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Source: Natural Areas Journal, 35(2) : 279-287

Published By: Natural Areas Association

URL: https://doi.org/10.3375/043.035.0208

RESEARCH ARTICLE

Birds that Eat Nonnative Buckthorn Fruit (*Rhamnus cathartica* and *Frangula alnus*, Rhamnaceae) in Eastern North America

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Natural Areas Journal 35:279–287

ABSTRACT: The buckthorns *Rhamnus cathartica* and *Frangula alnus* are nonnative invasive species in North America whose seeds are primarily dispersed by birds. This paper presents the first major compilation of the bird species that eat *R. cathartica* and *F. alnus* in eastern North America, where these buckthorns are most invasive and have few common congeners. Using fecal samples, observations, and an extensive literature search, I document 46 bird species that consume *R. cathartica* and *F. alnus*, and discuss which are the most competent dispersers of the seeds. I also correct a frequently repeated belief that "blackbirds" are efficient dispersers of *R. cathartica* and *F. alnus*.

Index terms: Frangula alnus, glossy buckthorn, *Rhamnus cathartica*, common buckthorn, birds

INTRODUCTION

Birds are common dispersers of fleshy-fruited plants and play a key role in the spread of nonnative species (Gosper et al. 2005). The success of fleshy-fruited plant invaders is, in part, dependent on the presence of appropriate dispersers, which may vary by geographic region (Buckley et al. 2006).

Common or European Buckthorn (*Rhamnus cathartica* L.) and Glossy Buckthorn (*Frangula alnus* Mill., syn. *Rhamnus frangula*) are well-established nonnative invasive shrubs in North America, originating in Europe and western Asia. *Rhamnus cathartica* was likely introduced in the northeastern United States prior to 1800, was in the Midwest by 1839, and in eastern Canada by 1864 (Kurylo and Endress 2012). It is now found over much of North America north of mid-continent, but most commonly in the upper Midwest, the Northeast, and southern Quebec and Ontario (Knight et al. 2007; Qaderi et al. 2009; Zouhar 2011; USDA 2013). *Frangula alnus* was introduced to North America around 1800, in Ohio prior to 1932, and is now established in much of central and northeastern North America (Howell and Blackwell 1977; Dukes et al. 2009; USDA 2013).

Both species have small, inconspicuous flowers that form drupes, which ripen from green to purple-black, typically containing two to four seeds (Godwin 1936; Kurylo et al. 2007; Zouhar 2011). Birds are the primary dispersers of both *R. cathartica* and *F. alnus* (Godwin 1936; Hampe and Bairlein 2000; Knight et al. 2007; McCay and McCay 2009; Zouhar 2011). However, relatively little has been published identifying specific bird species that consume fruits of these buckthorns in the wild, and some frequently cited sources provide incorrect information on which birds disperse the seeds. The spread, distribution, and population dynamics of nonnative plant species can only be fully understood by confirming the identity of their dispersers (Schupp et al. 2010; Westcott and Fletcher 2011).

This paper provides a list of *R. cathartica* and *F. alnus* consumers based on the author's fecal sample studies and compiled observations, as well as a literature search, and discusses which bird species are efficient dispersers of the seeds. Further, it corrects a frequently repeated error in the literature regarding a family of birds that is reported to disperse *R. cathartica* and *F. alnus* in North America.

METHODS

There are at least 12 species of native *Rhamnus* and *Frangula* west of the Mississippi, three of which (*R. lanceolata* Pursh, *R. alnifolia* L'Hér., and *F. caroliniana* (Walter) A. Gray) are also found in eastern North America (Kartesz 2013; USDA 2013). To reduce false hits on those species, my literature and online searches focused on the Great Lakes states (Wisconsin, Illinois, Michigan, Indiana, Ohio, Pennsylvania, New York), New England (Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island), and eastern Canada (Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island; neither *R. cathartica* nor *F. alnus* is present in Newfoundland). *Rhamnus cathartica* and *F. alnus* are generally widespread and common in these locations, whereas the other native species and two additional introduced species (*R. utilis* Decne. and *R. davurica* Pall.) are not present, uncommon, and/or restricted to specific habitats (Qaderi et al.

2009; Reznicek et al. 2011; Chadde 2012; Weeks and Weeks 2012; USDA 2013). The bird fauna in other eastern states where the target buckthorns occur, however, is comparable to the searched area.

Fecal Sampling

Fecal samples were collected during fall banding operations of the Rouge River Bird Observatory (RRBO) on the campus of the University of Michigan-Dearborn, Dearborn, Wayne County, Michigan. The campus is located just outside the city of Detroit, and includes a 120-ha natural area that is primarily secondary forest and old fields. This site is fairly typical of many urban or suburban parks and natural areas in eastern North America, with a high percentage of nonnative vegetation (for a complete site description, see Craves 2007, 2009). Birds representing over 90% of the genera of the principal frugivorous passerines of eastern North America (Willson 1986) have been banded at this site, providing a good opportunity to examine fruit in their diets.

Samples were collected from *Catharus* thrushes from 2007 to 2012 and from all birds that defecated seeds from 2009 to 2012 for an ongoing study of the diet of fall migratory birds. Samples were obtained from birds as they were being released from mist nets, from the clean cloth bags that each individual bird was transported and held in prior to being banded, and/or from droppings obtained while the bird was being processed. Seeds found in fecal samples were identified under a microscope using a reference collection compiled from fruits collected on site, as well as photographs of seeds from various print and online sources. All identifications were verified by at least two people.

From 2007 to 2012, a total of 1208 fecal samples comprising 7880 individual seeds were collected from 18 bird species. Only seven seeds were not identified to at least genus.

Feeding Observations

Bird surveys were conducted for RRBO primarily by the author, but also students and volunteers. These were performed mostly on campus, but also at several nearby urban parks and residential sites in southeast Michigan. From 2006 to 2012, experienced observers were asked to record observations of birds eating fruit. Seventy-seven observations from the months of July through February were recorded over the period, representing 21 bird species foraging on 19 fruit species. These observations were largely peripheral to other tasks, so they do not represent a random sample, but do add to the data set.

Literature Searches

I searched multiple online databases and websites, including Google Scholar, six major peer-reviewed journal publishers (BioOne, Elsevier, ProQuest, ScienceDirect, Springer, Wiley), the Searchable Ornithological Research Archive (15 ornithological journals), Birds of North America Online (life histories of over 700 bird species), and nine regional or state bird or natural history journals. I did not specify a start date, and searched through mid-2013. I searched using the term "bird" in combination with terms including "*Rhamnus*", "*cathartica*", and "*Frangula*", "fruit", "diet", "disperse", and "consume", which returned hundreds of hits with many redundancies.

Listservs

I performed similar searches in the online archives of 32 birding listservs (email lists or forums that cater to birders discussing sightings, identification, etc.) serving the states and provinces in the relevant region; not all states have these listservs or archives, and some states have more than one. Archives spanned the years 1998–2013. I only included seasonally appropriate messages that included sufficient overall detail indicating observer credibility.

If authors did not mention a specific buckthorn species and I doubted that the buckthorn species noted was either *R. cathartica* or *F. alnus* (due to location, habitat description, context, etc.), I did not include that account in my results.

RESULTS

Considering all sources, I was able to document 46 species of birds from 16 families and 31 genera as consumers of *R. cathartica* or *F. alnus* (Table 1).

Buckthorn seeds, among other taxa, were found in fecal samples from eight bird species. *Rhamnus cathartica* seeds were found in 43% of all samples (n = 1208), and in 44% of the samples from the eight species (n = 1167). *Frangula alnus* seeds were found in 6% of all samples, and 7% of the samples from the six species in which they were found (n = 1163). All the species that defecated *F. alnus* seeds also defecated *R. cathartica* seeds (although not necessarily in the same samples). Two bird species, White-breasted Nuthatch and Northern Cardinal, defecated *R. cathartica* seeds but not *F. alnus* seeds (see Table 1 for scientific names).

Twelve bird species were observed foraging on buckthorn fruit. All were observed using *R. cathartica*, while four species (American Robin, Gray Catbird, European Starling, and Cedar Waxwing) were also seen eating *F. alnus* fruit.

My literature search located reports of birds eating buckthorn, judged to be either *R. cathartica* or *F. alnus,* for 26 species from six states and one province. There were 128 reports of 33 species of birds eating *R. cathartica* or *F. alnus* from 10 states and one province found on the internet archives of birding listservs or forums.

DISCUSSION

In evaluating Internet and regional journal reports of birds eating *R. cathartica* or *F. alnus*, I found some bias towards uncommon or rare bird species. These birds attract attention, and their behavior is often noted in detail. This explains the reports of six species that are vagrants to eastern North America: Fork-tailed Flycatcher, Mountain Bluebird, Townsend's Solitaire, Varied Thrush, Phainopepla, and Western Tanager. As rarities, these species were well documented and their food sources were noted. Common or secretive species may not merit this kind of scrutiny, documenta-

Table 1. North American bird species reported to eat the fruit of *Rhamnus cathartica* or *Frangula alnus* in nature in eastern North America. Taxonomy follows the American Ornithologists' Union's Checklist of North American Birds, 7th ed., and all of its supplements (<checklist.aou.org>).

	Data Sources[a]	Locations, if noted
ORDER ANSERIFORMES		
Family Anatidae: Swans, Geese, and Ducks		
Wood Duck, *Aix sponsa*	Lit (Ridley [1930], who cited the work of Mabbott [1920], but erroneously as "Marrott")	
ORDER PICIFORMES		
Family Picidae: Woodpeckers and allies		
Northern Flicker, *Colaptes auratus*	Int	NY
ORDER PASSERIFORMES		
Family Tyrannidae: Tyrant Flycatchers		
Fork-tailed Flycatcher, *Tyrannus savana*	Lit (Iliff and Lovitch 2007)	NH
Family Vireonidae: Vireos		
Philadelphia Vireo, *Vireo philadelphicus*	Lit (Barrientos 2010)	WI
Red-eyed Vireo, *Vireo olivaceus*	Int	NY
Family Sittidae: Nuthatches		
White-breasted Nuthatch *Sitta carolinensis*	Fec	MI
Family Turdidae: Solitaires, Thrushes, and allies		
Eastern Bluebird, *Sialia sialis*	Lit (Huggins 1993, Lange 1998, Peterson 2008), Int, Obs	ME, MI, NY, WI
Mountain Bluebird, *Sialia currucoides*	Lit (Guthrie and Davis 1975)	NY
Townsend's Solitaire, *Myadestes townsendi*	Lit (Tessen 1981; Lange 1985, 1987, 1988; Manson 1990, Bowen 1997, Wood 1998), Int	MI, NY, ON, WI
Gray-cheeked Thrush, *Catharus minimus*	Fec	MI
Swainson's Thrush, *Catharus ustulatus*	Lit (Barrientos 2010), Int, Fec	IL, MI, WI
Hermit Thrush, *Catharus guttatus*	Int, Obs, Fec	MI, ON
Wood Thrush, *Hylocichla mustelina*	Lit (Granlund 1997)	WI
American Robin, *Turdus migratorius*	Lit (Comey 1902, Hoyt 1956, Lange 1984, Wheelwright 1986, Catling and Porebski 1994, Witmer 1996, Peterson 2001, Purcell 2003, Peterson 2008, Barrientos 2010), Int, Obs, Fec	IL, MA, MI, NY, ON, VT, WI
Varied Thrush, *Ixoreus naevius*	Lit (Weir 1983)	ON
Family Mimidae: Mockingbirds, Thrashers, and allies		
Gray Catbird, *Dumetella carolinensis*	Lit (Judd 1895, Moulton 1921, Barrientos 2010, Labbe 2011, Smith et al. 2011), Int, Obs, Fec	MA, MI, ON, PA, WI
Northern Mockingbird, *Mimus polyglottos*	Lit (Jacobs et al. 1981; Graves 1995; Lange 1997, 2005), Int	IL, NY, ON, WI
Brown Thrasher, *Toxostoma rufum*	Lit (Judd 1895)	
Family Sturnidae: Starlings		
European Starling, *Sturnus vulgaris*	Lit (Lindsey 1939, Catling and Porebski 1994, Purcell 2003), Int, Obs	IL, MI, NY, ON

Continued

Table 1. (Cont'd).

	Data Sources[a]	Locations, if noted
Family Bombycillidae: Waxwings		
Bohemian Waxwing, *Bombycilla garrulus*	Lit (Bent 1950, Lound and Lound 1958, Bauers 1962, Mack 1978, Clark 1979, Diers 1986, Catling and Porebski 1994, Peterson 1996, Crowell 1996), Int	NY, ON, VT, WI
Cedar Waxwing *Bombycilla cedrorum*	Lit (Scheider 1977, Lehman 1989, Catling and Porebski 1994, Crowell 1996, Witmer 1996, Gregoire and Gregoire 1999, Purcell 2003), Int, Obs, Fec	IL, MI, VT, NY, ON
Family Ptiliogonatidae: Silky-flycatchers		
Phainopepla, *Phainopepla nitens*	Lit (Boldt 1994), Int	ON, WI
Family Parulidae: Wood Warblers		
Tennessee Warbler, *Oreothlypis peregrina*	Int	IL
Orange-crowned Warbler, *Oreothlypis celata*	Int	IL, IN
Cape May Warbler, *Setophaga tigrina*	Int	IL
Magnolia Warbler, *Setophaga magnolia*	Int	NY
Blackpoll Warbler, *Setophaga striata*	Int, Obs	MI, OH
Black-throated Blue Warbler, *Setophaga caerulescens*	Int	NY, ON, PA
Yellow-rumped Warbler, *Setophaga coronata*	Lit (Barrientos 2010), Int, Obs	MI, NY, WI
Black-throated Green Warbler, *Setophaga virens*	Int	NY
Family Emberizidae: Sparrows		
Eastern Towhee, *Pipilo erythrophthalmus*	Lit (Barrientos 2010)	WI
American Tree Sparrow, *Spizella arborea*	Int	IL
Fox Sparrow, *Passerella iliaca*	Int	NY, ON
White-throated Sparrow, *Zonotrichia albicollis*	Lit (Barrientos 2010), Int	NY, WI
White-crowned Sparrow, *Zonotrichia leucophrys*	Lit (Barrientos 2010), Obs	MI, WI
Family Cardinalidae: Tanagers, Cardinals, New World Grosbeaks, and Buntings		
Summer Tanager, *Piranga rubra*	Int	NY
Scarlet Tanager, *Piranga olivacea*	Int	IL, ON
Western Tanager, *Piranga ludoviciana*	Int	ON
Northern Cardinal, *Cardinalis cardinalis*	Lit (Barrientos 2010), Int, Fec	MI, NY, WI
Rose-breasted Grosbeak, *Pheucticus ludovicianus*	Lit (Catling and Porebski 1994), Int, Obs	MI, ON, WI
Family Icteridae: Blackbirds, Meadowlarks, and Orioles		
Baltimore Oriole, *Icterus galbula*	Int	ON, WI

Continued

Table 1. (Cont'd).

	Data Sources[a]	Locations, if noted
Family Fringillidae: Finches and allies		
Pine Grosbeak, *Pinicola enucleator*	Lit (Brooks 1979, Peterson 1986), Int	NH, NY, ON
House Finch, *Haemorhous mexicanus*	Int, Obs	MI, NY
Purple Finch, *Haemorhous purpureus*	Lit (Pitzrick 1981, Pratt 2001), Int	IL, NY, VT, WI
Evening Grosbeak, *Coccothraustes vespertinus*	Lit (Brooks 1979)	NY
Family Passeridae: Old World Sparrows		
House Sparrow, *Passer domesticus*	Obs	MI

[a]Data sources: Lit = Literature search; Int = Internet archives of birding listservs and forums; Obs = observations made in southeast Michigan; Fec = seeds found in fecal samples of birds banded by the author at the University of Michigan-Dearborn.

tion, or even show up in published reports, although many records were from field trip leaders, seasonal bird survey compilers, and avid birders who provided detail on foraging sites and habits of many bird species in their reports.

The literature and online searches, and my own research, focused on the northeastern part of the continent. All the bird species reported with the exception of the vagrants mentioned above and three northerly breeding species (Bohemian Waxwing, Pine Grosbeak, and Evening Grosbeak), occur in the remainder of the range of *R. carthartica* and *F. alnus* in eastern North America at some point during the year. My compilation shares eight of the nine most highly ranked genera (in degree of frugivory) in Willson's (1986) list of the principal frugivorous birds in eastern North America.

Despite a slight bias toward rare birds, a filtered geographic focus, and the fact that some accounts may not have been uncovered, I regard this sample as representative of the bird species most apt to eat *R. cathartica* or *F. alnus* in eastern North America.

One group of birds that is notably absent is "blackbirds." Numerous resources, particularly invasive species management materials, fact sheets, and other publications, state that the fruit of both *R. cathartica* and *F. alnus* is "…efficiently dispersed by starlings, blackbirds, …" (e.g., Butterfield et al. 1996; NBII/ISSG 2005a, b; Jull 2007; Stork 2007; Anon. 2013; Sturtevant et al. 2013). In North America, "blackbirds" are commonly assumed to be the New World blackbirds in the family Icteridae.

The inclusion of blackbirds as buckthorn dispersers apparently originated in one of the earliest reviews of buckthorn ecology (Converse 1984), which cites Ridley (1930). Ridley's work was a collection of previously published data on the dispersal of plants. Ridley lists the dispersal of *R. cathartica* under "*Merula vulgaris*, the Blackbird." He is referring to the Common Blackbird, *Turdus merula*, a species in the Turdidae, or thrush, family (Gill and Donkster 2013), which is entirely unrelated to the New World blackbirds. Further, Ridley cites Woodruffe-Peacock (1918) as his source. Woodruffe-Peacock described "blackbirds" eating *R. cathartica* in North Lincolnshire, England, but states, "When I say blackbird…I mean that species [no scientific name given] and the rest of the common British Turdi [sic]." Ridley does list a few North American Icteridae as fruit consumers, but does not list either *R. cathartica* or *F. alnus* in their reported diets.

There is little evidence from my research—which included Beal's reports on the stomach contents of thousands of New World blackbirds (Beal 1896, 1900) and similar results reported by Goddard (1969) and Williams and Jackson (1981)—that New World blackbirds are frequent consumers of any fruit, much less *R. cathartica* or *F. alnus.* The inclusion of "blackbirds" without clarification regarding the proper taxonomic designation as dispersers of buckthorn in North America appears to be a misinterpretation of the primary literature, which has been repeated numerous times. (Likewise, "elk" is listed as a disperser of *R. cathartica,* citing Ridley, but tracing that back to the source indicates that this actually refers to moose, *Alces alces*).

Not all bird species that forage on *R. cathartica* or *F. alnus* are competent dispersers of the seeds. While the dynamics of seed dispersal by animals is complex, important measures of the effectiveness of dispersers include the type and degree of their frugivory, and relative abundance (Jordano and Schupp 2000; Godínez-Alvarez and Jordano 2007; Schupp et al. 2010). Frugivorous species might be considered poor dispersers if they eat the pulp or juices of a fruit then drop or digest the seeds, or leave the seed attached to the plant (Johnson et al. 1985; Willson 1986; Snow and Snow 1988; Jordano and Schupp 2000; Buckley et al. 2006; Schupp et al. 2010). Examples of inefficient dispersers noted by those authors include birds in the genera *Icterus* (orioles), *Piranga* (tanagers), *Pheucticus* (grosbeaks), and *Zonotrichia* (sparrows); small birds such as warblers (Parulidae); finches (Fringillidae); and the Northern Cardinal. My observations of six species (Blackpoll Warbler, Yellow-rumped Warbler, White-crowned Sparrow, Rose-breasted Grosbeak, House Finch, and

House Sparrow) foraging on *R. cathartica* are in agreement. No individuals of these species were seen swallowing the seeds; all dropped them under the parent plant.

In contrast, thrushes, mimids, starlings, and waxwings usually swallow small fruits similar in size to *R. cathartica* and *F. alnus* and later defecate the seeds (Johnson et al. 1985; Meyer and Witmer 1998; Craves, pers. obs.). Birds in these families (Turdidae, Mimidae, Sturnidae, and Bombycillidae) are among the most highly frugivorous in eastern North America (Thompson and Willson 1979; Willson 1986; Malmborg and Willson 1988; Parrish 1997; LaFleur and Rubega 2009). Herrera and Jordano (1981) consider medium-sized birds, such as most members of these families, which have high visitation rates to fruiting plants, as likely to disperse the most seeds.

With the exception of reports of single rare birds, the majority of reports in the literature or in internet archives did not provide a specific number of individuals of a species feeding on buckthorn, so no attempt was made to quantify the frequency of buckthorn consumption among species. However, several species were often noted as feeding on buckthorn in flocks, sometimes reported as being in the hundreds of birds: American Robin, Cedar Waxwing, and Bohemian Waxwing. Robins are the most abundant and widespread Turdidae in North America, and are gregarious in the nonbreeding season when feeding flocks can exceed 250 individuals (Sallabanks and James 1999). Both species of waxwings are highly social throughout the year, with the largest flocks occurring in winter (Witmer et al. 1997; Witmer 2002).

European Starlings are considered one of the most numerous bird species on the continent and are very gregarious all year (Cabe 1993). I did not find reports of starlings feeding in large numbers on buckthorn, but this may be due to a general disdain of this introduced species by many people, resulting in a lack of detailed reporting. Further, starlings prefer to forage in large open areas and in North America tend to avoid wooded or forested sites (Cabe 1993), perhaps reducing the numbers encountered by researchers or birders who typically make observations in more natural habitats.

The other families and species of birds that are efficient seed dispersers (other members of the Turdidae and the Mimidae) are not as social or quite as abundant as robins, waxwings, and starlings. Further, most migrant species in these families, such as Swainson's Thrush, Wood Thrush, and Gray Catbird, for example, are only present in eastern North America during the breeding season. European Starlings are resident year-round (Cabe 1993). American Robins and Cedar Waxwings do make seasonal movements, but are present over much of the continent most or all of the year (Witmer et al. 1997; Sallabanks and James 1999). Bohemian Waxwings have a much more northerly breeding distribution, but make periodic large southerly movements in winter, when they can occur in large numbers in the Northeast and Upper Great Lakes (Witmer 2002). These species, then, have a longer overlap with the fruiting period of *R. cathartica* and *F. alnus* in northeastern North America than most of the other dispersers in Table 1.

Westcott and Fletcher (2011) note that likely dispersers of invasive species can be predicted by knowledge of the invasive species' dispersers in their native range. In the Old World, *R. cathartica* and *F. alnus* are dispersed by (among others) many thrushes in the genus *Turdus*, (the sole New World member being American Robin), European Starling, and Bohemian Waxwing (Ridley 1930; Godwin 1936; Snow and Snow 1988).

Birds in the families Turdidae, Mimidae, Sturnidae, and Bombycillidae appear to be the most efficient dispersers of *R. cathartica* and *F. alnus* in eastern North America. Key species in those families are American Robin, both species of waxwings, and European Starling due to: (1) their high degree of frugivory; (2) medium body size, allowing them to swallow buckthorn fruit whole; (3) abundance; and (4) long seasonal residency in the region.

Bohemian Waxwings are irregular winter visitors to the northern portions of eastern North America and, thus, may be responsible only for sporadic and geographically limited dispersal of buckthorns. The reluctance of starlings to penetrate wooded sites, especially in fall and winter (Fischl and Caccamise 1985; Cabe 1993; Clergeau et al. 1998), indicates that they are probably best at dispersing buckthorns throughout more urban sites or in agricultural areas.

Given all the evidence, it is reasonable to conclude that American Robins and Cedar Waxwings, with their broad habitat preferences, which include forested areas, along with the other favorable life history traits noted above, are the most important dispersers of *R. cathartica* or *F. alnus* in eastern North America, as well as in other regions where the ranges of these birds and plants overlap.

Finally, contrary to some published sources, "blackbirds" (Icteridae) in North America rarely consume buckthorn and are not frequent or competent dispersers of *R. cathartica* or *F. alnus.*

ACKNOWLEDGMENTS

I thank the many volunteers and donors who make the work of RRBO possible. In particular, I thank Dana Wloch for her multi-year dedication to collecting and sorting seeds from fecal samples. Jerry Mitchell and Joe Stude provided many hours of field observations. The Michigan Audubon Society funded critical components of this research over two seasons, with other major funding provided by the Jimmy F. New Foundation, K. Bochenek, B.J. Murray, and B.S. O'Hair. Gifts directed toward publication costs were provided by D. Applebaum, R. and C. Dettling, D. Gertiser, K. Koch, L. Krause, C. Meldrum, M. Schwarz, and B. Wicke. Darrin O'Brien's assistance and support in all aspects of this work were invaluable—many, many thanks.

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systems, and the interactions of native and invasive species.

LITERATURE CITED

Anonymous. 2013. Buckthorns. *Rhamnus cathartica, Rhamnus frangula*. Information about Invasive Plants. The Stewardship Network. Accessed 17 June 2013. <http://www.stewardshipnetwork.org/atf/cf/%7BB4AF8F8B-E671-4661-B91B-D446CE18410D%7D/Buckthorn_Rhamnus%20cathartica.pdf>.

Barrientos, E. 2010. Fall birds and their food sources at the Schlitz Audubon Center. Passenger Pigeon 72:117-134.

Bauers, H.A. 1962. Field notes, winter season, December 1961–February 1962. Passenger Pigeon 24:93-103.

Beal, F.E.L. 1896. The Meadow Lark and Baltimore Oriole. Pp. 419–430 *in* Yearbook of the US Department of Agriculture, 1895. US Government Printing Office, Washington, DC.

Beal, F.E.L. 1900. Food of the bobolink, blackbirds, and grackles. Bulletin 13, US Department of Agriculture, Division of Biological Survey, Washington, DC.

Bent, A.C. 1950. Life Histories of North American Wagtails, Shrikes, Vireos, and Their Allies. US National Museum Bulletin 203. Smithsonian Institution, Washington, DC.

Boldt, B. 1994. [By the wayside] Phainopepla. Passenger Pigeon 56:185-185.

Bowen, R.V. 1997. Townsend's Solitaire (*Myadestes townsendi*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 14 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/269>.

Brooks, E.W. 1979. [Thirty-first Winter Bird-Population Study] Upland mixed pine-spruce hardwood plantation. American Birds 33:21.

Buckley, Y.M., S. Anderson, C.P. Catterall, R.T. Corlett, T. Engel, C.R. Gosper, R. Nathan, D.M. Richardson, M. Setter, O. Spiegel, G. Vivian-Smith, F.A. Voight, J.E.S. Weir, and D.A. Westcott. 2006. Management of plant invasions mediated by frugivore interactions. Journal of Applied Ecology 43:848-857.

Butterfield, C., J. Stubbendieck, and J. Stumpf. 1996. Species abstracts of highly disruptive exotic plants at Pipestone National Monument. *Rhamnus cathartica*. Jamestown, ND: Northern Prairie Wildlife Research Center Online, Version 16JUL97. Accessed 17 June 2013. <http://www.npwrc.usgs.gov/resource/plants/exoticab/piperham.htm>.

Cabe, P.R. 1993. European Starling (*Sturnus vulgaris*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 23 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/048>.

Catling, P.M., and Z.S. Porebski. 1994. The history of invasion and current status of glossy buckthorn, *Rhamnus frangula*, in Southern Ontario. Canadian Field Naturalist 108:305-310.

Chadde, S.W. 2012. A Great Lakes Wetland Flora, 4th ed. Bogman Guides. CreateSpace Independent Publishing Platform, San Berandino, CA.

Clark, D.B. 1979. Winter season 1977–1978. Records of Vermont Birds. Vermont Institute of Natural Science 6:1-6.

Clergeau, P., J-P. L. Savard, G. Mennechez, and G. Falardeau. 1998. Bird abundance and diversity along an urban-rural gradient: a comparative study between two cities on different continents. Condor 100:413-425.

Comey, A.C. 1902. Unusual winter records. Auk 19:293-294.

Converse, C.K. 1984. Element stewardship abstract for *Rhamnus cathartica, Rhamnus frangula* (syn. *Frangula alnus*). The Nature Conservancy, Arlington, VA.

Craves, J.A. 2007. The Birds of Dearborn; An Annotated Checklist. Rouge River Bird Observatory, Lulu Press, Dearborn, MI.

Craves, J.A. 2009. A fifteen-year study of fall stopover patterns of *Catharus* thrushes at an inland, urban site. Wilson Journal of Ornithology 121:112-118.

Crowell, K.L. 1996. [Regional Reports] Region 6 – St. Lawrence. The Kingbird 46:165-169.

Diers, R.W. 1986. [By the Wayside] Black-headed Grosbeak in Polk County. Passenger Pigeon 48:173.

Dukes, J.S., J. Pontius, D. Orwig, J.R. Garnas, V.L. Rodgers, N. Brazee, B. Cooke, K.A. Theoharides, E.E. Stange, R. Harrington, J. Ehrenfeld, J. Gurevitch, M. Lerdau, K. Stinson, R. Wick, and M. Ayres. 2009. Responses of insect pests, pathogens, and invasive plant species to climate change in the forests of northeastern North America: what can we predict? Canadian Journal of Forest Research 39:231-248.

Fischl, J., and D. F. Caccamise. 1985. Influence of habitat and season on foraging flock composition in the European Starling (*Sturnus vulgaris*). Oecologia 67:532-539.

Gill, F., and D. Donsker, eds. 2013. IOC World Bird List (v 3.4). International Ornithologists' Union. Accessed 24 Jun 2013. <http://www.worldbirdnames.org>.

Goddard, S.V. 1969. Fall and winter food habits of red-winged blackbirds and brown-headed cowbirds in western Oklahoma. Wilson Bulletin 81:336-337.

Godínez-Alvarez, H., and P. Jordano. 2007. An empirical approach to analysing the demographic consequences of seed dispersal by frugivores. Pp. 391–407 *in* A.J. Dennis, E.W. Schupp, R.J. Green, and D.A. Westcott, eds., Seed Dispersal: Theory and Application in a Changing World. CAB International, Cambridge, MA.

Godwin, H. 1936. Studies in the ecology of Wicken Fen III: The establishment and development of fen scrub (carr). Journal of Ecology 24:82-116.

Gosper, C.R., C.D. Stansbury, and G. Vivian-Smith. 2005. Seed dispersal of fleshy-fruited invasive plants by birds: contributing factors and management options. Diversity and Distributions 11:549-558.

Granlund, J. 1997. Great Lakes region. North American Birds 51:751-753.

Graves, J. 1995. [Regional Reports] Region 8 – Hudson-Mohawk. The Kingbird 45:123-137.

Gregoire, J., and S. Gregoire. 1999. [Eastern regional news; Atlantic Flyway review: Region II (North Central) Fall 1998] Kestrel Haven Farm. North American Bird Bander 24:21-22.

Guthrie, R.P., and J.A. Davis. 1975. Photographs of New York state rarities 24. Mountain Bluebird. The Kingbird 25:68-70.

Hampe, A., and F. Bairlein. 2000. Modified dispersal-related traits in disjunct populations of bird-dispersed *Frangula alnus* (Rhamnaceae): a result of its Quaternary distribution shifts? Ecography 23:603-613.

Herrera, C.M., and P. Jordano. 1981. *Prunus mahaleb* and birds: the high-efficiency seed dispersal system of a temperate fruiting tree. Ecological Monographs 51:203-218.

Howell, J.A., and W.H. Blackwell, Jr. 1977. The history of *Rhamnus frangula* (Glossy Buckthorn) in the Ohio flora. Castanea 42:111-115.

Hoyt, S.F. 1956. Food preferences of wintering robins in central New York state, 1955–1956. The Kingbird 6:50.

Huggins, G. 1993. [Regional Reports] Region 5 – Oneida Lake Basin. The Kingbird 43:56-61.

Iliff, M.J., and D. Lovitch. 2007. The changing seasons: food for thought. North American Birds 61:208-224.

Jacobs, J., J. Brue, S. Hester, and R. Korb. 1981. Unusual birds sighted at Bay Beach Wildlife Sanctuary, Green Bay. Passenger Pigeon 43:38-39.

Johnson, R.A., M.F. Willson, J.N. Thompson, and R.I. Bertin. 1985. Nutritional values of wild fruits and consumption by migrant frugivorous birds. Ecology 66:819-827.

Jordano, P., and E.W. Schupp. 2000. Seed disperser effectiveness: the quantity component and patterns of seed rain for *Prunus mahaleb*. Ecological Monographs 70:591-615.

Judd, S.D. 1895. Four common birds of the farm and garden. Pp. 405–418 *in* The US Department of Agriculture, 1895. US Government Printing Office, Washington, DC.

Jull, L. 2007. Common and Glossy Buckthorn (*Rhamnus catharticus* and *Rhamnus fragula*), Major Threats to Midwestern Woodlands. DNR PUB-FR-216 2007, University of Wisconsin, Cooperative Extension. Accessed 17 June 2013. <http://clean-water.uwex.edu/pubs/pdf/buckthorn.pdf>.

Kartesz, J.T. 2013. North American Plant Atlas. The Biota of North America Program (BONAP). Maps generated from J. T. Kartesz, in press. Floristic Synthesis of North America, version 1.0. Chapel Hill, NC. Accessed May 2013. <http://www.bonap.org>.

Knight, K.S., J.S. Kurylo, A.G. Endress, J.R. Stewart, and P.B. Reich. 2007. Ecology and ecosystem impacts of common buckthorn (*Rhamnus cathartica*): a review. Biological Invasions 9:925-937.

Kurylo, J., and A.G. Endress. 2012. *Rhamnus cathartica*: notes on its early history in North America. Northeastern Naturalist 19:601-610.

Labbe, M.A. 2011. Habitat Use, Productivity, and Fruit Selection of Birds in Early-successional Habitats in Western Massachusetts. MS thesis, University of Massachusetts, Amherst.

LaFleur, N., and M. Rubega. 2009. Does frugivory by European Starlings (*Sturnus vulgaris*) facilitate germination in invasive plants? Journal of the Torrey Botanical Society 136:332-341.

Lange, K.I. 1984. Field notes: winter season, December 1983–February 1984. Passenger Pigeon 46:149-158.

Lange, K.I. 1985. Field notes: winter season, December 1984–February 1985. Passenger Pigeon 47:141-150.

Lange, K.I. 1987. Field notes: winter season, December 1, 1986–February 28, 1987. Passenger Pigeon 49:184-191.

Lange, K.I. 1988. The Townsend's Solitaire in Wisconsin. Passenger Pigeon 50:15-20.

Lange, K.I. 1997. The winter season: 1996–97. Passenger Pigeon 59: 219-232.

Lange, K.I. 1998. The winter season: 1997–98. Passenger Pigeon 60: 251-268.

Lange, K.I. 2005. The winter season: 2004–2005. Passenger Pigeon 67:347-364.

Lehman, J.G. 1989. [Regional Reports] Region 4 – Susquehanna. The Kingbird 39:114-118.

Lindsey, A.A. 1939. Food of the starling in central New York State. Wilson Bulletin 51:176-182.

Lound, M., and R. Lound. 1958. Field notes: winter season, December 1957–February 1958. Passenger Pigeon 20:80-89.

Mabbott, D. 1920. Food Habits of Seven Species of American Shoal-Water Ducks. US Bulletin 862, US Department of Agriculture, Division of Biological Survey, Washington, DC.

Mack, T.D. 1978. [Regional Reports] Region 7 – Adirondack-Champlain. The Kingbird 28:118-120.

Malmborg, P.K., and M.F. Willson. 1988. Foraging ecology of avian frugivores and some consquences for seed dispersal in an Illinois woodlot. Condor 90:173-186.

Manson, H.C. 1990. [Regional Reports] Region 9 – Delaware-Hudson. The Kingbird 40:120-123.

McCay, T.S., and D.H. McCay. 2009. Processes regulating the invasion of European Buckthorn (*Rhamnus cathartica*) in three habitats of the northeastern United States. Biological Invasions 11:1835-1844.

Meyer, G.A., and M.C. Witmer. 1998. Influence of seed processing by frugivorous birds on germination success of three North American shrubs. American Midland Naturalist 140:129-139.

Moulton, C.E. 1921. A catbird in winter at Fays. Bulletin of the Essex County Ornithological Club of Massachusetts 3(1):71.

[NBII/ISSG] National Biological Information Infrastructure and IUCN/SSC Invasive Species Specialist Group. 2005a. *Frangula alnus*. Global Invasive Species Database. 100 of the Worst Invasive Alien Species. Accessed 17 June 2013. <http://www.issg.org/database/species/ecology.asp?si=810&fr=1&sts=tss&lang=EN>.

[NBII/ISSG] National Biological Information Infrastructure and IUCN/SSC Invasive Species Specialist Group. 2005b. *Rhamnus cathartica*. Global Invasive Species Database. 100 of the Worst Invasive Alien Species. Accessed 17 June 2013. <http://www.issg.org/database/species/ecology.asp?si=809&fr=1&sts=tss&lang=EN>.

Parrish, J.D. 1997. Patterns of frugivory and energetic condition in Nearctic landbirds during autumn migration. Condor 99:681-697.

Peterson, J.M.C. 1986. [Regional Reports] Region 7 – Adirondack-Champlain. The Kingbird 36:38-42.

Peterson, J.M.C.. 1996. [Regional Reports] Region 7 – Adirondack-Champlain. The Kingbird 46:72-79.

Peterson, J.M.C. 2001. [Regional Reports] Region 7 – Adirondack-Champlain. The Kingbird 51:546-550.

Peterson, J.M.C. 2008. [Regional Reports] Region 7 – Adirondack-Champlain. The Kingbird 58:72-77.

Pitzrick, V.M. 1981. [Regional Reports] Region 1 – Niagara frontier. The Kingbird 31:231-237.

Pratt, F.A. 2001. Winter 2000–01. Records of Vermont Birds. Vermont Institute of Natural Science 29:1-10.

Purcell, B. 2003. [Regional Reports] Region 5 – Oneida Lake Basin. The Kingbird 53:152-156.

Qaderi, M.M., D.R. Clements, and P.B. Cavers. 2009. The biology of Canadian weeds. 139. *Rhamnus cathartica* L. Journal of Plant Science 89:169-188.

Reznicek, A.A., E.G. Voss, and B.S. Walters. 2011. Michigan Flora Online. University of Michigan, Ann Arbor. Accessed 17 June 2013. <http://michiganflora.net/>.

Ridley, H.N. 1930. The Dispersal of Plants Throughout the World. Reeve and Co., Kent, UK.

Sallabanks, R., and F.C James. 1999. American Robin (*Turdus migratorius*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 23 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/462>.

Scheider, F. 1977. [Regional Reports] Region 5 – Oneida Lake Basin. The Kingbird 27:103-106.

Schupp, E.W., P. Jordano, and J.M. Gomez. 2010. Seed dispersal effectiveness revisited: a conceptual review. New Phytologist 188:333-353.

Smith, R.J., M.I. Hatch, D.A. Cimprich, and F.R. Moore. 2011. Gray Catbird (*Dumetella carolinensis*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 23 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/167>.

Snow, B., and D. Snow. 1988. Birds and Berries: A Study of an Ecological Interaction. Poyser, London, UK.

Stork, E. 2007. Vegetation Management Guideline. Exotic Buckthorns: Common, Glossy, Dahurian, Japanese, and Chinese Buckthorn (*Rhamnus cathartica* L., *Frangula alnus*

Mill. syn. *R.frangula* L., *R.davurica* Pall., *R. japonica* Maxim., and *R. utilis* Decne.). Illinois Nature Preserve Commission Management Guidelines, Vol 1, No. 5 (Rev.). Accessed 17 June 2013. <http://dnr.state.il.us/inpc/pdf/VMG%20Buckthorns%20revised%202007.pdf>.

Sturtevant, R., L. Berent, and A. Fusaro. 2013. *Frangula alnus*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Revision Date: 10/8/2012. Accessed 17 June 2013. <http://nas.er.usgs.gov/queries/GreatLakes/SpeciesInfo.asp?NoCache=11%2F12%2F2012+2%3A54%3A15+PM&SpeciesID=2697&State=&HUCNumber=DGreatLakes>.

Tessen, D. 1981. [By the Wayside] Townsend's Solitaire. Passenger Pigeon 43:36.

Thompson, J.N., and M.F. Willson. 1979. Evolution of temperate fruit/bird interactions: phenological strategies. Evolution 33:973-982.

[USDA] United States Department of Agriculture, Natural Resources Conservation Service. 2013. The PLANTS Database. Accessed 13 May 2013. <http://plants.usda.gov>.

Weeks, S.S., and H.P. Weeks, Jr. 2012. Shrubs and Woody Vines of Indiana and the Midwest. Purdue University Press, Bloomington, IN.

Weir, R.D. 1983. Ontario region. American Birds 37:296-299.

Westcott, D.A., and C.S. Fletcher. 2011. Biological invasions and the study of vertebrate dispersal of plants: Opportunities and integration. Acta Oecologica 27:650-656.

Wheelwright, N.T. 1986. The diet of American Robins: An analysis of U.S. Biological Survey records. Auk 103:710-725.

Williams, R.E., and W.B. Jackson. 1981. Dietary comparisons of Red-winged Blackbirds, Brown-headed Cowbirds, and European Starlings in north-central Ohio. Ohio Journal of Science 81:217-225.

Willson, M.F. 1986. Avian frugivory and seed dispersal in eastern North America. Pp. 223–279 *in* R.J. Johnston, ed., Current Ornithology, Vol. 3. Plenum Press, New York.

Witmer, M.C. 1996. Annual diet of Cedar Waxwings based on US Biological Survey records (1885–1950) compared to diet of American Robins: contrasts in dietary patterns and natural history. Auk 113:414-430.

Witmer, M.C. 2002. Bohemian Waxwing (*Bombycilla garrulus*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 27 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/714>.

Witmer, M.C., D.J. Mountjoy, and L. Elliot. 1997. Cedar Waxwing (*Bombycilla cedrorum*). The Birds of North America Online. A. Poole, ed., Cornell Lab of Ornithology, Ithaca, NY. Accessed 23 June 2013. <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/309>.

Wood, T.C. 1998. [By the Wayside] Townsend's Solitaire. Passenger Pigeon 60:193-194.

Woodruffe-Peacock, E.A. 1918. A fox-covert study. Journal of Ecology 6:110-125.

Zohar, K. 2011. *Rhamnus cathartica, R. davurica*. *In* Fire Effects Information System Version 2011 Mar 16. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Lab. Accessed 12 June 2013. <http://www.feis-crs.org/beta/>.