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The Influence of European Buckthorn (*Rhamnus cathartica)* on Captures of North American Passerines

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Abstract: Common buckthorn (*Rhamnus cathartica*) is an aggressive invasive species in North America. It quickly establishes as a dominant shrub in existing forests, forms a dense, thorny understory that shades existing vegetation, and substantially alters or eliminates the native plant and animal community. We compared the number of birds captured between sites where buckthorn was cleared to sites not cleared of buckthorn at a Monitoring Avian Productivity and Survivorship (MAPS) station. To do this, we first cleared buckthorn from around three net locations in late 2020 and randomly selected three net locations as non-cleared control sites. Then we captured birds on seven dates each summer and examined captures 3 years before and 3 years after buckthorn removal. For this we used a paired approach, calculating the difference between the number of birds captured in the cleared vs. not cleared sites for each date, and then we analyzed the four most captured bird species. Before removing the buckthorn, we captured more birds at sites slated for buckthorn removal than at sites scheduled for no buckthorn removal. After removing the buckthorn, we similarly captured more total birds at sites where the buckthorn was removed than at sites with no buckthorn removal. However, capture rates for individual species were not different between cleared and uncleared sites after buckthorn removal. More yellow warblers were captured at unaltered sites scheduled for buckthorn removal than at unmanipulated sites prior to removal. We found no trends in the abundance of American redstarts, American robins, gray catbirds, or yellow warblers. Research is needed to identify specific vegetative characteristics that yellow warblers selected as well as a longer-term design to assess population trends with and without buckthorn.

Introduction

Common buckthorn (*Rhamnus cathartica*) is a destructive invasive species native to Europe and Asia and introduced to North America. The invasion distribution is centered on the Great Lakes region, but it is found in at least 37 states and 6 Canadian provinces (United States Department of

Agriculture 2024). It was brought to the United States as an ornamental shrub but has since expanded its distribution (Bisikwa et al. 2020). Buckthorn quickly establishes itself in temperate forests and outcompetes native vegetation (Knight et al. 2007). It can also quickly reproduce up to 14,000 stems per acre after only a few years (Bisikwa et al. 2020).

Buckthorn's impact on resident passerine populations is less clear. Knight et al. (2007) found that bird diversity declines with increasing buckthorn density. A dense buckthorn understory may offer more secure areas for birds to forage, exclude birds because it is too thick, or change bird use with the loss of the native vegetation. Common buckthorn invasions also directly affect lower trophic levels, such as passerines (Jacobs 2024), impacting the entire plant and animal community. Buckthorn has also been shown to reduce the populations and diversity of native insects, including caterpillars (Tarr 2022). Tarr (2022) also showed a decrease in the passerine population, likely because of reduced insect food sources. Buckthorn's rapid invasion and ecosystem alteration changes nearly every component of the passerine habitat (e.g., the vegetation community composition, vegetative structure, insect communities, microclimates).

Buckthorn invasions diminish native plant communities, alter the vegetative structure of forested ecosystems, and reduce the diversity and abundance of insect and possibly bird communities. Therefore, we examined avian abundance in the presence and absence of buckthorn at an existing Monitoring Avian Productivity and Survival (MAPS) banding station.

Methods

We conducted this study at the University of Minnesota Crookston's Red River Valley Natural History Area (RRVNHA). The RRVNHA is 90 acres of forest, grassland, and wetland vegetation. Common buckthorn has been present for over 30 years and it is the dominant shrub throughout the forest cover types. Natural Resources Program faculty and staff have used mist nets to capture birds as part of the MAPS Program (Institute for Bird Populations 2024) since 2012. We captured birds in 10 nets over six hours, seven times during the summer. Net locations are the same each year (Figure 1). We recorded both initial and re-captures. We captured ~250 birds annually. All birds were captured and handled by Drs. Bell and Loegering under Federal USGS Banding Permit #23672 and the University of Minnesota IACUC protocol #2005-38132A.

We analyzed data collected during the 2018-2023 field seasons. In the fall of 2020, three net sites (2, 3, and 5) were cleared of all buckthorn within 20m. To balance the study, we randomly selected three control net sites, namely 1, 6, and 7. Capture data from the other four net sites was ignored. Throughout the experiment, we limited our analyses to the four most captured species.

We compared the number of birds captured at sites where buckthorn was removed (i.e., the sum of the number of birds captured at net sites 2, 3, and 5), hereafter known as cleared sites, and where buckthorn was not removed (i.e., the sum of the number of birds captured at net sites 1, 6, and 7), hereafter noted as non-cleared sites. We recorded these sums for each banding date (n=7 banding dates/year). We

used a Wilcoxon signed-rank test to compare the difference in the daily sum of captures between cleared and non-cleared sites: 1) before the buckthorn clearing (2018-2020) and 2) after the clearing (2021-2023). We used a Mann-Kendall Test for Monotonic Trend (Meals et al. 2011) on the annual sum of birds captured between 2018 and 2023.

Results

We caught 323 of the four most captured bird species during 2018-2023 (Table 1): 73 American redstarts (*Setophaga ruticilla*, AMRE), 61 American robins (*Turdus migratorius*, AMRO), 110 gray catbirds (*Dumetella carolinensis*, GRCA), and 79 yellow warblers (*Setophaga petechia*, YEWA). During 2018-2020, before removing any buckthorn, we captured more total birds at sites slated for buckthorn removal than those scheduled for no buckthorn removal (Wilcoxon signed-rank test, V=170, P=0.0002, n=21). More yellow warblers were captured at sites scheduled for buckthorn removal than at non-cleared sites (V=117.5, P=0.0104, n=21). We captured American redstarts, American robins, and gray catbirds at similar rates (all P>0.05) between treatments before clearing.

During 2021-2023, after removing buckthorn at three net sites, we similarly captured more total birds at sites where buckthorn was removed than at sites with no buckthorn removal (Wilcoxon signed-rank test, V=173.5, P=0.0102, n=21). However, capture rates for individual species were not different between cleared and uncleared sites after manipulation (all P>0.05). We found no trends in the abundance of American redstarts (Mann-Kendall Test t=0.33, P=0.45, n=42), American robins (t=-0.28, P=0.57, n=42), gray catbirds (t=-0.77, P=0.44, n=42), or yellow warblers (t=-0.33, P=0.45, n=42, Table 2).

Discussion

We found no positive impact of removing buckthorn from around MAPS net sites for the four most captured species. Only yellow warbler capture rates changed; more warblers were found at sites scheduled to be cleared than in sites not manipulated before the clearing. After we cleared the sites of buckthorn, yellow warbler captures were no different between cleared and uncleared sites. Latif et al. (2011) suggested that yellow warblers prefer a dense overhead cover, and our clearing of sites removed most of the overhead cover. Continued research is needed to assess the impact of buckthorn's complex understory on yellow warbler populations.

American redstarts, American robins, and gray catbirds did not increase in abundance in buckthorn-removed stands. We think this is because food sources were not affected in those buckthorn stands, while yellow warblers could better thrive in those areas. Yellow warblers tend to forage lower in forested areas and are unaffected by a dense understory where insects can be eaten below the dominant understory (Morse 1973). American redstarts tend to forage higher in forested areas, with buckthorn removal not providing any benefits or detriments depending on tree height (Morse 1973). American robins forage in similar areas where they scavenge insects and can feed on buckthorn berries (Wheelwright 1986). Similarly, gray catbirds also use buckthorn fruit as a common food source (Hazelton et al. 1984).

We found no trends in abundance for the four most captured species during 2018-2023. In contrast, Rosenberg et al. (2019) noted strong declining trends in North America in the families of these species since 1970. We suspect our 6-year dataset lacks the statistical power to detect these larger regional declines. The limitations of this study include a limited number of years of study, the unintentional clustering of cleared net sites, and the physical proximity of the cleared sites to a potentially compensatory habitat for some bird species. The three net sites where buckthorn was removed were all near a cattail (*Typha* species) marsh that may have provided alternate habitat components for birds at the sites where buckthorn was removed, muddling the impact of buckthorn removal. For example, the yellow warbler response could include an interaction with their habitat selection at an effect larger than the buckthorn removal as they have a close affinity to watercourses (Lowther et al. 2020) and the three sites where buckthorn was removed were all adjacent to a wetland. Moreover, the post-removal study period may not have been long enough. Lastly, sites where buckthorn was removed may have needed several growing seasons for native vegetation to recover before offering suitable habitat for breeding passerines. Future research could clarify these confounding relationships in complex ecosystems with a longer duration of study and the use of sites that are more carefully stratified to assure homogenous cover types.

Conclusion

Removing buckthorn within 20m of a mist net had a negligible impact on the bird community's capture rates. However, we captured more yellow warblers in areas with an intact buckthorn understory. Our study's lack of observed differences highlighted that our work may have been too small in scope and scale. Recommendations for future research are 1) a larger buckthorn removal buffer of at least 50m to include multiple passerine home ranges, 2) a study design to ensure each treatment is in a homogenous forest, 3) a longer monitoring period to assess the magnitude of the treatment differences within the naturally high variability of annual songbird abundances, and 4) additional study sites to replicate these treatments among different forest types invaded by buckthorn.

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Avian Species	Cleared Sites 2018-2020	Non-cleared Sites 2018-2020	Cleared Sites 2021-2023	Non-cleared Sites 2021-2023
AMRE	17	6	32	18
AMRO	23	6	20	12
GRCA	32	11	51	16
YEWA	34	8	16	21

Table 1. Total captures of American redstarts (AMRE), American robins (AMRO), gray catbirds (GRCA), and yellow warblers (YEWA) at sites cleared of buckthorn in late 2020 and at sites not cleared at the Red River Valley Natural History Area, 2018-2023.

Avian Species	2018	2019	2020	2021	2022	2023
AMRE	7	6	10	4	25	21
AMRO	5	16	8	32	0	0
GRCA	6	26	11	61	6	0
YEWA	15	14	13	3	25	9

Table 2. Captures per year of American redstarts (AMRE), American robins (AMRO), gray catbirds (GRCA), and yellow warblers (YEWA) at the Red River Valley Natural History Area, 2018-2023.

Figure 1. Aerial view of the Red River Natural History Area with mist net locations.

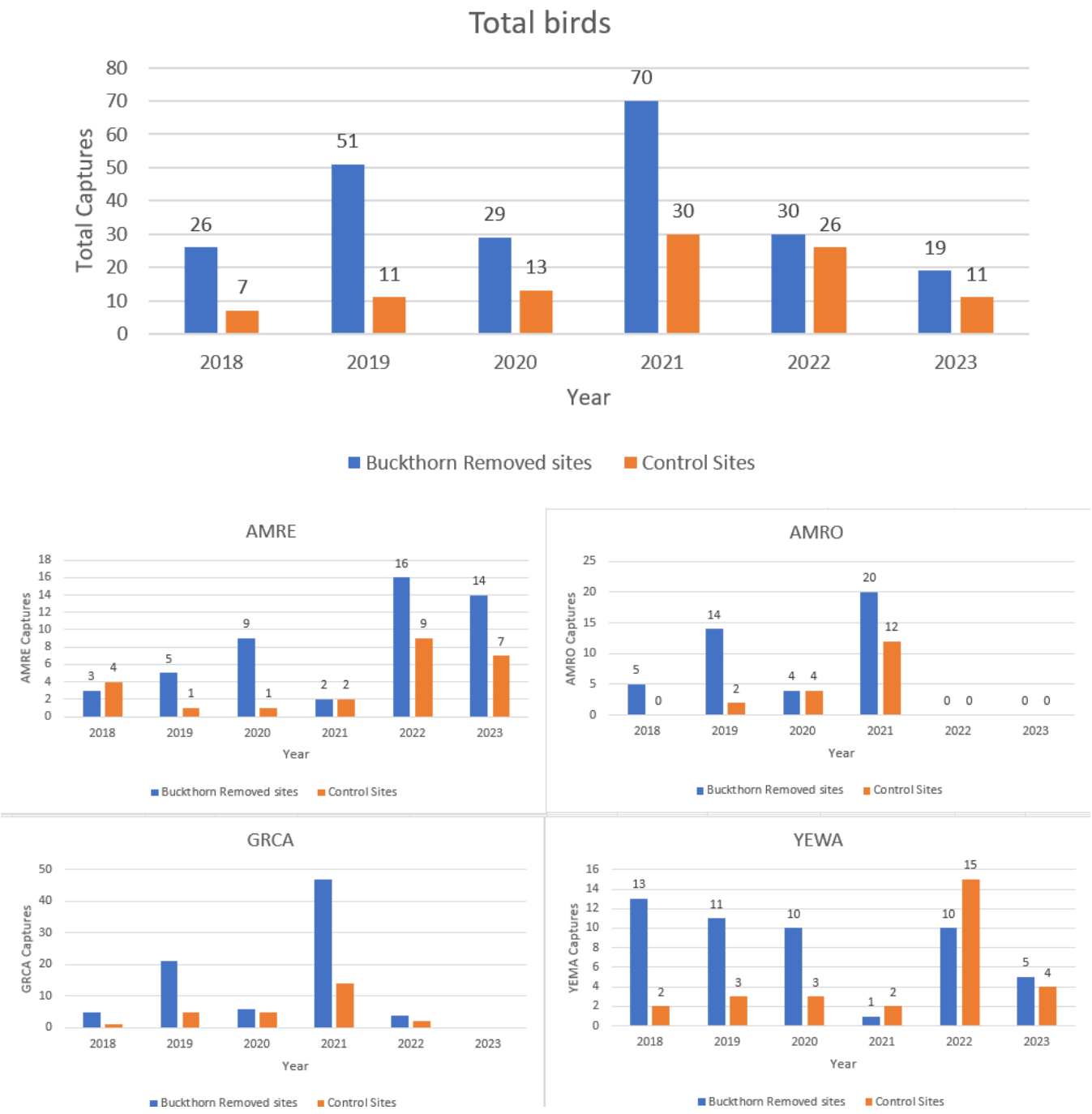

Figure 2. Total captures of the four most captured birds (Total birds), American redstarts (AMRE), American robins (AMRO), gray catbirds (GRCA), and yellow warblers (YEWA) at sites cleared of buckthorn in late 2020 and at sites not cleared (Control) at the Red River Valley Natural History Area, 2018-2023.

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