2012-2017 Monitoring Report for AIS Control Grants

By Tom Bernthal

Introduction

This Monitoring Report is written to satisfy monitoring requirements for Wisconsin Department of Natural Resources Aquatic Invasive Species Control Grant ACEI-157-16, "Wetland Invasives Control at Pheasant Branch Conservancy" to the Friends of Pheasant Branch Conservancy, Inc. This grant covered wetland invasives control activities for the period from July 1, 2015 through June 30, 2018, continuing work funded under a previous AIS Grant, ACEI 114-12, from July 1, 2012 through June 30, 2015. All AIS grant-funded wetland invasive control work at the Dane County Unit of Pheasant Branch Conservancy has been based on the recommendations made in the "Aquatic Invasive Species Assessment and Management Plan for Recovery of Remnant Sedge Meadow at Pheasant Branch Marsh, Dane County Unit," hereafter referred to as the "Sedge Meadow Recovery Plan." This plan was prepared by Craig A. Annen and David G. Cordray of Integrated Restorations, LLC, funded through Wisconsin Department of Natural Resources Planning Grant AEPP-272-11 to the Friends of Pheasant Branch Conservancy, Inc.

Because grant-funded wetland invasive control work has been conducted continuously from July 1, 2012 through June 30, 2018, this report will cover monitoring results for that entire time period, covering both grants. The Monitoring goal is to track trends in plant community condition, or floristic quality, in the vegetation associations (which will be referred to as "plant communities") mapped in the "Sedge Meadow Recovery Plan," towards the ultimate goal of re-establishing a fair-to-high quality Southern Sedge Community. Initial Timed-Meander vegetation surveys were conducted to calculate Floristic Quality Assessment Metrics, "Weighted Mean C" and "Weighted Floristic Quality Index (FQI)" within these mapped areas to establish baseline conditions prior to invasives control work where possible. As work progressed over the years, follow-up surveys using the same method were conducted within the subsequent growing season within these plant communities. The change in FQA values along with change in percent cover of targeted wetland invasives is used to assess the effectiveness of grant-funded activities.

Methods

Floristic Quality Assessment Metrics for Wetland Plant Community Condition

The Wisconsin Floristic Quality Assessment method was chosen for its time-efficiency, flexibility, replicability and institutional support from the Wisconsin Department of Natural Resources and University of Wisconsin Herbarium. Wisconsin Floristic Quality Assessment using the WDNR Timed-Meander Standard Operating Procedure and the Wisconsin Floristic Quality Assessment Calculator are available on the WDNR website: https://dnr.wi.gov/topic/Wetlands/methods.html. Timed-Meander surveys are extremely time-efficient and thorough, yielding a complete plant inventory with percent cover estimates for every species found in a given Assessment Area. Data entry into the WFQA Calculator allows calculation of the 2 key metrics and the percent cover of invasives that are reported below.

The FQA system is based on an expert-assigned "coefficient of conservatism" for every vascular plant species found in a regional flora – a number between 0 and 10 that reflects each species tolerance of disturbance and the likelihood of that species being found in undisturbed plant communities in the region. A "0" is assigned to species that thrive with disturbance and "10" to highly intolerant species only likely to be found in undisturbed sites. Non-natives are automatically assigned a "0." These values were established for the state of Wisconsin as a single region in 2003 by a group of 8 botanists with the highest degree of expertise in the flora of Wisconsin. "Weighted Mean C" is calculated as the average of the C values for all plant species found in the survey, weighted by the percent cover of each species and varies between 0 and 10. It is a measure of the degree to which species intolerant of disturbance and pollution dominate the assessed plant community. "Weighted Floristic Quality Index (FQI)" is calculated as the product of the Weighted

Mean C multiplied by the square root of the total number of species found in the survey. Its lower limit is 0, but has no pre-set upper limit, depending on the total number of species found and the Weighted Mean C.

Plant Community Condition Categories

The Wisconsin Department of Natural Resources has conducted over 1,000 WFQA timed-meander surveys across the four major ecoregions of the state. Surveys have targeted both “least disturbed” and “most disturbed” wetlands for the commonly occurring wetland plant communities in each ecoregion. The results have been used to calculate “Preliminary WFQA Benchmarks,” a set of statistically and scientifically defensible, numerical benchmarks to define 5 categories of wetland plant community condition or health for each surveyed wetland plant community in each ecoregion. The categories are “Very Poor, Poor, Fair, Good and Excellent.” The study found Weighted Mean C to be a more robust reliable measure of plant community condition, so Benchmarks were set based on that metric. For example, for Southern Sedge Meadow – the target community for most of our work – the Benchmark dividing “Very Poor” from “Poor” Condition is a Weighted Mean C of 1.9, while the dividing line between “Poor” and “Fair” is 3.8, and the dividing line between “Fair” and “Good” is 5.5. A value of 6.4 was set to divide “Good” from “Excellent.” This research is currently under peer review so the Benchmark values may be subject to change, but we refer to condition category for Southern Sedge Meadow in the SE Glacial Plains to give more contextual meaning to numerical results.

We also report Weighted FQI values. This metric has not been found to be statistically robust enough to be appropriate for defining condition categories but this it is useful for tracking increases in species richness. For example, an increase in Weighted FQI while Weighted Mean C stays relatively constant would indicate that the species being added are conservative. A decrease in Weighted Mean C while Weighted FQI remains relatively stable would indicate that the species being added are weedy. Where sites are very low in species richness, the Weighted Mean C alone is not a good indicator of floristic quality. Our recommendation is to use both metrics to understand change in vegetation composition at a site.

Survey Personnel and Design

All of the vegetation surveys were conducted by Patricia Trochlell and Tom Bernthal, with several other surveyors joining them from time to time, ensuring inter-observer comparability from survey to survey over the 6 year time period. The Timed-Meander survey, a “plotless” method chosen for its greater efficiency and completeness compared to other plot-based methods, has been used for all surveys. This is the same method used by WDNR for the statewide WFQA Benchmarks Survey project, which took place from 2011 – 2018.

Survey areas were chosen based on the “vegetation associations” defined in the Recovery Plan, since specific actions were planned for each area.

Map 1. Vegetation Associations delineated in the Recovery Plan.

The major targets for the 2 grants were the Fredericks' Springs, and areas A, B, C, D, E and I, coinciding with the general strategy of working from north to south. Over the course of the project some areas have been combined and some have been further subdivided to reflect changes in location of management activities, diverging vegetation composition, or to create efficiency for conducting comparable surveys. Initially Area A was added to Area B, and Area I was combined with Area C. Beginning with the 2017 survey, Area C was subdivided into Area C – East and Area C – West. A large willow clone in Area C that was cut and treated in December of 2014 has been surveyed separately from 2015 to the present.

Baseline surveys were to take place for all areas early in the 2012 growing season before grant funded control work was conducted, but because of Tom Bernthal's illness throughout that year, the only area to be surveyed was the small Frederick's Springs area. Unfortunately true baseline conditions were not documented by surveys for most areas. The first surveys of areas C and D were conducted in 2013 after the first year of control work was completed. The first survey of area B was conducted in 2014. Significant work in these two areas took place in 2013. In addition previous work funded by other sources has taken place, and these are described in the narrative for each area.

Limitations on the amount of time available to conduct surveys meant that not all areas could be surveyed every year. Surveys have been undertaken based on the location, timing and type of work occurring within the area and the amount of time since the previous survey. Where significant work was done, that area was prioritized to be surveyed within the next growing season to allow the vegetation response to take place before the next survey was conducted.

Results

Fredericks' Springs – Highly Degraded Seepage Meadows

The Fredericks' Springs and its surrounding seepage meadows around is the most visited wetland area in the area in the Conservancy. During the floods of 2008, water backed up from Lake Mendota to cover Conservancy wetlands with

several feet of sediment-laden water. Over the next several years, reed canary grass, *Phalaris arundinacea,* became well-established and expanded to cover approximately 75% percent of the meadow wetlands by the end of the 2010 growing season, prompting the Friends of Pheasant Branch to apply for an AIS Planning Grant in 2011.

Fredericks' Springs WFQA Results

Year	Target Wetland Invasive Species Absolute % cover		wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native	Relative % Cover Native vs Non-Native
2012	*Phalaris arundinacea* *Typha X glauca*	60% 20%	0.9	4.2	Very Poor	23 vs 7	22% vs 78%
2014	*Phalaris arundinacea* *Typha X glauca*	19% 10%	3.1	21.0	Poor	47 vs 8	70% vs 30%
2015	*Phalaris arundinacea* *Typha X glauca*	15% 15%	3.0	19.5	Poor	43 vs 7	60% vs 40%
2016	*Phalaris arundinacea* *Typha X glauca*	*5%* *1%*	3.7	29.3	Poor	55 vs 7	85% vs 15%
2017	*Phalaris arundinacea* *Typha X glauca*	5% 1%	4.1	30.3	Fair	45 vs 10	90% vs 10%
2018	*Phalaris arundinacea* *Typha X glauca*	*5%* *1%*	4.2%	32.2	Fair	51 vs 8	84% vs 16%

Annual control work at the Frederick's Springs produced dramatic progress from a highly degraded, *Phalaris arundinacea* (reed canary grass) dominated community with low species richness toward a high quality sedge meadow community has taken place. A smaller mixed stand of *Typha X glauca* and *Typha angustifolia* was also present in the area. Because genetic studies have shown the ability to distinguish *T. X glauca* from *T. angustifolia* in the field is not reliable, and both species are targets for the project, we combine their surveyed cover as *Typha X glauca* throughout the report. This stand of invasive Typha has also been nearly eliminated.

In 2012, 60% of the assessment area was covered by *Phalaris*, and 20% by *Typha* with few native species present, leading to a Weighted Mean C of 0.9 (on a scale of 0.0 to 10.0) and a Weighted FQI of 4.2 (on a scale from 0 up with no upper limit). This put the Springs in the bottom of the "Very Poor" range for Southern Sedge Meadow (see Figure 1 for "Proposed Floristic Quality Benchmarks for the Southeast Till Plains"). Following imazypyr applications to flowering *Phalaris* and cut-stumps of *Typha i*n June of 2013 and 2014, the site was surveyed again in mid-September 2014, and showed a sharp increase in FQA metrics; Weighted Mean C increased to 3.1 and Weighted FQI increased to 21.0. The percent cover of both the targeted wetland invasives, *Phalaris* and *Typha,* dropped to 15% each, with the relative cover of non-native species decreasing from 78% in 2012 to 30% in 2014, while the number of native species doubled from 23 to 47, and relative native cover more than tripled, from 22% to 70%.

Imazypyr treatments of *Phalaris* and *Typha* have continued annually through 2018, and they have continued to decrease in cover each year to their current low levels. The 2017 survey resulted in a Weighted Mean C of 4.2, and a Weighted FQI of 27.3. The treatment of the targeted species appears to be highly successful, with *Phalaris arundinacea* reduced to 2% cover and *Typha X glauca* to 1% cover in the 2017 survey.

Area D – The Ditch-fill Area

A major hydrologic disturbance took place in the 1960s when a drainage ditch was dug from west to east to connect the smaller western springs to the stream flowing out of the Fredericks' Springs. The dredge spoils were piled on the south side of the ditch, which became heavily colonized by shrubs and provided a source area for native and non-native shrubs to spread into areas B, C, D, E and F and form dense thickets in some areas. A major hydrologic wetland restoration was undertaken in 2003 and 2004. The drainage ditch was filled, not just plugged, and two sediment detention basins were

dug along an intermittent stream in the restored prairie upstream of the wetlands. Because of the deep frost that formed during the extremely cold period when excavation took place in the winter of 2003 it was not possible to create a complete seal around both edges of the ditchfill. Several areas of ponding formed along the edges of the ditch-fill areas allowing *Typha X glauca* (hybrid cattail) and small populations of Phragmites australis (giant reed grass) to invade. Shrubs also re-invaded portions of the ditch-fill.

The primary management goal for Area D was to reduce cover of wetland invasive shrubs *Lonicera X bella* (honeysuckle), *Rhamnus cathartica* (common buckthorn) and *Salix interior,* as well as overall shrub cover, including *Cornus stolonifera* (red-osier dogwood) and Cornus racemosa (gray dogwood), as targets because of their tendency to invade and dominate sedge meadow communities. A second goal was to reduce the cover of Phalaris arundinacea (reed canary grass) and treat any new invasions of treated areas, completely remove small Phragmites australis (giant reed grass) stands and treat any new invasions, and reduce the cover of *Typha X glauca* in ponded areas and treat any new invasions.

Ditch-fill WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2013	*Salix interior* 15% *Lonicera X bella* 3.5% *Rhamnus cathartica* 1% *Typha X glauca* 15% Phalaris arundinac 1%	3.1	24.2	Poor	60 vs 8	76% vs 24%
2015	*Salix interior* 22% *Lonicera X bella* 1% *Rhamnus cathartica* 1% *Typha X glauca* 15%	3.9	28.7	Fair	53 vs 7	70% vs 30%
2018	*Salix interior* 3% *Lonicera X bella* 1% *Rhamnus cathartica* 1% ***Typha X glauca* 70%**	2.9	24.0	Poor	57 vs 11	55% vs 45%

Beginning in 2013 and continuing annually in the winter shrubs along the Ditchfill Area were cut and treated with Garlon by contractors in 2013 and 2014 and from 2015 on these work efforts were augmented by Operation Fresh Start (OFS) crews lead by the part time Dane County Land Steward Limited Term Employee. This part-time position is funded by the Friends to scout for invasives, and to plan and manage restoration activities carried out by volunteers, a summer intern crew (shared with other non-profit conservation groups) and the OFS crews. Initially efforts focused on cutting and treating *Lonicera X bella, Rhamnus cathartica* and *Cornus sericea*, but at the same time as these were removed and re-sprouting minimized, an area on the west end of the ditchfill was the site of new *Salix interior* saplings becoming established and gradual expansion of *Typha X glauca*. The *Salix interior* saplings were treated starting in the winter of 2015-16 as they became large enough in diameter to cut and treated efficiently. This conitinued in the winter of 2016-17-18. After 3 winters of treatment the cover of Salix interior was down to just 3% from 15% and 22% in 2013 and 2015. Annual cutting and treating of *Typha* stumps was also begun in the winter of 2016-16 and continued in the winter of 2016-17. The treatment were able to hold Typha at a density of 15% cover. However during the wet growing season of 2017 and 2018 Typha X glauca expanded explosively. Unfortunately we were not able to survey the area in 2017, but in the 2018 survey Typha X glauca cover was documented at 70%, 5 times greater than the 2013-2015 period. Our new grant has a major focus on *Typha X glauca* control to address this alarming trend.

Areas C and I – Recovering Southern Sedge Meadow, with embedded Calcareous Fen

These two areas were combined into one Assessment Area for monitoring purposes. Area I was delineated because it hosts a population of *Eriophorum angustifolium*, or cottongrass, a highly conservative species rarely found in southern Wisconsin. Further scouting and vegetation surveys revealed this area to also support several important calcareous fen species of special conservation interest as well, such as *Pedicularis lanceolatus* (swamp lousewort), *Cirsium muticum* (swamp thistle), Parnassia glauca (grass of Parnassus), and Solidago riddellii (Riddell's goldenrod). A series of aerial photos showed this area to have been an open sedge meadow in the 1930's and 1940's with sparse shrub cover. After the drainage ditch was dug in Area D, described above, shrub invasion increased in this area, yet a fairly complete suite of sedge meadow species co-occurred in areas that remained open. It was hypothesized that elimination of shade suppression following shrub removal would allow increased growth of sedge meadow vegetation from the seedbank and from colonization from adjacent vegetation after treatments. Starting in 2015 native sedge meadow seed was also harvested by volunteers and sown into newly treated areas.

Prior to the grant some cut and treat shrub removal work had already been done in 2005 and 2006. However, a significant amount of re-invasion had taken place. The primary management goal for Area C (including Area I) was to continue to reduce cover of wetland invasive shrubs *Lonicera X bella* (honeysuckle), *Rhamnus cathartica* (common buckthorn) and *Salix interior,* as well as overall shrub cover, including *Cornus stolonifera* (red-osier dogwood) and Cornus racemosa (gray dogwood), as targets because of their tendency to invade and dominate sedge meadow communities. A second goal was to treat small areas of herbaceous invaders, *Phalaris, Phragmites* and *Typ*ha and treat any new invasions of these species.

Areas C and I: WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native and Native Targets	Relative % Cover Native vs Non-Native and Non Native Targets
2013	*Cornus sericea* 37.5% *Lonicera X bella* 1% *Salix interior* 1% *Phalaris arundinacea* 3.5%	4.2	30.6	Fair	52 vs 13	70% vs 30%
2015	*Cornus sericea* 7% *Lonicera X bella* 1% *Rhamnus cathartica* 1% *Salix interior* 12% *Typha X glauca* 1% *Phalaris arundinacea* 1%	4.2	31.0	Fair	55 vs 5	87% vs 13%

In 2017 and 2018 Area C&I was subdivided into East and West Areas due to these areas differentiating in vegetative composition.

Area C - East

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native and Native Targets	Relative % Cover Native vs Non-Native and Native Targets
2017	*Cornus sericea* 1% *Lonicera X bella* 1% *Rhamnus cathartica* not found *Salix interior* not found	5.2	43.3	Fair	69 vs 11	92% vs 8%

	Typha X glauca 1% Phalaris arundinacea 1%					
2018	*Cornus sericea* 1% *Lonicera X bella* 1% *Rhamnus cathartica* not found *Salix interior* not found *Typha X glauca* 1% *Phalaris arundinacea* 1%	4.6	40.2	Fair	65 vs 12	91% vs 9%

Area C - West 1/3 – including fen area

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native and Native Targets	Relative % Cover Native vs Non-Native
2017	*Cornus sericea* 3% *Lonicera X bella* 1% *Rhamnus cathartica* not found *Salix interior* not found *Typha X glauca* 1% *Phalaris arundinacea* 2%	4.7	36.2	Fair	53 vs 8	95% vs 5%
2018	*Cornus sericea* 1% *Lonicera X bella* not found *Rhamnus cathartica* 1% *Salix interior* not found *Typha X glauca* 3% *Phalaris arundinacea* 1%	4.9	40.5	Fair	60 vs 8	94% vs 6%

Intensive cut and treat control work by our contractor and by Operation Fresh Start crews.greatly reduced un-desirable shrubs within the first several years, with shrub cover down to acceptable levels by 2015, and it has stayed at low levels since then. Re-sprouting and re-invasion from seed have been less of a problem since prescribed fire has been started as a control technique.

Introduction of Prescribed Fire

Prescribed burning was first introduced to this area in the spring of 2016, from the ditchfill (Area D) north throughout Area C. That was a relatively complete burn in terms of area. In 2017 the boundaries of the burn area were extended southward to the Acker stream, using it as the western and southern boundary. Areas E, F , G and H, which extend into the City of Middleton portion of the Conservancy, were now within the burn unit. At this time the City of Middleton became involved, and assisted with mowing firebreaks. Spring burns conducted in 2017 and 2018 were relatively patchy but resulted in top killing shrubs that had re-sprouted. The 2018 burn unit was expanded west of the Acker stream to include Area B and contiguous City land. In 2019 this unit was burned again, with a much more complete coverage. As a result Area C has been burned for four consecutive years and much less cut and treat work has been required to maintain the low shrub levels. It appears the combination of these approaches has led to maintenance of almost completely shrub free areas without the reinvasion that had taken place in the past.

Area B (including A) –Southern Sedge Meadow Degraded by Shrub invasion

Area B is similar to Area C, but is on the west side of the Acker stream. Prior to the 2012 grant some shrub removal had taken place, but the treated area was expanded by contractors in 2014-15 , and further expanded by Operation Fresh Start crews starting in the winter of 2017-18 and continuing in 2018-19.

Area B WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native and Native Targets	Relative % Cover Native vs Non-Native and Native Targets
2014	*Cornus sericea* 3.5% *Rhamnus cathartica* 1% *Phalaris arundinacea* 3.5%	2.1	15.6	Poor	56 vs 24	60% vs 40%
2017 East	*Cornus sericea* 1% *Lonicera X bella* 2% *Rhamnus cathartica* 1% *Typha X glauca* 1% *Phalaris arundinacea* 1%	4.2	34.3	Fair	56 vs 12	91% vs 9%
2017 West	*Cornus sericea* 1% *Lonicera X bella* 1% *Rhamnus cathartica* 1% *Salix interior* 2% L*ythrum salicaria* 1% *Typha X glauca* 2% *Phalaris arundinacea* 1%	4.7	39.1	Fair	61 vs 9	93% vs 7%

Results for this area have been very encouraging, with target shrub cover kept at low levels throughout the treated areas. Native vegetation response has resulted in a doubling of FQA metrics. In 2018 and 2019 work has focused on clearing shrubs further south into the City-managed part of the Conservancy. Area B has been included in the prescribed fire plan and was burned in spring of 2018 and 2019, along with areas C, D, E ,F and G. Baseline surveys were completed in 2018 prior to cutting and treatment in the newly expanded zones in the City, south of Area B. Future surveys will be able to document the vegetation response.

Invasive Willow Clone (not mapped in Plan)

Within Area C, straddling the wetland-upland boundary was an acre-sized monocultural *Salix interior* clone existed that was expanding in size. Though not specifically recommend in the plan, it's presence and expansion were recognized as a serious threat to maintaining sedge meadow vegetation and posed a barrier to grassland bird species. In December of 2014 a decision was made to completely remove the clone. This area was not formally surveyed, but it was obvious that it was essentially a 100% monoculture. The first year following treatment, Salix interior responded with a flush of growth from rhizomes that were unaffected by the treatment due to incomplete translocation of herbicide. The 2015 found 65% cover, consisting of half inch or less diameter saplings. There was also a large growth of non-native plants, likely from the seedbank and some nearby upland and wetland vegetation.

Willow Clone WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	Number of Species Native vs Non-native or Native Target	Relative % Cover Native vs Non-Native or Native Target
2014	*Salix interior* 100%	2.0	2.0	Poor	1 vs 1	100% vs 100%
2015	*Salix interior* 65% *Lonicera X bella* 2% *Phalaris arundinacea* 1%	2.5	18.7	Poor	55 vs 16	50% vs 50%
2017	*Salix interior* 4% *Lonicera X bella* 1% *Cornus sericea* 3% *Typha X glauca* 1% *Phalaris arundinacea* 1%	2.6	20.9	Poor	64 vs 22	78% vs 22%

Conclusions

Trends from 2012 through June 2017. Floristic Quality Assessment monitoring results show that most treated areas have improved dramatically, especially in terms of reducing the cover of targeted invasive shrub species. Native-dominated seedbanks have responded to the elimination of shade suppression from shrubs with a flush of mostly herbaceous growth that has greatly increased native species cover, measured by Weighted Mean C values diversity. This is reflected in a pattern of strong increase in FQA metrics.

For recovering sedge meadow communities, such as Areas B, C, and D, the use of prescribed burning following cutting and treating appears to be successful in maintaining low levels of cover for target shrub species. These communities responded as expected, by increasing species richness of herbaceous natives, as evidenced by increases in weighted Mean C and Weighted FQI. For the Frederick's Springs, where burning is not possible, it appears that it will be necessary to continue imazypyr treatments of *Phalaris arundinacea*. If its cover can be reduced to 1% it may be reasonable to skip treatment for a year and monitor the response.

However these results indicate there may a limit to the degree the plant community can recover in terms of floristic quality. The next few years of monitoring for the 3rd grant will be focused to survey Areas C and B.

While control of shrubs has been largely successful the last two wet years of 2017 and 2018 appear to be stimulating fast expansion of *Typha X glauca* (and *T. angustifolia).* This appears to be the next big challenge for the wetlands of Pheasant Branch conservancy. Baseline surveys in small dense clusters of *Typha* were conducted in 2018 before cut and treat control took place. These will be re-surveyed in 2019, but casual observation indicates a small amount of resprouting has taken place and native cover is increasing.