Bartel Grassland Trends
2002-2011

Audubon Chicago Region
April, 2012

In 2002, the Bartel Grassland partners completed a management plan for the site that contained three major goals:

1. To restore the natural hydrology of the site as much as possible while increasing the amount of breeding habitat for grassland birds.

2. To develop low-maintenance, fire-managed permanent native grassland that is good habitat for grassland birds, especially those of wet-mesic and wet grasslands, and for other wildlife.

3. To establish wetlands with a diversity and abundance of conservative plant species that provide habitat for a range of wetland wildlife.

To accomplish these goals, management has included the disabling of drain tiles, extensive seeding and plugging with native species, controlled burns, herbiciding of aggressive invasive species, and mowing of tall goldenrod areas.

Ten years into the project, we have studied the vegetation and bird communities to determine the extent to which goals are being met and to evaluate the effectiveness of specific management practices.

Monitoring methods

In 2002 and again in 2010-11, we recorded all vegetation species and their percent cover within 120 quadrats (¼ m^2 size) across Bartel Grassland. The site was divided into six "plots" so that we may draw conclusions about management strategies or on-the-ground conditions that might differ across the site and might differentially affect plant or bird communities. (See Appendix A for locations of plots). Vegetation sampling was conducted for all plots in 2002; plots 1-3 were monitored again in 2010, while plots 4-6 were covered in 2011.

Within each of the six plots, we established four bird point count locations of 75-m radius (see Appendix A for locations). Annually since 2002 at least two points from each plot have been visited twice in June, and monitors have recorded all bird species seen or heard within the 75-m radius circles. We also have three years of data from 1999 to 2001, prior to the beginning of the restoration project, that were collected from 23 points along three transects that partially overlapped the six study plots.

Goal #1: Hydrologic restoration and grassland bird habitat

One of our questions when the project began was the degree to which the site would get wetter when drain tiles were disabled. We did not want to create "Lake Bartel" but rather to restore some of the original wetness to this grassland.

Bartel has, indeed, gotten wetter as drain tiles have been disabled, but overall the site remains grassland rather than open wetland, in keeping with our goals for the project. Figure 1 shows the average wetness index of the plant species recorded within the site's 120 quadrats before and after drain tile disabling (which occurred in 2002). Every plant species in Chicago Wilderness has been assigned a wetness coefficient, from -5 to +5, with smaller numbers indicating a preference for wet habitat. The smaller average wetness index of Bartel's 2010-11 species compared to 2002 species demonstrates that the site has gotten wetter and is favoring the establishment of wetter species.

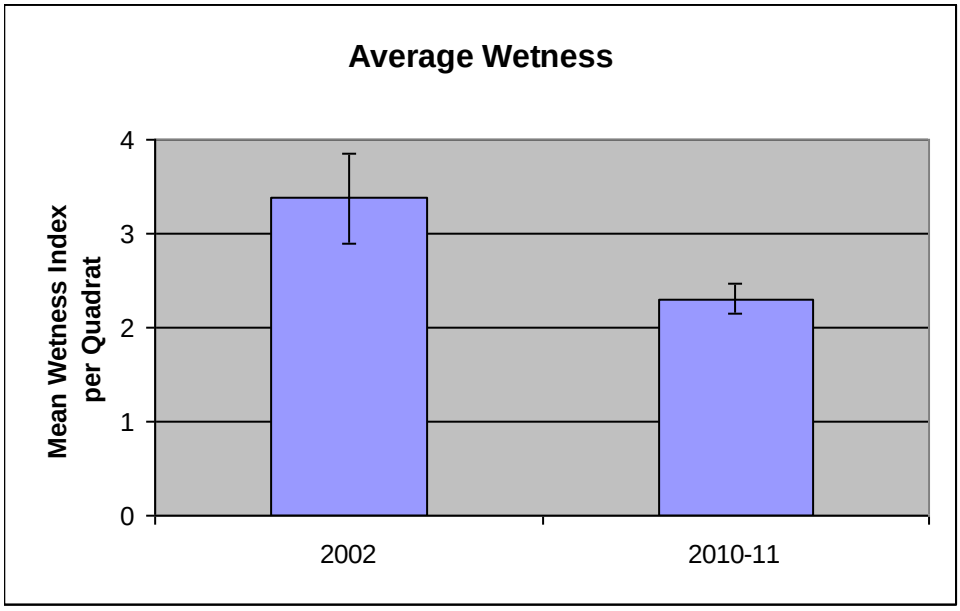


Figure 1. The average wetness index of vegetation within quadrats. Lower numbers indicate plants that prefer wetter habitat.

Looking at wetness within the six plots, we found that most plots have gotten wetter, especially plots 4 and 5 (see Fig. 2). Plot 2 has not changed, and plot 6 has gotten somewhat drier since 2002.

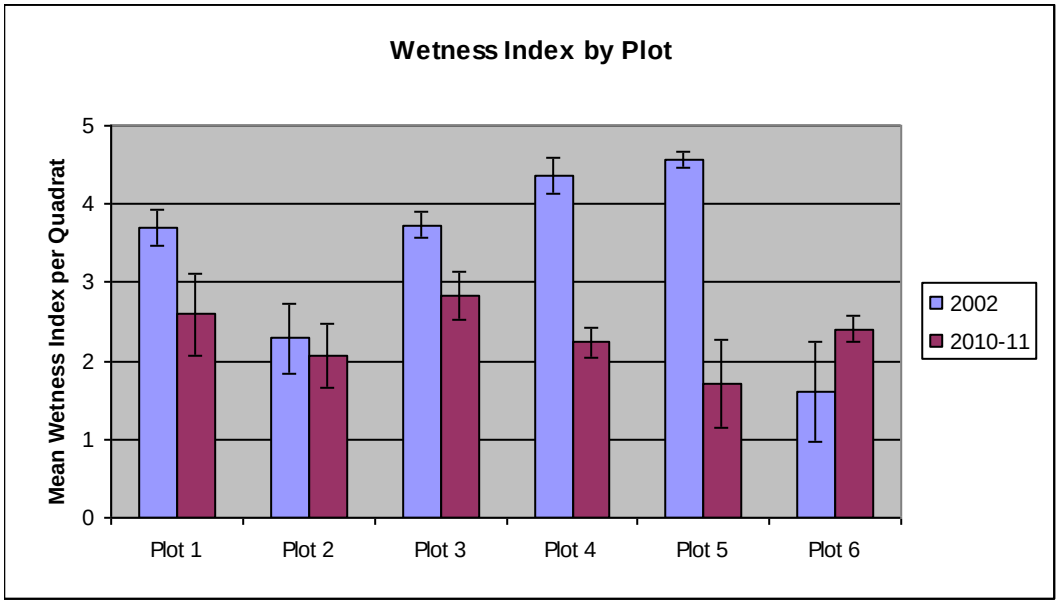


Figure 2.

Grassland Birds

One of the challenges currently facing restoration ecologists is to establish high quality prairies that provide good grassland bird habitat. Most of the region's best grassland bird habitat currently is found in old fields dominated by cool-season grasses, with little native plant diversity. Earlier prairie restorations that established large populations of tall, native grasses such as big bluestem and Indian grass proved to be poor grassland bird habitat. At Bartel, the goal is to maintain the high numbers of grassland birds that inhabited the site prior to the restoration, while also establishing a high quality native grassland.

Figure 3 shows that Bartel has continued to provide habitat for large numbers of grassland birds since the project's inception. After the site's hedgerows were removed in the winter of 2001-02, grassland bird numbers increased for several years. Since then bird numbers have fluctuated widely but have remained at or above pre-management levels, with the exception of the year 2009. The 2006 spike in numbers was seen for every grassland species except the Savannah Sparrow.

Looking at regionwide trends for grassland birds (see Fig. 4), we see roughly the same pattern of fluctuations as at Bartel, with a peak around 2006 and a decline from 2007 to 2009 (the year 2003 is an exception to this matching pattern). Thus, it seems likely that Bartel's year-to-year fluctuations in grassland bird numbers are due to factors beyond the site level, possibly including weather, food availability, or winter habitat conditions the prior year.

The important point for our purposes is that Bartel's grassland bird numbers have remained consistently high over the ten years of the project. In fact, the average number of grassland birds at Bartel was 10 birds per point (see Fig. 3), which was much higher than the regionwide average of two birds per point (see Fig. 4). Even when we include

only those regionwide sites that are considered good grassland bird habitat (having at least one year with at least four grassland species), Bartel still ranks higher, with the regionwide average being seven birds per point (data not shown here). These results provide strong evidence that Bartel is providing important habitat for grassland birds.

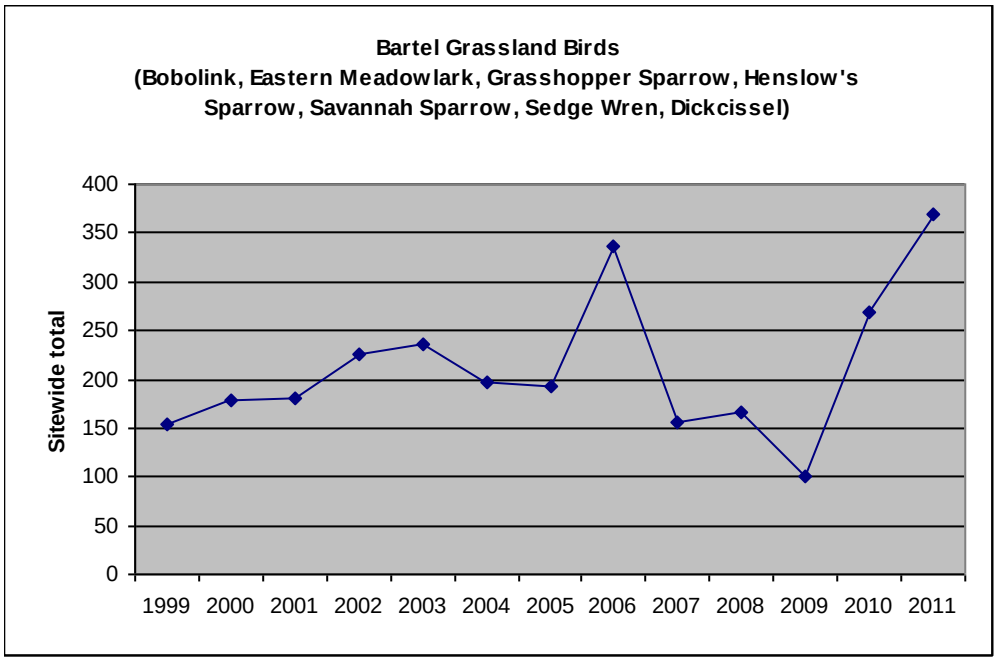
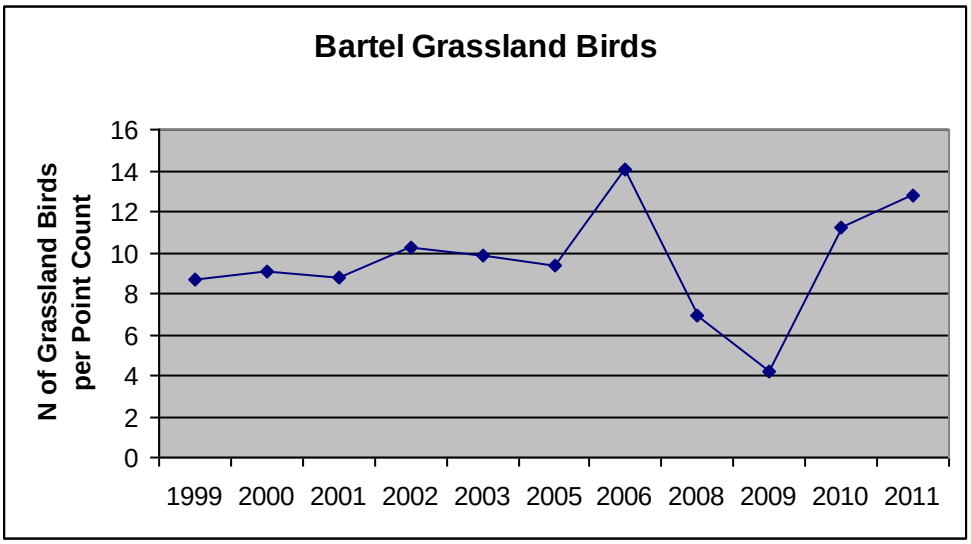


Figure 3. The total number of grassland birds at Bartel over time.



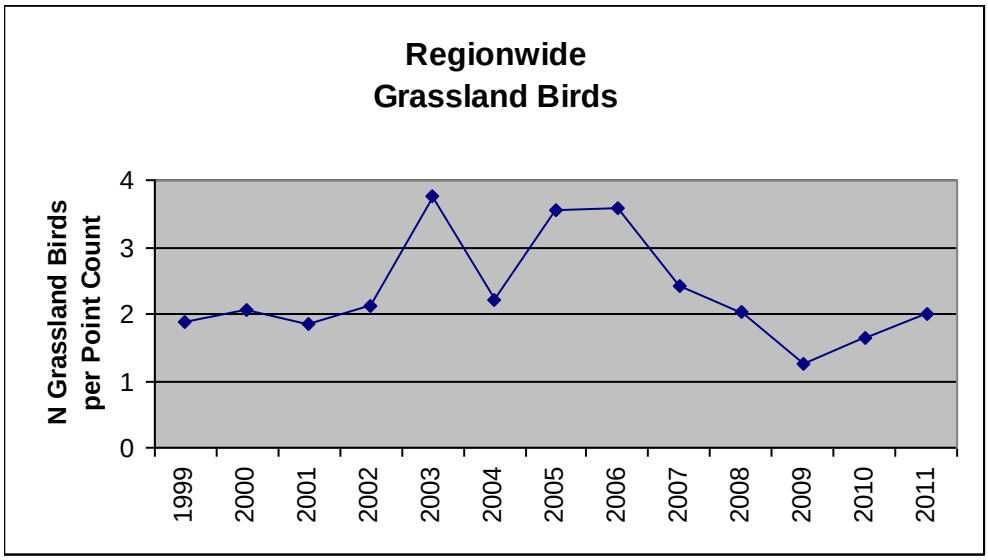


Figure 4. The number of grassland birds at Bartel and regionwide over time. Numbers are expressed as the average number of birds per point count, to allow for comparison. The minor trend differences between this Bartel graph and Figure 3 are due to the fact that only data from within the six plots were considered for this figure, while all point count data at Bartel were used for Figure 3. Grassland birds are: Bobolink, Eastern Meadowlark, Grasshopper Sparrow, Henslow's Sparrow, Savannah Sparrow, Sedge Wren, and Dickcissel.

The four birds that provide the most useful feedback about grassland habitat are the Bobolink, Eastern Meadowlark, Grasshopper Sparrow, and Henslow's Sparrow, however the broad patterns at Bartel were consistent across all seven grassland species, with no single species responsible for marked increases or decreases in any given year (see Fig. 5). Henslow's sparrows showed the most marked year-to-year fluctuations in numbers, ranging from two to 50 birds. Bobolinks were consistently the most abundant grassland bird species and sedge wrens the least abundant. Dickcissels were not recorded on the site from 1999 to 2001 but appeared in 2002, and monitors have recorded from two to 22 individuals every year since then, with the exception of 2009. Looking at bird numbers

among the six different plots, we see that the broad patterns of increase and decrease were generally seen across all six plots (see Fig. 5).

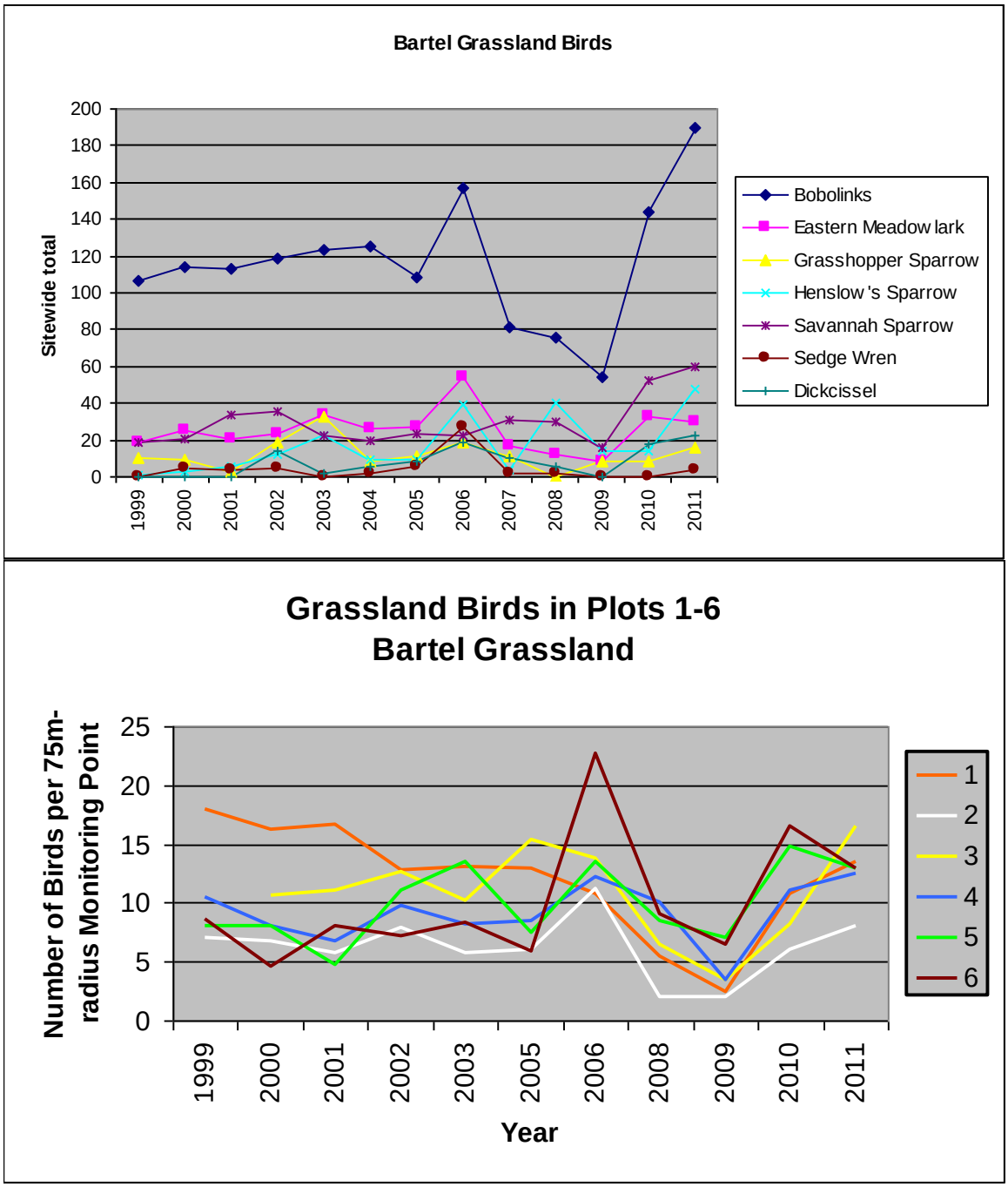


Figure 5. Sitewide totals for each grassland bird species (above); and number of grassland birds per point count, within each of the six plots (below).

Goal #2: Develop native grassland that remains good habitat for grassland birds
While grassland bird numbers have remained high the native floristic quality of the site has gradually improved. The number of native plant species at Bartel has increased since

2002 (see Figure 6), although the overall numbers are still low, with only about three native species per quadrat.

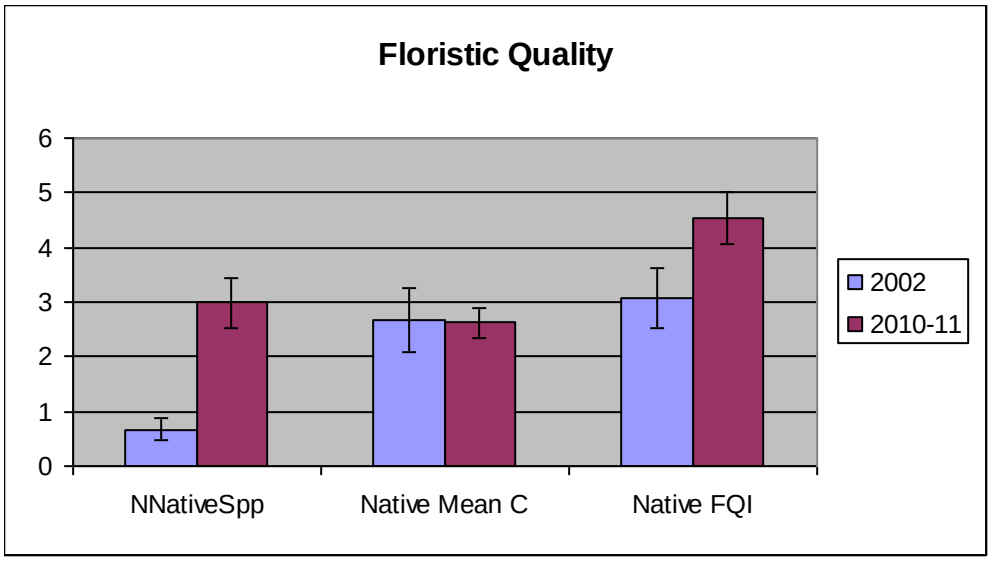


Figure 6. Sitewide averages of per-quadrat variables.

The Native Mean C provides a measure of the conservatism of the area. Species that are more restricted to undisturbed habitats have high C-values (10 is the maximum). Species that are less restricted have low C-values. Even having a tiny sprig of a single conservative plant in the quadrat can boost the quadrat's Mean C considerably, so the quadrat's Mean C can be viewed as a measure of the area's potential – these little sprigs could spread if given the chance.

To put the Bartel Mean C value in context (see Fig. 6), the Illinois Natural Areas Inventory (INAI) found Grade A and B sites to have Native Mean C values greater than 5, while Grade C areas had values of about 4 to 5. The Native Mean C at Bartel has not changed much since 2002, but this value changes more slowly over time than does species number or FQI.

The Native FQI – or Floristic Quality Index - uses a formula that combines Mean C with a measure of the number of species. This helps distinguish between the quadrat that just has one species of, say, C-value 4, versus the quadrat that has ten species, all with C-value 4. The latter is clearly better from a biodiversity standpoint.

Studies have found that a ¼ m^2 quadrat-level Native FQI of more than 9 indicates an area of very high quality, with an FQI of 7-9 indicating high quality, an FQI of 4-7 indicating fair quality, and FQI less than 4 indicating poor quality. While the floristic quality at Bartel still ranks only "fair" (see Fig. 6), we are moving in the right direction. Other restoration projects that have gone from old field to native prairie have taken decades to reach high quality status, and with patience we hope to see continued floristic quality improvement at Bartel.

Differences among plots

Most of the metrics discussed above changed differently over time in different parts of the site. Looking at how we have managed the various areas differently, or how other factors such as hydrology may have changed differently in the various areas, may help inform our management efforts going forward.

Remember that sitewide (Fig. 6), the number of native species per quadrat has increased since 2002. This trend was consistent across all plots (see Fig. 7), indicating that species gains were widespread across the site.

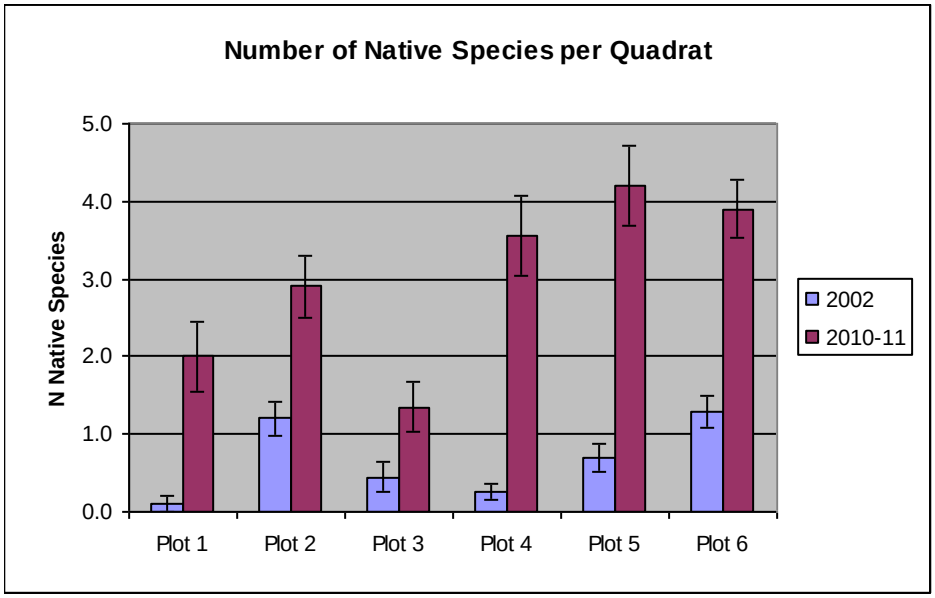


Figure 7.

Sitewide, Mean C was unchanged from 2002 to 2010-11 (see Fig. 6). However, changes in Mean C differed from plot to plot (see Fig. 8). Mean C trended slightly up in some plots, was unchanged in others, and showed a marked decline in plot 4.

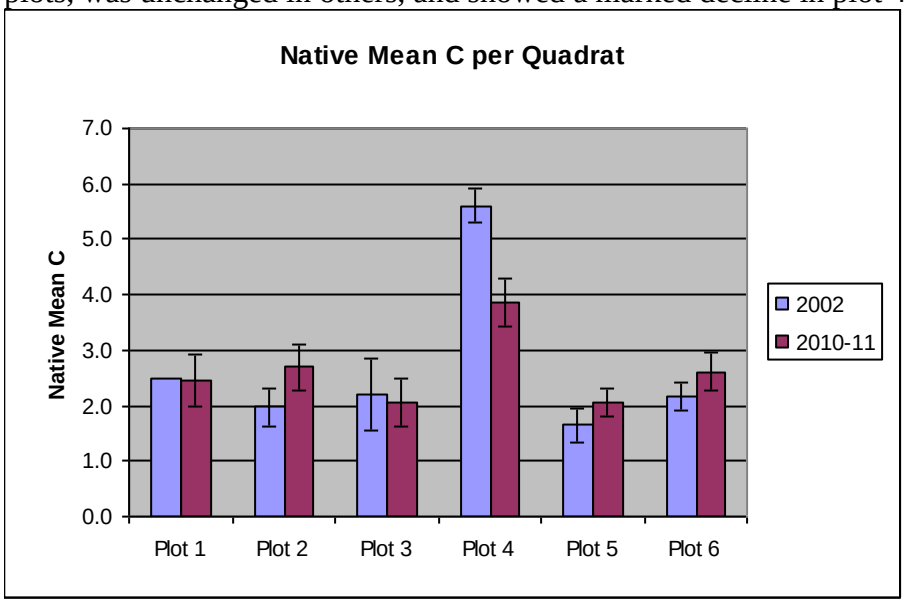


Figure 8.

The combination of native species and Mean C is reflected in the native FQI values shown in figure 9. Again, we see widespread gains in FQI across the site. The plots showing the largest gains in native FQI were plots 4, 5, and 6 (see Fig. 10).

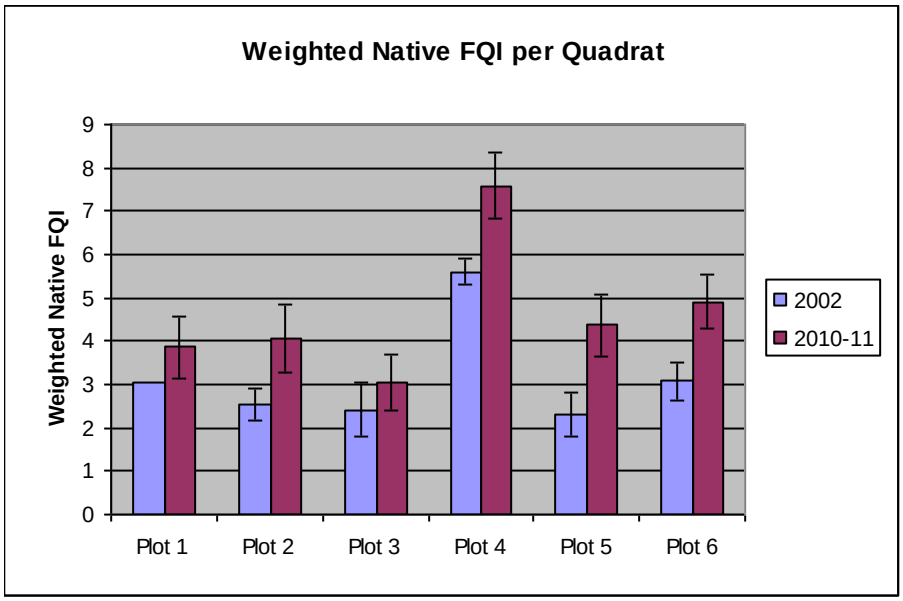


Figure 9.

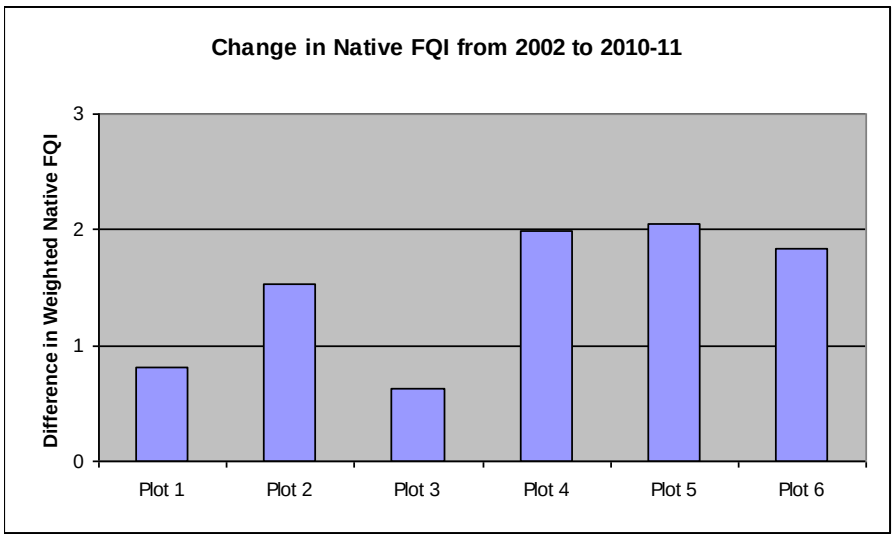


Figure 10.

Invasive Species

An important component of establishing a native grassland is controlling aggressive invasive species. The species of greatest concern at Bartel are tall goldenrod, reed canary grass, cattails, sweet clover, and leafy spurge. With the exception of tall goldenrod, all of these species appear to be well under control. These invaders (minus tall goldenrod)

covered less than 2% of the area within the sampled quadrats in 2010-11. Our success in controlling reed canary grass deserves to be celebrated as an especially significant triumph. Most wetland restorations are immediately overwhelmed by reed canary grass, which continues to spread and suppress native species for many years. At Bartel, we focused considerable resources on controlling this weed from the start and have remained vigilant every year. At the beginning of the project, we used broadscale herbiciding to control reed canary grass where it was heaviest, in the southeast corner of the site. In more recent years weed scouts have walked the site regularly and reported even a single plant of reed canary grass to the stewards, who then send the interns to spot-herbicide the grass, or do it themselves. Interns have spent approximately 1,260 hours controlling reed canary grass at Bartel since 2002, and volunteers added significantly to that total. The result has been that this species is well under control on the site, even in the wettest areas.

However, it does appear that our tall goldenrod strategy needs to be revisited, as its prevalence on the site has dramatically increased over time, although its density in any one quadrat remains low, at under 10% (see Fig. 11). The prevalence of tall goldenrod increased in all six plots and was especially marked in plots 4 and 5 (see Fig. 12). Only a handful of quadrats contained more than 50% cover by tall goldenrold (data not shown here), so it appears to be widely but sparsely distributed throughout the site. Suggested management changes include the use of scything by volunteers to control small patches of goldenrod, combined with more regular mowing of large patches in early August. Maps showing the locations of quadrats with goldenrod will help us locate smaller patches in the field.

Finally, although sweet clover and leafy spurge were not abundant in our quadrats, having been found in only three out of 120 quadrats and at very low cover, anecdotal reports from stewards and monitors suggest that these weeds are present on the site and should continue to receive focused management attention to prevent their spread.

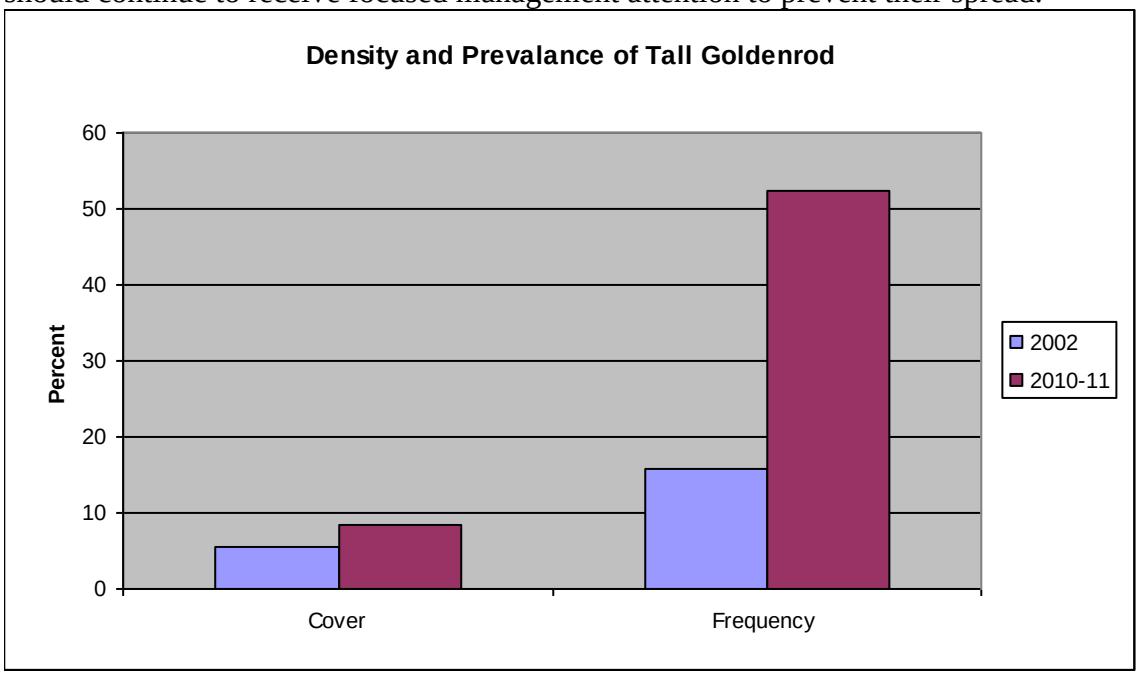


Figure 11. Density, or cover, is the percent of a quadrat's area that was covered by tall goldenrod. Frequency is the percentage of quadrats, out of 120, that contained tall goldenrod in any amount.

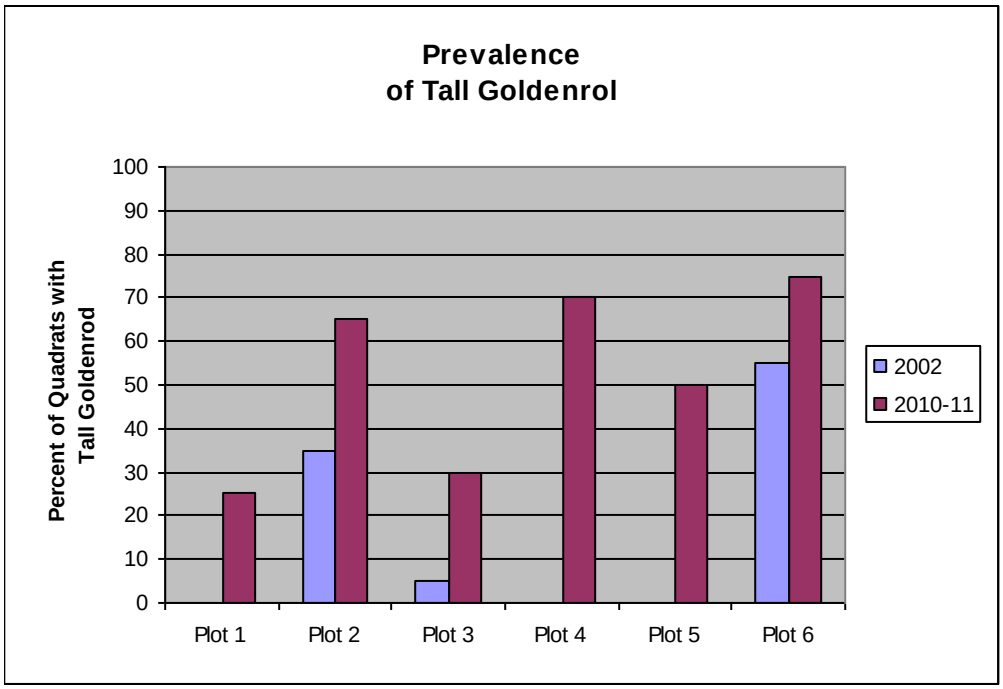
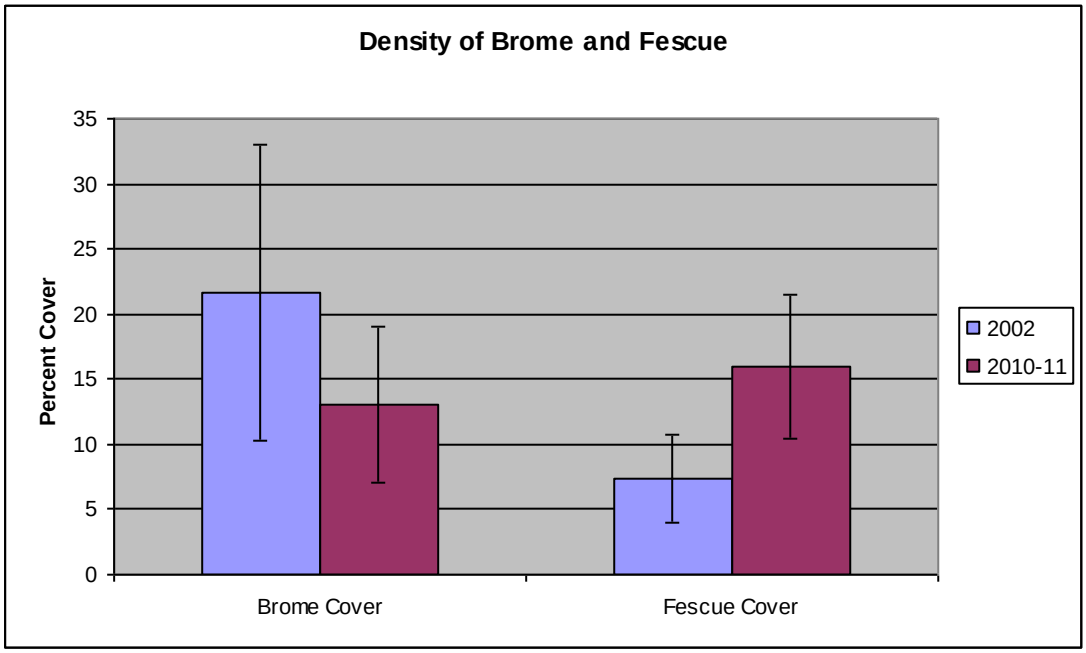


Figure 12. Prevalence of tall goldenrod throughout the site.

Grassland Bird Habitat

In 2002, Bartel was primarily old-field, cool-season grasses such as brome and fescue. While these species can be considered invasive in prairies, they nonetheless are often maintained by land managers during the period of native plant establishment to avoid giving ground to more aggressive invaders. Additionally, these grasses provide habitat for grassland birds, which are more responsive to the structure of a grassland than to its species composition.

At Bartel we implemented a similar strategy, transitioning gradually from brome and fescue to maintain bird habitat, while focusing our invasive species control on the more aggressive invaders such as reed canary grass, cattails, and white sweet clover, as well as woody plant resprouts. Figure 13 shows that the average cover by brome has decreased (not statistically significantly) over time, while cover by fescue has increased. Looking at prevalence (see Fig. 13), brome has remained present in 40% of quadrats, while fescue has spread from 18% to 43% of quadrats.



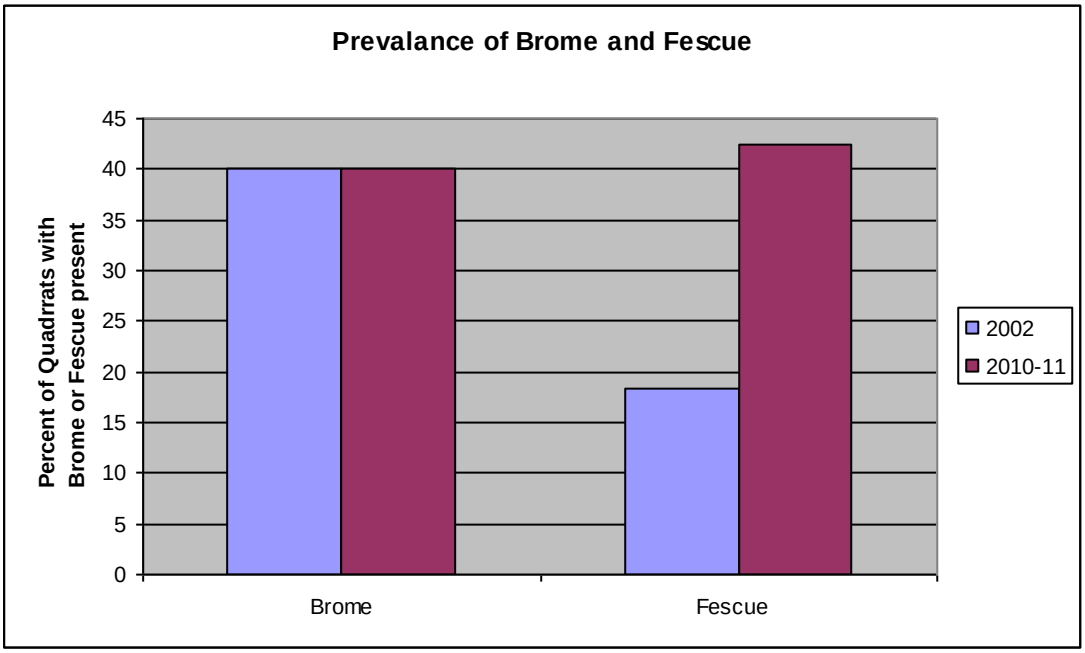


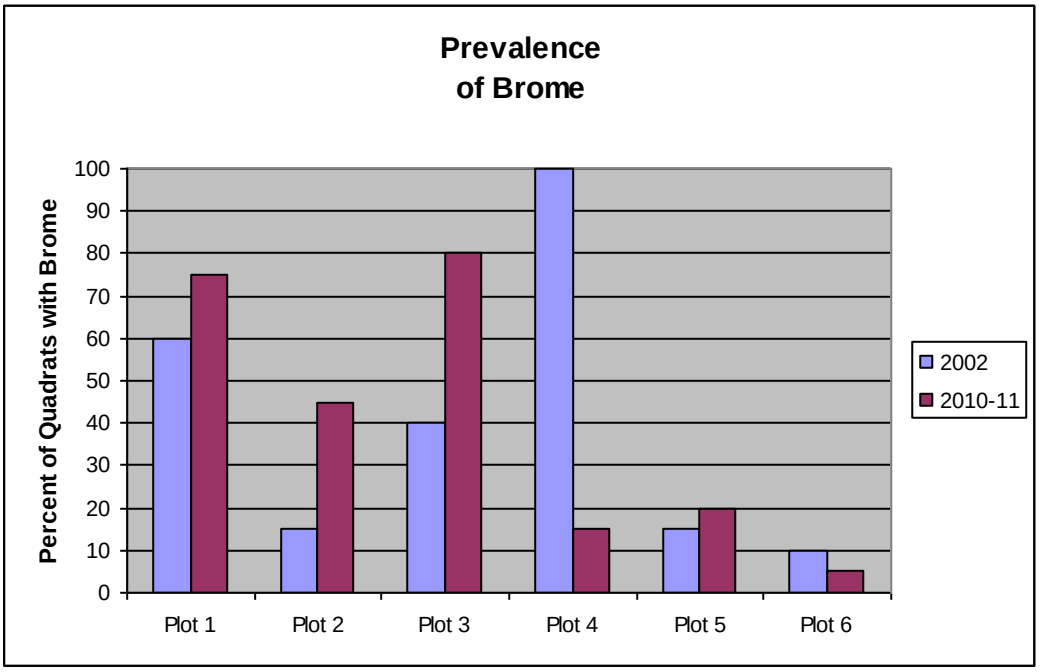
Figure 13. Density, or cover, is the percent of a quadrat's area that was covered by brome or fescue. Frequency is the percentage of quadrats, out of 120, that contained brome or fescue in any amount.

Plots 4, 5, and 6 showed a large increase in the presence of fescue, with plot 4 showing a strong decrease in the prevalence of brome (see Fig. 14). The decrease in brome is likely due to broadscale herbiciding of plot 4 prior to seeding in 2003. Ed Collins of McHenry County Conservation District has found that brome eventually gives way to more conservative, native species, provided the site has a good burn regimen, although this turnover may take decades and can be slower on wetter sites such as Bartel. The site's burn plan has been implemented inconsistently, with a recent five-year period of missed

or weak burns. As we transition away from dominance by cool season grasses and toward a native grassland, we will need to increase the emphasis on frequent, effective burning.

Future management should control the spread of fescue, as this grass can suppress the establishment of native species if it gets too thick. While brome can be controlled with frequent burning, fescue can increase with burning alone. Management should include later spring burns when fescue is green, which has proven effective in other restorations. In addition, we should herbicide fescue followed by seeding of native species.

In any case, our goal of maintaining grassland bird populations is being met throughout this transition period. All plots, including those where brome has decreased and those where fescue has increased, continue to show strong grassland bird numbers over time. We should continue to focus on a gradual transition from cool-season grasses to native prairie, only using aggressive management techniques in areas where fescue is dense enough to suppress the establishment of native species.



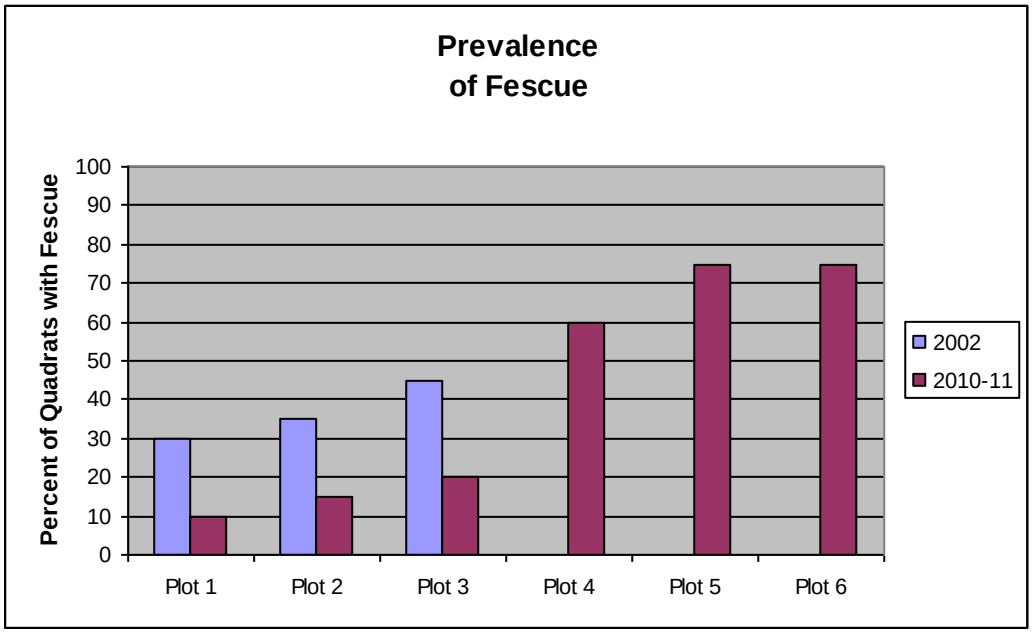


Figure 14. Prevalence of brome or fescue throughout the site.

Goal #3: Establish wetlands with a high quality plant community and good wildlife habitat

As discussed above, Bartel has generally gotten wetter over time. Looking in more detail at the floristic quality of these wetlands, we see that wetter areas showed the greatest improvement in floristic quality over time (see Fig. 15) The plots at Bartel that currently have the wettest suite of plant species (on the left side of the graph) have shown the

greatest improvement in FQI since 2002. The drier plots (on the right side of the graph) have shown the smallest improvement in floristic quality.

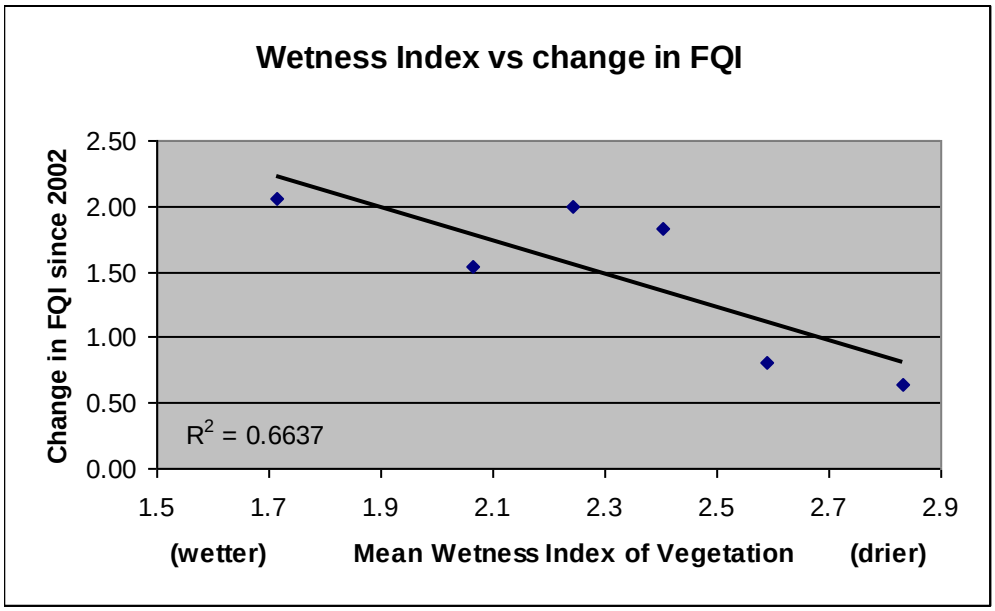


Figure 15. Each point represents one of the six plots. The average wetness of each plot's 20 quadrats is plotted against the average change in FQI for the plot.

One possible explanation for this pattern might be that the wetter species also happen to have higher C-values, and so any place we see more of these wet species we will also see a higher Mean C and FQI. However, an examination of W-index versus C-value for the species seeded or plugged at Bartel showed no correlation between W-index and C-value (graph not shown here).

The more likely explanation is that the wetter areas have received more management attention at Bartel. These areas have contained some of the most aggressive invaders such as reed canary grass and cattails, so they have received more invasive species control compared to drier areas. The drier areas also have heavier brome cover (graph not shown here), and since we currently are seeking a gradual transition from cool-season to native grassland, these drier areas have received less management activity. We have focused our plugging in wetter areas, and this, combined with the fact that wetlands tend to have more significant seed banks than do prairies, has resulted in an increase in native species in the wetter areas.

Wildlife habitat

Breeding birds of wet habitat that have been recorded at Bartel since 1999 are the Great Blue Heron, Great Egret, Green Heron, Mallard, Ring-billed Gull, and Wood Duck (see Fig. 16). The numbers shown in Figure 16 have fluctuated considerably over time, with a marked increase in 2011, possibly due to the increased amount of wetland habitat that has been restored at the site just north of Bartel in recent years. In addition, a heron rookery was established nearby in about 2007, and Great Blue Herons accounted for 18 and 48 of the birds recorded in 2010 and 2011, respectively. These herons feed in the wetlands at

Bartel and its neighboring wetlands, so the hydrologic changes within Bartel are contributing to a landscape-level increase in habitat for these birds.

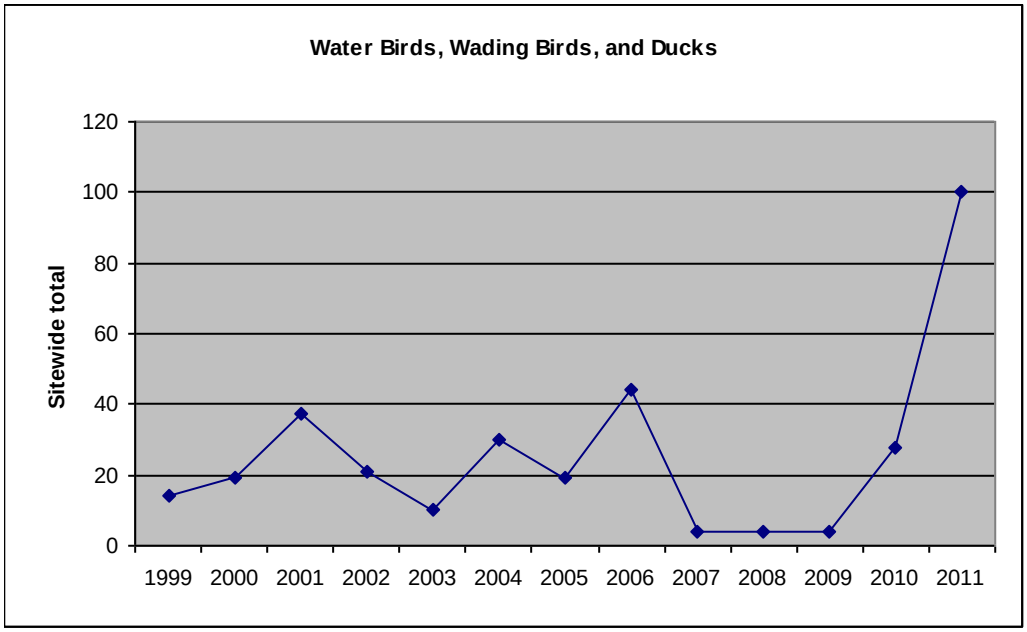


Figure 16. The numbers of Great Blue Herons, Great Egrets, Green Herons, Mallards, Ring-billed Gulls, and Wood Ducks at Bartel.

While no systematic monitoring of frogs and toads has been done at Bartel, we have had reports of Western Chorus Frogs, Leopard Frogs, and American Toads on the site, and the wetlands abound with tadpoles.

Adaptive Management

The purpose of monitoring plants and animals at Bartel is to provide feedback into the management strategies being used on the site. This "adaptive management" should result in the ever-increasing effectiveness of our work as we adjust according to the responses of the plants and animals to our management activities.

Our primary means of establishing native grassland at Bartel has been overseeding with prairie species, planting plugs in wetter areas, and controlled burns. Broadcast herbiciding of cover grasses such as brome and fescue was employed twice but was not a regular method of seed establishment. Aggressive invaders such as reed canary grass continue to be spot-herbicided wherever they occur. Each of the six plots differs from the others in its hydrology, its initial state of degradation in 2002, and it management history since then. Looking at these differences can help us interpret the effectiveness of our management techniques.

For example, we would expect that areas that have received more seeds and plugs of native species would then show an increased abundance of native species in subsequent sampling. Figure 17 shows the number of times seeds were sown or plugs were planted within each plot.

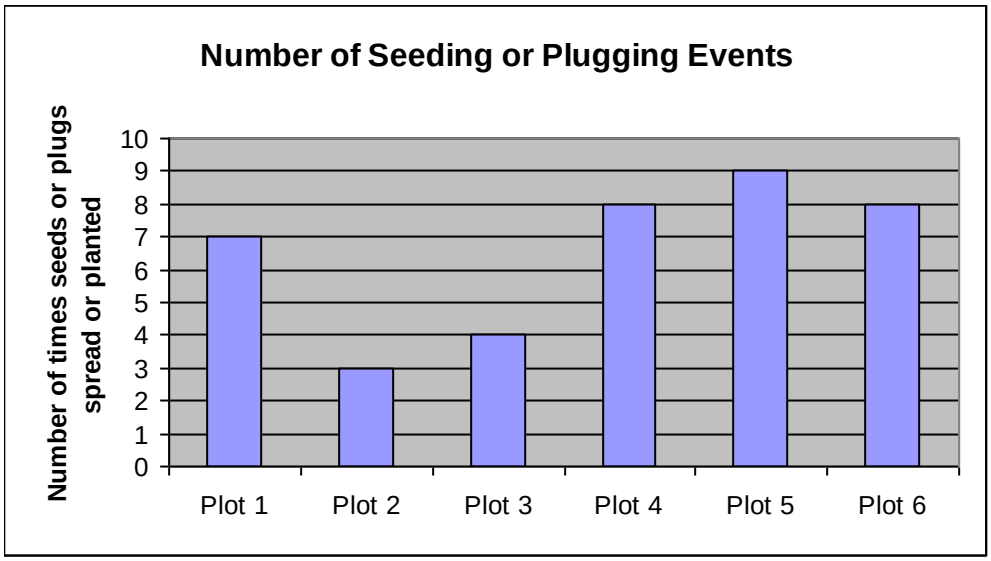


Figure 17.

Looking at figure 18, we see a positive correlation between the number of times natives were introduced through seeding or plugging and the increase in FQI since 2002. This response to our seeding efforts is encouraging and suggests that repeated introduction of natives is important for widespread establishment of native species.

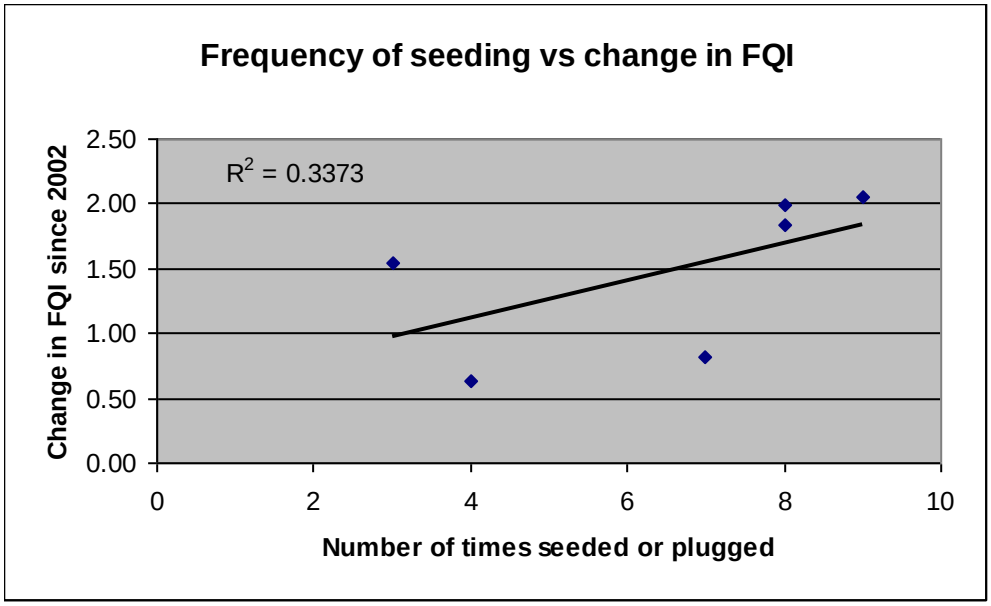


Figure 18.

The frequency of controlled burns also appears to have influenced floristic quality. Figure 19 shows the number of times a controlled burn was conducted within each plot since 2002. Looking at figure 20, we see a positive correlation between the number of burns and the change in FQI over time. In a multiple regression (data not shown), burning accounted for more of the variation than did seeding, suggesting that repeated burning may be more important than repeated seeding, assuming adequate initial seeding rates.

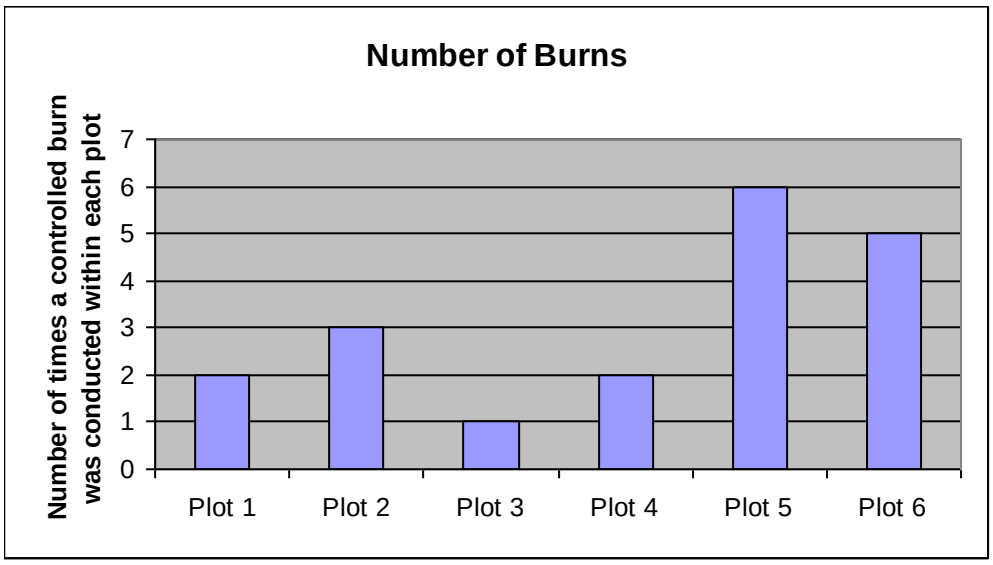


Figure 19.

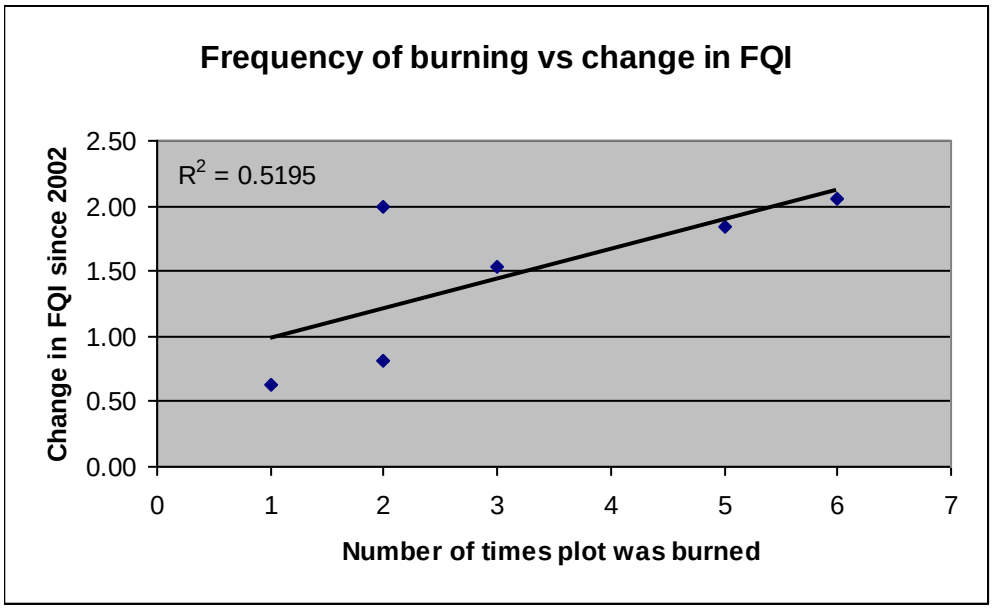


Figure 20.

These results suggest that a continued emphasis on fire is important for the success of the restoration. Fire followed by seeding is especially effective, and while this management combination only occurred three times at Bartel, the plots where it happened at least twice (plots 4, 5, and 6) showed the greatest increase in FQI from 2002 to 2010-11 (data not shown here). Going forward, more effort should be placed on achieving this burn-seeding combination.

Species establishment

Of 106 species seeded or plugged at Bartel since 2002, only 29 species were recorded in our quadrats in 2010-11. Of course, a species may be present at Bartel without having appeared in our dataset, since the quadrats only took data at 80-100-meter intervals.

When we included casual observations outside of our formal sampling process, we found that 57 out of 106 species were present on the site, and additional species almost certainly will be found if we look harder. These additional species are likely be more rare than those that appeared within the quadrats, since the more common a species is on the site, the more likely we would have picked it up in our quadrats. Additionally, casual observations will tend to include species that are more like to be spotted or identified, such as showy, tall, or otherwise noteworthy species. Thus, while casual observations provide important feedback on the presence of seeded species, they provide a less quantifiable assessment of our restoration success than do the unbiased quadrat samples.

When the restoration began in 2002, we knew that the site's hydrology would change after the drain tiles were disabled, but we did not know precisely which areas would get wetter nor how wet they would get. Thus, our seed mixes have contained a broad range of species, including wet, wet-mesic, and mesic species. We expected that some species would be successful and many would not. The current data provide the opportunity to review our seed mixes and determine which species have been most successful at establishing at Bartel and which species have not. Going forward, we can adjust our seed mixes accordingly.

Looking in more detail at which seeded species were found in the quadrat sampling, we saw that, broadly speaking, species of mid-level conservatism (C-value = 4-6) were seeded at the highest rates and also showed the greatest abundance in our 2010-11 sampling (see Table 1). Species within the 1-3 conservatism class were seeded at the lowest level and also showed the lowest abundance in our sampling. Species within the 7-10 class were in between the other classes for both seeding rates and recorded abundance.

Table 1. *Comparison of the amount (and percentage) of species within three different conservatism classes that were seeded or plugged at Bartel versus those that were recorded in quadrat sampling.*

	Conservatism Class			Totals
	1-3	4-6	7-10	
Amount seeded (oz.)	430	15,391	5,550	21,371
Amount observed (sum cover)	174	1,039	328	1,541
Expressed as percentages:				
Seeded	2%	72%	26%	100%
Observed	11%	67%	21%	100%

The seed strategy purposefully included only very low amounts of species within the lowest conservatism class, on the assumption that these species by nature are weedy and thus will establish and spread without much help. These species represented only 2% of the seed spread at Bartel, but they represented 11% of the total cover found in 2010-11 sampling. These results support our strategy and confirm that our seed resources are best spent on the higher level conservatives.

We also found that the species we seeded or plugged that were found on site, either in quadrats or casual observations, tended to be drier than those species that were *not* found on the site (see Fig. 21). The trend is not statistically significant but nonetheless suggests that mesic and wet-mesic species have established with greater success than wetter species.

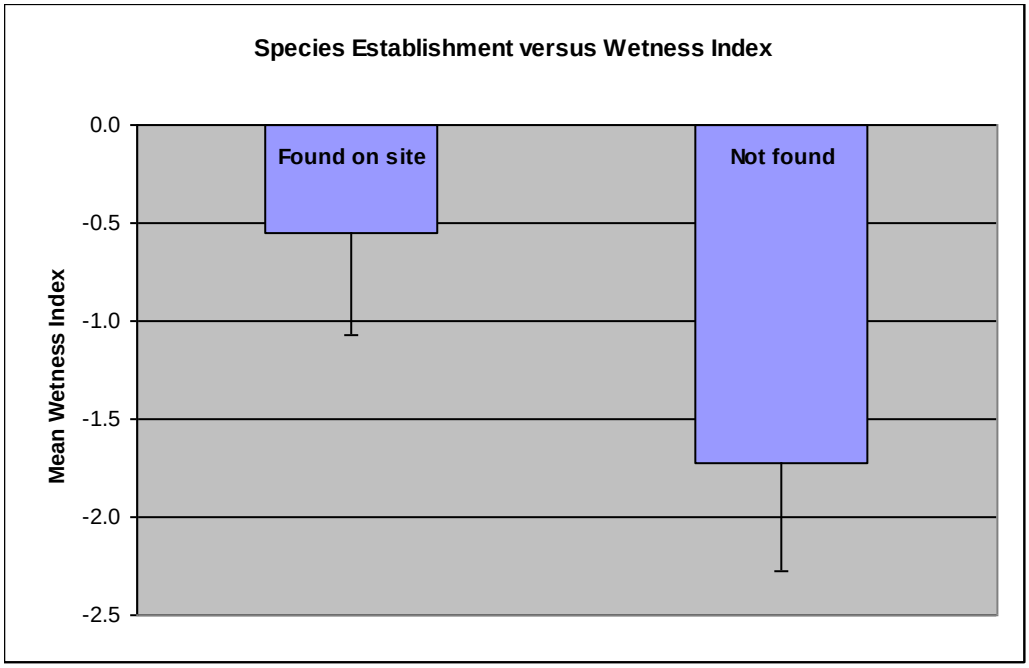


Figure 21. Comparison of the average wetness index of seeded/plugged species that were found in quadrats or casual observations at Bartel, versus those species that have not been seen on the site.

Management notes show that seldom was the site burned immediately after seeding, a strategy that has proven effective at increasing native establishment at other sites. Going forward we need an increased emphasis on the use of strategic burning to improve species establishment.

Changes in weeds versus conservatives over time

Another way to look at the success of specific species over time is shown in Figure 22. This graph shows the total cover across the site for all species, grouped into conservatism classes. Total cover by weedy species has increased at Bartel. Cover by the most conservative species also has increased, going from 0.06% of total coverage in 2002 to 3.5% of total coverage in 2010-11. While this group still represents a very small percentage of total cover, this 60-fold increase is encouraging. By their nature, conservative species increase (and decrease) more slowly over time than do weedier species, so any kind of positive trend is good news.

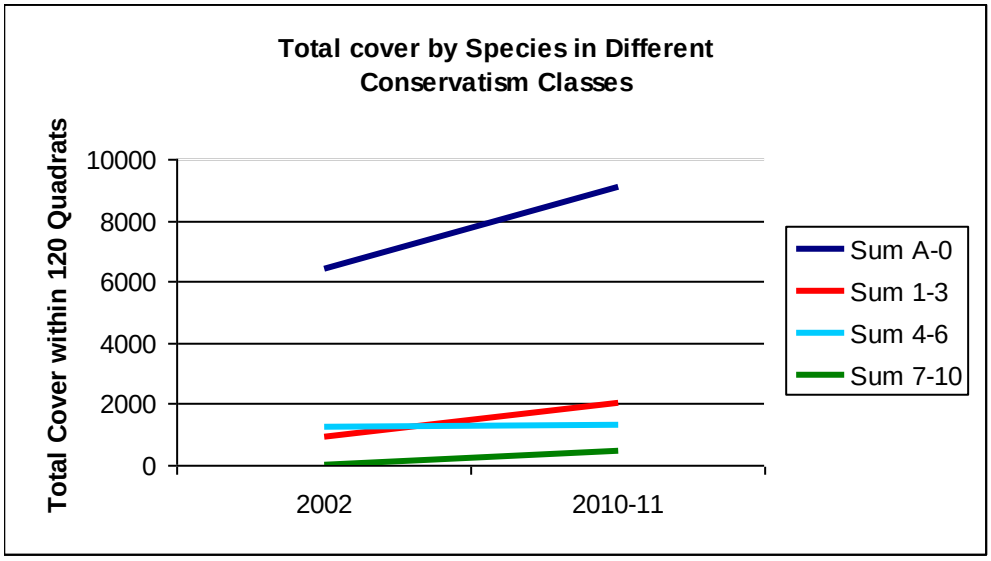


Figure 22.

The mid-level conservatives (C-value 4 to 6) show a trend that is more difficult to interpret. Their coverage increased only slightly, from 1270 to 1320. However, since overall cover at Bartel increased (because we are adding more plants and they are growing), the percent of total cover by this group actually decreased from 15% to 10%. This mid-level group has proven to be quite responsive to changes at other sites – increasing rapidly after management has ensued and quickly decreasing when management has been halted. We might have expected them to increase more significantly at Bartel over the last ten years.

The less conservative group with C-values from 1 to 3 has increased from a total cover of 900 to 2000, or from 10% to 16% of total coverage. Some of these species have been actively seeded or plugged at the site, and others were present on the site prior to the restoration. We would expect these species to increase in these early stages of the restoration and to decrease in future years as the more conservative species take root.

Appendices B-D show the full list of species recorded in 2002 and 2010-11. It is encouraging to note the richer suite of species that represent the most abundant plants in 2010-11, including such prairie notables as Mountain Mint, Little Bluestem, and Heath Aster.

Conclusions

Many of the goals we established in 2002 are being met. Bartel has gotten wetter as we expected, and grassland bird numbers have remained high over time. The native grassland is slowly establishing, and floristic quality is improving. Most aggressive invaders are under control, with the exception of tall goldenrod. The wetland areas at Bartel have the highest floristic quality of the site and are relatively free of reed canary grass and cattails. Our vigilance in controlling reed canary grass has been especially effective. Wetland birds do not appear to have responded strongly to the site's hydrologic changes, although they may be increasing due to wetland restoration and heron nest sites to the north. These birds were not a primary target of the restoration, but we will continue to follow their numbers over time to learn whether Bartel is providing habitat for them.

Management Recommendations

The results of vegetation and bird monitoring across the site allow us to make the following conclusions regarding our management strategy:

1. Floristic quality has increased, and this increase has been greatest in areas that have been more frequently seeded/plugged and more often burned.
    a. Future management should continue to regularly seed and plug, focusing on mesic and wet-mesic species.
    b. Seed mixes should continue to emphasize more conservative species over those with C-value in the 1 to 3 range.
    c. Annual controlled burns should be a priority and should be coordinated with seeding events whenever possible.

2. Strategies for controlling most aggressive invasive species have been effective and should be continued. However, the tall goldenrod strategy should be revised, and sweet clover and leafy spurge should receive continued attention.
    a. It would be beneficial for volunteers to use scythes to control small goldenrod patches, as this method has proven effective at other sites.
    b. For large goldenrod patches, we need more regular mowing in early August.
    c. For sweet clover, leafy spurge, and all aggressive weeds we need improved coordination among project partners to ensure that our team is addressing the appropriate priorities during each time window.

3. Annual controlled burns should result in decreased brome over time, but we need to implement additional management strategies to control the spread of fescue. We should continue the slow conversion that is proving beneficial for grassland bird populations. Strategies to consider include:
    a. Implementing at least one late spring burn, when fescue is green, in plots 4, 5, and 6.
    b. Herbiciding fescue followed by seeding of native species, in plots 4, 5, and 6.

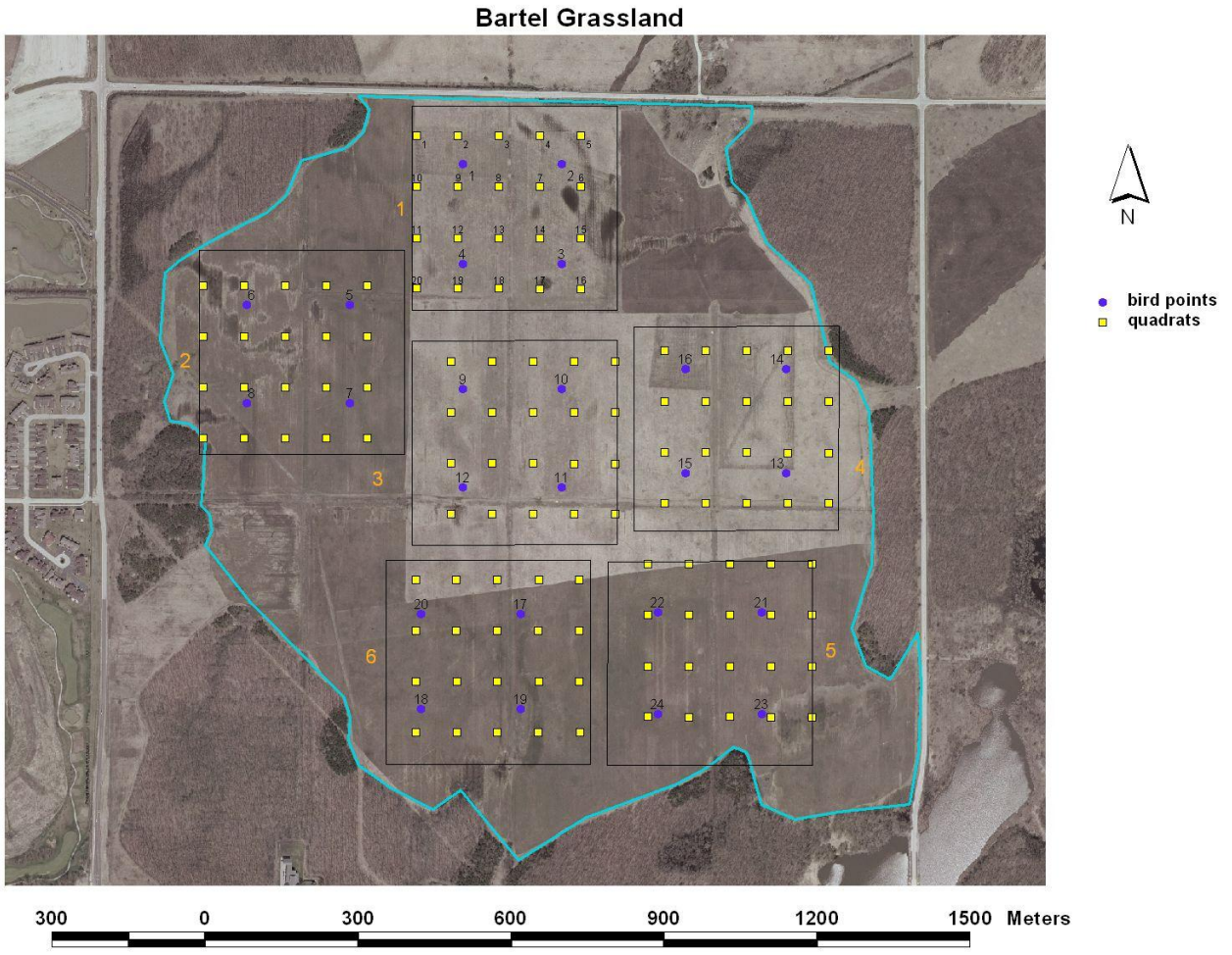
4. Bird numbers have remained high over time and continue to place Bartel among the region's best grassland bird habitats. We should continue to collect consistent, regular monitoring data so that we may continue to track the birds closely over time.

Acknowledgments

Bartel's partners include Audubon Chicago Region, the Forest Preserve District of Cook County, the Bartel Grassland Volunteers, Thorn Creek Audubon, and the Army Corps of Engineers.

Bird monitors were Marianne Hahn, Marlys Oosting, Penny Kniesler, Dick Riner, and Robert Sliwinski. Plant monitors and data recorders were Pat Brownlow, John Denk, Stephanie Frischie, Karen Glennemeier, David Johannesen, Alan Kawaters, Anne Kawaters, Mary Anne McLean, Ron Milnarik, Keith Nowakowski, and Paul Strand.

Appendix A. Locations of six study plots, 120 vegetation quadrats, and 24 bird points.



Appendix B. Lists of plants recorded within vegetation quadrats at Bartel in 2002.

Species List 2002	Common Name	SumCover
Bromus inermis	HUNGARIAN BROME	2598
Spartina pectinata	PRAIRIE CORD GRASS	1145
Trifolium pratense	RED CLOVER	1111
Festuca elatior	TALL FESCUE	889
Solidago altissima	TALL GOLDENROD	664
Daucus carota	QUEEN ANNE'S LACE	583
Phleum pratense	TIMOTHY	538
Medicago sativa	ALFALFA	271
Poa pratensis	KENTUCKY BLUE GRASS	173
Rudbeckia hirta	BLACK-EYED SUSAN	110
Phalaris arundinacea	REED CANARY GRASS	90
Dianthus armeria	DEPTFORD PINK	80
Galium obtusum	WILD MADDER	60
Cornus racemosa	GRAY DOGWOOD	60
Solidago juncea	EARLY GOLDENROD	45
Parthenocissus quinquefolia	VIRGINIA CREEPER	29
Rhus typhina	STAGHORN SUMAC	25
Solidago rigida	STIFF GOLDENROD	20
Dactylis glomerata	ORCHARD GRASS	20
Taraxacum officinale	COMMON DANDELION	16
Rosa multiflora	MULTIFLORA ROSE	10
Prunella vulgaris lanceolata	SELF HEAL	8
Vitis riparia	RIVERBANK GRAPE	6
Tragopogon pratensis	COMMON GOAT'S BEARD	5
Ambrosia artemisiifolia elatior	COMMON RAGWEED	5
Asclepias sullivantii	PRAIRIE MILKWEED	5
Convolvulus arvensis	FIELD BINDWEED	4
Cerastium vulgatum	MOUSE-EAR CHICKWEED	3
Rhus radicans	POISON IVY	2
Plantago major	COMMON PLANTAIN	2
Bellis perennis	ENGLISH DAISY	1
Erigeron annuus	ANNUAL FLEABANE	1

Appendix C. Lists of plants recorded within vegetation quadrats at Bartel in 20010-11.

Species List 2010-11	Common Name	SumCover
Festuca elatior	TALL FESCUE	1911
Bromus inermis	HUNGARIAN BROME	1565
Trifolium pratense	RED CLOVER	1253
Poa pratensis	KENTUCKY BLUE GRASS	1062
Solidago altissima	TALL GOLDENROD	1012
Poa compressa	CANADA BLUE GRASS	790
Daucus carota	QUEEN ANNE'S LACE	665
Galium mollugo	WHITE BEDSTRAW	446
Helianthus grosseserratus	SAWTOOTH SUNFLOWER	350
Trifolium hybridum	ALSIKE CLOVER	286
Pycnanthemum virginianum	COMMON MOUNTAIN MINT	272
Galium boreale	NORTHERN BEDSTRAW	259
Bidens polylepis	BUR MARIGOLD	245
Andropogon scoparius	LITTLE BLUESTEM GRASS	237
Aster ericoides	HEATH ASTER	151
Ambrosia artemisiifolia elatior	COMMON RAGWEED	141
Rudbeckia hirta	BLACK-EYED SUSAN	121
Eupatorium altissimum	TALL BONESET	119
Prunella vulgaris lanceolata	SELF HEAL	109
Carex sp.		105
Panicum dichotomiflorum	KNEE GRASS	101
Eleocharis obtusa	BLUNT SPIKE RUSH	85
Juncus sp.		85
Phalaris arundinacea	REED CANARY GRASS	82
Monarda fistulosa	WILD BERGAMOT	80
Alisma subcordatum	COMMON WATER PLANTAIN	70
Aster pilosus	HAIRY ASTER	65
Galium trifidum	SMALL BEDSTRAW	65
Chrysanthemum leucanthemum pinnatifidum	OX-EYE DAISY	62
Ludwigia palustris americana	MARSH PURSLANE	60
Solidago juncea	EARLY GOLDENROD	55
Setaria glauca	YELLOW FOXTAIL	50
Eupatorium serotinum	LATE BONESET	45
Lonicera tatarica	TARTARIAN HONEYSUCKLE	45
Ratibida pinnata	YELLOW CONEFLOWER	41
Agrostis alba	REDTOP	38
Phleum pratense	TIMOTHY	36
Andropogon gerardii	BIG BLUESTEM GRASS	35
Rosa multiflora	MULTIFLORA ROSE	35
Medicago lupulina	BLACK MEDICK	33
Solidago graminifolia	COMMON GRASS-LEAVED GOLDENROD	33
Carex cristatella	CRESTED OVAL SEDGE	30

Coreopsis tripteris	TALL COREOPSIS	30
Helianthus rigidus	PRAIRIE SUNFLOWER	30
Erigeron strigosus	DAISY FLEABANE	27
Carex frankii	BRISTLY CATTAIL SEDGE	25
Liatris spicata	MARSH BLAZING STAR	25
Vitis riparia	RIVERBANK GRAPE	25
Asclepias verticillata	WHORLED MILKWEED	20
Eupatorium purpureum	PURPLE JOE PYE WEED	20
Cornus racemosa	GRAY DOGWOOD	20
Asclepias syriaca	COMMON MILKWEED	19
Carex molesta	FIELD OVAL SEDGE	18
Hypericum perforatum	COMMON ST. JOHN'S WORT	18
Potentilla norvegica	NORWAY CINQUEFOIL	18
Asclepias incarnata	SWAMP MILKWEED	17
Silphium laciniatum	COMPASS PLANT	17
Epilobium coloratum	CINNAMON WILLOW HERB	16
Liatris pycnostachya	PRAIRIE BLAZING STAR	16
Solidago rigida	STIFF GOLDENROD	16
Acalypha rhomboidea	THREE-SEEDED MERCURY	15
Carex brevior	PLAINS OVAL SEDGE	15
Carex tribuloides	AWL-FRUITED OVAL SEDGE	15
Carex vulpinoidea	BROWN FOX SEDGE	15
Juncus dudleyi	DUDLEY'S RUSH	15
Lycopus americanus	COMMON WATER HOREHOUND	15
Trifolium repens	WHITE CLOVER	15
Dactylis glomerata	ORCHARD GRASS	15
Aster novae-angliae	NEW ENGLAND ASTER	14
Sorghastrum nutans	INDIAN GRASS	12
Taraxacum officinale	COMMON DANDELION	12
Ambrosia trifida	GIANT RAGWEED	10
Crataegus crus-galli	COCKSPUR HAWTHORN	10
Eleocharis erythropoda	RED-ROOTED SPIKE RUSH	10
Geum laciniatum trichocarpum	ROUGH AVENS	10
Parthenium integrifolium	WILD QUININE	10
Stachys palustris homotricha	WOUNDWORT	10
Convolvulus arvensis	FIELD BINDWEED	10
Hieracium sp.		9
Bidens sp.		8
Solidago riddellii	RIDDELL'S GOLDENROD	8
Convolvulus sepium	HEDGE BINDWEED	7
Fraxinus pennsylvanica subintegerrima	GREEN ASH	7
Solanum carolinense	HORSE NETTLE	7
Leersia oryzoides	RICE CUT GRASS	6
Asclepias sullivantii	PRAIRIE MILKWEED	6
Cirsium discolor	PASTURE THISTLE	5
Erechtites hieracifolia	FIREWEED	5
Lactuca biennis	TALL BLUE LETTUCE	5
orchid sp.		5
Physalis sp.		5
Typha latifolia	BROAD-LEAVED CATTAIL	5
Zizia aurea	GOLDEN ALEXANDERS	5

Spartina pectinata	PRAIRIE CORD GRASS	5
Cirsium arvense	FIELD THISTLE	4
Melilotus alba	WHITE SWEET CLOVER	4
Oenothera biennis	COMMON EVENING PRIMROSE	4
Scirpus pendulus	RED BULRUSH	4
Silphium terebinthinaceum	PRAIRIE DOCK	4
Solidago nemoralis	OLD-FIELD GOLDENROD	4
Plantago major	COMMON PLANTAIN	4
Apocynum sibiricum	PRAIRIE INDIAN HEMP	3
Helenium autumnale	SNEEZEWEED	3
Juncus acuminatus	SHARP-FRUITED RUSH	3
Prunus serotina	WILD BLACK CHERRY	3
Medicago sativa	ALFALFA	3
Erigeron sp.		2
Galium triflorum	SWEET-SCENTED BEDSTRAW	2
Melilotus officinalis	YELLOW SWEET CLOVER	2
Polygonum sp.		2
Acer saccharinum	SILVER MAPLE	1
Lactuca sp.		1
Oxalis stricta	COMMON WOOD SORREL	1
Potentilla simplex	COMMON CINQUEFOIL	1

Appendix D. List of plants seeded or plugged at Bartel, and their appearance in quadrats or casual observations.

Species seeded or plugged into Bartel 2002-2010	Species recorded in 2010-11 sampling? ("casual observation" means it has been observed outside of formal sampling process.)
Alisma subcordatum	yes
Andropogon scoparius	yes
Asclepias incarnata	yes
Aster ericoides	yes
Carex brevior	yes
Carex cristatella	yes
Carex molesta	yes
Carex tribuloides	yes
Carex vulpinoidea	yes
Cirsium discolor	yes
Galium boreale	yes
Helenium autumnale	yes
Helianthus rigidus	yes
Juncus acuminatus	yes
Juncus dudleyi	yes
Leersia oryzoides	yes
Liatris pycnostachya	yes
Liatris spicata	yes
Lycopus americanus	yes
Monarda fistulosa	yes
Parthenium integrifolium	yes
Pycnanthemum virginianum	yes
Ratibida pinnata	yes
Rudbeckia hirta	yes
Silphium laciniatum	yes
Silphium terebinthinaceum	yes
Solidago graminifolia	yes
Solidago riddellii	yes
Spartina pectinata	yes
Zizia aurea	yes
Allium cernuum	casual observation
Amorpha canescens	casual observation
Anemone canadensis	casual observation
Asclepias tuberosa	casual observation
Aster azureus	casual observation
Aster laevis	casual observation
Cacalia plantaginea	casual observation
Carex pellita	casual observation
Eryngium yuccifolium	casual observation
Eupatorium maculatum	casual observation
Eupatorium perfoliatum	casual observation

Iris virginica shrevei	casual observation
Liatris aspera	casual observation
Lobelia cardinalis	casual observation
Lobelia siphilitica	casual observation
Lythrum alatum	casual observation
Penstemon digitalis	casual observation
Penthorum sedoides	casual observation
Petalostemum candidum	casual observation
Petalostemum purpureum	casual observation
Physostegia virginiana	casual observation
Scirpus validus creber	casual observation
Silphium perfoliatum	casual observation
Tradescantia ohiensis	casual observation
Verbena hastata	casual observation
Vernonia fasciculata	casual observation
Veronicastrum virginicum	casual observation
Zizia aptera	casual observation
Acorus calamus	no
Allium canadense	no
Angelica atropurpurea	no
Aster umbellatus	no
Baptisia leucophaea	no
Bromus kalmii	no
Calamagrostis canadensis	no
Carex annectens	no
Carex annectens xanthocarpa	no
Carex aquatilis altior	no
Carex atherodes	no
Carex comosa	no
Carex emoryi	no
Carex festucacea	no
Carex hystericina	no
Carex lacustris	no
Carex retrorsa	no
Carex scoparia	no
Carex stipata	no
Carex stricta	no
Cicuta maculata	no
Coreopsis palmata	no
Dodecatheon meadia	no
Elymus canadensis	no
Euphorbia corollata	no
Gentiana andrewsii	no
Glyceria striata	no
Hieracium scabrum	no
Juncus canadensis	no
Juncus effusus	no
Lobelia spicata	no
Ludwigia alternifolia	no
Mimulus ringens	no
Oenothera pilosella	no

Oxypolis rigidior	no
Pedicularis canadensis	no
Pedicularis lanceolata	no
Phlox pilosa	no
Phlox pilosa fulgida	no
Prenanthes racemosa	no
Rosa carolina	no
Saxifraga pensylvanica	no
Scirpus atrovirens	no
Silphium integrifolium	no
Sium suave	no
Sparganium eurycarpum	no
Sporobolus heterolepis	no
Tephrosia virginiana	no