The Effects of Seasonal Wetland Drawdowns on Water Quality and Biodiversity

Ashley Simmons

Department of Sciences & Mathematics, Saint Mary-of-the-Woods College, Saint Mary-of-the-Woods, IN 47876

Indiana Department of Natural Resources

Introduction

Wetlands remain to be one of the most valuable ecosystems in the world by providing countless services. These include natural products, climate and air regulation, water purification, carbon storage, flood control, etc. From the 1780s to 1980s, Indiana has lost more than 95% of its original wetlands. Therefore, efficient management is urgent for wetland protection. To replicate natural occurring fluctuations of water, wetland property managers will do artificial seasonal drawdowns on specific wetland sites to control water levels. This study assessed the effects of fall season drawdowns on the water quality and biodiversity of wetlands at Goose Pond Fish & Wildlife Area by tracking the water quality and macroinvertebrate biodiversity pre-drawdown and post-drawdown season.

It was hypothesized that water quality and macroinvertebrate biodiversity will decrease following a seasonal drawdown.

Materials and Methods

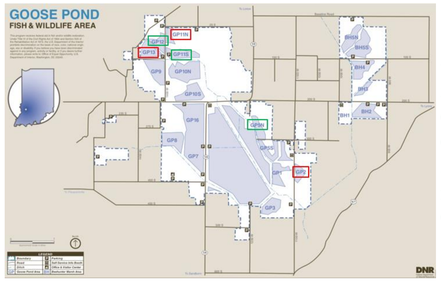


Figure 1. Study done on 6 lentic wetland units---3 drawdown: GP2, GP11N, GP13 (in red) and 3 that were not: GP5N, GP11S, GP12 (in green).

- Water Quality and Macroinvertebrate Sampling
- Nitrate/Phosphate/Turbidity Tests
- Separation and Identification of Macroinvertebrates
- BOD Measurements
- Calculation of Water Quality Scores
- Calculation of Simpson's Indexes of Diversity

Figure 2. Separating and identifying macroinvertebrate samples.

Figure 3. Collecting water samples in GP11N.

Results & Discussion

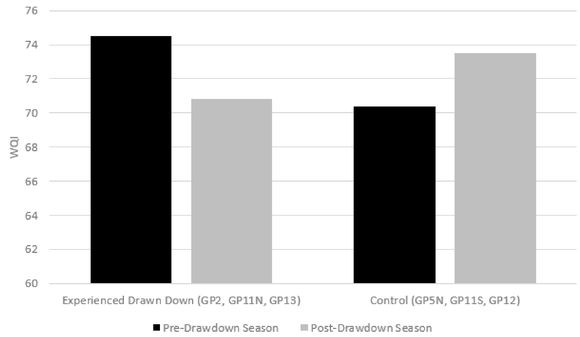
Table 1. Water Quality Index (WQI) scores before and after seasonal drawdown.

Treatment Group	n	$M_{pre\text{-}season}$	$SD_{pre\text{-}season}$	$M_{post\text{-}season}$	$SD_{post\text{-}season}$
N	6	-	-	-	-
Experienced Draw Down (GP2, GP11N, GP13)	3	74.5	6.0	70.8	0.7
Control (GP5N, GP11S, GP12)	3	70.4	3.4	73.5	1.5

Table 2. Two-way ANOVA for the effects of season and drawdown treatment on water quality.

	SS	df	*MS*	*F*	*p*
Season	.282	1	.282	.023	.884
Treatment Group	1.44	1	1.44	.117	.742
Season + Treatment Group	35.9	1	35.9	2.90	.127

Figure 4. Mean Water Quality Index (WQI) before and after seasonal drawdown.



During drawdown season, water quality decreased in pools that were drawn down (M_{pre} = 74.5, SD_{pre} = 6.0; M_{post} = 70.8, SD_{post} = .7), while water quality increased in pools that were not drawn down (M_{pre} = 70.4, SD_{pre} = 3.4; M_{post} = 73.5, SD_{post} = 1.5) (Table 1, Figure 4).

No statistically significant interaction between the effects of season and treatment group [$F(1, 8) = 2.90$, $p = .127$] (Table 2). Simple main effects analysis also showed that neither season or treatment group alone have a statistically significant effect on water quality ($p = .884$, $p = .742$, respectively).

Table 3. Simpson's Index of Diversity (1-D) scores before and after seasonal drawdowns.

Treatment Group	n	$M_{pre\text{-}season}$	$SD_{pre\text{-}season}$	$M_{post\text{-}season}$	$SD_{post\text{-}season}$
N	6	-	-	-	-
Experienced Draw Down (GP2, GP11N, GP13)	3	.83	.04	.74	.04
Control (GP5N, GP11S, GP12)	3	.53	.37	.36	.34

Table 4. Two-way ANOVA for the effects of season and drawdown treatment group on biodiversity.

	SS	df	*MS*	*F*	*p*
Season	.050	1	.049	.768	.406
Treatment Group	.349	1	.349	5.46	.048
Season + Treatment Group	.004	1	.004	.067	.803

Figure 5. Simpson's Index of Diversity (1-D) scores before and after seasonal drawdowns.

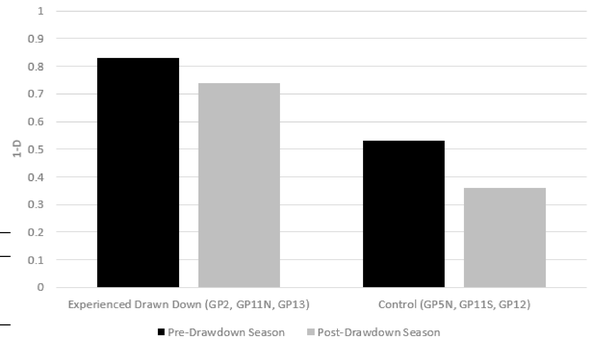


Table 5. Tukey HSD post-hoc pairwise comparisons for the effect of drawdown treatment group on biodiversity.

Group 1	Group 2	*M*	*SE*	*p*	*d*
GP5N (control)	GP2	.727	.068	1.53 E^{-7}	4.31**
GP5N (control)	GP11N	.671	.068	8.00 E^{-7}	3.98**
GP5N (control)	GP13	.654	.068	1.30 E^{-6}	3.88**
GP5N (control)	GP11S (control)	.714	.075	1.79 E^{-6}	4.24**
GP5N (control)	GP12 (control)	.398	.075	.009	2.36**
GP2	GP12 (control)	.329	.068	.019	1.95*

Note: *very large effect size (Cohen's d > 1.2), ** huge effect size (Cohen's d > 2.0)

During drawdown season, biodiversity decreased in all pools, regardless of whether they were drawn down (M_{pre} = .83, SD_{pre} = .04; M_{post} = .74, SD_{post} = .04) or not drawn down (M_{pre} = .53, SD_{pre} = .37; M_{post} = .36, SD_{post} = .34) (Table 3, Figure 5).

No statistically significant interaction between the effects of season and treatment group [$F(1, 8) = .067$, $p = .803$] (Table 4). Season did not have a statistically significant effect on biodiversity ($p = .406$), but biodiversity was significantly lower in GP5N, and GP2 was significantly more biodiverse than GP12 (Table 5).

Conclusions

- Drawdowns seems to have no significant effect on water quality.
- Drawdowns seems to have no significant effect on biodiversity.
- GP5N is less diverse than all other pools.

Future Work

- The effect of drawdowns on waterfowl biodiversity.
- Drawdowns and fish die-offs.
- Compare fall vs. spring drawdowns.
- Extend drawdown research at Everglades National Park.

Literature cited

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