Table 1.Summary of marshbird surveys on large cattail (*Typha angustifolia* and *Typha* x *glauca*)-dominated wetlands on Minnesota Department of Natural Resources Wildlife Management Areas (WMAs) in northwestern Minnesota, USA that were targeted for a large-scale glyphosate herbicide application to control cattail during late summer and autumn 2015. We evaluated whether herbicide application affected marshbird abundance by conducting surveys during spring breeding seasons at paired treatment and control sites and evaluated change in number of detections from before to 3 years after herbicide application (2015 – 2018).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study site name | Area of WMA | Treatment area | No. survey locations | | Years |
|  | (ha) | (ha) | Herbicide | Control | surveyed |
| Beaches Lake | 12,393 | 62.3 | 2 | 2 | 2 |
|  |  |  |  |  |  |
| East Park | 4,220 | 122.0 | 2 | 4 | 4 |
|  |  |  |  |  |  |
| Eckvoll | 2,626 | 121.9 | 4 | 2 | 3 |
|  |  |  |  |  |  |
| Elm Lake | 6,370 | 370.1 | 4 | 4 | 4 |
|  |  |  |  |  |  |
| Pembina | 2,638 | 186.8 | 4 | 4 | 4 |
|  |  |  |  |  |  |
| Roseau River east | 30,418 | 58.2 | 4 | 4 | 4 |
|  |  |  |  |  |
| Roseau River west | 213.0 | 2 | 2 | 4 |
|  |  |  |  |  |  |
| Thief Lake | 22,241 | 30.4 | 3 | 3 | 4 |
|  |  |  |  |  |  |
| Twin Lakes | 3,591 | 45.1 | 3 | 3 | 3 |
| Total |  |  | 28 | 28 |  |

Table 2. Marshbird detections and summary statistics on large cattail (*Typha angustifolia* and *Typha* x *glauca*)-dominated wetlands on Minnesota Department of Natural Resources Wildlife Management Areas (WMAs) in northwestern Minnesota, USA that were targeted for a large-scale glyphosate herbicide application to control cattail during late summer and autumn 2015. Detections were either auditory or visual, with visual detections noted in parentheses). We evaluated whether herbicide application affected mean marshbird abundance by conducting surveys during spring breeding seasons at paired treatment and control sites and evaluated change in number of detections from before to 3 years after herbicide application (2015 – 2018). Statistical results are pairwise comparisons between the mean expected counts in the control site and the herbicide sites based on a generalized linear mixed model with site as a random effect and a treatment-by-year interaction that was run for each individual species (log link, Poisson family). The model that was run across all species (Total row) matched the species-specific models with the addition of species as another random effect. Bolded statistical values are significant at a 90% confidence level.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | 2015 | 2016 | 2017 | 2018 |  |
| Species | Site | 8 June to 13 June | 26 May to 7 June | 30 May to 3 June | 28 May to 4 June | Total |
| American bittern | Control | 29 | 55 | 22 | 4 (4) | 114 |
|  | Herbicide | 13 | 31 | 28 | 6 (7) | 85 |
|  |  | *t193 = 2.241 p = 0.332* | *t193 = 2.447 p = 0.225* | *t193 = -0.926 p = 0.983* | *t193 = -1.183 p = 0.936* |  |
| Least bittern | Control | 4 | 4 | 3 | 2 | 13 |
|  | Herbicide | 11 | 2 | 6 | 0 (1) | 20 |
|  |  | *t193 = -1.855 p = 0.583* | *t193 = 0.735  p = 0.996* | *t193 = -1.065 p = 0.963* | *t193 = 0.519 p = 1.000* |  |
| Pied-billed grebe | Control | 11 | 18 | 11 | 2 (1) | 43 |
|  | Herbicide | 6 | 7 | 7 | 10 | 30 |
|  |  | *t193 = 1.013 p = 0.972* | *t193 = 1.952  p = 0.517* | *t193 = 0.778 p = 0.994* | *t193 = -1.936 p = 0.528* |  |
| Sora | Control | 24 | 16 | 15 | 1 (1) | 57 |
|  | Herbicide | 20 (1) | 9 | 31 | 16 (7) | 84 |
|  |  | *t193 = 0.318 p = 1.000* | *t193 = 1.326  p = 0.888* | *t193 = -2.385 p = 0.255* | ***t193 = -3.373 p = 0.020*** |  |
| Virginia Rail | Control | 7 | 8 | 9 | 1 | 25 |
|  | Herbicide | 12 | 4 | 13 | 17 (7) | 53 |
|  |  | *t193 = -1.230 p = 0.922* | *t193 = 1.106  p = 0.955* | *t193 = -0.884 p = 0.987* | ***t193 = -3.167 p = 0.037*** |  |
| Total | Control | 75 | 101 | 60 | 16 | 252 |
|  | Herbicide | 63 | 53 | 85 | 71 | 272 |
|  |  | *t1000 = 0.649 p = 0.998* | ***t1000 = 3.547  p = 0.010*** | *t1000 = -2.326 p = 0.280* | ***t1000 = -5.574 p < 0.001*** |  |