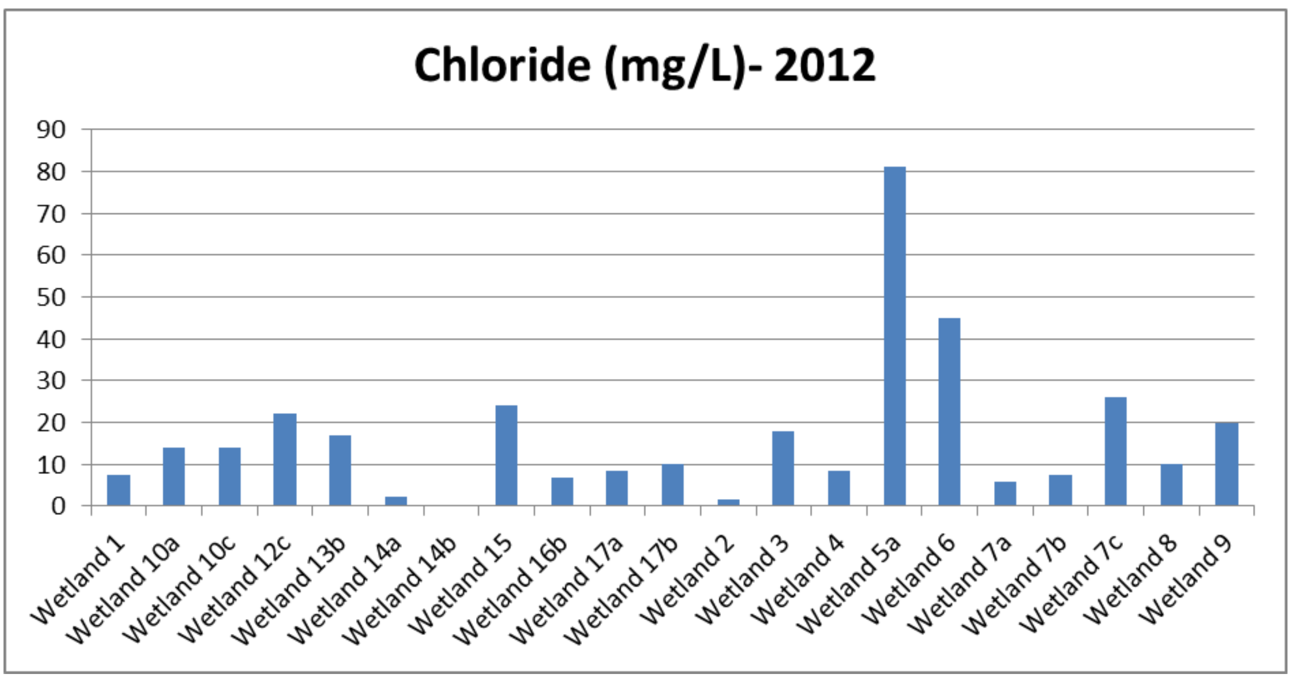
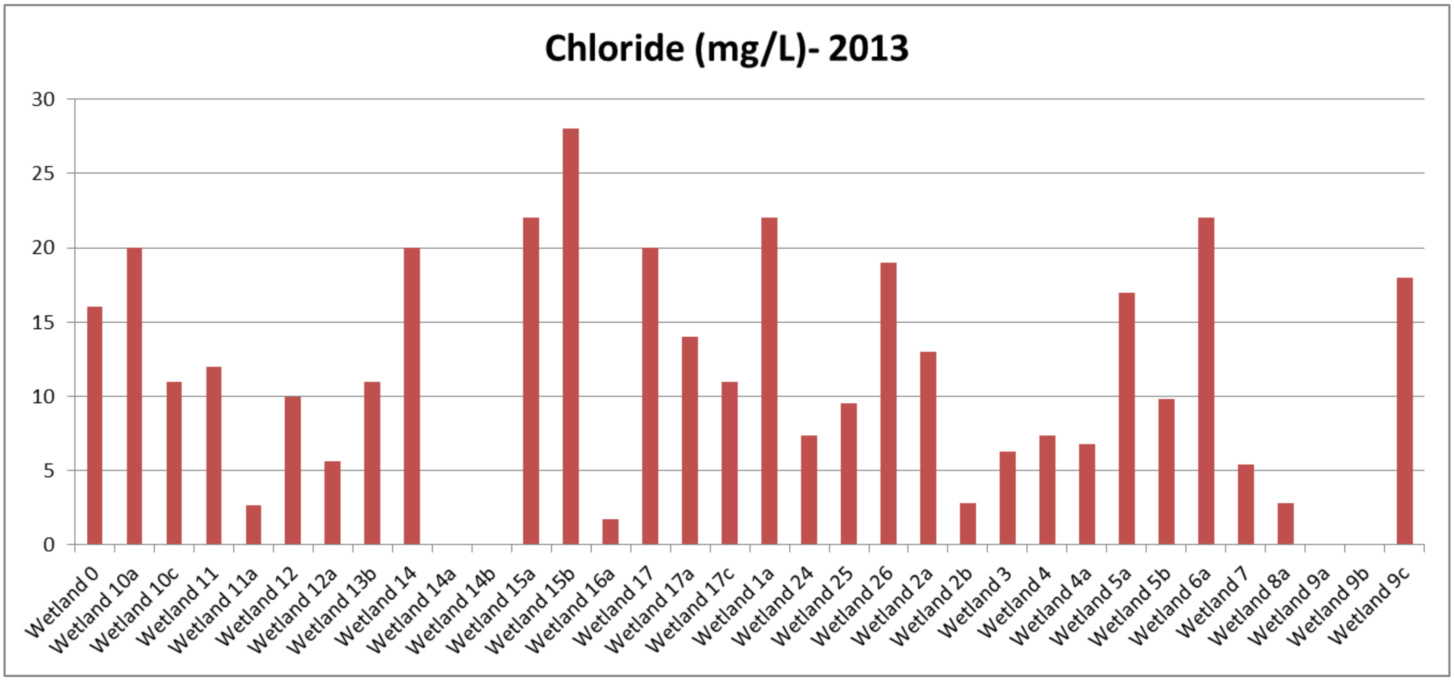
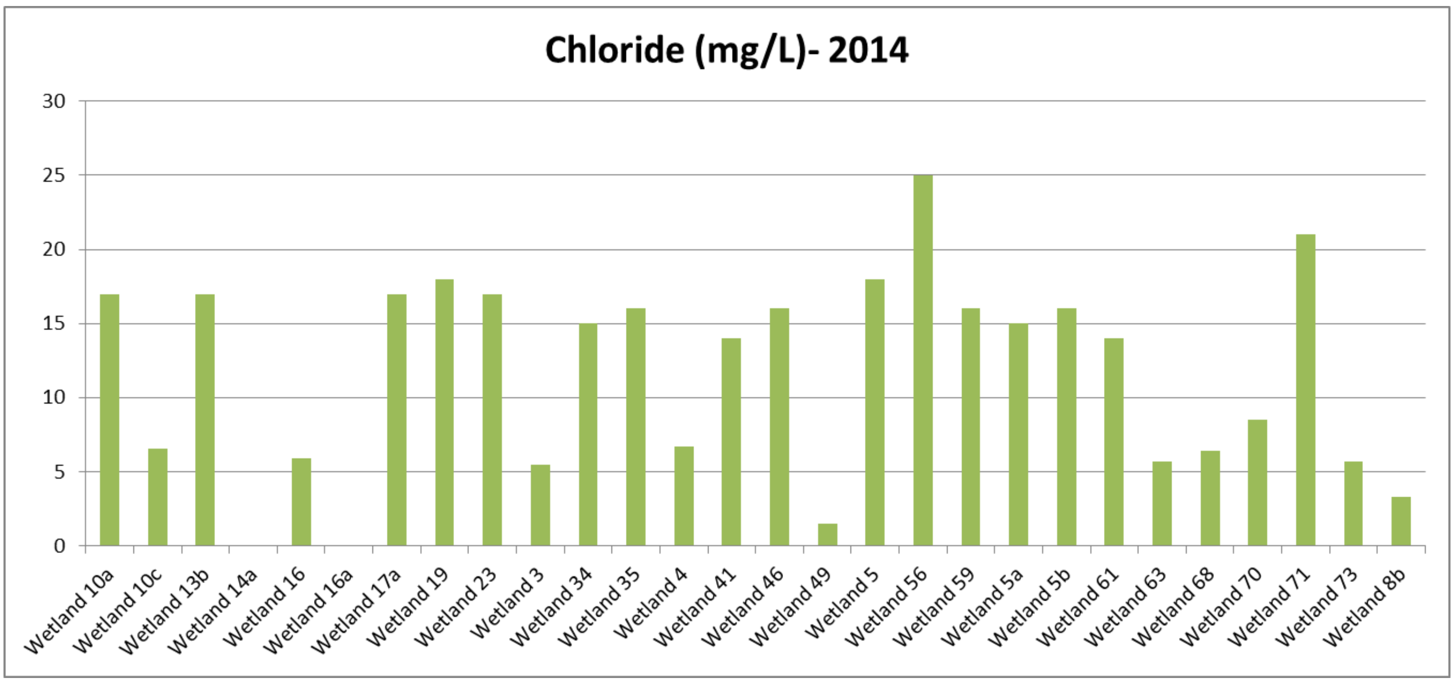


Figure 10.Chloride for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).




Chloride (mg/L)- 2013
30
25
20
15
10
5
0
Wetland 0
Wetland 10a
Wetland 10c
Wetland 11
Wetland 11a
Wetland 12
Wetland 12a
Wetland 13b
Wetland 14
Wetland 14a
Wetland 14b
Wetland 15a
Wetland 15b
Wetland 16a
Wetland 17
Wetland 17a
Wetland 17c
Wetland 1a
Wetland 24
Wetland 25
Wetland 26
Wetland 2a
Wetland 2b
Wetland 3
Wetland 4
Wetland 4a
Wetland 5a
Wetland 5b
Wetland 6a
Wetland 7
Wetland 8a
Wetland 9a
Wetland 9b
Wetland 9c


Chloride (mg/L)- 2014
30
25
20
15
10
5
0
Wetland 10a
Wetland 10c
Wetland 13b
Wetland 14a
Wetland 16
Wetland 16a
Wetland 17a
Wetland 19
Wetland 23
Wetland 3
Wetland 34
Wetland 35
Wetland 4
Wetland 41
Wetland 46
Wetland 49
Wetland 5
Wetland 56
Wetland 59
Wetland 5a
Wetland 5b
Wetland 61
Wetland 63
Wetland 68
Wetland 70
Wetland 71
Wetland 73
Wetland 8b

Total phosphorus (TP) ranged from 2.20 to 0.15 mg/L in 2012, 2.10 to 0.02 mg/L in 2013, and 3.00 to 0.06 mg/L in 2014 (Figures 11 and 12). TP concentrations greater than 0.1 mg/L indicate a hypereutrophic system. In 2012 all TP concentrations in wetlands sampled were greater than this level. In 2013 all but eight and in 2014 all but two wetlands had TP concentrations greater than 0.1 mg/L. The average in 2012, 2013, and 2014 was 0.70 mg/L, 0.52 mg/L and 0.54 mg/L, respectively.

Figure 11. Total Phosphorous (TP) for all wetlands sampled multiple years.

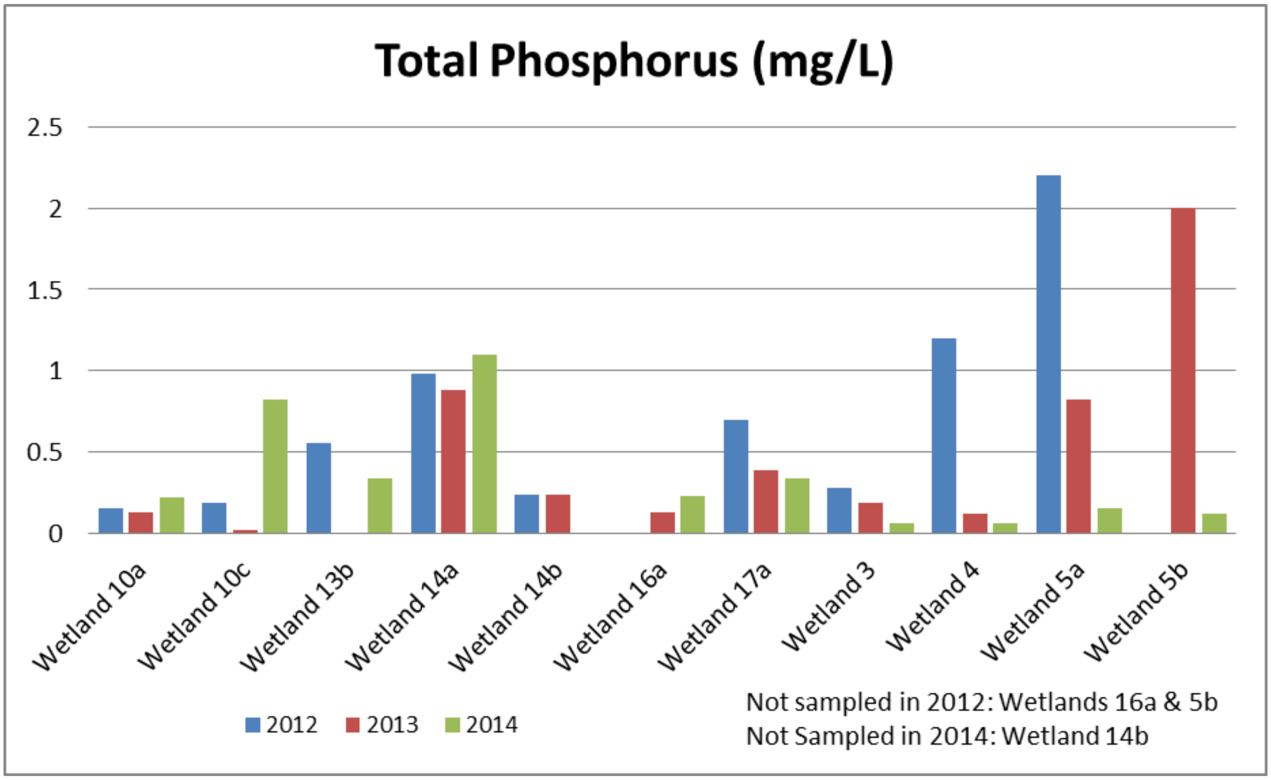
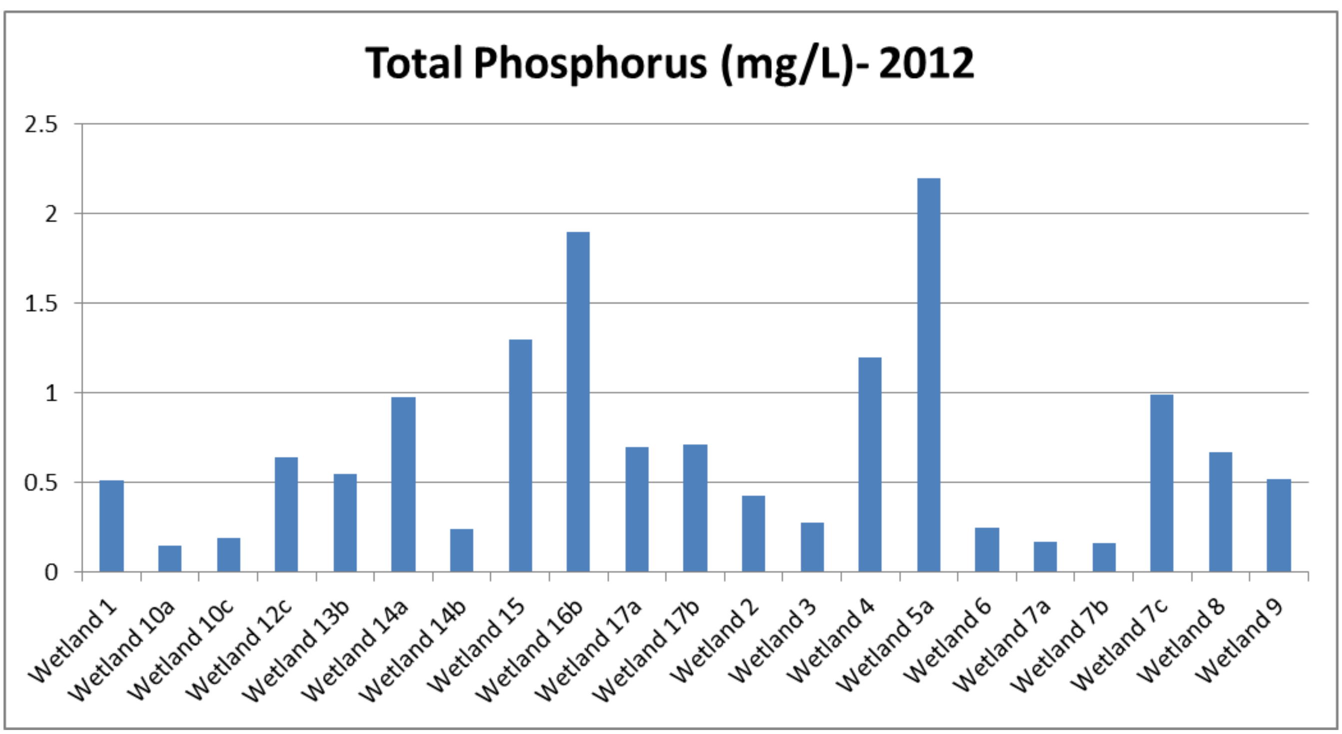
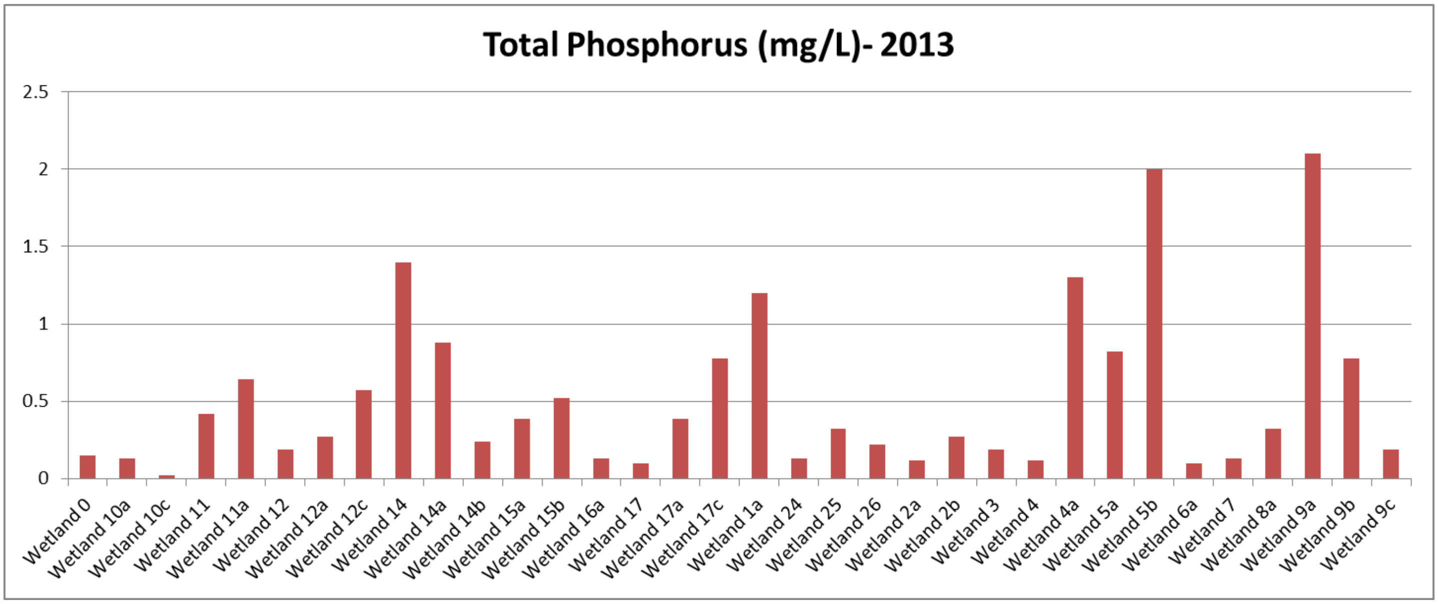
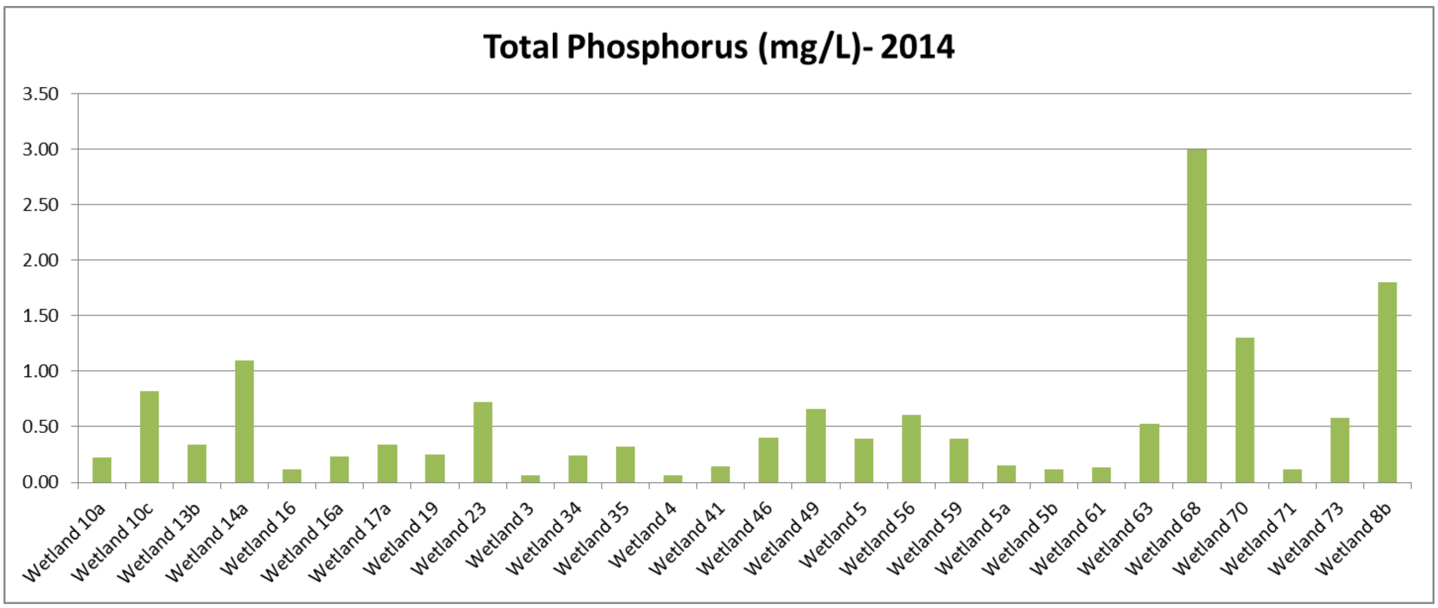


Figure 12. Total Phosphorous (TP) for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).








Wetland 1a in Muscatine County
is a hypereutrophic system

Ortho-phosphate (Ortho-P) ranged from 0.47 to 0.03 mg/L in 2012, 1.20 to zero mg/L in 2013, and 1.20 to zero mg/L in 2014 (Figures 13 and 14). On average the Ortho-P was higher in 2012 than in 2013 and 2014. This is most likely due to the very dry conditions experienced in 2012 and the much wetter springs of 2013 and 2014. The average in 2012, 2013, and 2014 was 16.62 mg/L, 11.01 mg/L, and 11.71 mg/L, respectively.

Figure 13. Ortho- Phosphate for all wetlands sampled multiple years.

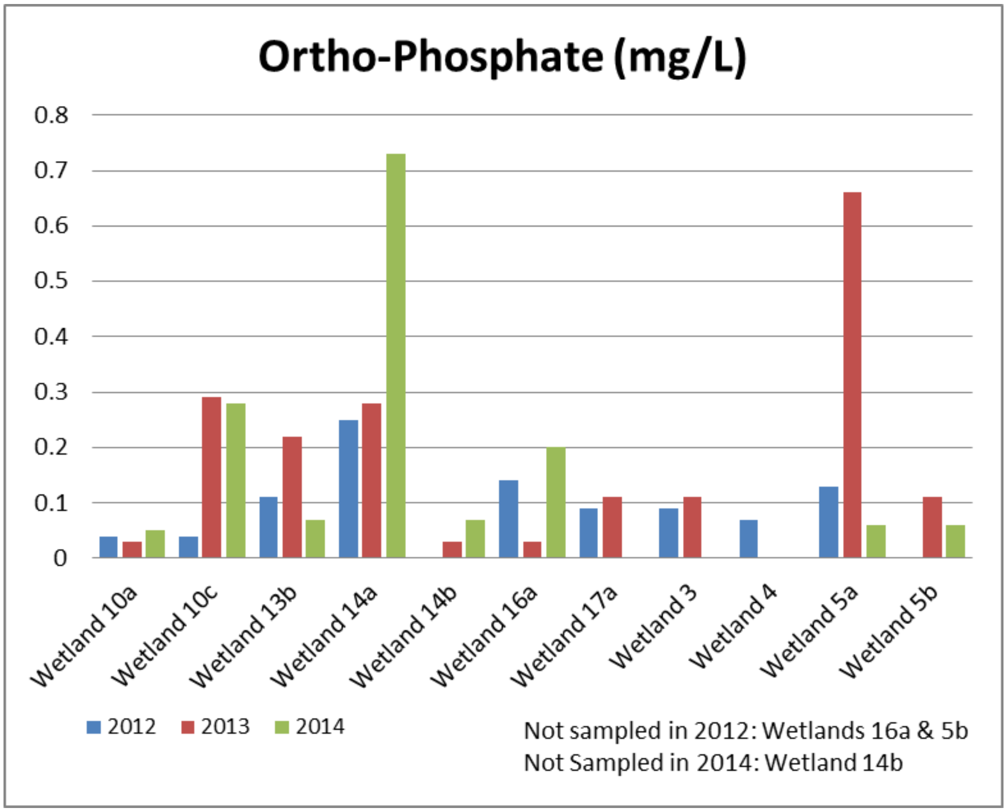
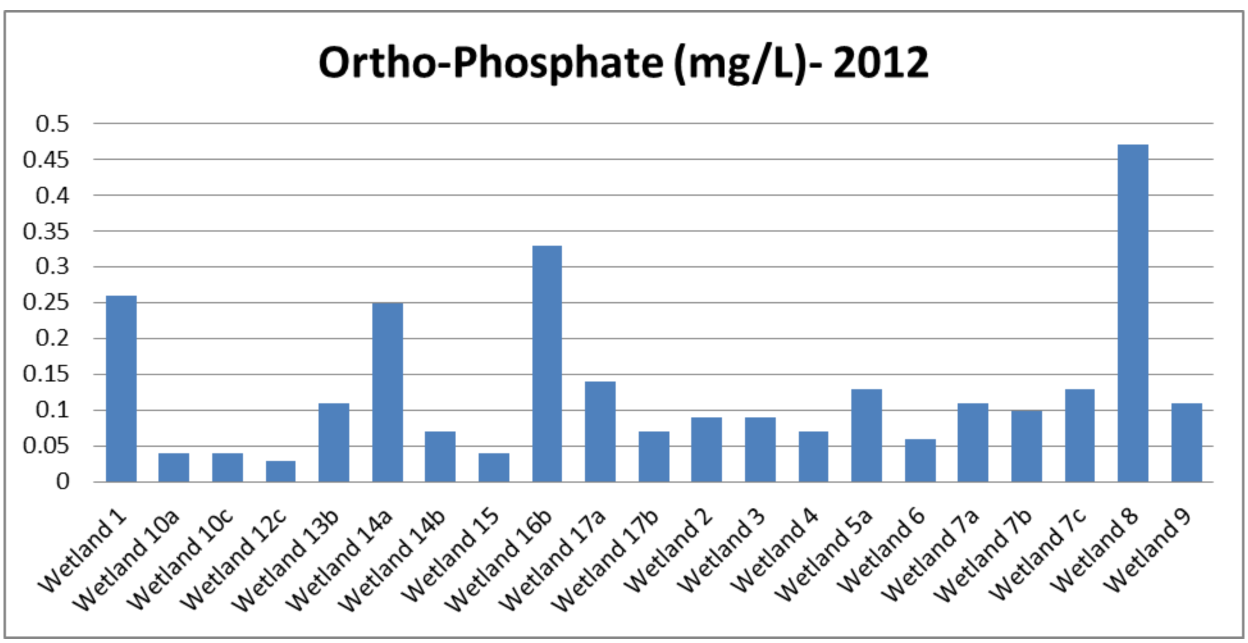
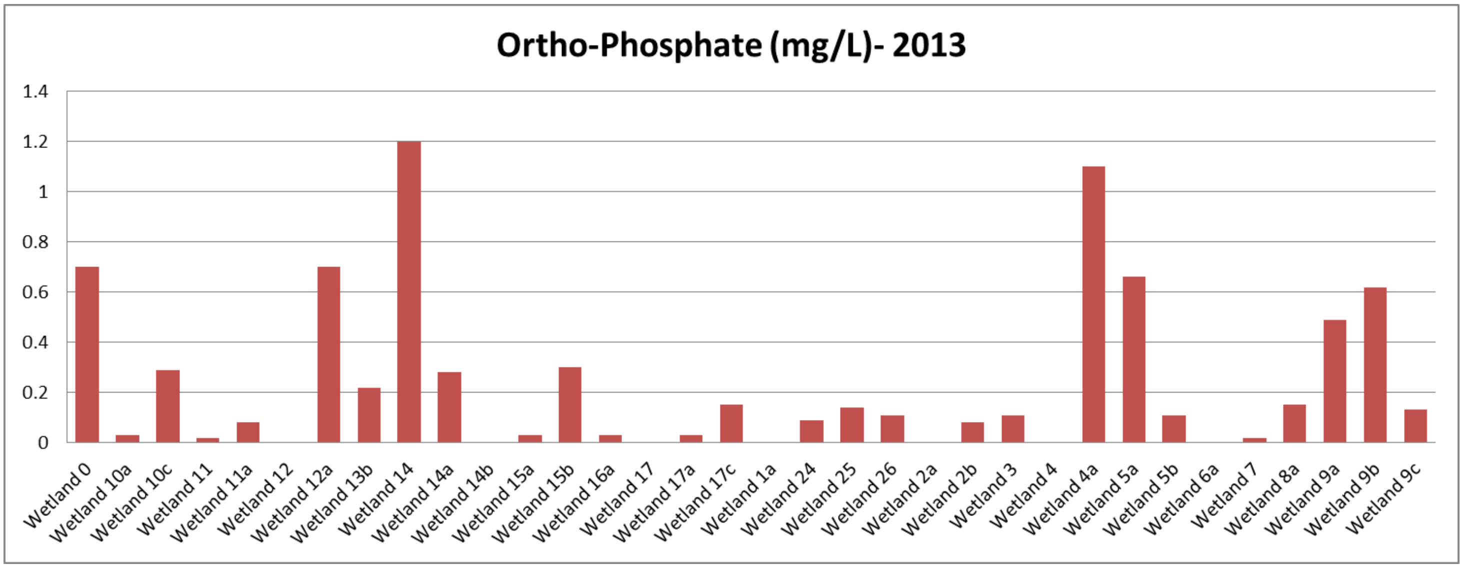


Figure 14. Ortho-Phosphate for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).




Ortho-Phosphate (mg/L)- 2013
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Wetland 0
Wetland 10a
Wetland 10c
Wetland 11
Wetland 11a
Wetland 12
Wetland 12a
Wetland 13b
Wetland 14
Wetland 14a
Wetland 14b
Wetland 15a
Wetland 15b
Wetland 16a
Wetland 17
Wetland 17a
Wetland 17c
Wetland 1a
Wetland 24
Wetland 25
Wetland 26
Wetland 2a
Wetland 2b
Wetland 3
Wetland 4
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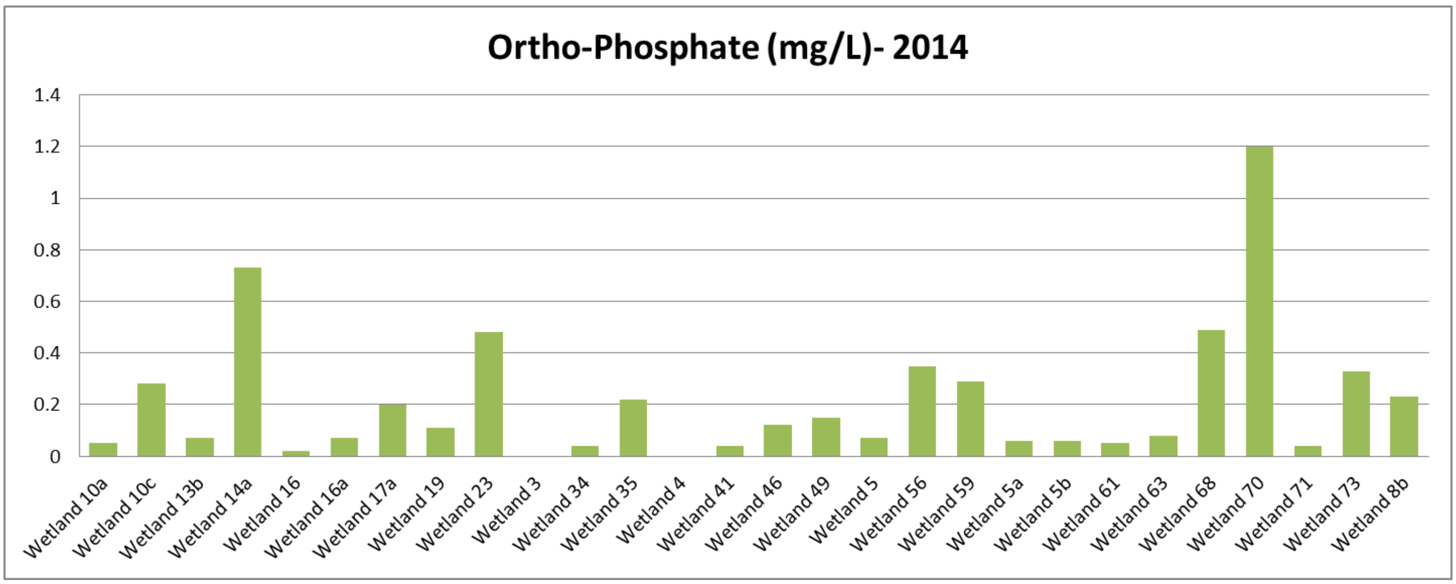
Wetland 6a
Wetland 7
Wetland 8a
Wetland 9a
Wetland 9b
Wetland 9c


Ortho-Phosphate (mg/L)- 2014
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Wetland 10a
Wetland 10c
Wetland 13b
Wetland 14a
Wetland 16
Wetland 16a
Wetland 17a
Wetland 19
Wetland 23
Wetland 3
Wetland 34
Wetland 35
Wetland 4
Wetland 41
Wetland 46
Wetland 49
Wetland 5
Wetland 56
Wetland 59
Wetland 5a
Wetland 5b
Wetland 61
Wetland 63
Wetland 68
Wetland 70
Wetland 71
Wetland 73
Wetland 8b

Ammonia Nitrogen ranged from 2.5 to zero mg/L in 2012, 3.5 to zero mg/L in 2013, and 1.5 to zero mg/L in 2014 (Figures 15 and 16). There were no violations of the acute ammonia water quality standard used for warm water streams. The average in 2012, 2013, and 2014 was 0.44 mg/L, 0.25 mg/L and 0.11 mg/L, respectively.

Figure 15. Ammonia Nitrogen for all wetlands sampled multiple years.

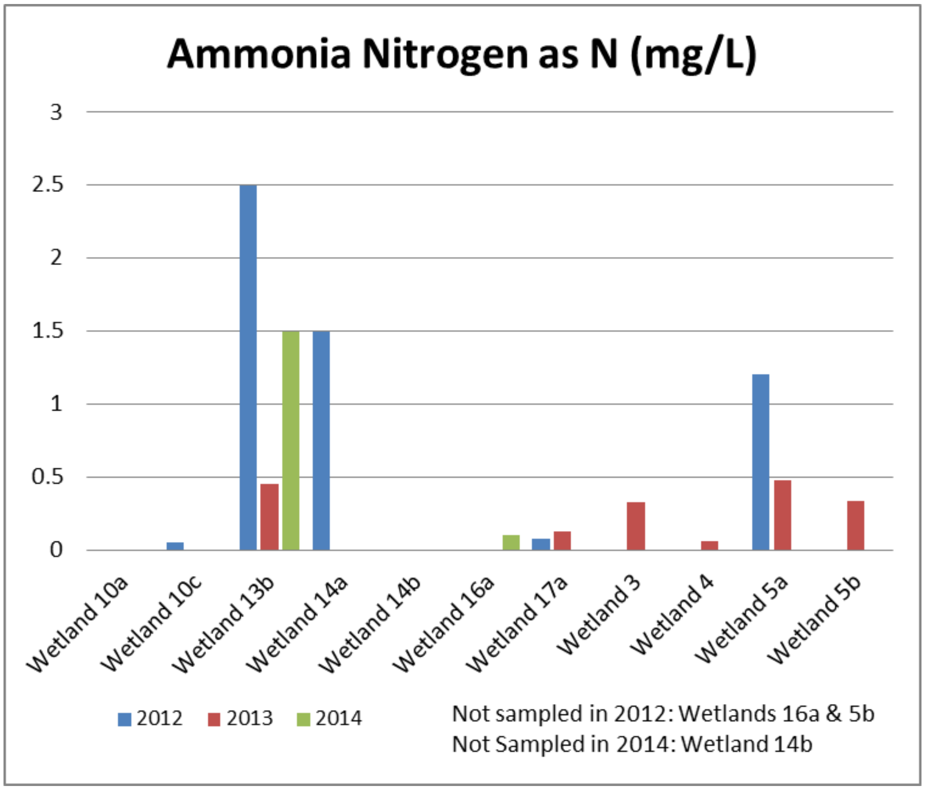
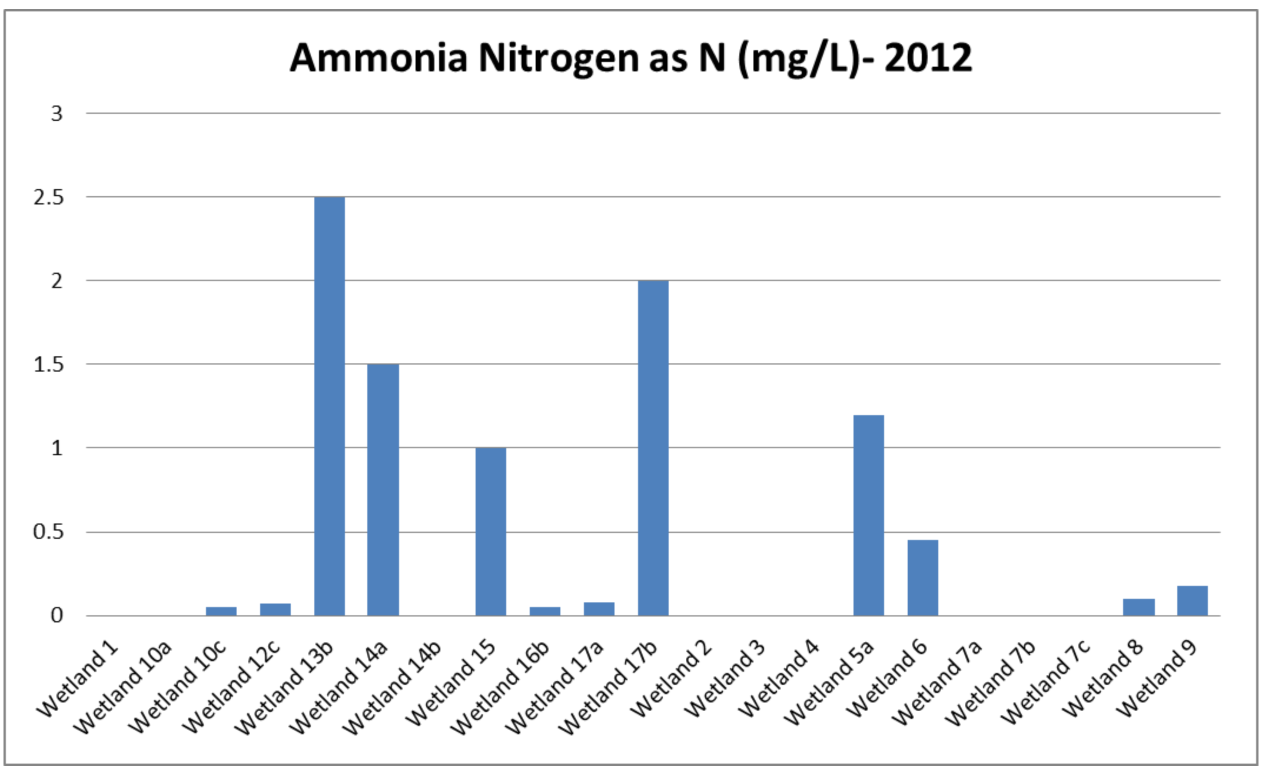
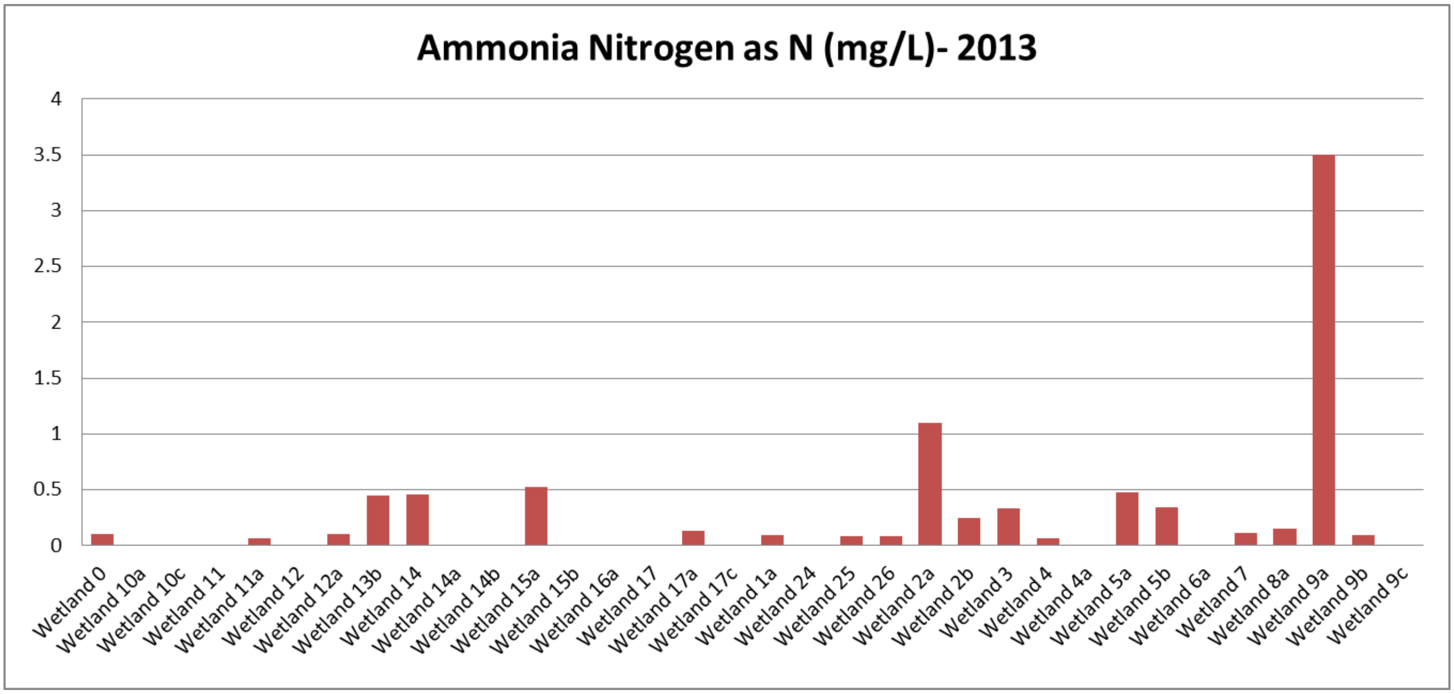
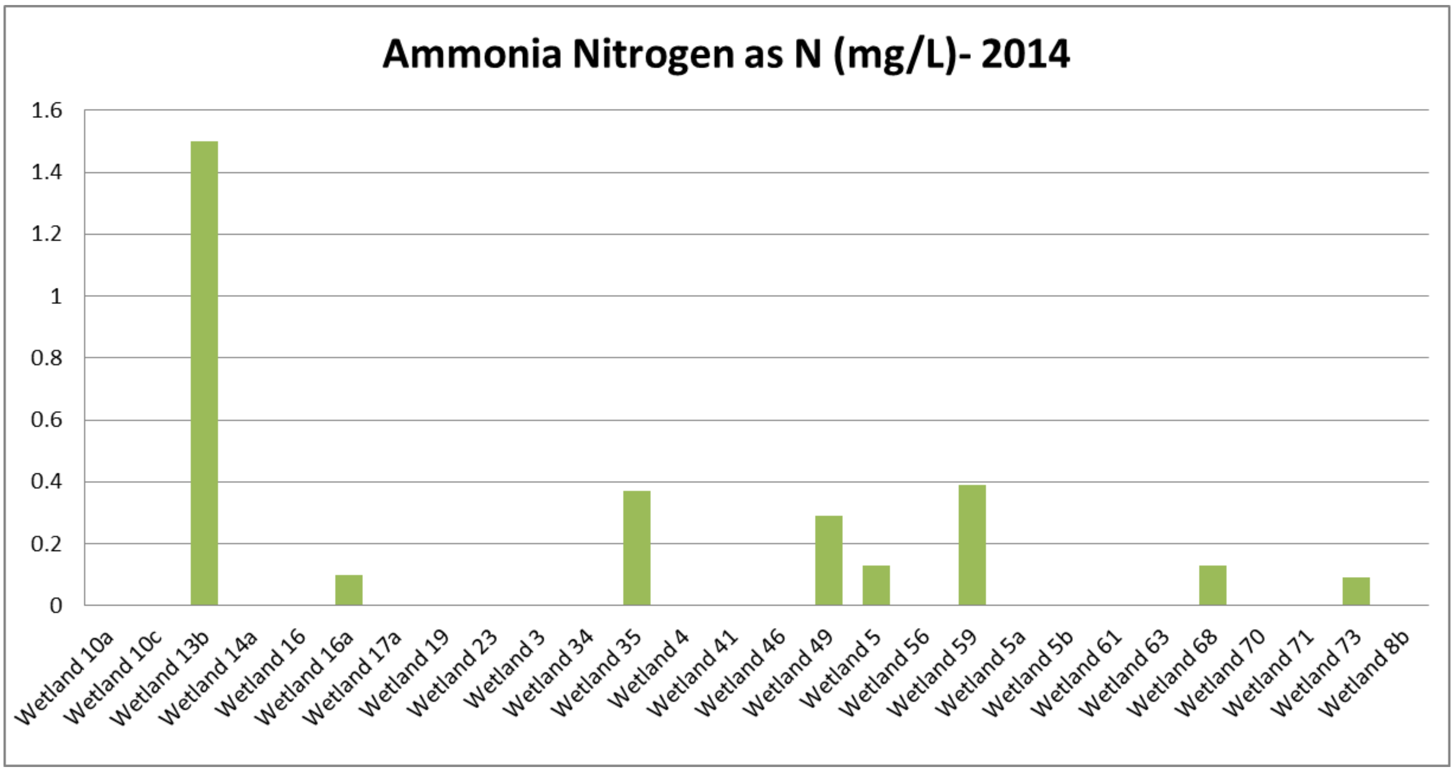


Figure 16. Ammonia Nitrogen for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).




Ammonia Nitrogen as N (mg/L)- 2013
4
3.5
3
2.5
2
1.5
1
0.5
0
Wetland 0
Wetland 10a
Wetland 10c
Wetland 11
Wetland 11a
Wetland 12
Wetland 12a
Wetland 13b
Wetland 14
Wetland 14a
Wetland 14b
Wetland 15a
Wetland 15b
Wetland 16a
Wetland 17
Wetland 17a
Wetland 17c
Wetland 1a
Wetland 24
Wetland 25
Wetland 26
Wetland 2a
Wetland 2b
Wetland 3
Wetland 4
Wetland 4a
Wetland 5a
Wetland 5b
Wetland 6a
Wetland 7
Wetland 8a
Wetland 9a
Wetland 9b
Wetland 9c


Ammonia Nitrogen as N (mg/L)- 2014
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Wetland 10a
Wetland 10c
Wetland 13b
Wetland 14a
Wetland 16
Wetland 16a
Wetland 17a
Wetland 19
Wetland 23
Wetland 3
Wetland 34
Wetland 35
Wetland 4
Wetland 41
Wetland 46
Wetland 49
Wetland 5
Wetland 56
Wetland 59
Wetland 5a
Wetland 5b
Wetland 61
Wetland 63
Wetland 68
Wetland 70
Wetland 71
Wetland 73
Wetland 8b

Total Kjeldahl Nitrogen (TKN) ranged from 28 to zero mg/L in 2012, 8.2 to zero mg/L in 2013, and 5.2 to zero mg/L in 2014 (Figures 17 and 18). The average in 2012, 2013 and 2014 was 4.84mg/L, 1.73 mg/L, and 1.75 mg/L, respectively.

Figure 17. Total Kjeldahl Nitrogen (TKN) for all wetlands sampled multiple years.

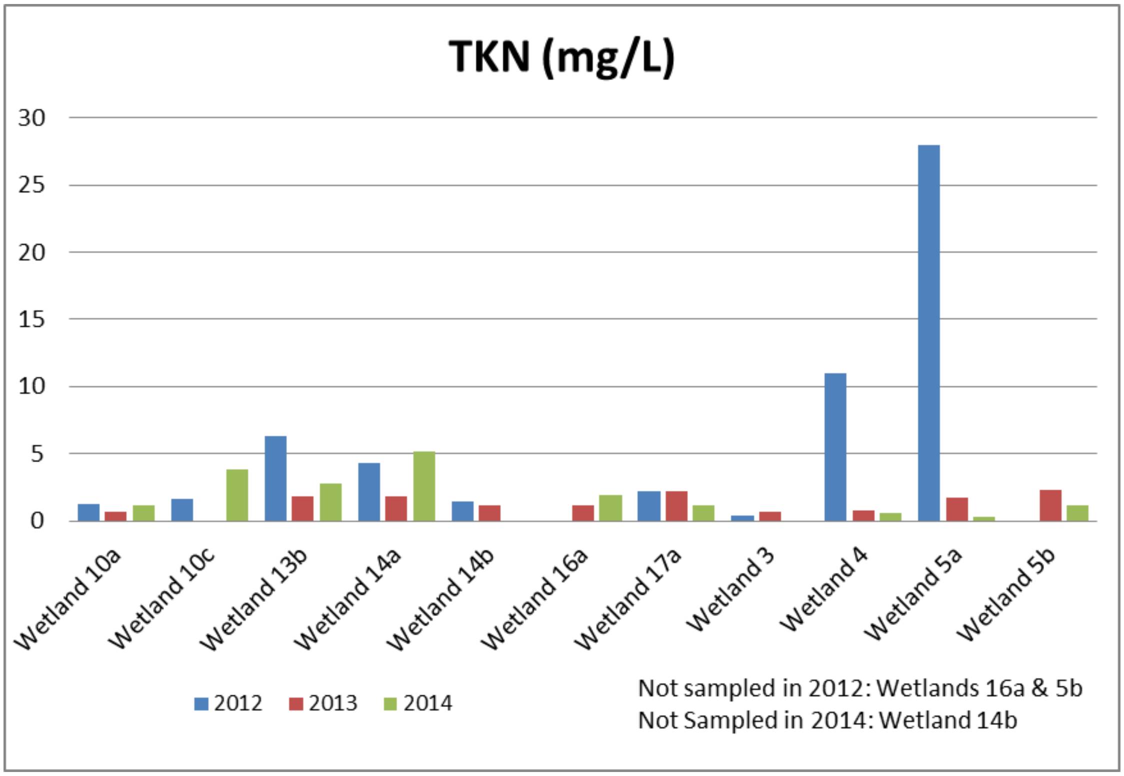
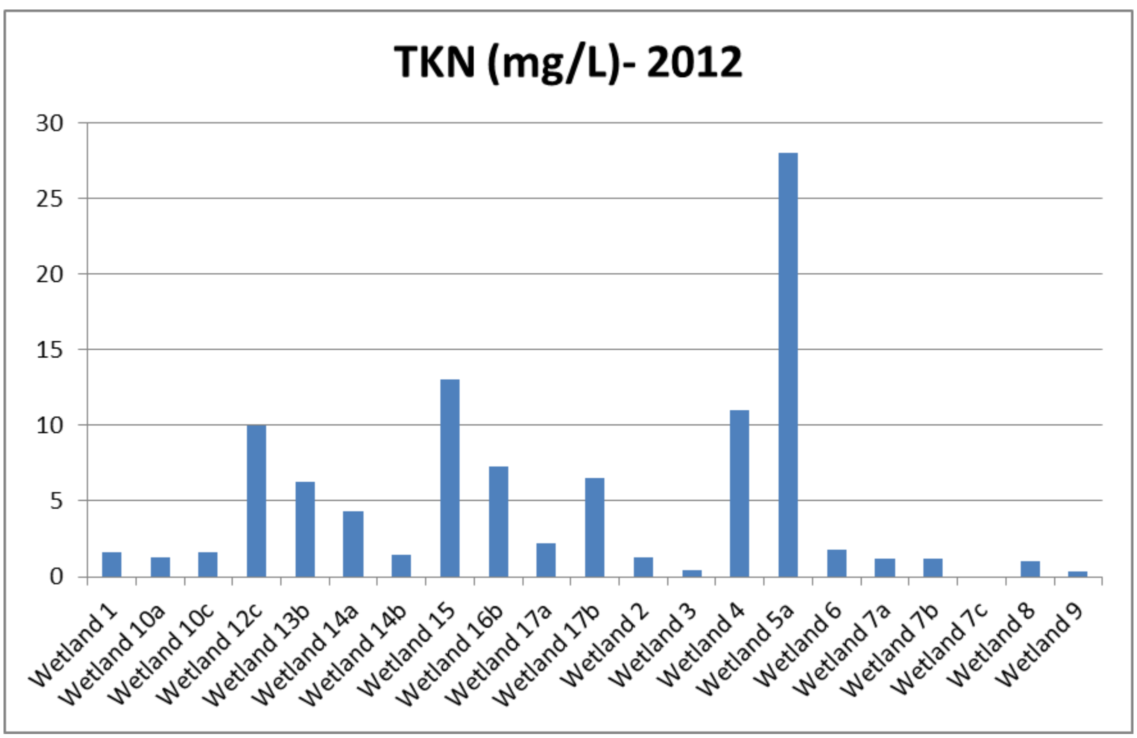
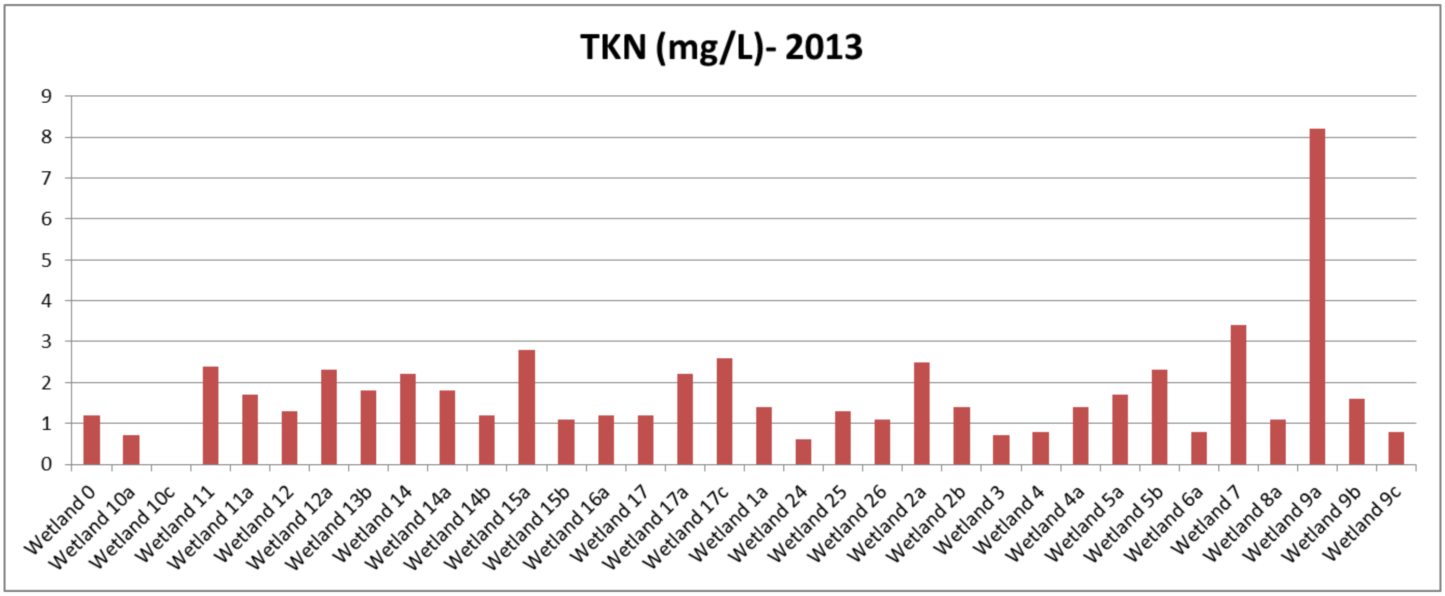
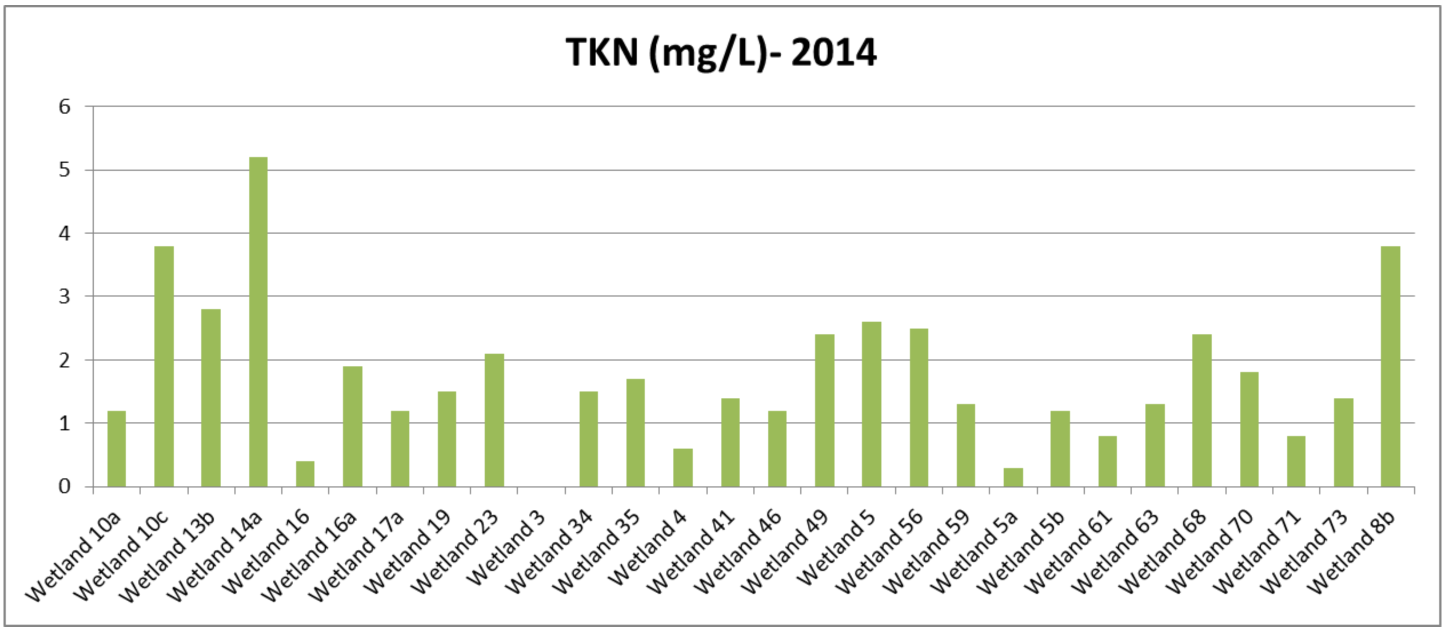


Figure 18. Total Kjeldahl Nitrogen (TKN) for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







In 2012 ***Nitrate + Nitrite Nitrogen*** (N+N) was not detected in the 21 wetlands sampled. This is not unexpected as 2012 was the 19th driest and the 3rd warmest year in Iowa. Warm dry weather leads to drought and high evaporation rates. In 2013 N+N ranged from 14 to zero mg/L and in 2014 it ranged from 9.8 to zero mg/L in 2014 (Figures 19 and 20). The average in 2013 and 2014 was 2.05 mg/L and 0.80 mg/L, respectively. Weather most likely affected 2013 and 2014 N+N levels since 2013 was the wettest spring on record and 2014 had the third wettest June on record, both of which lead to widespread flooding.

Figure 19. Nitrate + Nitrite Nitrogen for all wetlands sampled multiple years.

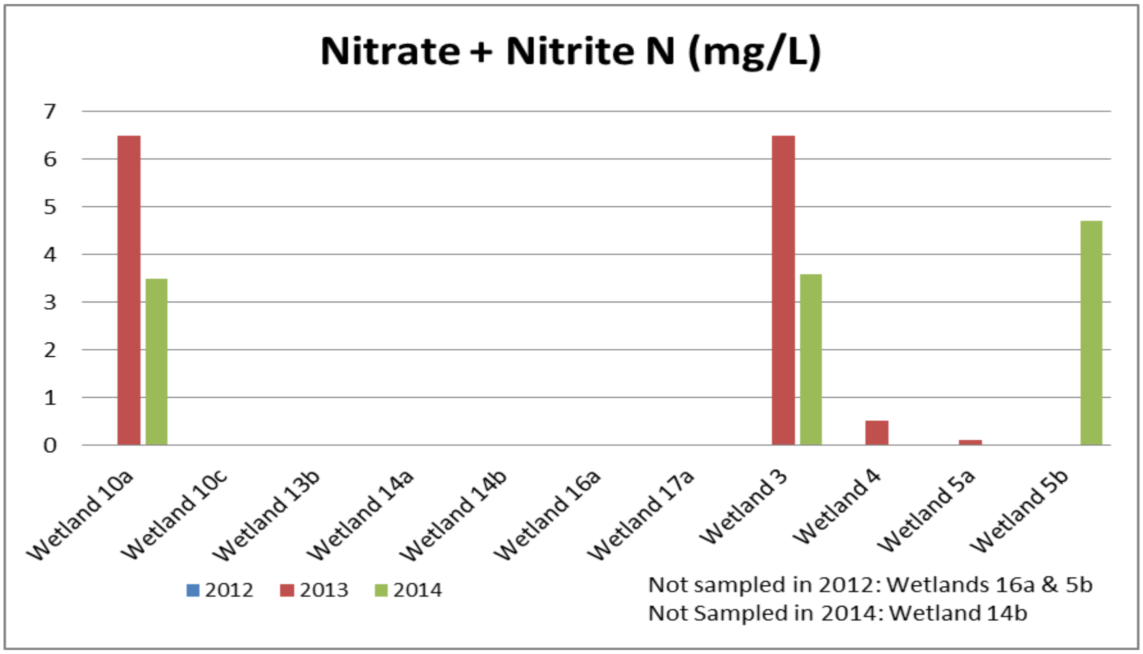
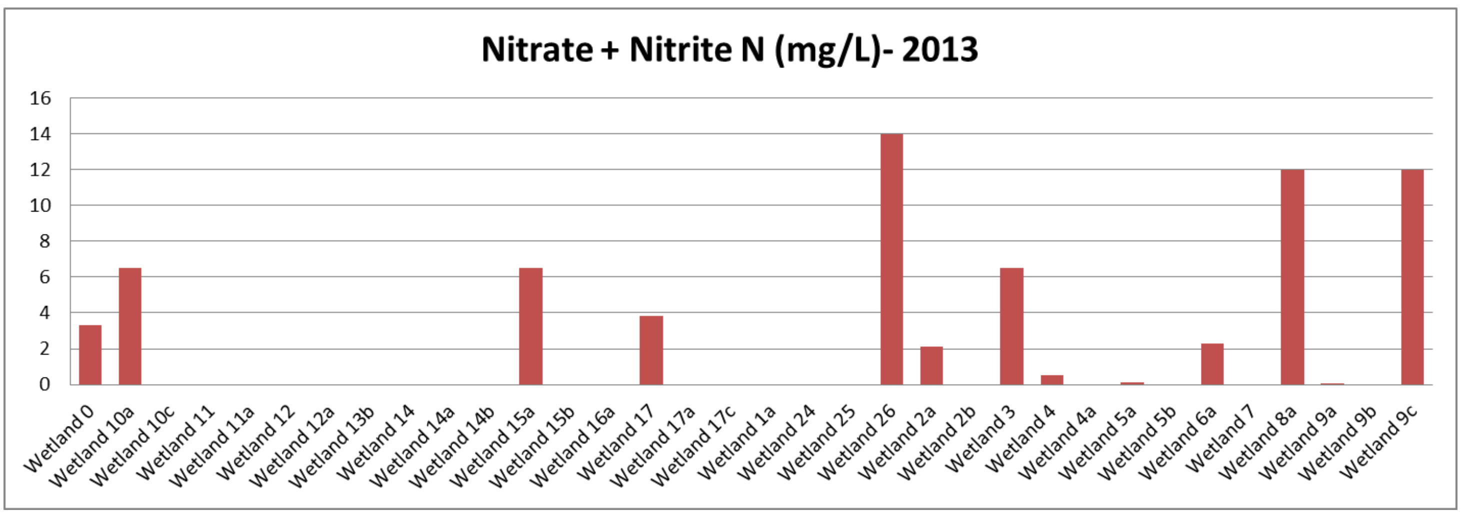
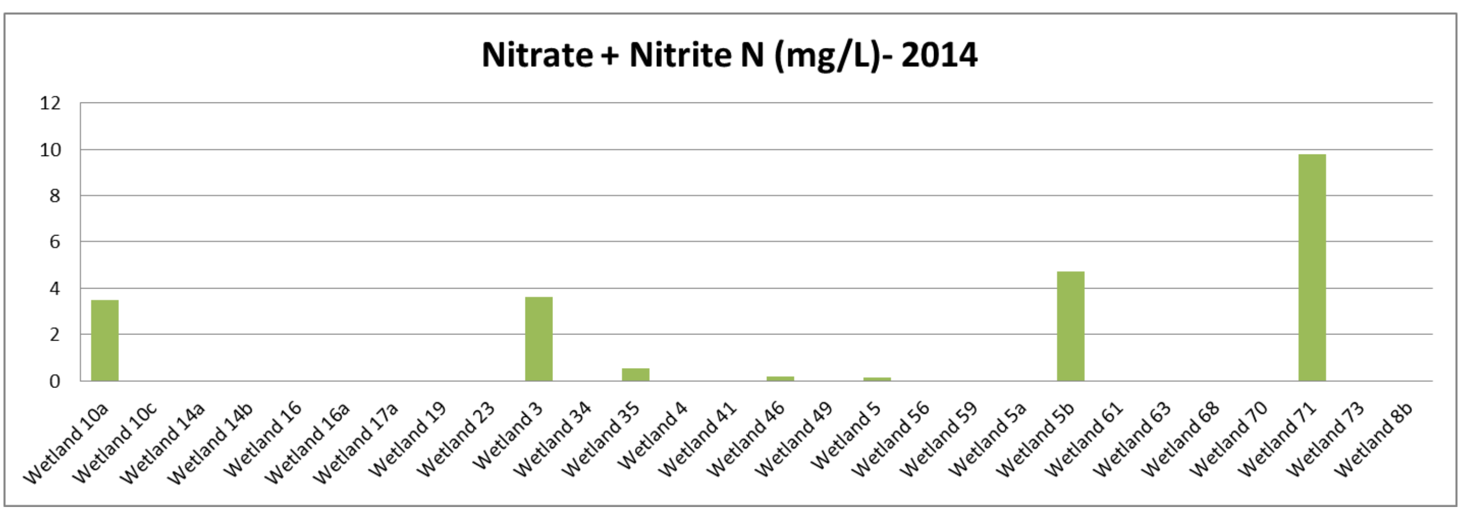


Figure 20. Nitrate + Nitrite Nitrogen for all wetlands sampled in 2013 (in red) & 2014 (in green). Note Nitrate + Nitrite Nitrogen was not detected in any of the 21 wetlands sampled that year.





Dissolved Oxygen (DO) ranged from 10.89 to 1.62 mg/L in 2012, 14.30 to 0.87 mg/L in 2013, and 11.01 to 7.10 mg/L in 2014 (Figures 21 and 22). Iowa has a warm water DO standard of 5 mg/L. Wetland 13b in Jasper County had the lowest DO in 2012 (1.62 mg/L), which also suffered a fish kill in early August in which only black bullheads survived. In 2012 wetland 17a in Louisa County also had a DO level (4.32 mg/L) below the 5 mg/L standard; the water level was very low at this time. In 2013 there were 14 wetlands with DO levels below the 5 mg/L standard. In 2014 all wetlands had DO levels above the 5 mg/L standard.


Black bullheads in Wetland 13b in Jasper County

Figure 21. Dissolved Oxygen for all wetlands sampled multiple years.

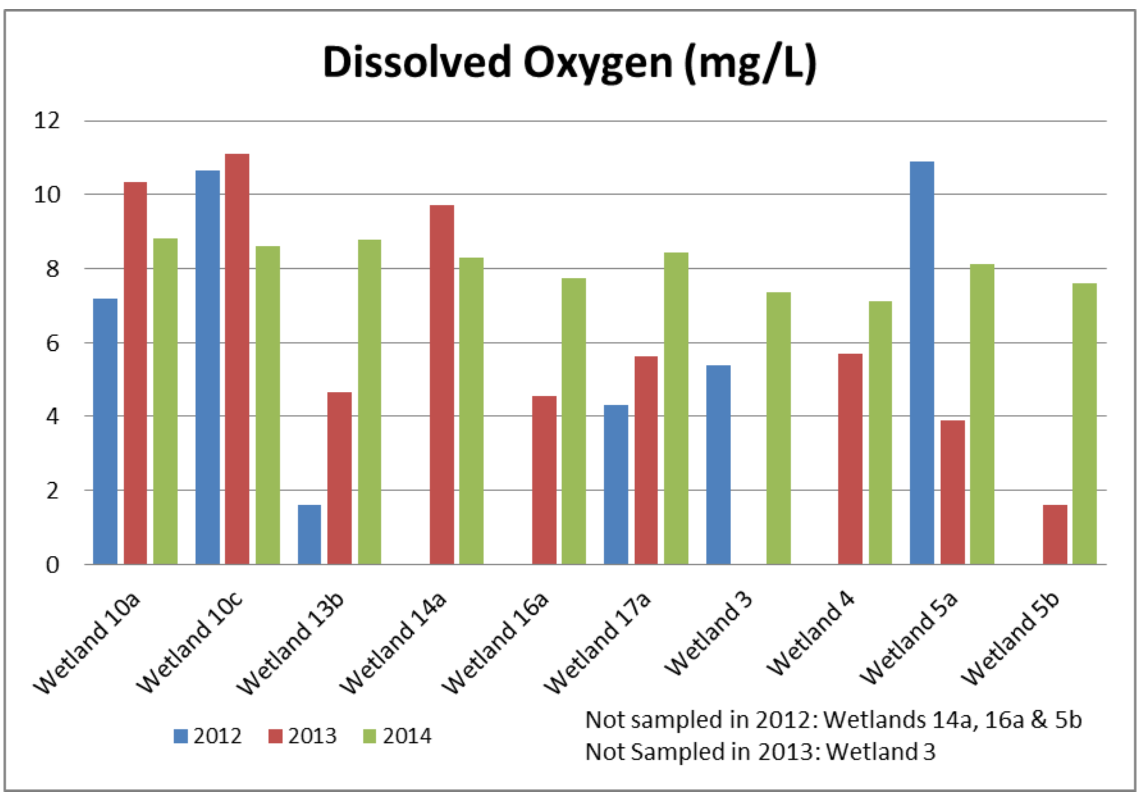
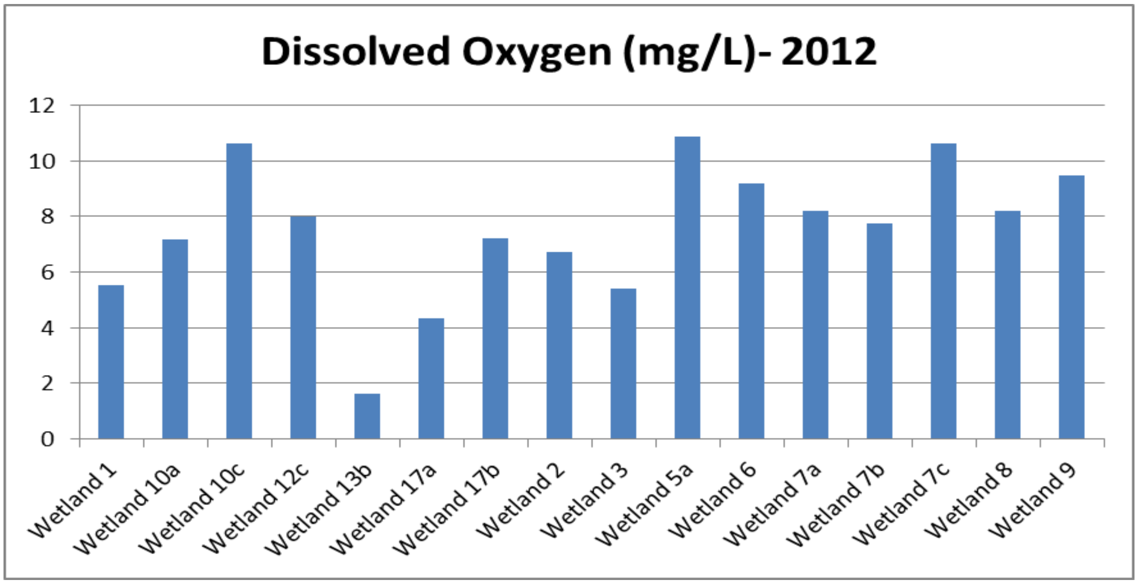
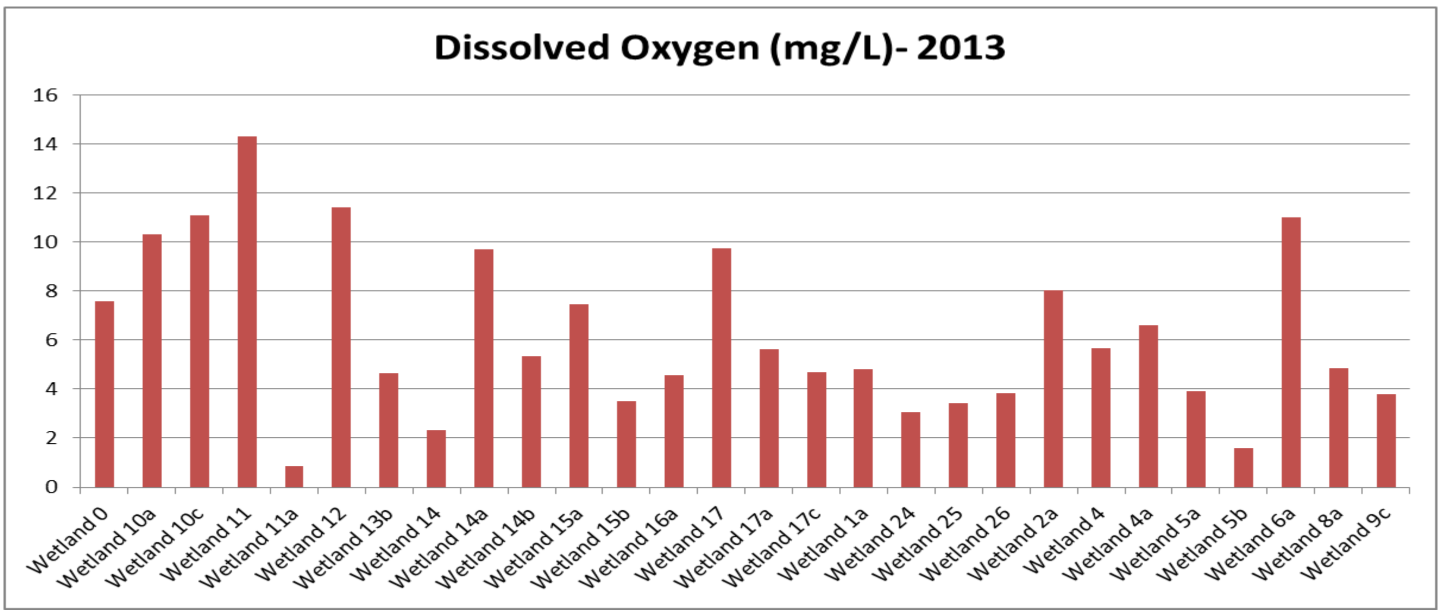
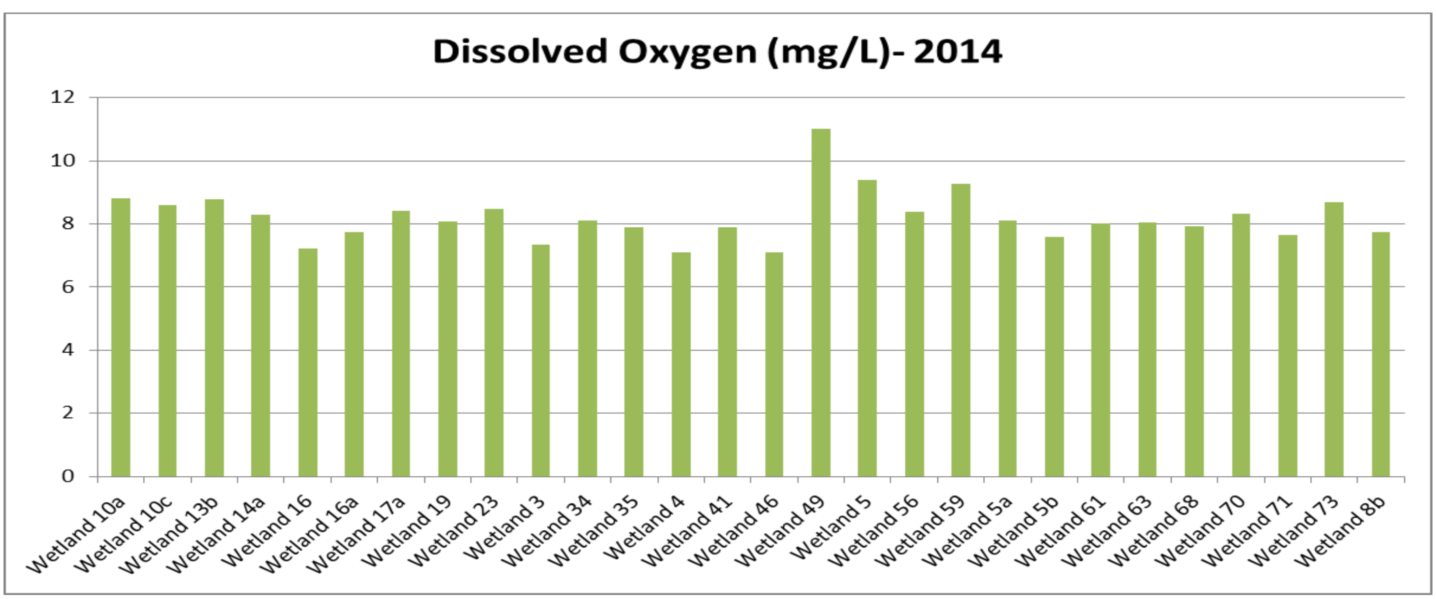


Figure 22.Dissolved Oxygen for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







In 2012 ***pH*** ranged from 9 to 6.6, in 2013 it ranged from 8.87 to 5.58, and in 2014 it ranged from 9.89 to 7.13 (Figures 23 and 24). The average in 2012, 2013, and 2014 was 7.57, 8, and 8.14, respectively.

Figure 23. pH for all wetlands sampled multiple years.

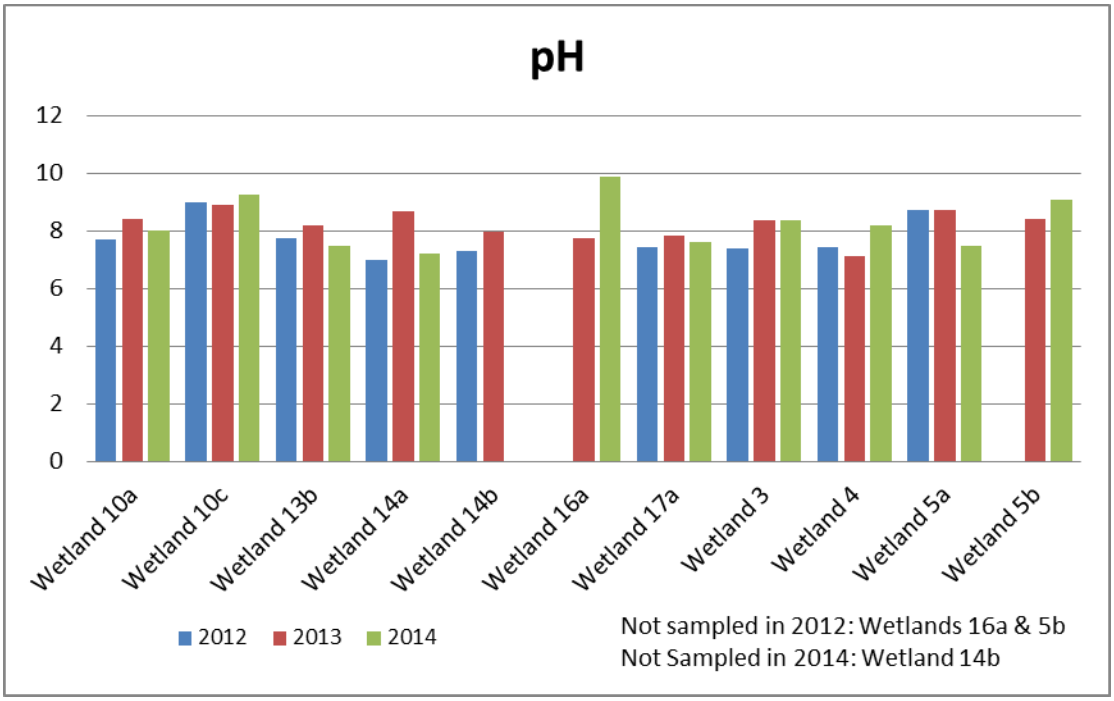
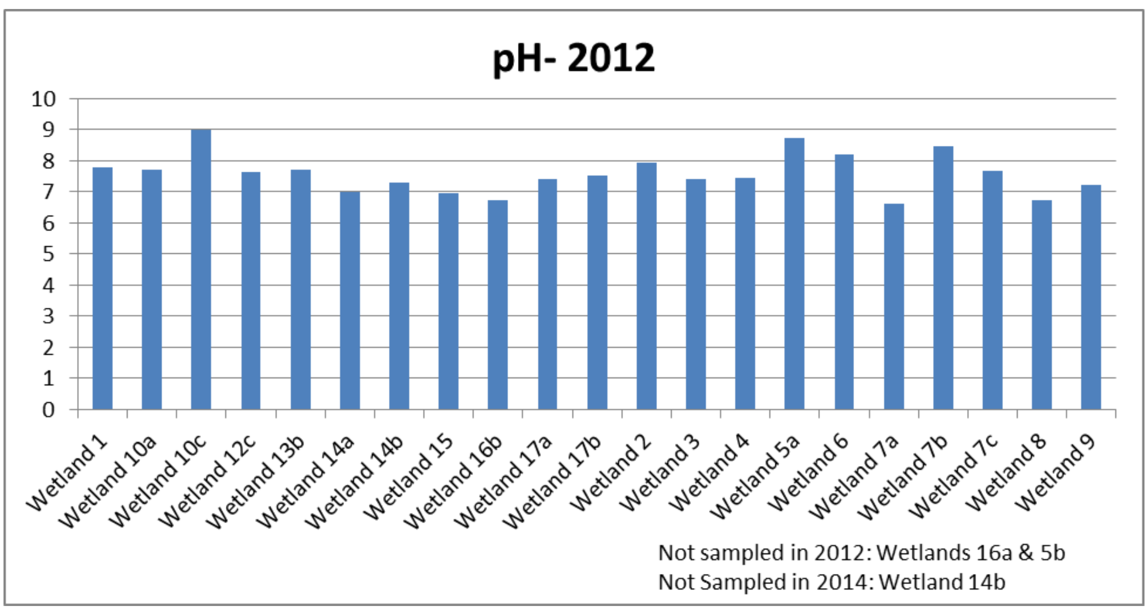
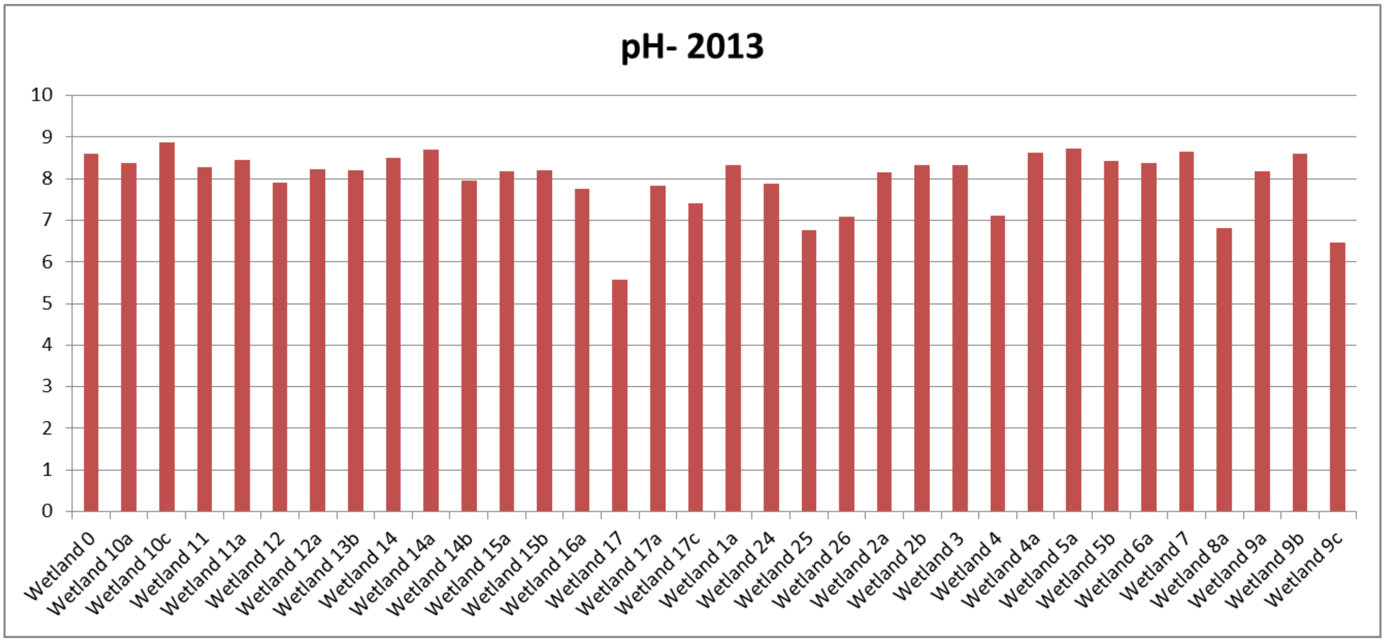
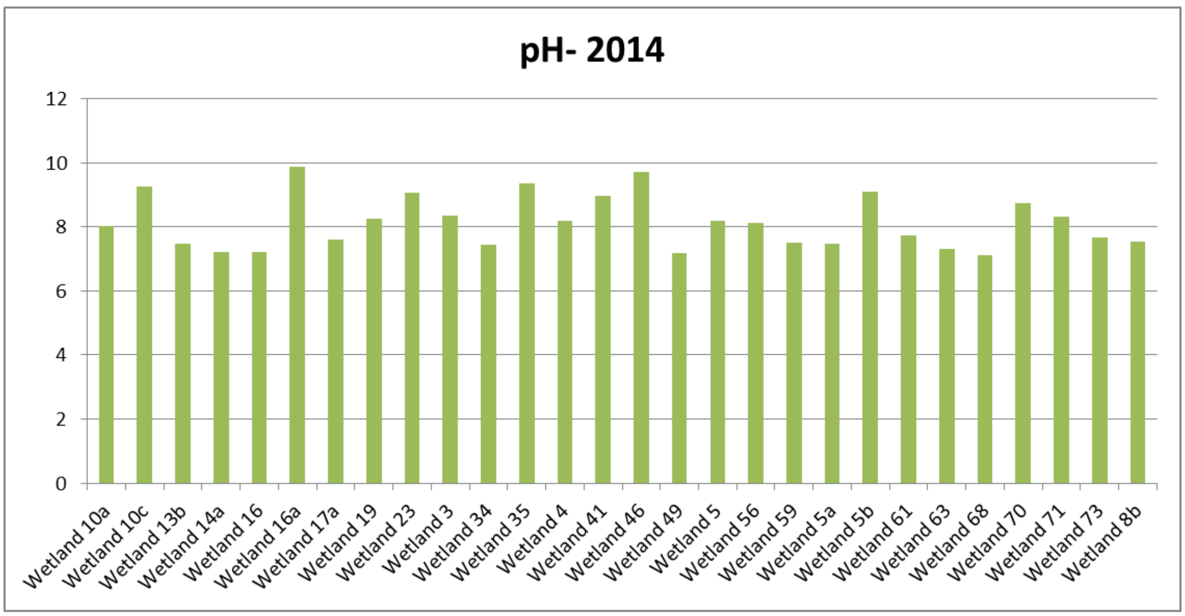


Figure 24. pH for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







Thirty-eight ***herbicides*** and their breakdown products were sampled for in each wetland in 2012 to 2014 (Table 2). Seven were detected in 2012, 11 in 2013, and 9 in 2014. In 2012 herbicides were detected in 12 of the 25 wetlands sampled, in 2013 herbicides were detected in 32 of the 34 wetlands sampled, and in 2014 herbicides were detected in all 28 wetlands sampled (Table 3). These results may be connected to the drought conditions which occurred in 2012 where there was little to no recharge into most wetlands. The summers of 2013 and 2014 were much wetter and more recharge may have transported more herbicides into the wetlands.

Table 2. Herbicides tested for from 2012 to 2014 and the number of detects per year.

Compound	# of Detects 2012	# of Detects 2013	# of Detects 2014	total # of Detects
2,4,5-T	0	0	0	0
2,4-D	0	1	0	1
2,4-DB	0	2	0	2
Acetochlor	1	7	7	15
Acifluorfen	0	0	0	0
Alachlor	0	0	0	0
Ametryn	1	0	1	2
Atrazine	12	32	26	70
Bentazon	0	1	0	1
Bromacil	0	0	0	0
Butachlor	0	0	0	0
Butylate	0	0	0	0
Carbaryl	0	0	0	0
Carbofuran	0	0	0	0
Chloramben	0	0	0	0
Chlorthal-dimethyl	0	0	0	0
Clomazone	0	0	0	0
Cyanazine	0	0	0	0
Desethyl atrazine	7	13	11	31
Desisopropyl atrazine	3	1	1	5
Dicamba	0	0	0	0
Dichlorprop	0	0	4	4
Dimethenamid	0	1	1	2
Dinoseb	0	0	0	0
EPTC	0	0	0	0
Metolachlor	0	19	8	27
Metribuzin	0	0	0	0
Pendimethalin	0	0	0	0
Pentachlorophenol	0	0	0	0
Picloram	1	1	1	3
Prometon	0	0	0	0
Propachlor	0	0	0	0
Propazine	1	0	0	1
Silvex	0	1	0	1
Simazine	0	0	0	0
Triallate	0	0	0	0
Trifluralin	0	0	0	0
Total Compounds Detected	7	11	9	
Total Number of Detects	26	79	60	165

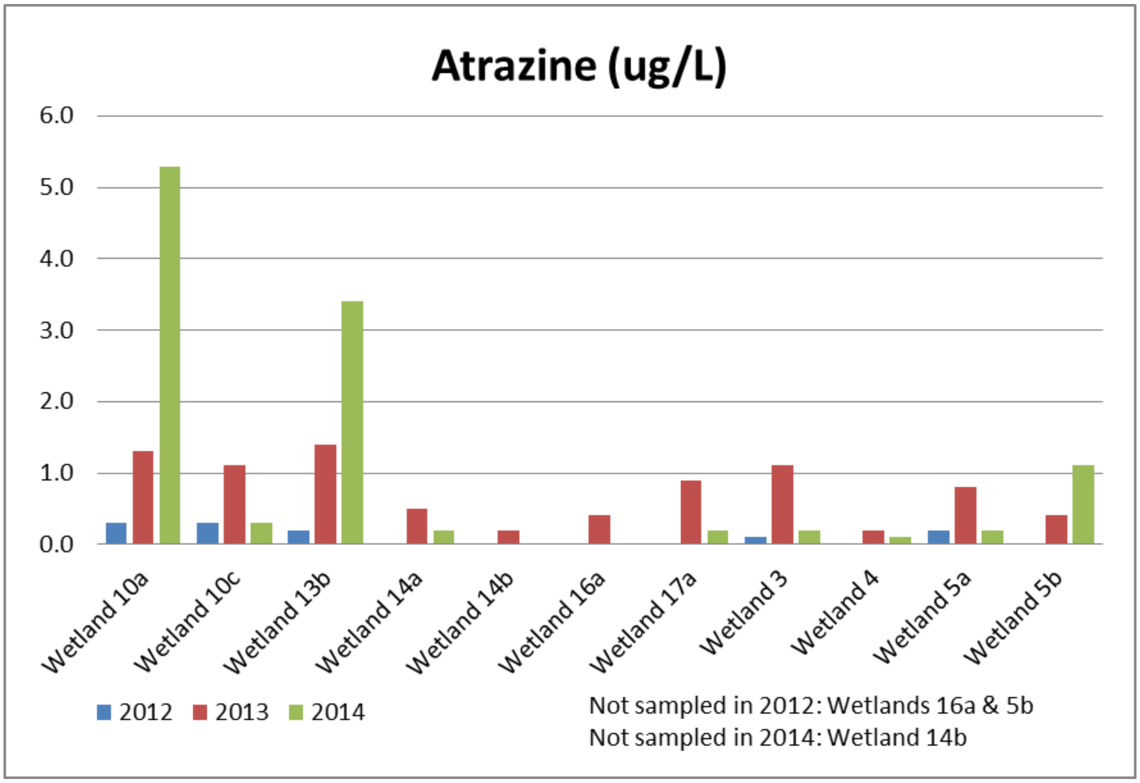
Table 3. Number of Pesticide detects in wetlands sampled from 2012 to 2014.

Number of Pesticides Detected								
Site	2012	2013	2014		Site	2012	2013	2014
Wetland 0		2			Wetland 3	3	4	3
Wetland 1	0				Wetland 34			1
Wetland 10a	2	3	5		Wetland 35			1
Wetland 10c	1	2	2		Wetland 4	0	1	2
Wetland 11		1			Wetland 41			3
Wetland 11a		3			Wetland 46			2
Wetland 12		4			Wetland 49			2
Wetland 12a		1			Wetland 4a		1	
Wetland 12c	2				Wetland 5			1
Wetland 13b	2	4	4		Wetland 56			4
Wetland 14		1			Wetland 59			1
Wetland 14a	0	2	2		Wetland 5a	1	3	2
Wetland 14b	0	1			Wetland 5b		2	4
Wetland 15	2	1			Wetland 6	0		
Wetland 15a		3			Wetland 61			1
Wetland 15b		2			Wetland 63			1
Wetland 16			2		Wetland 68			1
Wetland 16a		2	2		Wetland 6a		3	
Wetland 16b	5				Wetland 7		3	
Wetland 17		0			Wetland 70			1
Wetland 17a	0	3	3		Wetland 71			1
Wetland 17b	2				Wetland 73			2
Wetland 17c		4			Wetland 7a	2		
Wetland 19			1		Wetland 7b	1		
Wetland 1a		2			Wetland 7c	0		
Wetland 2	2				Wetland 8	0		
Wetland 23			2		Wetland 8a		2	
Wetland 24		2			Wetland 8b			2
Wetland 25		1			Wetland 9	0		
Wetland 26		2			Wetland 9a		2	
Wetland 2a		0			Wetland 9b		4	
Wetland 2b		5			Wetland 9c		3	

The most commonly detected herbicide was ***Atrazine*** which was detected a total of 70 times from 2012 to 2014 (Table 2). Desethyl Atrazine and Desisopropyl Atrazine, two breakdown products of Atrazine, were also detected 31 times and 5 times, respectively.

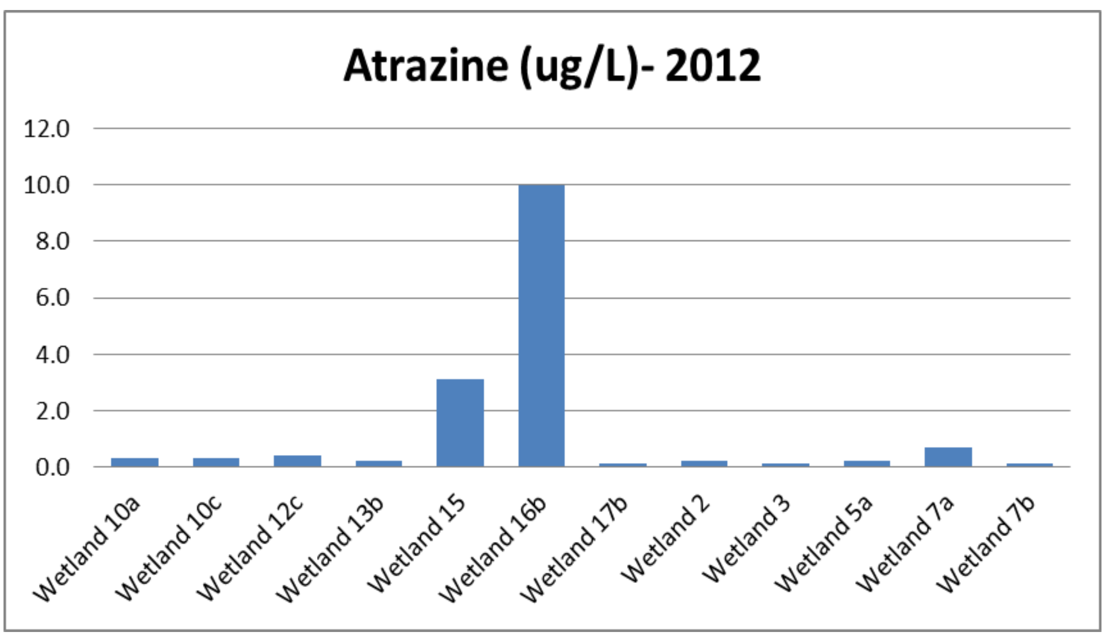
In 2012 Atrazine was found in 12 of 28 wetlands sampled (Figures 25 and 26; Table 2). In 2013 it was found in 32 of 34 wetlands sampled including four resample wetlands, which it was not found in during 2012. In 2014 Atrazine was found in 26 of the 28 wetlands sampled including those same four resample wetlands. Of the five resample wetlands in which atrazine was detected in all years (Wetlands 10a, 10c, 13b, 3 and 5a) concentrations in 2013 were between three and 11 times greater than in 2012; in 2014 they were up to 17 times higher (Figures 25 and 26).

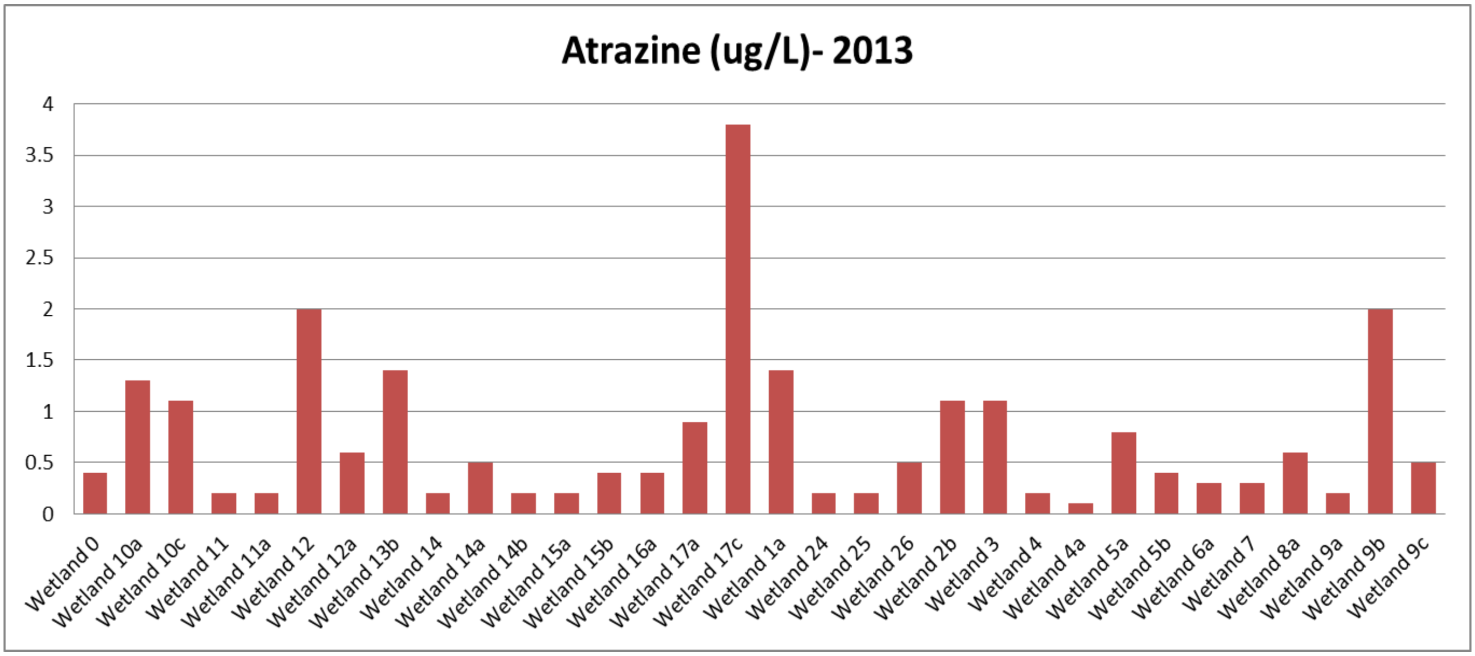
Figure 25. Atrazine for all wetlands sampled multiple years.

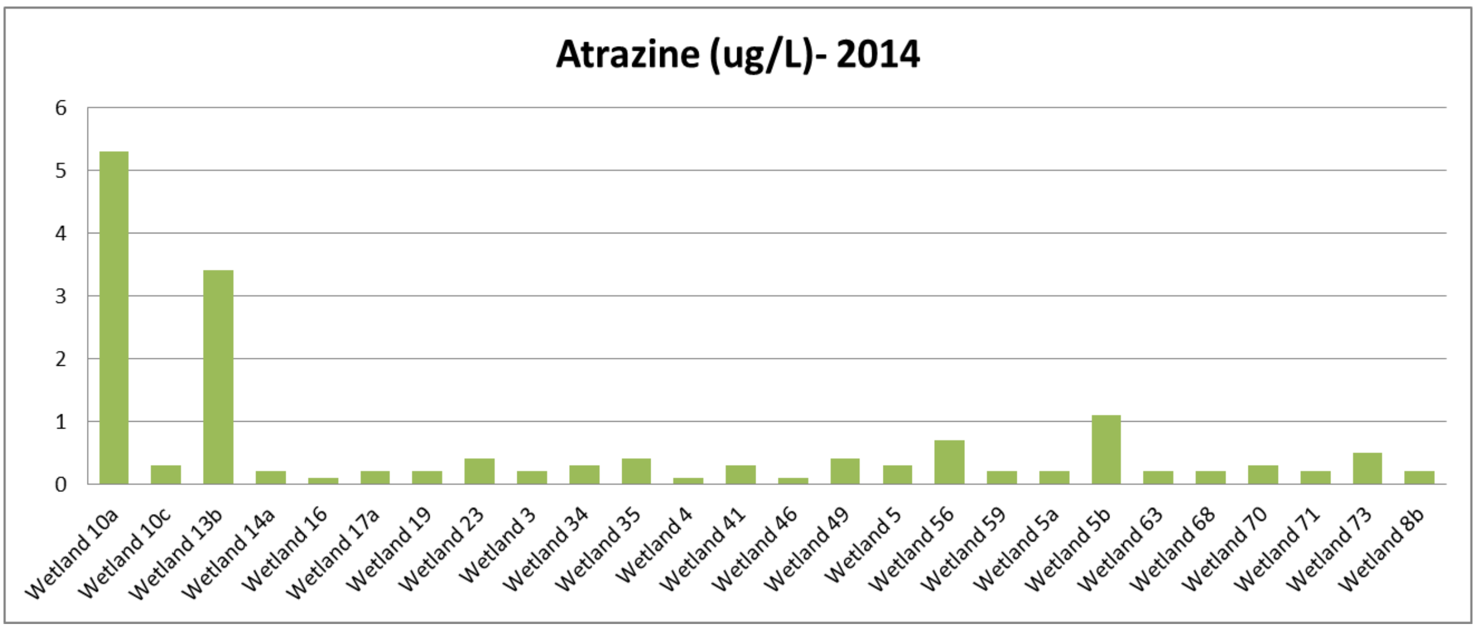


In 2012 Wetland 16b in Henry County had the highest Atrazine levels with a concentration of 10 ug/L; over 3 times higher than the next highest concentration (Figure 26). This wetland also had the highest number of herbicide detections in 2012 at 5 (Table 3). The US EPA has set the acute invertebrate aquatic life benchmark for Atrazine at 360 ug/L and the chronic benchmark at 60 ug/L.

Figure 26. Atrazine for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







In 2012 ***Metolachlor*** was not found in any wetlands sampled, but in 2013 it was found in 19 of 34 wetlands sampled including five resample sites in which it was not previously detected. In 2014 it was found in eight of the 28 wetlands sampled including three of those same resample wetlands (Figure 27). The US EPA has set the acute invertebrate aquatic life benchmark for Metolachlor at 550 ug/L and the chronic benchmark at 1 ug/L.

Figure 27. Metolachlor concentrations for all wetlands sampled multiple years.

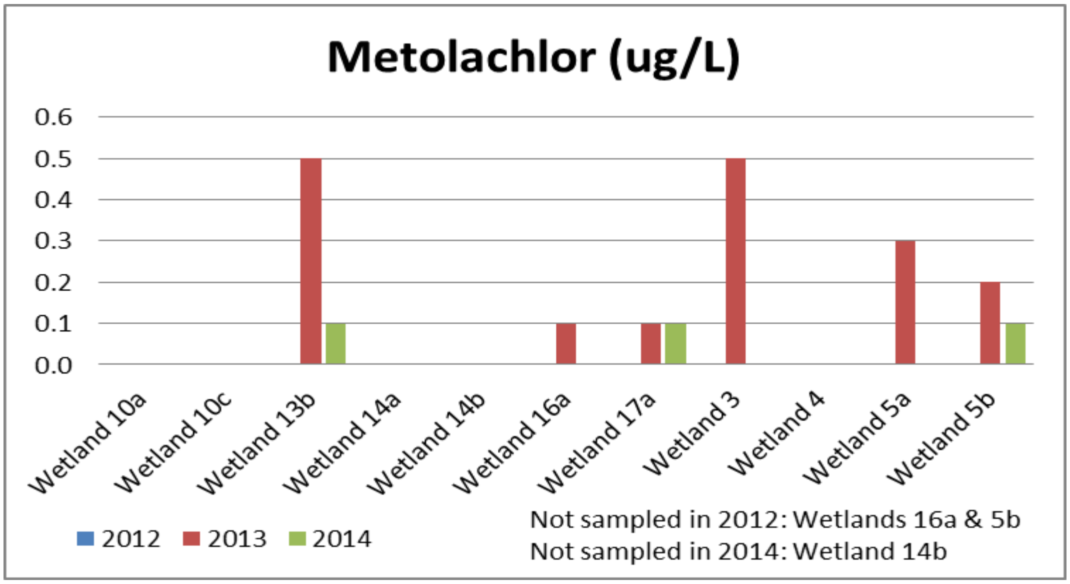
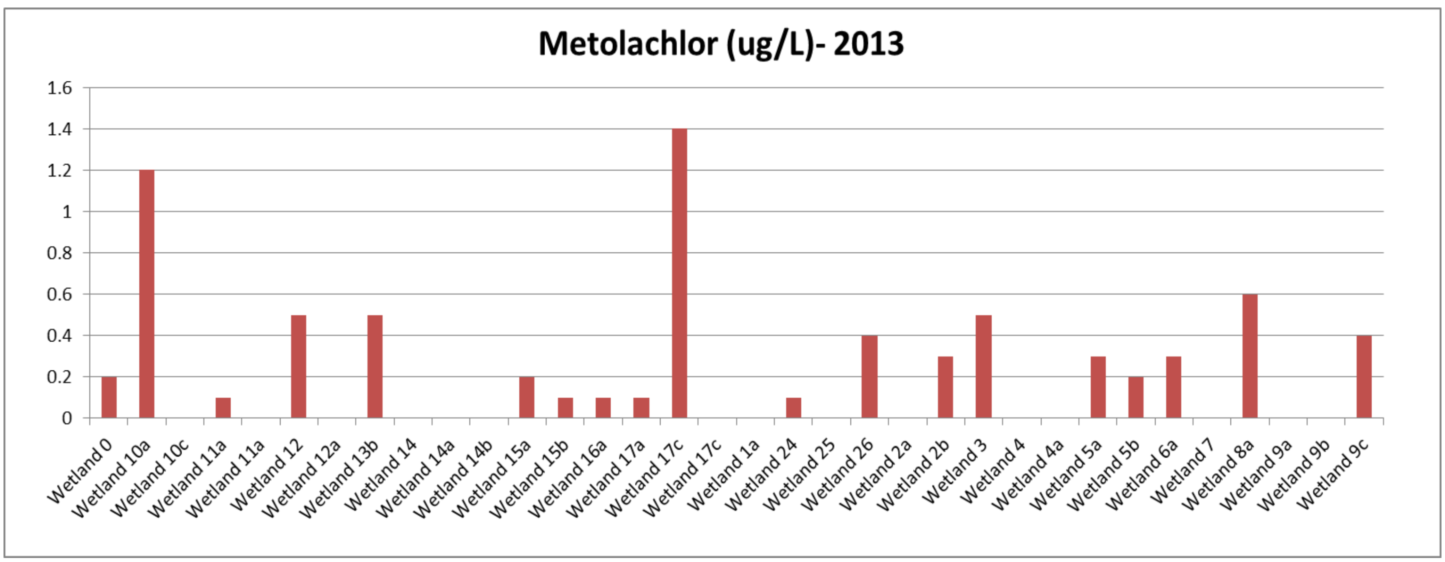
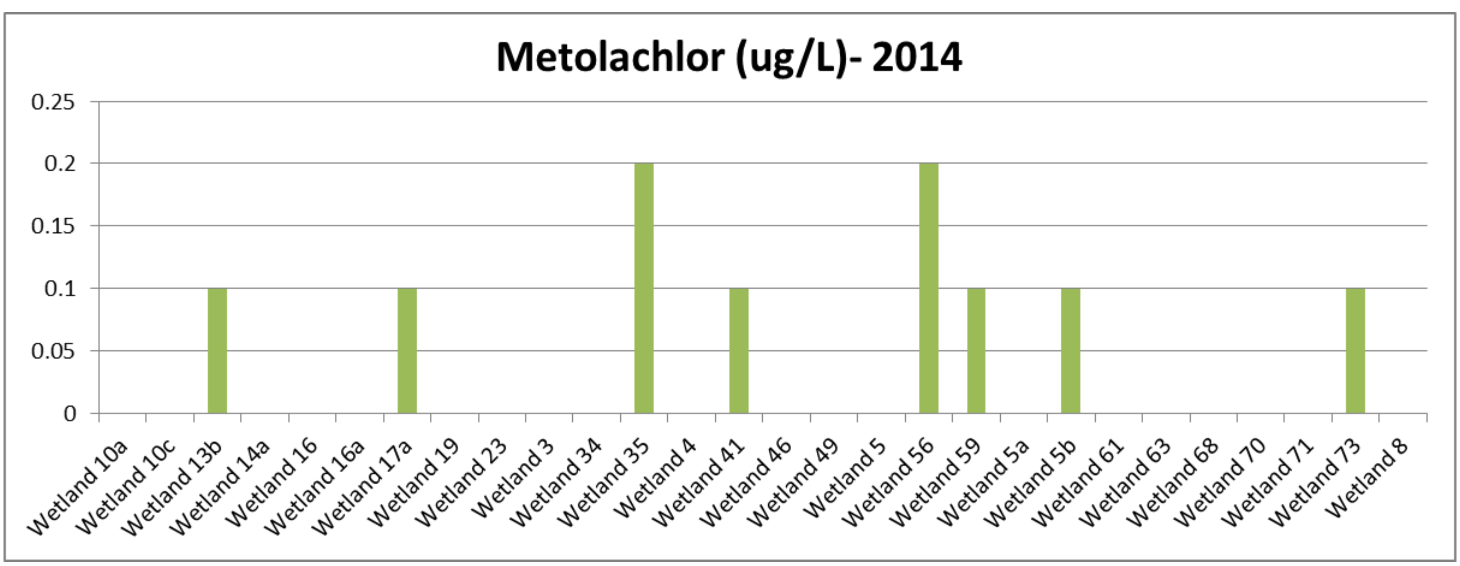


Figure 28. Metolachlor concentrations for all wetlands sampled in 2013 (in red) & 2014 (in green). Note Metolachlor was not detected in any of the 21 wetlands sampled during 2012.





Aquatic invertebrates were sampled in eight revisit sites both in 2012 and 2013. In 2013 and 2014 one additional revisit site was sampled for aquatic invertebrates.

Taxa richness at was highest in 2013 at all but one revisit site; Wetland 4; than both 2012 and 2014 (Figure 29). In 2012 taxa richness ranged from three to 12, in 2013 it ranged from seven to 32, and in 2014 it ranged from four to 19 (Figure 30). The average in 2012, 2013, and 2014 was seven, 18 and ten, respectively.

Invertebrate sampling in Wetland 17a in Louisa County

Figure 29. Invertebrate taxa richness for wetlands sampled multiple years.

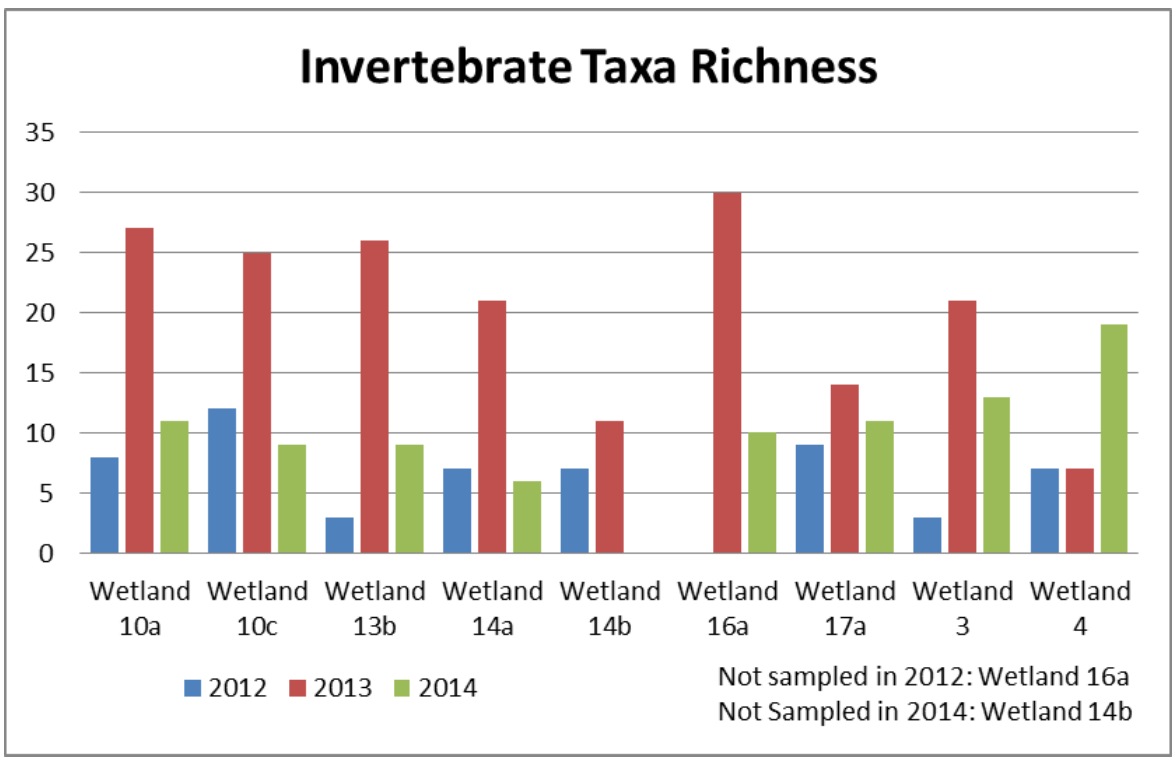
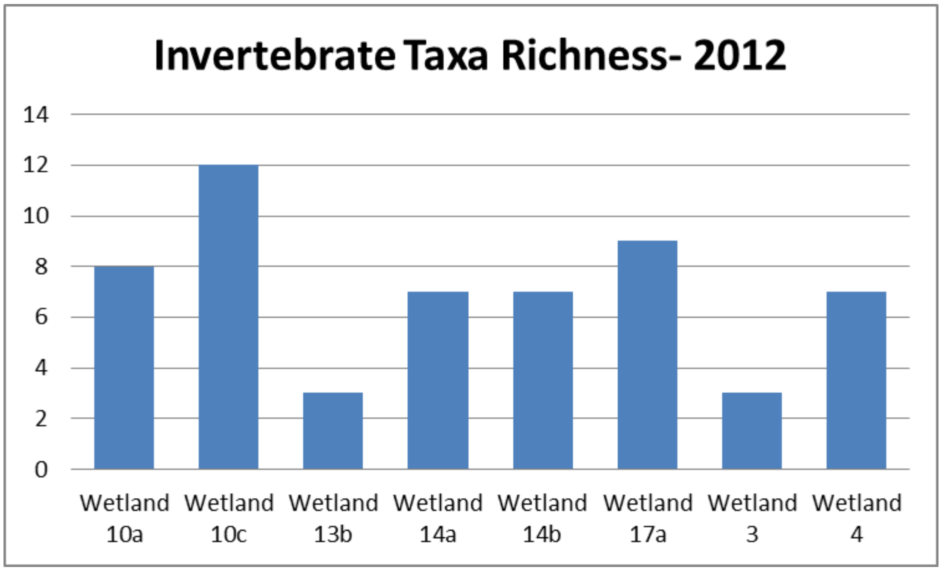
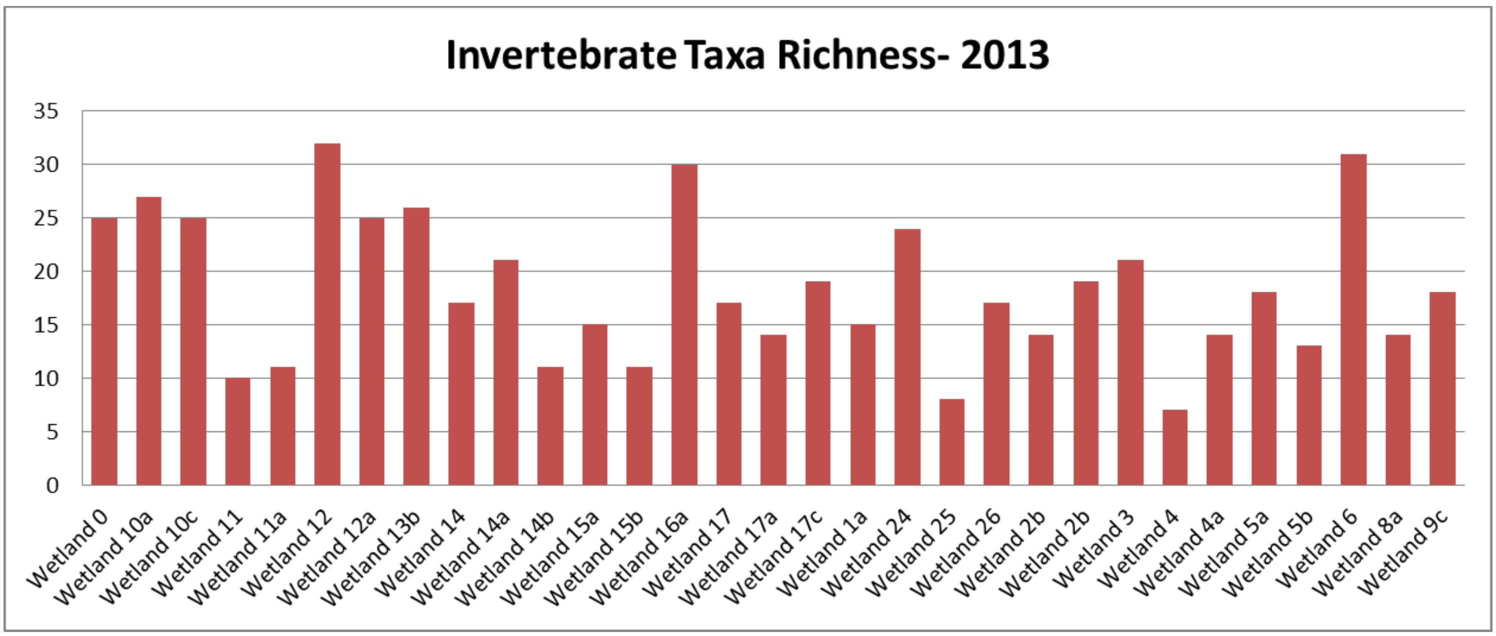
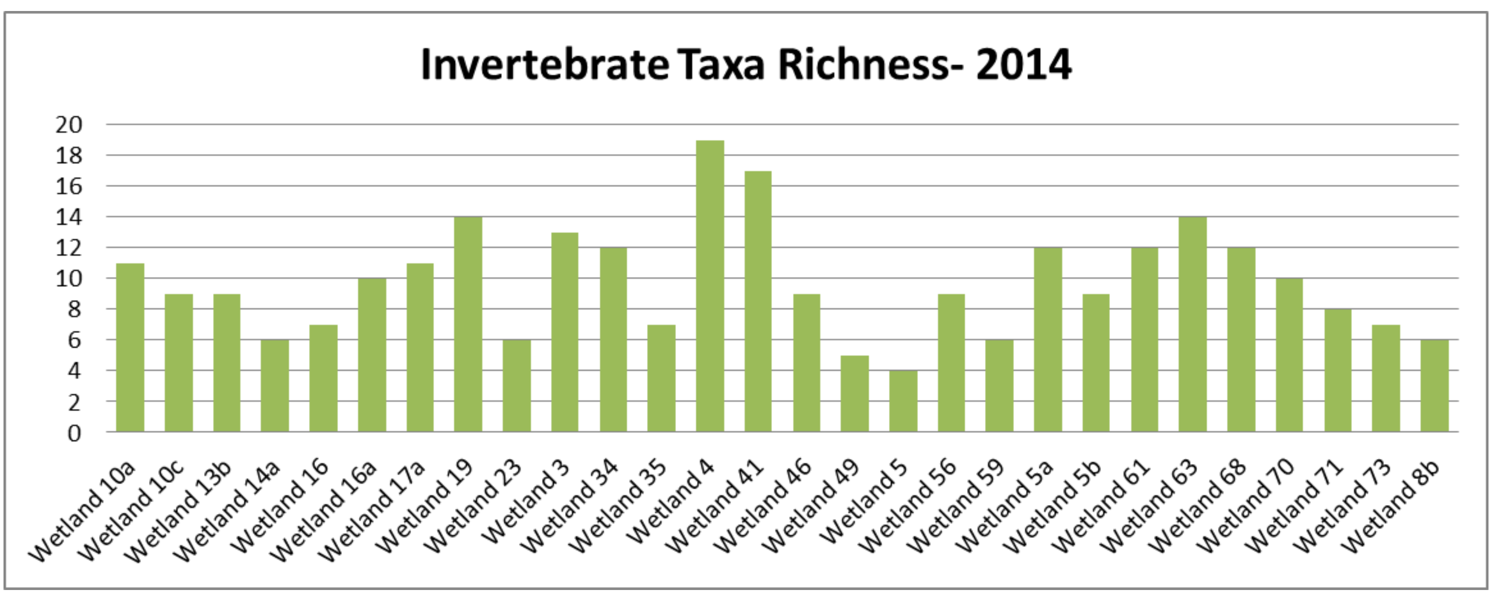


Figure 30. Invertebrate taxa richness for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).







Invertebrate abundance was highest in 2013 at all but three revisit sites; Wetlands 14b, 17a and 4; then both 2012 and 2014 (Figure 31). In 2012 invertebrate abundance ranged from five to 156 individuals, in 2013 it ranged from 20 to 913 individuals, and in 2014 it ranged from eight to 104 individuals (Figure 32). The average in 2012, 2013, and 2014 was 54, 182, and 40, respectively.

Figure 31. Invertebrate abundance for wetlands sampled multiple years.

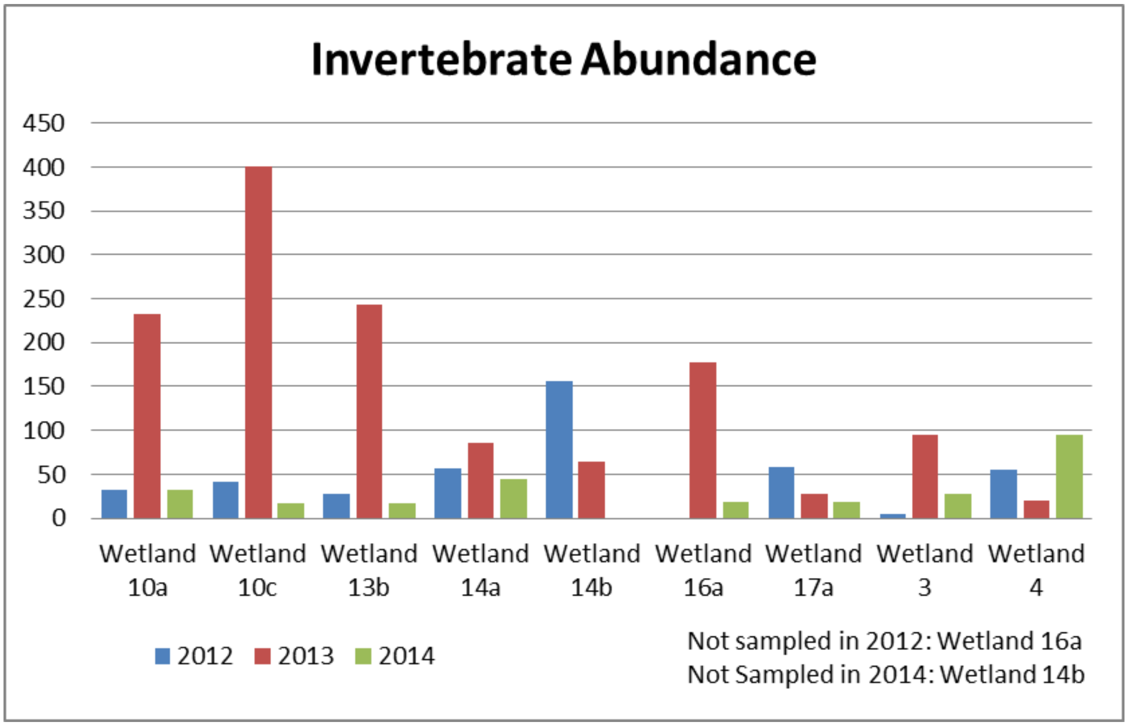
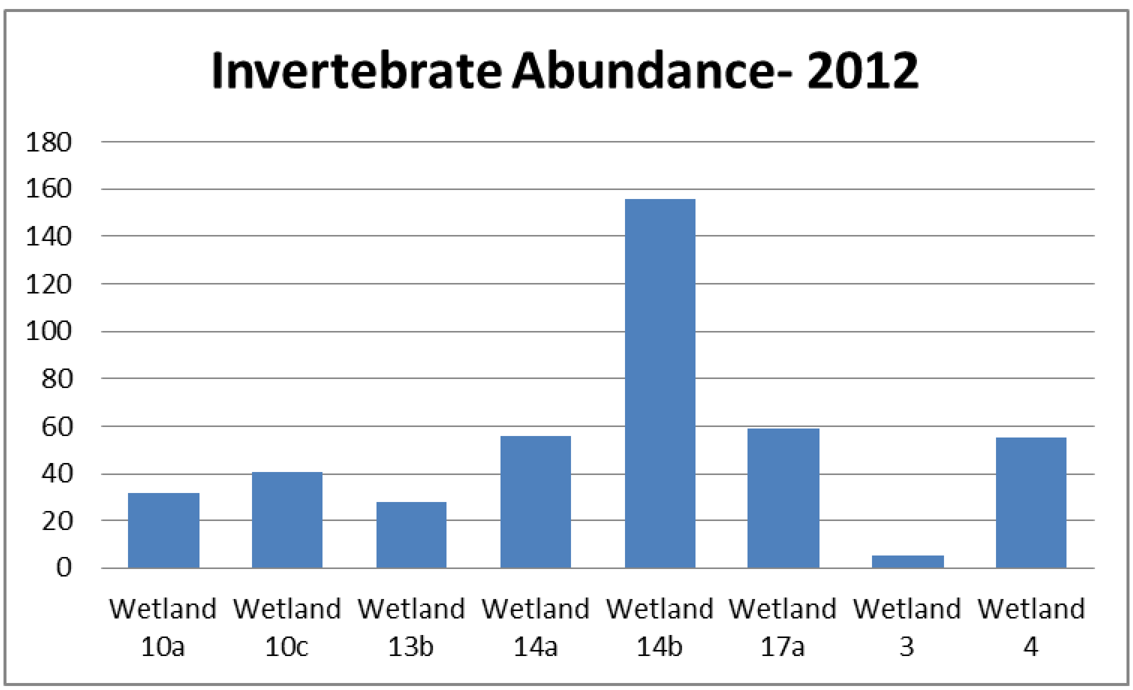
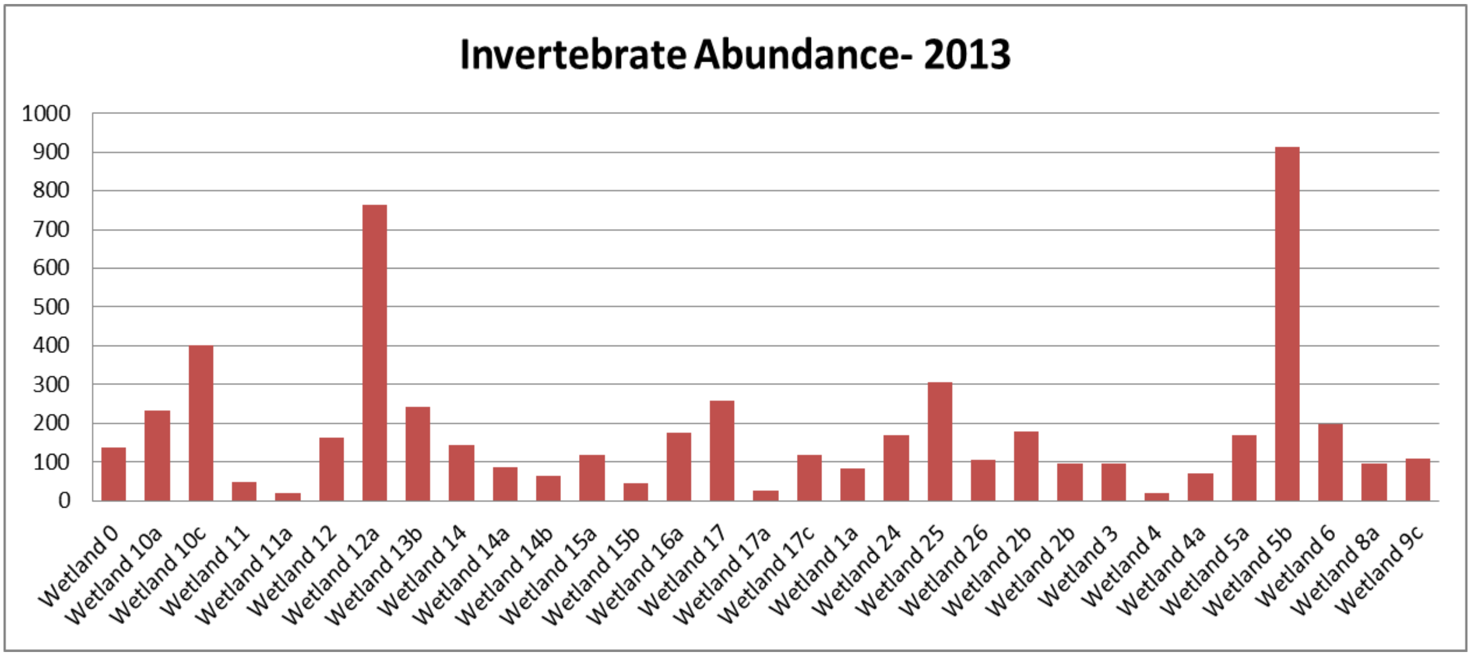
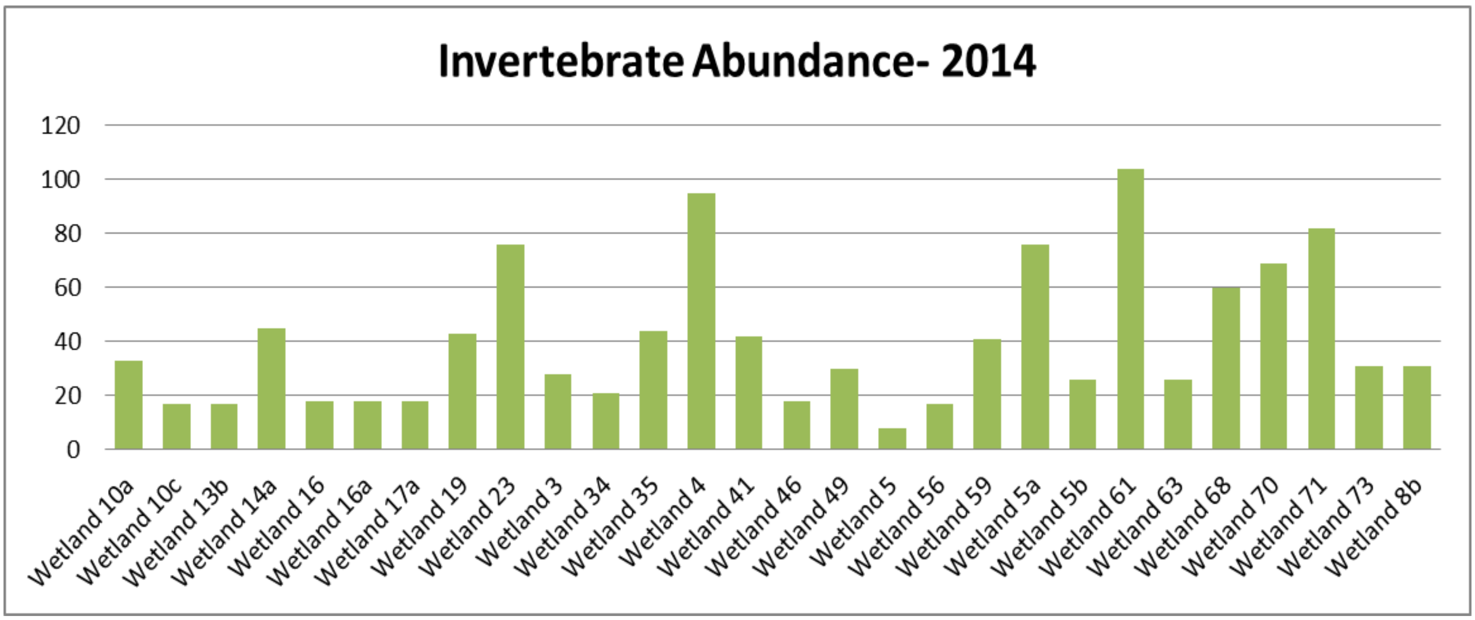


Figure 32. Invertebrate abundance for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).








A Common Green Darner Larvae collected in 2013

An invertebrate Index of Biotic Integrity (IBI) was calculated using the abundance of sensitive and tolerant organisms, This IBI is called the Simple IBI in this report. The Simple IBI scores are separated into three categories. Those wetlands that score below 3.33 are considered to have a good Simple IBI, between 3.33 and 6.66 are fair scores and above 6.66 are poor Simple IBI scores.

Simple IBI scores for Wetlands 10a, 13b 14a, 14b and 4 all increased from 2013 to 2012 however, declined again in 2014; in some cases below the 2012 scores. Wetlands 10c, 17a and 3 all had their highest Simple IBI score in 2012 (Figure 33).

In 2012 Simple IBI scores ranged from 5.31 to 7.5, in 2013 scores ranged from 5.31 to 8.43, and in 2014 scores ranged from 4.23 to 8.38 (Figure 34). The average scores in 2012, 2013, and 2014 was 6.56, 7.31 and 6.42, respectively.

Figure 33. An Invertebrate Simple IBI for wetlands sampled multiple years.

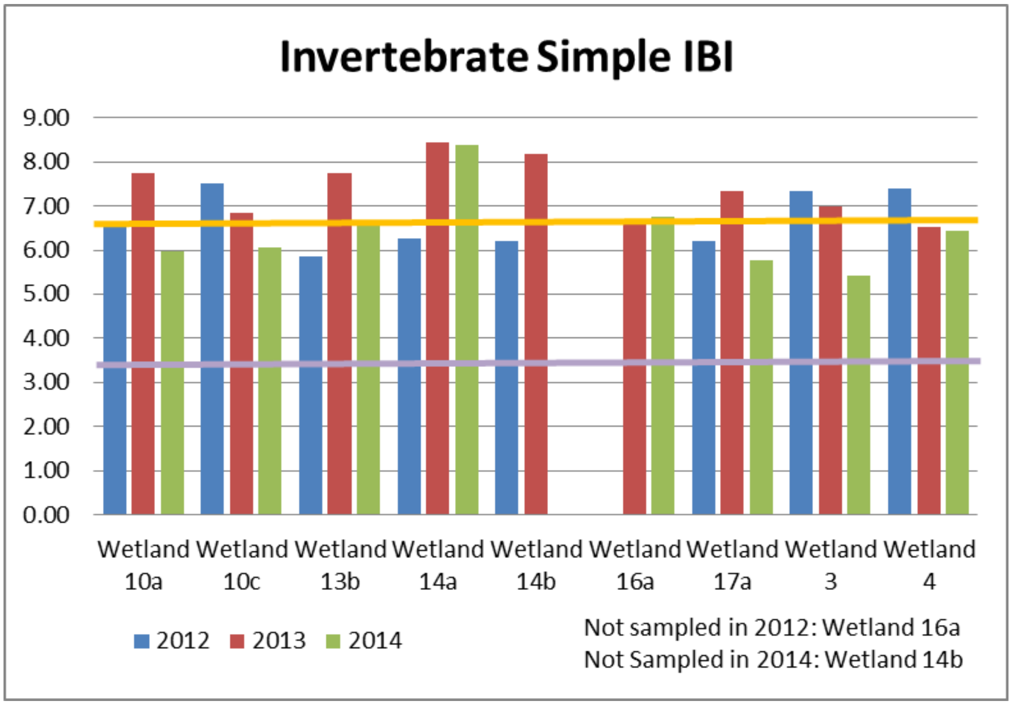
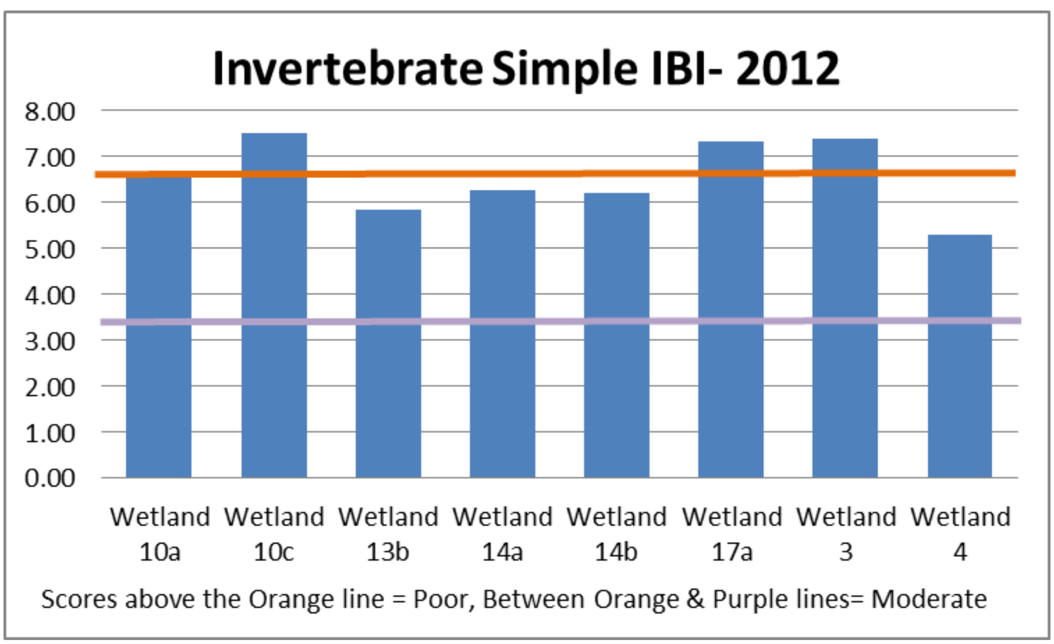
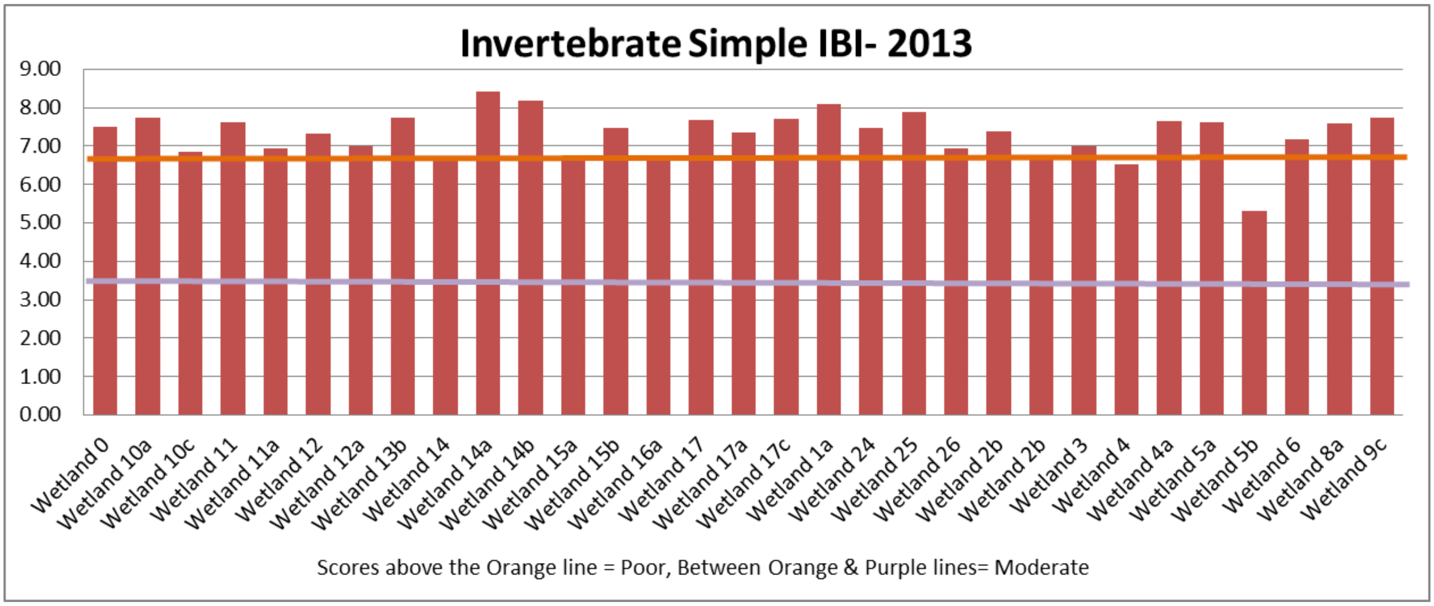
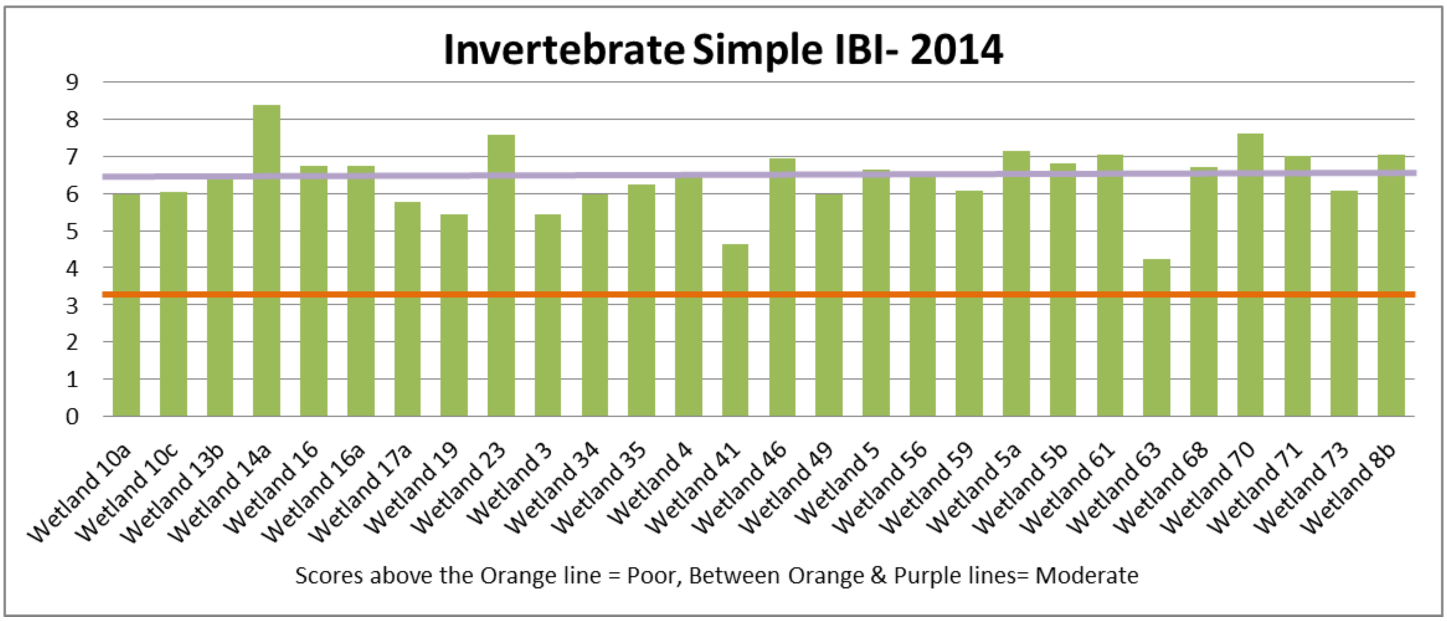


Figure 34. An Invertebrate Simple IBI for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).








A Water Scavenger Beetle collected in 2013

Another invertebrate Index of Biotic Integrity (IBI) based on wetlands was calculated using a method used by the Minnesota Pollution Control Agency (Helgen, 2002). This IBI is call the MN IBI in this report. The MN IBI scores are separated into three categories. Those wetlands that score 23 or higher are considered to have an excellent score, scores between 22 and 15 are moderate, and those 14 and below are poor.

MN IBI scores for Wetlands 10a, 10b, 13b 14a, 14b, 17a, and 3 all increased from 2012 to 2013 however, declined again in 2014; in some cases below the 2012 scores. Wetland 4 was the only score to decline from 2012 to 2013 but it rebounded in 2014 doubling its 2012 score (Figure 35).

In 2012 MN IBI scores ranged from ten to 14, in 2013 scores ranged from six to 20 and in 2014 scores ranged from six to 20 (Figure 36). The average scores in 2012, 2013, and 2014 were 11, 15 and 12, respectively.

Figure 35. The MN IBI for invertebrates for wetlands sampled multiple years.

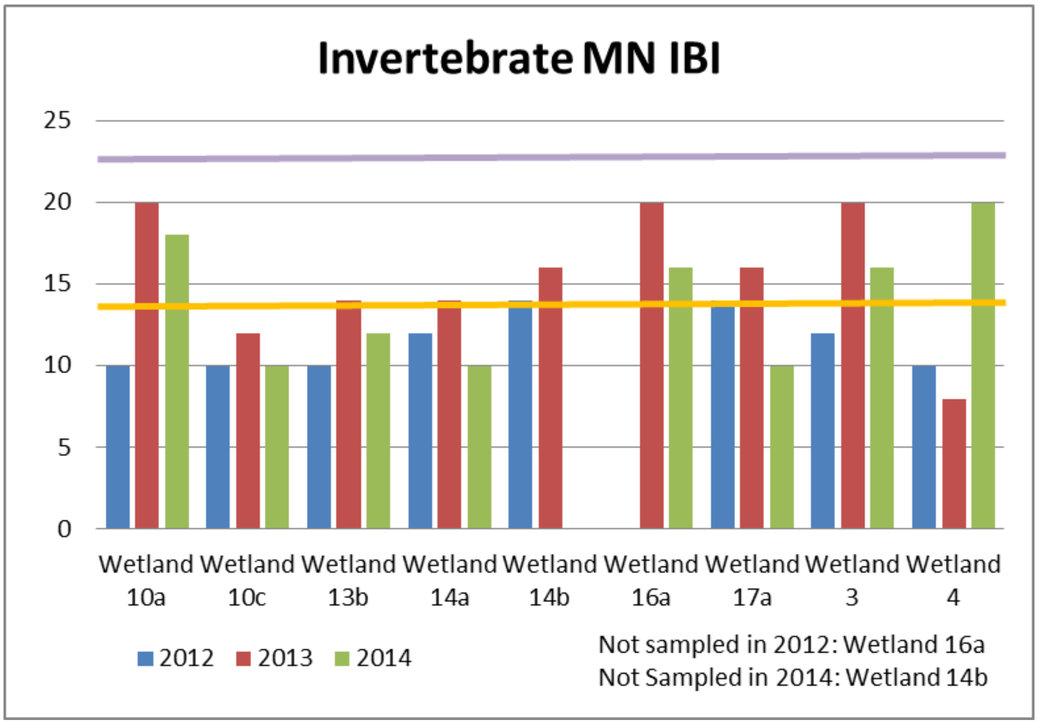
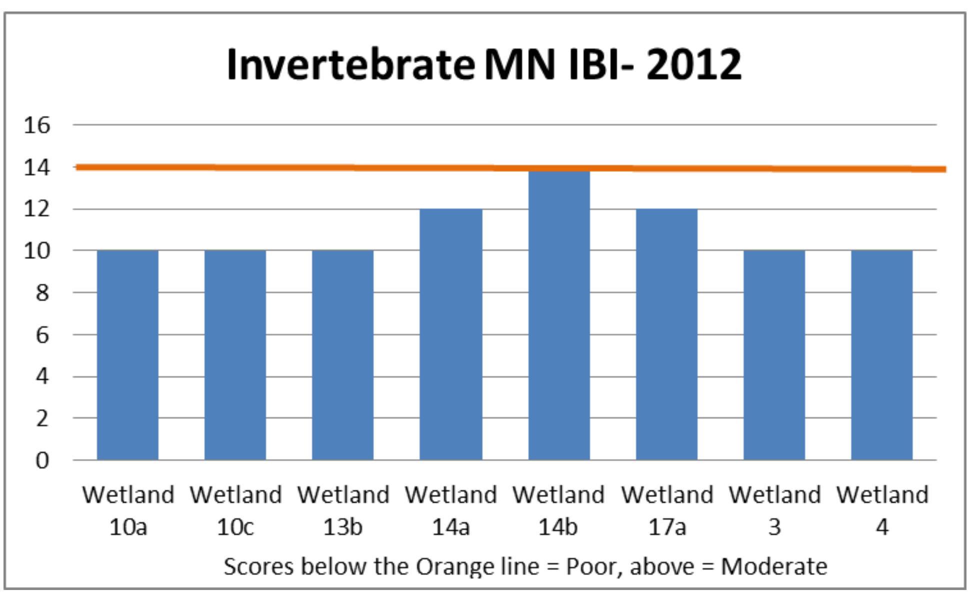
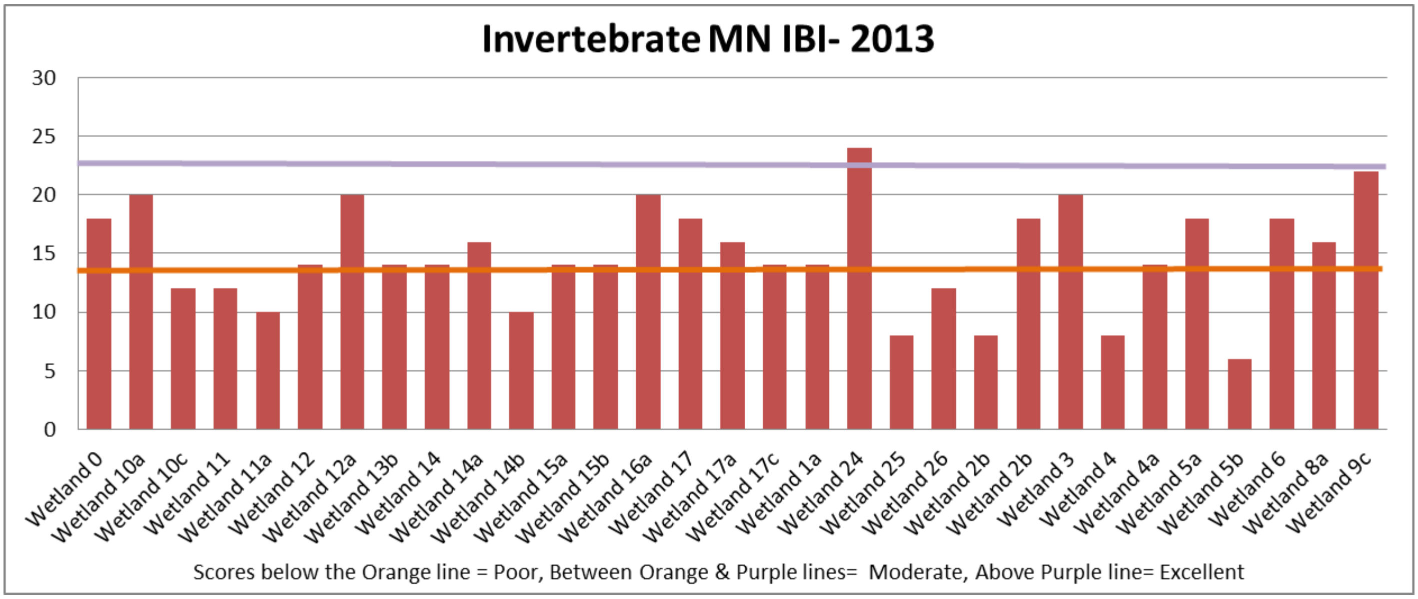
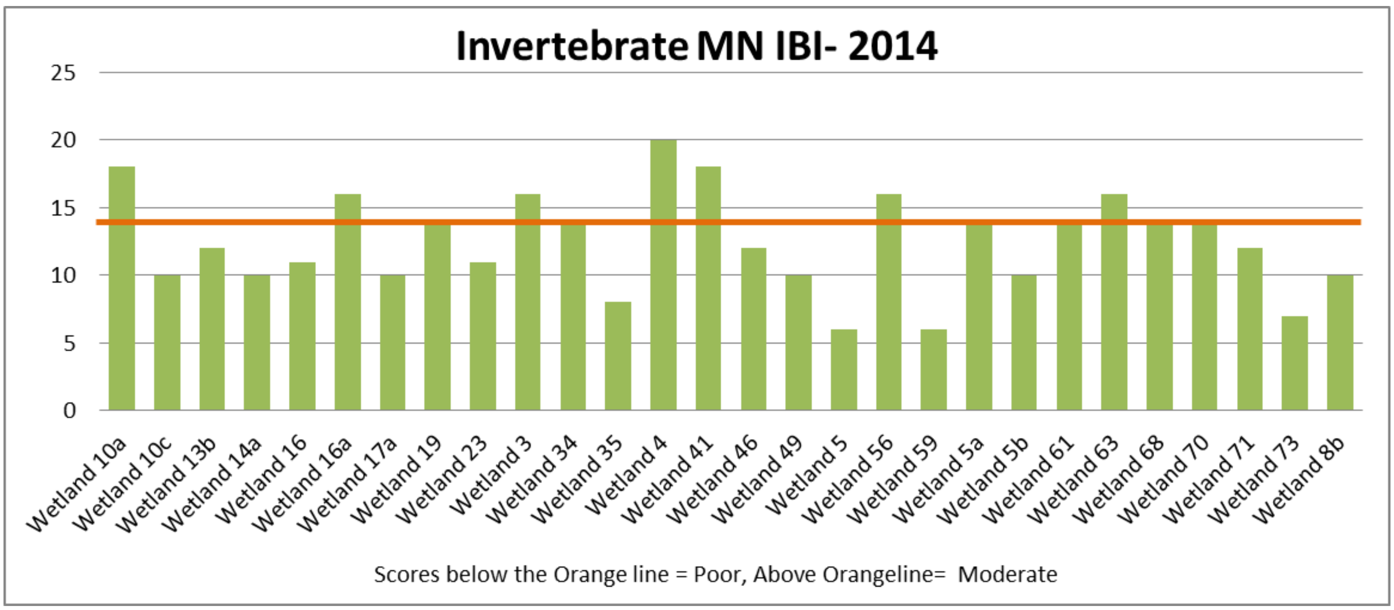


Figure 36. The MN IBI for all wetlands sampled in 2012 (in blue), 2013 (in red) & 2014 (in green).








Dragonfly Larvae Collected in 2013

Fish surveys were conducted using fyke nets at a total six wetlands in 2012, nine wetlands in 2013, and 20 wetlands in 2014 (Figures 37 and 38; Table 4). In 2012 there were five fish species collected, only one of which (green sunfish) was collected in more than one wetland. In 2013 a total of 22 fish species were collected, 12 of which were found in only one wetland. In 2014 a total of 35 species collected, eight of which were found in only one wetland.

Table 4. Summary of fish collected in wetlands 2012 to 2014.

	# of wetlands without Fish	# of Wetlands with Fish	# of Species	Most Abundant Species Captured	Most Common Species Captured
2012	2	4	5	Western Mosquito Fish, Green Sunfish, Central Mudminnow, Black Bullhead & Golden Shiner	Green Sunfish, Western Mosquito Fish, Central Mudminnow, Black Bullhead & Golden Shiner
2013	1	8	22	Fathead Minnow, Bluegill, Green Sunfish, Black Bullhead & Common Carp	Black Bullhead, Green Sunfish, Black Crappie, Golden Shiner
2014	0	20	35	Black Bullhead, Bluntnose Minnow, White Crappie, Common Shiner & Bluegill	Bluegill, Black Bullhead, Green Sunfish, White Cappie, Common Carp, Largemouth Bass

Three ***amphibian*** species were observed in wetlands sampled in 2012; tiger salamander found in Wetland 3 in Mitchell County, leopard frog and green frog both found in Wetland 4 in Mitchell County (Table 5). Five amphibian species were observed in wetlands sampled in 2013. Cricket frogs were the most common amphibian, occurring in five wetlands. Bullfrogs were observed in two wetlands. Tiger salamanders, leopard frogs and green frogs were observed in one wetland each. In 2014 six amphibians were observed and tiger salamanders were the most common found in four wetlands. Bullfrogs were found in three wetlands and American toads were found in two wetlands. Chorus frogs, green frogs and spring peepers were found in one wetland each in 2014.

Two species of turtles were collected in 2012. Painted turtles were found in two wetlands and a Blanding's turtle in Wetland 10c. Four species of turtle were found in wetlands surveyed in 2013. Painted turtles were the most common species collected in 2013 occurring in five of the nine wetlands sampled. Snapping turtles were found in two wetlands, and red-eared sliders and spiny softshell turtles were each found in one wetland in 2013. Five species of turtles were collected in 2014. Painted turtles were the most commonly collected turtle in 2014, collected in seven wetlands. Snapping turtles were collected in 2 wetlands in 2014 and false map turtles, red-eared sliders and Blanding's turtles were collected in one wetland each.

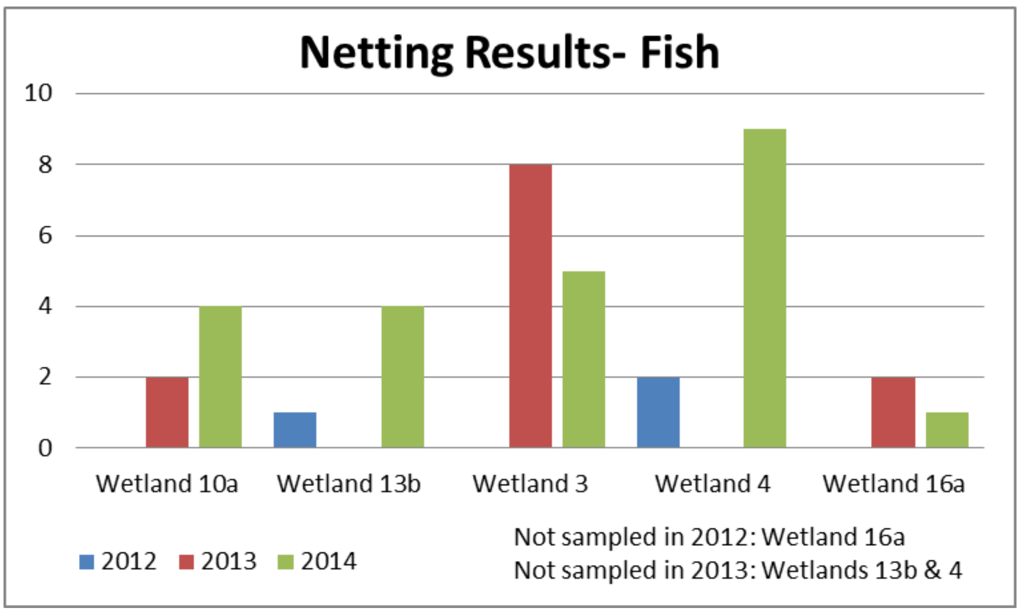
In 2014 four snake species were also collected. Brown snakes were collected in two wetlands. Northern water snake, bullsnake, and garter snake were collected in one wetland each in 2014. Snakes were not found in 2012 or 2013 in any of the wetlands sampled.

Brown Snake collected from Wetland 10c in 2014.

Table 5. Summary of herps collected in wetlands 2012 to 2014.

	Turtles	Wetlands present	Amphibians	Wetlands present	Snakes	Wetlands present
2012	Painted Turtle	Wetlands 10a & 3	Tiger Salamander	Wetland 3	None Found	
	Blanding's Turtle	Wetland 10c	Leopard Frog	Wetland 4		
			Green Frog	Wetland 4		
2013	Painted Turtle	Wetlands 10a , 12, 16a, 17 & 2b	Tiger Salamander	Wetland 16a	None Found	
	Red-eared Slider	Wetland 12	Cricket Frog	Wetlands 10c,12a & 5a		
	Snapping Turtle	Wetlandd 17 & 2b	Green Frog	Wetland 10a		
	Spiny Softshell Turtle	Wetland 17	Leopard Frog	Wetland 14b		
			Bullfrog	Wetlands 15a & 2a		
2014	False Map Turtle	Wetland 10a & 71	Tiger Salamander	Wetland 13b, 16a, 3 & 4	Bullsnake	Wetland 59
	Snapping Turtle	Wetlands 13b & 41	Bullfrog	Wetlands 5b & 61	Northern Water Snake	Wetland 70
	Painted Turtle	Wetlands 16a, 19, 41, 46, 59 & 61	American Toad	Wetlands 10a & 56	Garter Snake	Wetland 61
	Red-earred Slider	Wetland 17a	Chorus Frog	Wetland 73	Brown Snake	Wetlands 10c & 73
	Blanding's Turtle	Wetland 3	Green Frog	Wetland 16a		
			Spring Peeper	Wetland 16a		

Figure 37. Netting results for wetlands sampled multiple years.



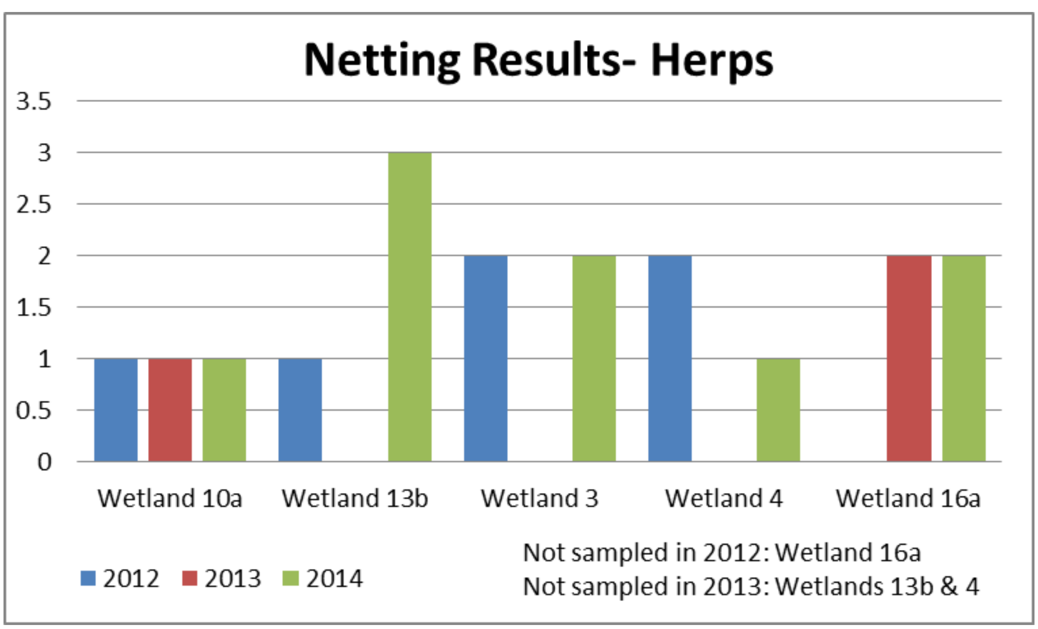
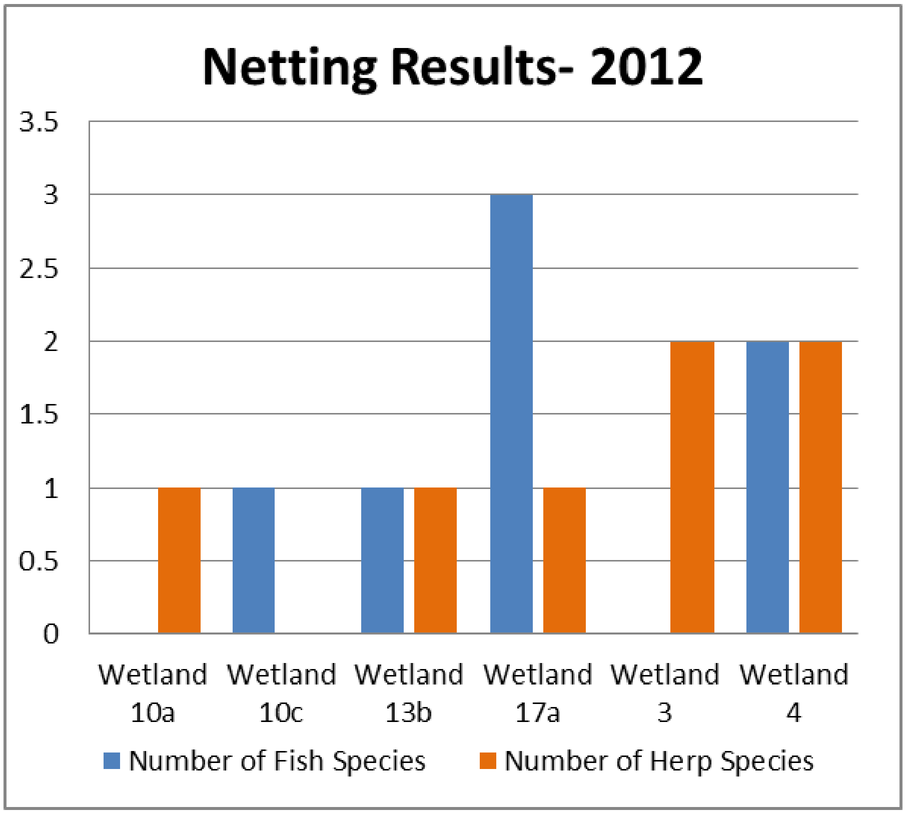
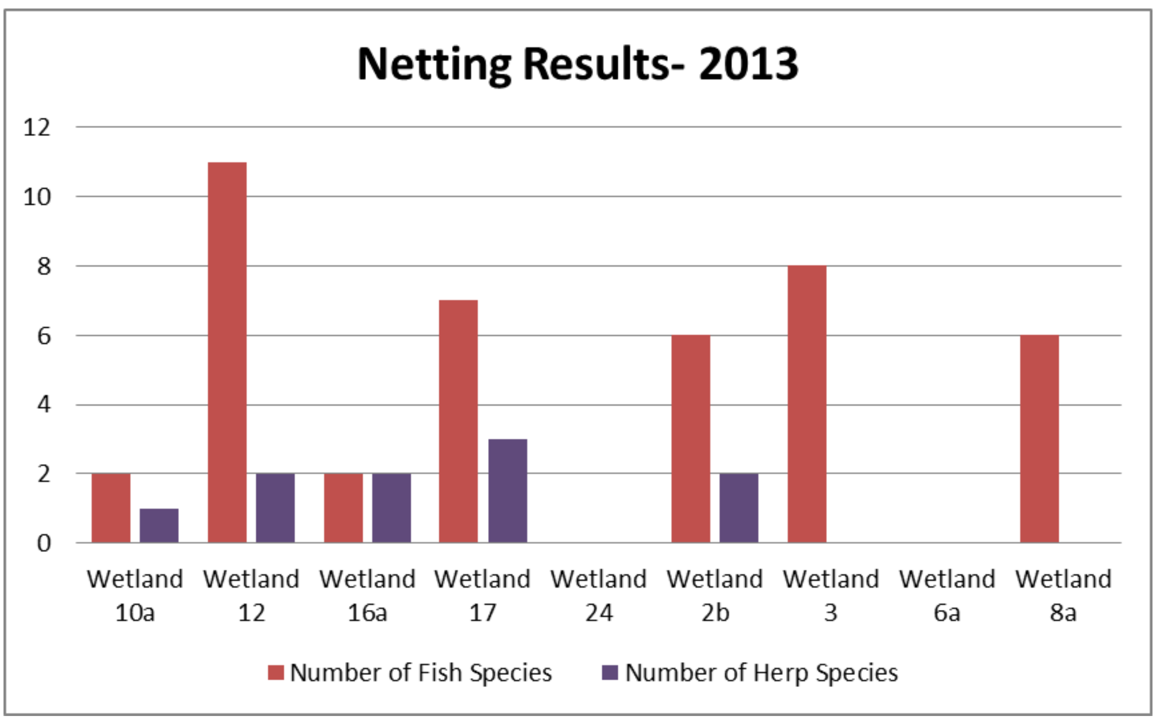
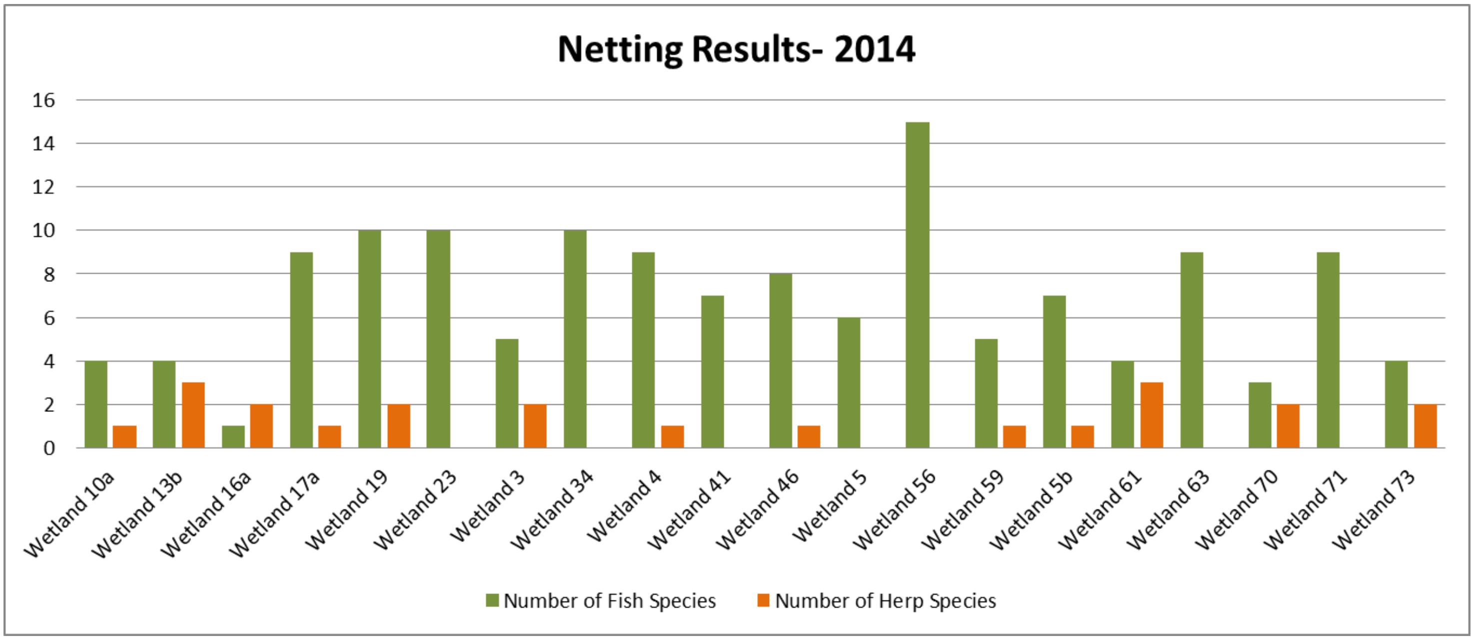


Figure 38. Fish and Herp netting results for all wetlands sampled in 2012 (in blue & orange), 2013 (in red & purple) & 2014 (in green & orange).







Vegetation surveys were conducted at a total 13 wetlands in 2012, 26 wetlands in 2013, and 12 wetlands in 2014 (Table 6). In 2012 there were 99 plant species observed including six invasive species, in 2013 there were 69 species including two invasive species, and in 2014 there were 57 species including two invasive species. The most abundant species observed in wetlands for each year is listed in table 6.

Table 6. Summary of Vegetation Surveys conducted in wetlands 2012 to 2014.

	# of Wetlands Surveyed	# of Veg Species	# of Invasive Species	Most Abundant Species Observed
2012	13	99	6	Lesser Duckweed, Wolffia, River Bulrush, Reed Canary Grass, Water Smartweed
2013	26	69	2	Reed Canary Grass, Water Smartweed, Lesser Duckweed, Flatstem Pondweed, Coontail, Arrowhead & Filamentous Algae
2014	12	57	2	Algae, Lesser Duckweed, Elodea, Flatstem Pondweed & Coontail

From 2012 to 2014 the number of invasive vegetation species found ranged from zero to two per wetland (Figures 39 and 40). The number and type of invasive species remained fairly consistent in revisit sites (Figure 39). In 2012 smooth brome, Canada thistle, creeping Charlie, reed canary grass, narrow leaf/hybrid cattail, and honeysuckle were the invasive species observed. Reed canary grass was observed in six wetlands, smooth brome in three wetlands and all other invasive species were found in just one wetland each in 2012. In 2013 reed canary grass was found in 21 wetlands surveyed and curly-leaf pondweed was only found in Wetland 24 located in the Mississippi River floodplain in Allamakee County. In 2014 reed canary grass was observed in ten wetlands and creeping Charlie was found in three wetlands surveyed. In many wetlands, reed canary grass was present primarily around the margins of the wetland or in wetlands it had colonized in 2012 when water levels were low and conditions were more favorable for its advance. The highest percent cover of reed canary grass in any one wetland surveyed in 2012 was 5%, in 2013 was 10%, and in 2014 was 14%.

Figure 39. Number of invasive species collected for wetlands surveyed multiple years.

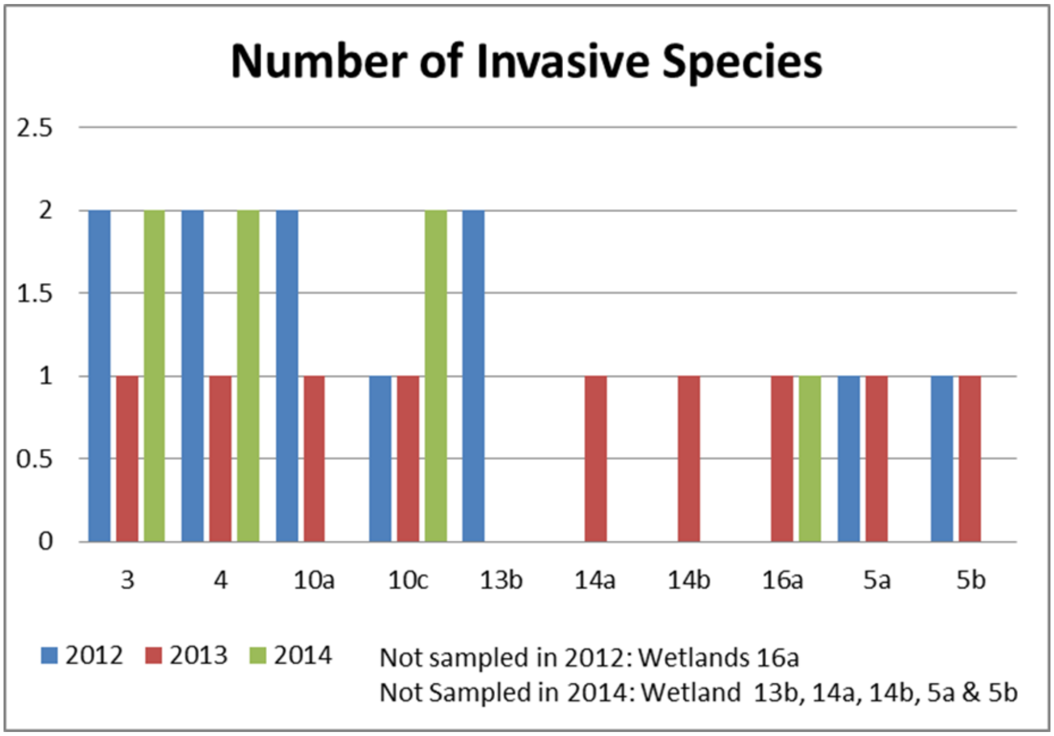
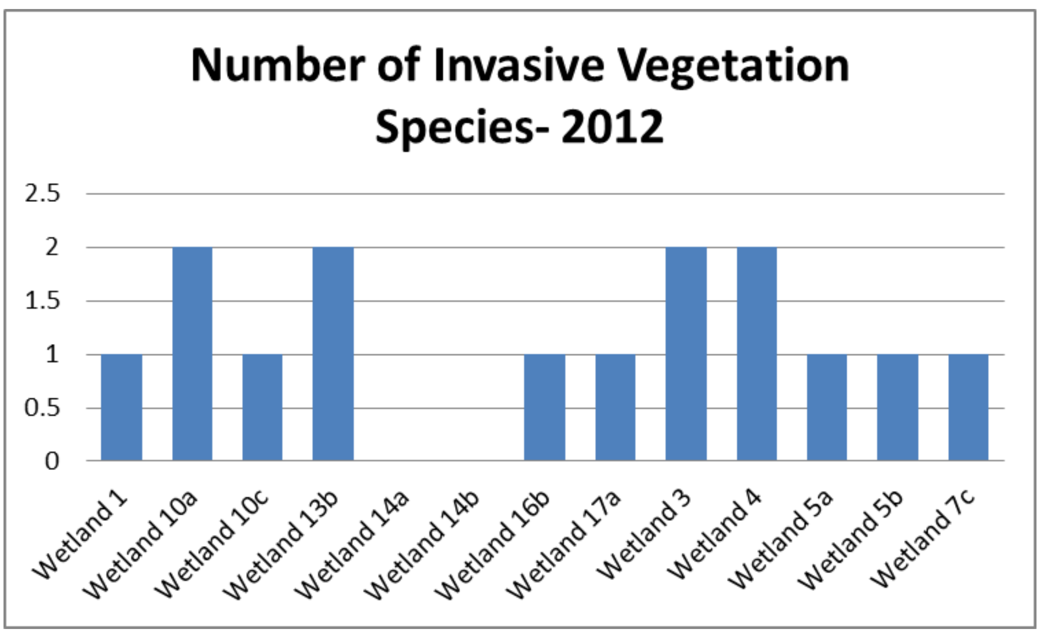
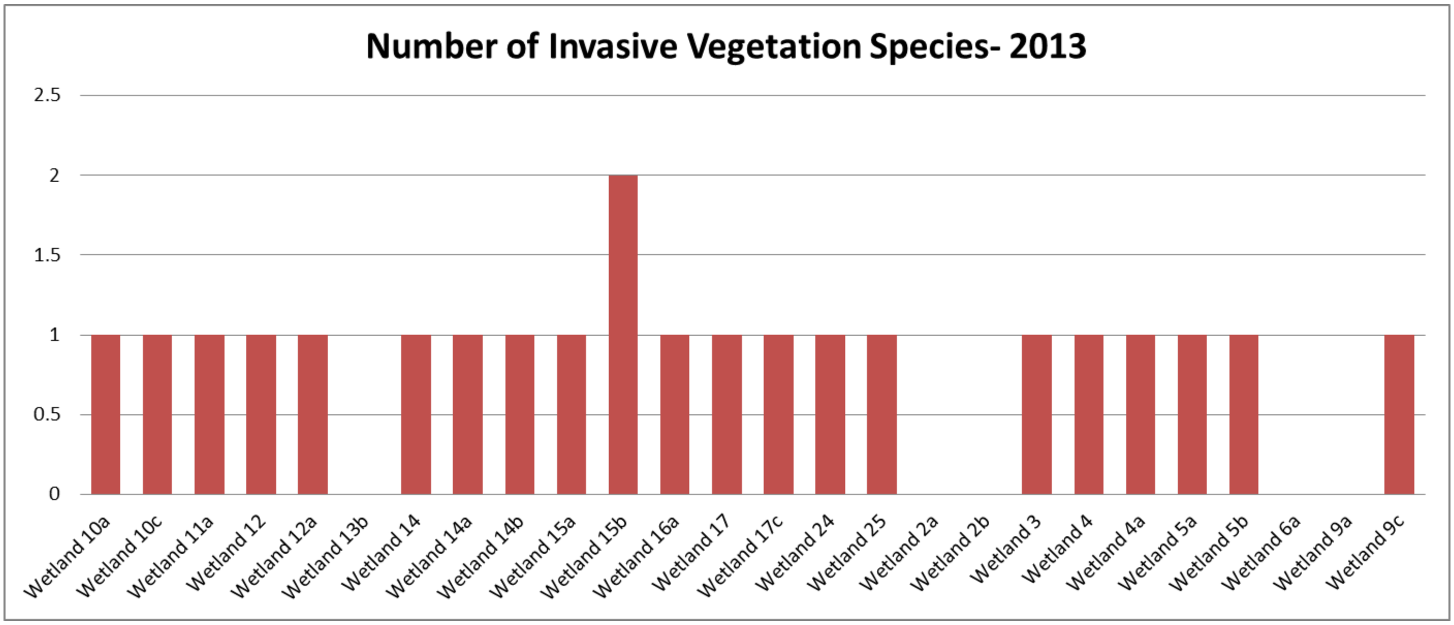
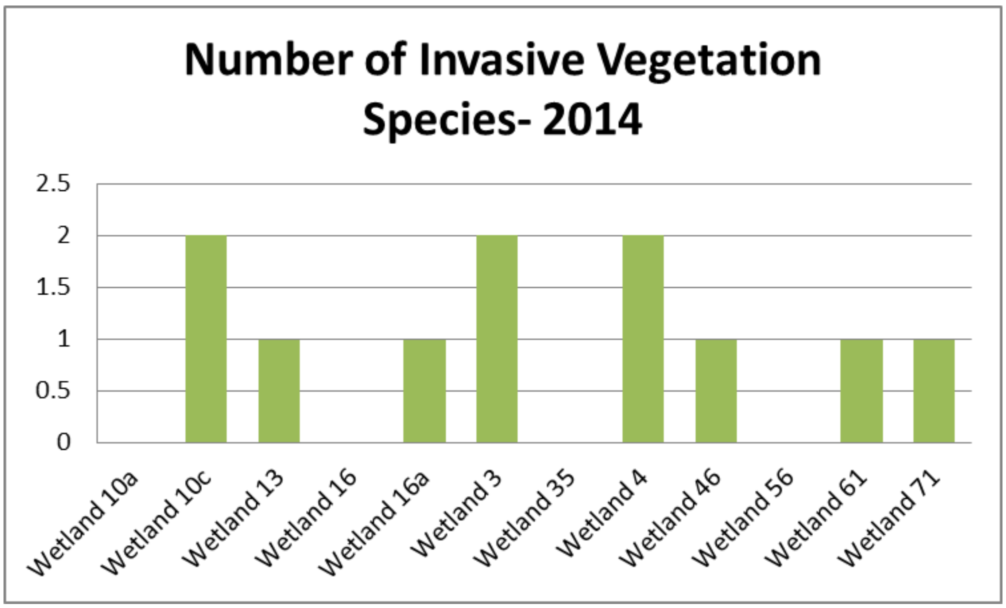


Figure 40. Number of invasive species collected for all wetlands surveyed in 2012 (in blue), 2013 (in red) & 2014 (in green).








Curly-leaf Pondweed found in Wetland 24 in 2014.

In 2012 Vegetation cover ranged from 19.8% to 96% cover (Figures 41 and 42). In 2013 percent cover was as low as 5.5% to as high as 96.65% cover. In 2014 percent cover ranged from 2% to 81%. The average percent vegetation cover in 2012, 2013, and 2014 were 58%, 54%, and 41%, respectively.

Figure 41. Percent vegetation cover for wetlands surveyed multiple years.

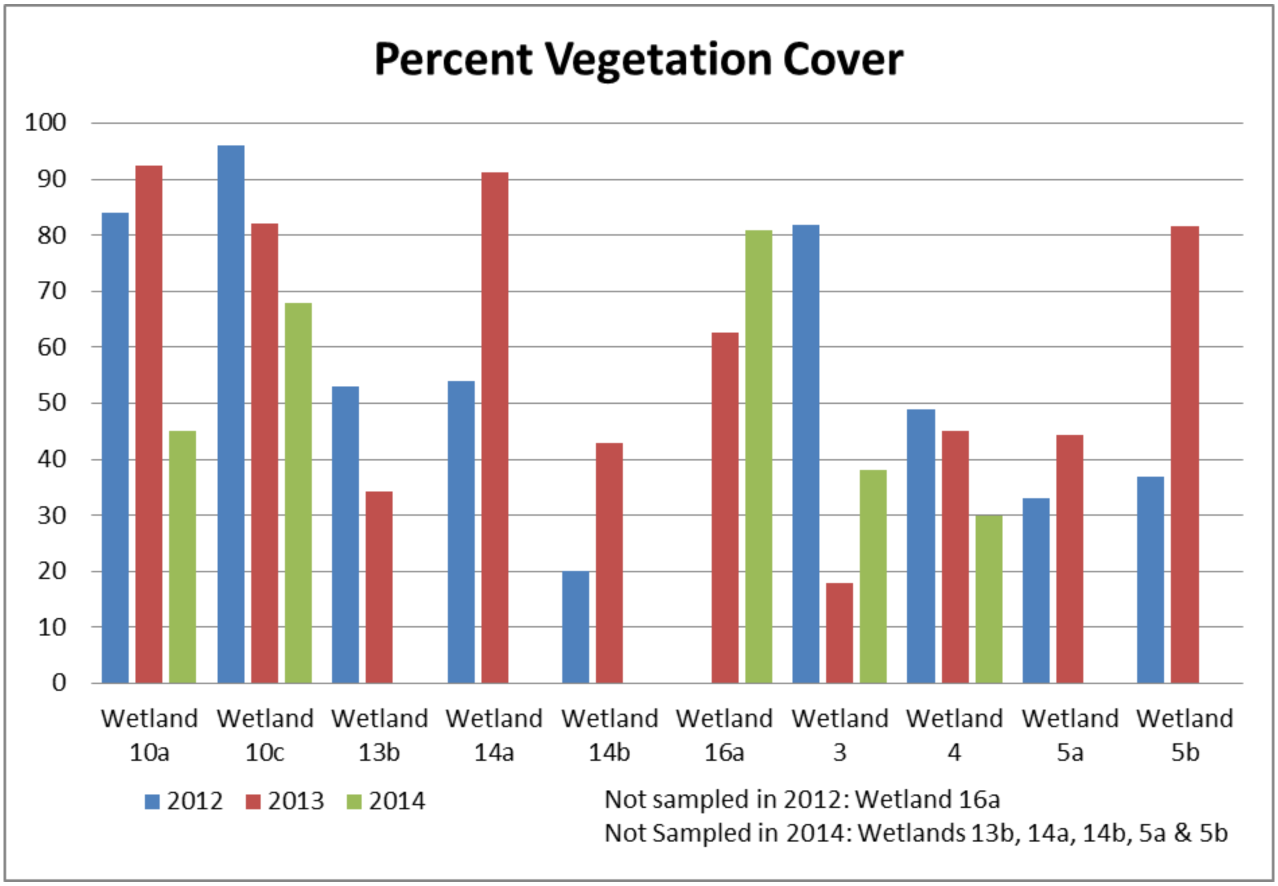
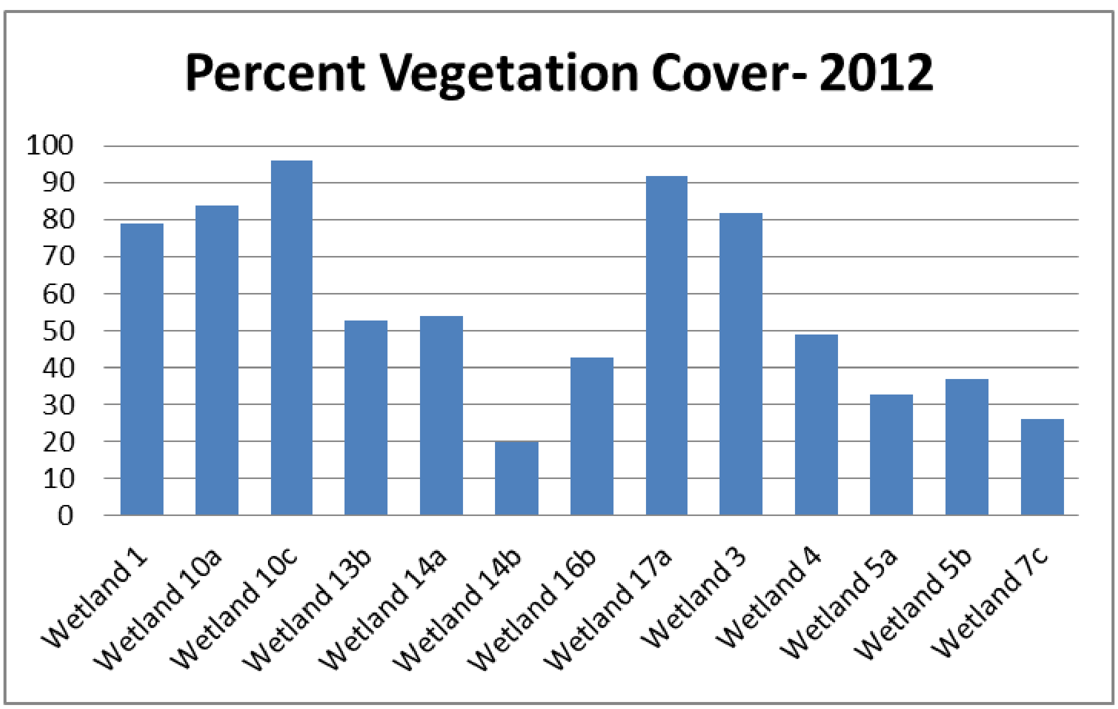
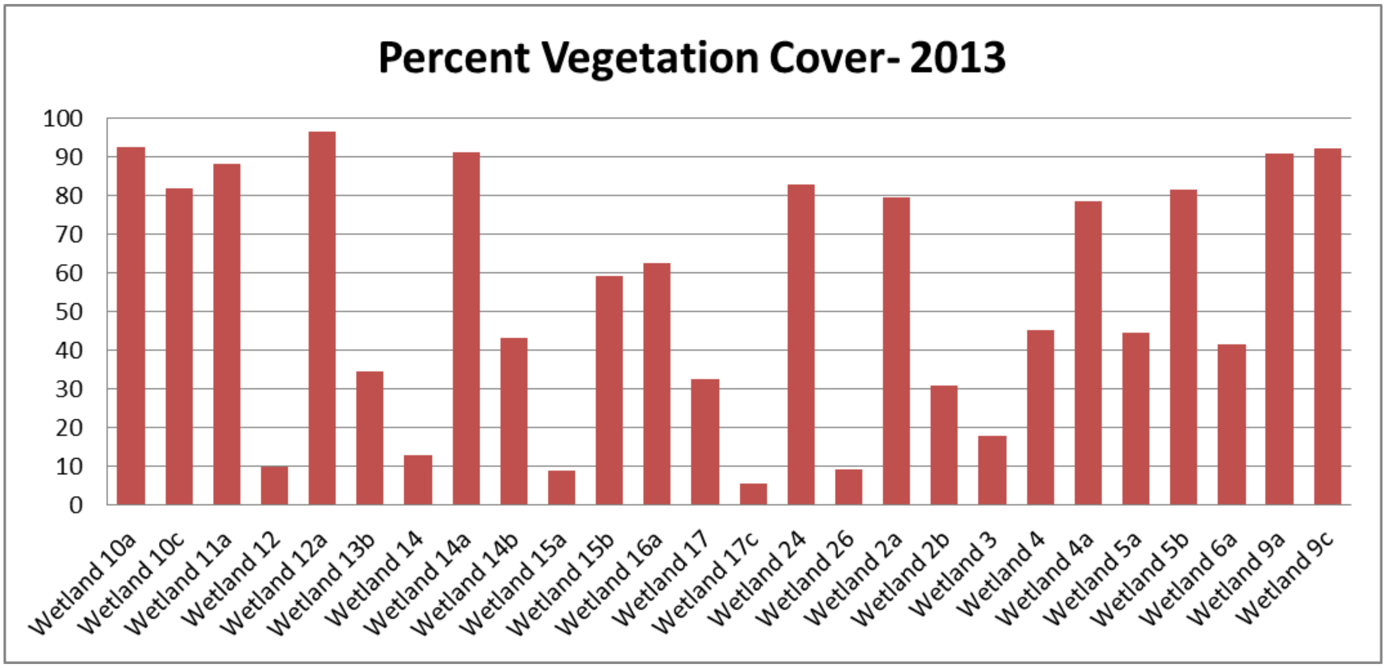
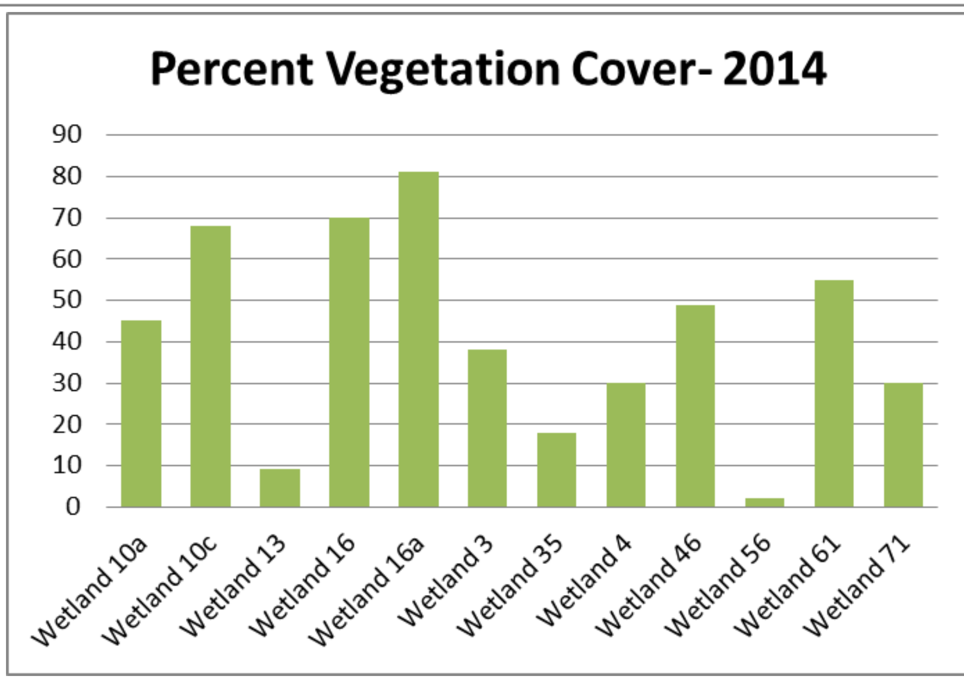


Figure 42. Percent vegetation cover for all wetlands surveyed in 2012 (in blue), 2013 (in red) & 2014 (in green).








Wetland 12 in Louisa County with low % vegetation cover


Wetland 14a in Henry County with high % vegetation cover

Vegetation species richness ranged from four species to 23 species in 2012 (Figures 43 and 44). In 2013 species richness ranged from three to 22. In 2014 species richness ranged from three to 26. The average vegetation species richness in 2012, 2013, and 2014 were 15, 12, and 13, respectively. Wetland 16a in Allamakee County was the most diverse wetland in our surveys, and also home to six species of plants not found in any other wetland surveyed. One of these plants was swamp loosestrife which is endangered in the state of Iowa.

Many of the species observed during vegetation surveys were not widespread throughout most wetlands. This reflects the varied conditions which exist throughout Iowa's riverine wetlands and floodplains from the Missouri to the Mississippi River. Of the 99 total species observed in 2012 vegetation surveys, 58 of them were found in only one wetland. In 2013 of the 68 total species recorded, 31 of them were found in only one wetland. In 2014 of the 57 total species recorded, 29 of them were found in only one wetland.

Figure 43. Vegetation species richness for wetlands sampled multiple years.

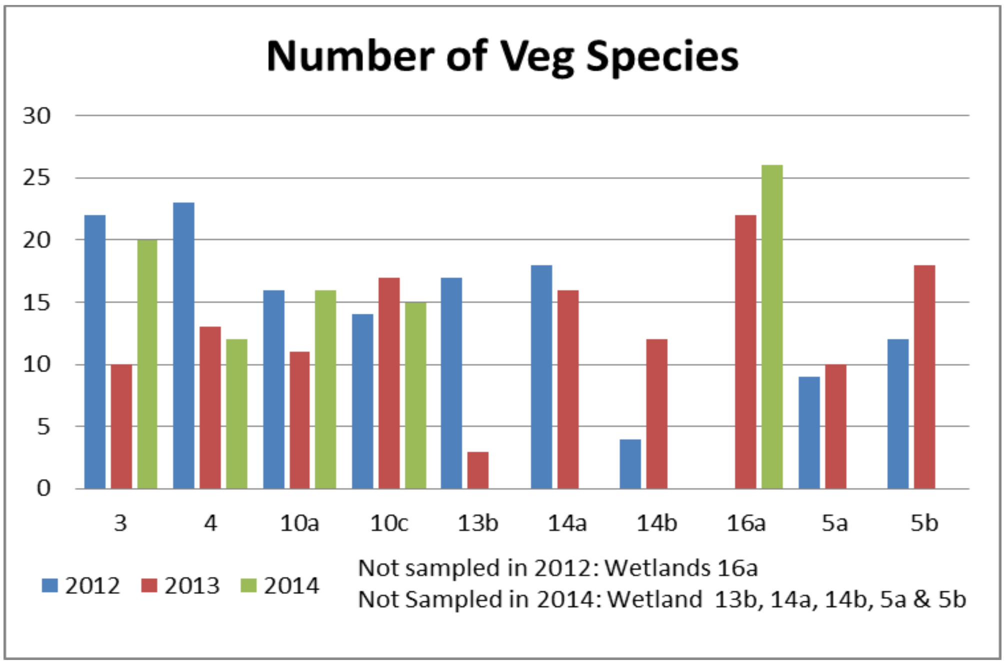
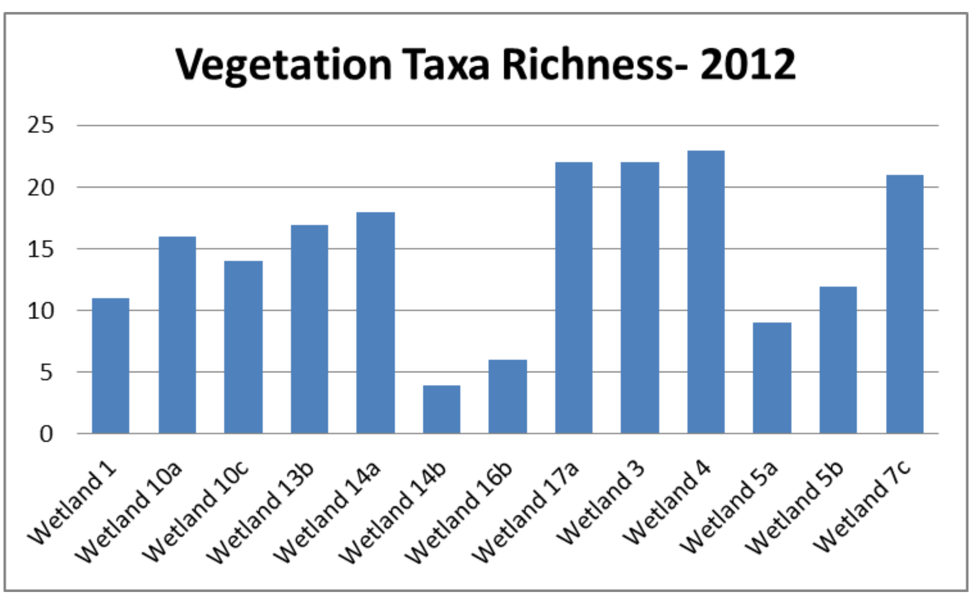
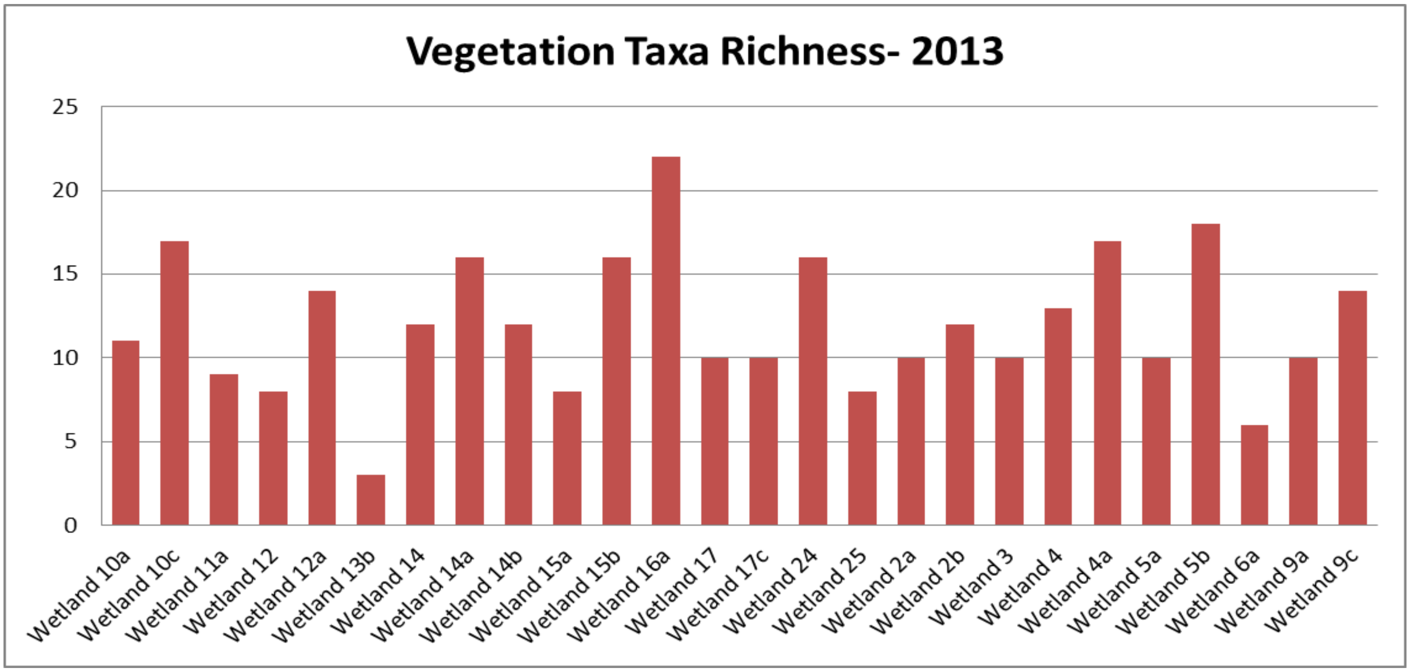
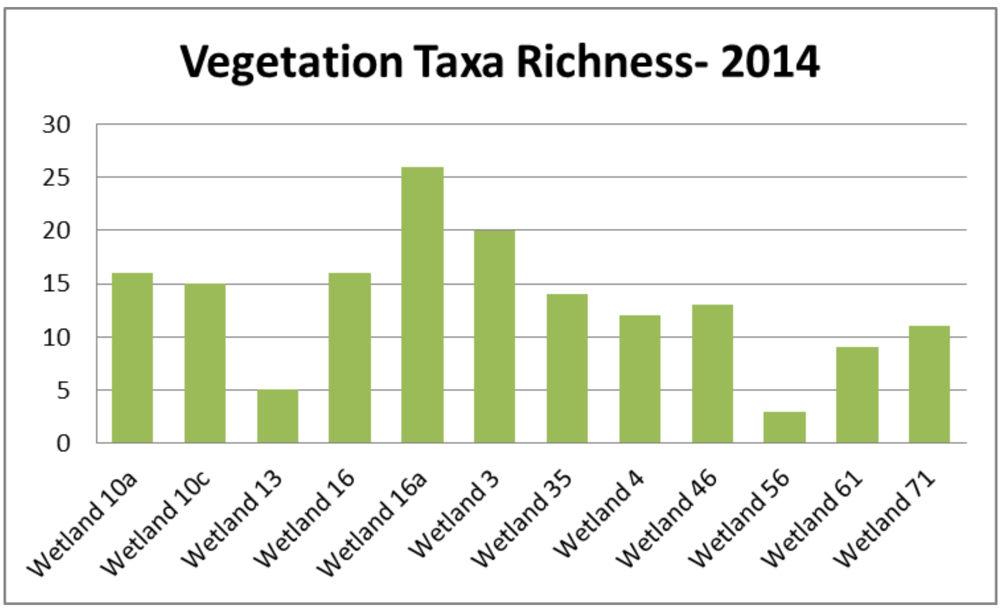


Figure 44. Vegetation species richness for all wetlands surveyed in 2012 (in blue), 2013 (in red) & 2014 (in green).







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