

# Increased Bufflehead (*Bucephala albeola*) Breeding Activity in Minnesota

SUSAN N. ELLIS-FELEGE<sup>1, 4</sup>, CASSANDRA G. SKAGGS<sup>1, 3</sup>, and GREGORY A. KNUITSEN<sup>2</sup>

<sup>1</sup>Biology Department, University of North Dakota, 10 Cornell Street, Stop 9019, Grand Forks, North Dakota 58202-9019 USA

<sup>2</sup>U.S. Fish and Wildlife Service, Glacial Ridge and Rydell National Wildlife Refuges, 17788 349th Street SE, Erskine, Minnesota 56535 USA

<sup>3</sup>Louisiana State University, School of Renewable Natural Resources, LSU Agricultural Center, Baton Rouge, Louisiana 70803 USA

<sup>4</sup>Corresponding author: susan.felege@email.und.edu

Ellis-Felege, Susan N., Cassandra G. Skaggs, and Gregory A. Knutsen. 2017. Increased Bufflehead (*Bucephala albeola*) breeding activity in Minnesota. *Canadian Field-Naturalist* 131(4): 338–343. <https://doi.org/10.22621/cfn.v131i4.1963>

Buffleheads (*Bucephala albeola*) predominantly nest in the boreal forests and aspen parklands of Canada and Alaska. Historically, Buffleheads were common migrants but not summer residents in Minnesota. However, recent observations in Minnesota and surrounding states suggest increased breeding activity in the region. In 1978, the first Bufflehead brood in Minnesota was recorded at East Park Wildlife Management Area. Annually, Agassiz National Wildlife Refuge (NWR) has conducted pair and brood surveys, with species-specific records available from 1990 to 2014. We report an increase in numbers of Bufflehead breeding pairs and broods at Agassiz NWR and new pair observations in surrounding areas.

Key Words: Breeding range; *Bucephala albeola*; Bufflehead; cavity nesting; expansion; Great Plains; upper midwest

## Introduction

Buffleheads (*Bucephala albeola*) are a secondary cavity-nesting species that frequently use the cavities of Northern Flickers (*Colaptes auratus*) and, to a lesser extent, Pileated Woodpeckers (*Dryocopus pileatus*). Nest cavities used by Buffleheads are most common in live or dead poplar or aspen trees (*Populus* spp.). They also will use nest boxes (Gauthier 1988). Most Bufflehead nesting activity occurs in Canada and Alaska, with a smaller portion of the breeding population extending into parts of Washington, California, Oregon, Idaho, Montana, and Wyoming (Erskine 1972; Gauthier 2014). Although this small, cavity-nesting duck is a common fall and spring migrant throughout much of Minnesota, it is considered a rare summer resident (Janssen 1987; Gauthier 2014). Erskine (1972) suggested Buffleheads may have been present in early summer in northwestern Minnesota, but that most of these individuals were sub-adults or non-breeding adults that would remain in the region into the breeding season. Scattered historical breeding records do exist for North Dakota (1873), Iowa (1880s), Wisconsin (1903), South Dakota (1949), Idaho (1953), and more recently Nevada (Floyd *et al.* 2007). It was not until 1978, however, that the first Bufflehead brood in Minnesota was documented at East Park Wildlife Management Area (WMA) in the northwestern part of the state (Davis 1978). An increasing number of reports of breeding activity occurred over the next 10 years across northwestern Minnesota (Heidel 1983; Mattsson 1986). Since 1985, Bufflehead broods have been observed at Agassiz National Wildlife Refuge (NWR), located in northwestern Minnesota, almost every year.

Recent observations have documented Bufflehead breeding activity in the southern half of Minnesota, including a 2012 brood in Cottonwood County in southern Minnesota (Pfanmuller *et al.* 2017). Additionally, broods have recently been confirmed in southeastern Wisconsin (Bahl and Bartholmai 2011), south-central and eastern North Dakota (Knutsen and King 2004; M. R. Fisher, personal communication, 2012), and northeastern South Dakota (Whitt 1999). Scattered observations reported to eBird document Buffleheads during June and July in areas as far south as Texas and Louisiana (eBird 2012). These observations across the upper midwest (Wisconsin, Minnesota, North Dakota, South Dakota) and Great Plains suggest that Buffleheads may be increasing their breeding activities. Our objective was to evaluate changes in Bufflehead reproductive activity in northwestern Minnesota and summarize recent accounts of breeding activity across the upper midwest region.

## Study Area

Long-term monitoring of Bufflehead reproduction was conducted at Agassiz NWR (centroid 48.315836°N, 95.947023°W), Marshall County, Minnesota (Figure 1). Agassiz NWR was established in 1937 as a “refuge and breeding ground for migratory birds and other wildlife”. The refuge is 24 889 ha in total, including 15 136 ha of wetland habitat, 4715 ha of shrubland, 4007 ha of woodland (primarily aspen), and 737 ha of grassland. Wetland area includes 26 impoundments that range in size from 12 to > 4000 ha and are managed as sedge meadow and emergent marsh habitats (USFWS 2005). Recent man-

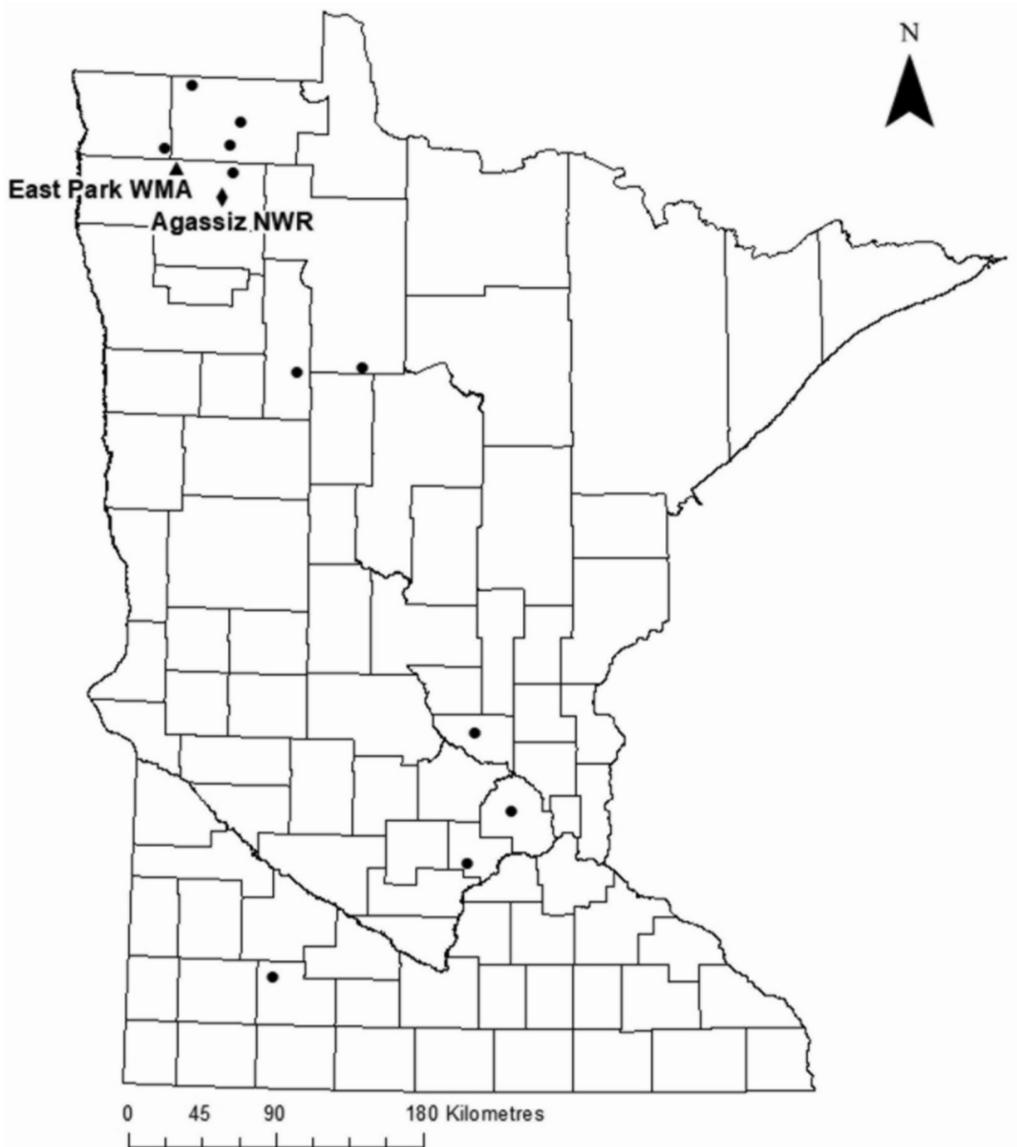


FIGURE 1. Reported or suspected Bufflehead (*Bucephala albeola*) breeding activity in Minnesota, 1978–2014. East Park Wildlife Management Area (WMA) had the first Bufflehead observation in 1978 (triangle), and Agassiz National Wildlife Refuge (NWR) had the most observations overall (diamond). Observations outside study area (solid circles) were obtained from Pardieck *et al.* (2016).

agement efforts have focussed on controlling overabundant cattails across the refuge.

Historically, the area that is now Agassiz NWR was a boggy wilderness, checkered with wetlands and ponds. After European settlement in the 1890s, wetlands were drained for agriculture which resulted in more than 1900 km of county and legal drainage ditches. Agassiz NWR lies within the aspen parkland transitional zone (USFWS 2005). Climatic conditions at the refuge are typical of the region, where variation in temperatures is

wide and extreme, including cold winters with moderate snowfall and approximately 56 cm of annual precipitation (USFWS 1978).

In addition to Agassiz NWR, we conducted roadside surveys at six wildlife management areas, two flood storage impoundments, and one state park in northwestern Minnesota to determine the extent of breeding occurrences in the region (Table 1). Of these, five sites had no prior reports of Bufflehead activity during the breeding season whereas five others did (Table 1).

TABLE 1. Maximum number of Bufflehead (*Bucephala albeola*) pairs observed during spring roadside surveys at five sites with previous records of pairs (noted with an \*) and five sites with no previous records located in northwestern Minnesota, 2012–2013.

Site	Bufflehead Breeding Pair Summary for 2012 and 2013					Max. pairs detected outside of survey constraints (2012/2013) <sup>†</sup>
	Max. pairs 2012	Max. pairs 2013	Change in pairs from 2012	Newly detected site 2012	Newly detected site 2013	
Agassiz NWR East*	10	8	-2	–	–	2/4
Agassiz NWR South*	3	2	-1	–	–	2/0
Agassiz NWR West*	5	4	-1	–	–	2/2
Agassiz Valley Project	0	0	0	No	No	0/1
East Park WMA*	2	2	0	–	–	3/2
Hayes Lake State Park	0	0	0	No	No	0/0
Moose River Impoundment	0	2	2	No	Yes	0/0
Nereson WMA*	0	3	3	–	–	1/2
Red Lake WMA	0	1	1	No	Yes	0/0
Roseau River WMA*	4	3	-1	–	–	3/1
Thief Lake WMA*	1	1	0	–	–	0/1
Twin Lakes WMA	1	0	-1	Yes	No	0/0

\*Known breeding locations before 2012.

<sup>†</sup>Pairs observed but not included in our other counts (e.g., pairs observed outside of our defined survey area or between points). The first number is the maximum number of pairs observed in 2012 and the second number is the maximum number of pairs observed in 2013.

## Methods

Breeding duck pair and brood surveys are conducted annually at Agassiz NWR (USFWS 2008). A double sampling method of ground and aerial surveys was used to estimate pairs across one third of the refuge. Ground surveys were conducted using roadside pair counts on a single morning each spring between 16 and 24 May. Observers drove 8–16 km/h on transects totalling 80.5 km within the refuge. Pairs were recorded by species out to 200 m from each transect. Indicated pairs included one male and one female, a lone male, or males in groups of two to five (Hammond 1969). During the completion of ground surveys, 17 aerial transect surveys were flown in a fixed-wing aircraft at an altitude of 45–46 m over the refuge. Two observers, not including the pilot, recorded all indicated duck pairs and classified them as either “diving ducks” or “dabbling ducks” within 200 m on each side of the aircraft. Approximately 38.5 km were concurrently surveyed by both air and ground to provide a ground/air correction factor.

Only ground surveys were used to calculate duck brood estimates. Two separate brood surveys were conducted by driving the same transects as for pair surveys. Surveys were conducted between 5–12 July and 15–23 August, with a minimum of 42 days between surveys to minimize duplicate brood counts. All broods within 200 m of each side of the transect were recorded, identified to species, and aged according to Gollop and Marshall (1954). During the second (August) survey, only ducklings age class IIc (Gollop and Marshall 1954) and younger were counted by trained observers to avoid double counting broods that were recorded during the first survey.

Pair and brood surveys were conducted only on days without steady precipitation and winds not exceeding 24 km/h for pairs and 8 km/h for broods (Giudice 2001). Each survey was initiated 30 min after sunrise and took approximately 3.5–4 h to complete. Due to staff limitations, brood surveys were not conducted in 2013 or 2014.

In 2012 and 2013, we expanded surveys across northwestern Minnesota to include other sites where Bufflehead breeding activity may potentially occur. Of the ten sites selected, five had documented broods in past years, whereas five had no documented Bufflehead breeding activity, but possessed potential habitat (Figure 1). Given that aerial surveys were not available across these sites, we conducted repeat count surveys to allow examination of detection while estimating occurrence of potential breeding pairs. Similar to the ground surveys for pairs conducted at Agassiz NWR, roadside surveys were conducted 18–30 May. Observers stopped at points (250 m apart) along routes to count pairs within 200 m of the survey point, because not all wetlands allowed for equal road-based visibility of wetlands.

For the initial Agassiz NWR surveys conducted from 1990 until 2014, we estimated breeding Bufflehead pairs based upon aerial and ground surveys. The total number of pairs for dabbling ducks and diving ducks were calculated from both aerial and ground surveys. The ratio of ground to air (total number of pairs counted from ground/total number of pairs counted from aerial surveys) provides a correction factor between survey methods. Because aerial surveys effectively sampled one third of the refuge, the total number of diver and dabbler pairs tallied during the aerial survey was multiplied by three and the ground/air correction factor to

estimate total number of divers on the refuge. Finally, the number of Bufflehead pairs was obtained by estimating the proportion of divers that were classified as Buffleheads on the ground survey.

We only report summary statistics from broods detected along survey routes for each year, given we had limited information on other aspects of the reproductive process (e.g., nest success, brood survival) that influence productivity. Prior to 2001, surveys were conducted from the bed of the pickup truck with higher elevation. Beginning in 2001, federal safety policy required that all observers conduct surveys from inside the truck's cab instead. Thus, broods observed after 2001 are corrected for detections estimated from concurrent bed and cab surveys that found a 0.65 detection rate from the cab (Agassiz NWR, unpublished data, 1999–2001).

For the 2012–2013 data, we used the maximum pairs or broods detected across three repeated surveys. This allowed us to account for detection issues of missing pairs or broods during some surveys. Due to a limited sample size of wetlands that we could monitor, we did not conduct a formal occupancy analysis to estimate detection (MacKenzie *et al.* 2006).

## Results

Bufflehead breeding pair numbers have increased across Agassiz NWR since 1990, with an estimated average of 329 breeding pairs across the refuge over the

most recent 10 years (2004–2014) of data (Figure 2). Over that 10-year period, there was an 84% increase in number of pairs using the refuge. Similarly, the number of brood sightings has an increasing trend since 1990, with an average of 11 (range 0–26) Bufflehead broods detected along survey routes from 2002 through 2012 at Agassiz NWR.

The 2012 and 2013 pair surveys revealed three locations with new occurrences of potential breeding pairs (Table 1). These include new observations at Moose River Impoundment, Red Lake WMA, and Twin Lakes WMA. However, we did not detect broods at any of the sites other than Agassiz NWR during brood surveys in 2012.

## Discussion

Based on aerial-ground surveys conducted by U.S. Fish and Wildlife Service since 1990, Bufflehead breeding activity in northwestern Minnesota has rapidly increased since the first brood observation at Agassiz NWR in 1985. Additional observations in North Dakota and the southwest corner of Minnesota (i.e., Cottonwood County) demonstrate other areas with possible breeding populations. Given some historical observations, there may be increased Bufflehead breeding activity occurring in areas south of what was thought to be the traditional breeding range of the species. A southward range expansion in California also has been docu-

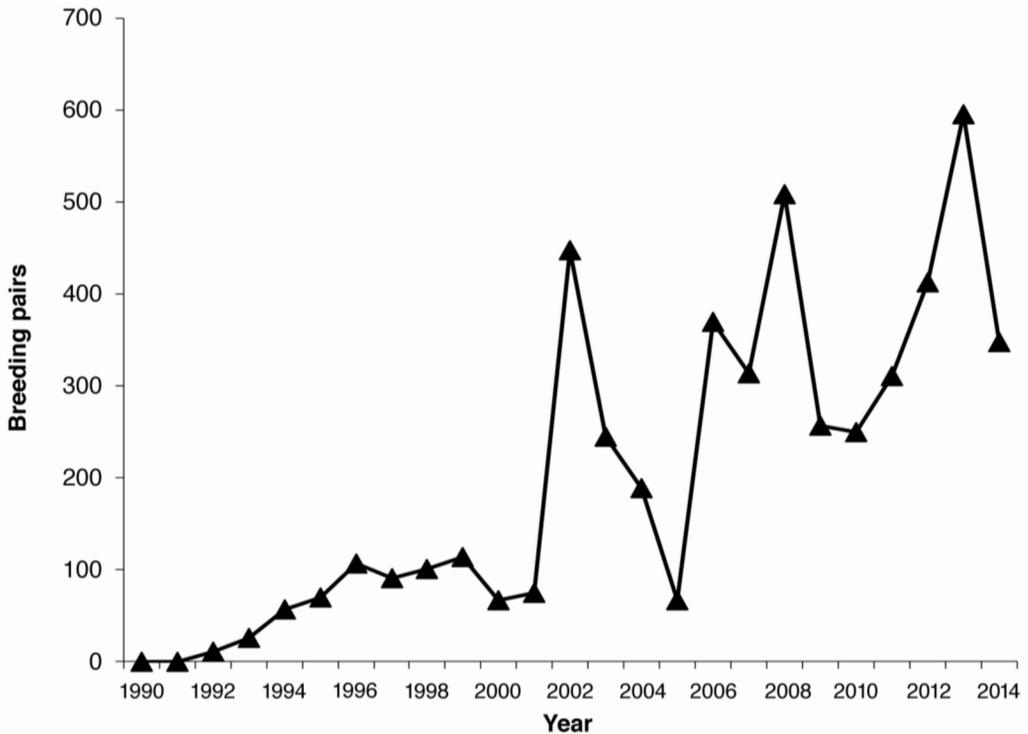


FIGURE 2. Estimated number of breeding Bufflehead (*Bucephala albeola*) pairs each May at Agassiz National Wildlife Refuge, based on 1990–2014 aerial-ground surveys.

mented, with Bufflehead breeding activity observed as far as 850 km south of their traditional breeding range (Richardson 2004).

The North American Bufflehead population trend shows an increasing overall population (1955–1992: Gauthier 2014) and a stable to increasing breeding population (1955–2010: Zimpfer *et al.* 2010; 1966–2010: Sauer *et al.* 2011). While the Bufflehead population in the boreal forests of Canada undergoes annual fluctuations, it has a stable long-term population trend (Fast *et al.* 2011).

There are several possible explanations for observing increased Bufflehead breeding activity in Minnesota as shown by the increased number of pairs and occurrences of potential breeding in new locations. Because Buffleheads nest in cavities and cavities can be a limiting factor, one possible explanation is that Buffleheads are finding more suitable nesting cavities along historical migratory routes. Aging trees or increases in the number of dead standing trees caused by flooding or insects could be involved.

In Minnesota, aspen stand ages may be reaching an appropriate diameter at breast height (DBH; Denton *et al.* 2012) for Northern Flickers to create more nesting cavities for Buffleheads. Martin *et al.* (2004) found Buffleheads using Trembling Aspen (*Populus tremuloides* Michaux) with an average DBH of 33 cm. The wet period recently experienced in the upper midwest and Great Plains (Millet *et al.* 2009) also could have increased the availability of dead standing trees near wetlands; warmer temperatures can facilitate the spread of pests such as beetles that may increase the amount of dead timber and cavities on the landscape (Dale *et al.* 2001).

Although aging or flooded or insect killed aspen stands may increase the number of potential breeding sites on a regional level, they do not entirely explain the southward expansion of the breeding range in California that likely is the result of a combination of factors (Richardson 2004). Hooded Mergansers (*Lophodytes cucullatus*), another cavity nesting species, appear to be expanding their breeding activity southward in California, likely as the result of an increasing population and available nesting cavities (Pandolfino *et al.* 2006). Increases in numbers of pairs and broods of this species have been documented at Agassiz NWR (USFWS, unpublished data, 1990–2014).

While many breeding bird ranges appear to be shifting northward (Whitaker 2017), Zuckerberg *et al.* (2009) found 43% of 129 avian species in New York state showed a southward shift in their mean breeding range latitude between 1980 and 2005. They found a shift of 34 km southward for Common Loons (*Gavia immer*), another boreal nesting, but not cavity-nesting, species.

Nest box programs could increase breeding opportunities for cavity-nesting ducks like Buffleheads. Even though a modest number of nest boxes (< 30) were erected on state Wildlife Management Areas adjacent

to Agassiz NWR by the Minnesota Department of Natural Resources around 2010, there has not been an active nest box program at Agassiz NWR since Bufflehead breeding activity was first documented at the refuge.

While habitat changes or shifts in breeding range are plausible explanations for increases in breeding activity observations for Buffleheads, some could be due to the increased ease and opportunity to report breeding activities. For example, eBird (eBird 2012) and several of the breeding bird state atlases (e.g., Minnesota) now have convenient ways for birders to report observations with detailed location and date information. As a result, some of the increased breeding observations across the United States could simply be an artifact of improved reporting and access to such reports rather than true range extensions or increases in breeding activity. However, the observations at Agassiz NWR appear to be increased activity, likely as the result of increased breeding success and suitable habitat available for Buffleheads given their high levels of natal philopatry.

Learning about the role of more southern latitude breeding sites could provide information on how Bufflehead populations are responding to climate, habitat changes, and even information about reporting of such observations. Furthermore, because limited research on Bufflehead has been conducted outside of British Columbia, Canada, studies are needed to understand habitat preferences in this newly utilized breeding range. In an era when many species are declining, it is important to understand factors contributing to stable or increasing populations.

#### Acknowledgements

Funding was provided by the University of North Dakota Biology Department, the University of North Dakota Senate Scholarly Activities Committee New Faculty Award, and the U.S. Fish and Wildlife Service. We thank Audubon Minnesota, Minnesota Department of Natural Resources, North American Breeding Bird Survey participants, Red Lake Watershed District, Middle-Snake-Tamarac River Watershed District, M. Anderson, B. Determan, J. B. Ellis, A. Hitt, A. Higgins, N. Janochoski, S. Lofgren, and J. Selchow for their assistance with Bufflehead pair and brood surveys, as well as numerous staff at Agassiz NWR who have assisted with duck production surveys over the past 22 years. We appreciate personal communications from B. Sample (Minnesota Audubon), and M. R. Fisher (U.S. Fish and Wildlife Service). In addition, we thank two anonymous reviewers and the associate editor (J. McCracken) and editor (D. A. W. Lepitzki) for valuable input that improved the manuscript. The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service. Data files associated with this project can be downloaded at: <http://und.edu/faculty/susanfelege/buffleheads.cfm>.

## Literature Cited

- Bahls, J., and J. Bartholmai.** 2011. Bufflehead nesting in Wisconsin. *Wood Duck Newsgram* 63: 9–11.
- Dale, V. H., L. A. Joyce, S. McNulty, R. P. Neilson, M. P. Ayres, M. D. Flannigan, P. J. Hanson, L. C. Irland, A. E. Lugo, C. J. Peterson, D. Simberloff, F. J. Swanson, B. J. Stocks, and B. M. Wotton.** 2001. Climate change and forest disturbances. *BioScience* 51: 723–734. [https://doi.org/10.1641/0006-3568\(2001\)051\[0723:CCAFD\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2001)051[0723:CCAFD]2.0.CO;2)
- Davis, G.** 1978. Bufflehead brood in Marshall County. *The Loon* 50: 213–214.
- Denton, J. C., C. L. Roy, G. J. Soulliere, and B. A. Potter.** 2012. Change in density of duck nest cavities at forests in the north central United States. *Journal of Fish and Wildlife Management* 3: 76–88. <https://doi.org/10.3996/112011-JFWM-067>
- eBird.** 2012. eBird: An online database of bird distribution and abundance. eBird, Cornell Lab of Ornithology, Ithaca, New York, USA. Accessed 21 September 2017. <http://www.ebird.org>.
- Erskine, A. J.** 1972. Buffleheads. Canadian Wildlife Service Monograph Series (4). Information Canada, Ottawa, Ontario, Canada.
- Fast, M., B. Collins, and M. Gendron.** 2011. Trends in breeding waterfowl in Canada. Canadian biodiversity: ecosystem status and trends 2010, technical thematic report no. 8. Canadian Councils of Resource Ministers. Ottawa, Ontario, Canada. Accessed 21 September 2017. <http://www.biodivcanada.ca/default.asp?lang=En&n=9F45F292-1>.
- Floyd, T., C. S. Elphick, G. Chisholm, K. Mack, R. G. Elston, E. M. Ammon, and J. D. Boone.** 2007. Atlas of the Breeding Birds of Nevada. University of Nevada Press, Reno, Nevada, USA.
- Gollop, J. B., and W. H. Marshall.** 1954. A guide for aging duck broods in the field. Mississippi Flyway Council Technical Section. Northern Prairie Wildlife Research Center Online. Accessed 7 October 2017. <http://archive.is/fpqWk>.
- Gauthier, G.** 1988. Factors affecting nest-box use by Buffleheads and other cavity-nesting birds. *Wildlife Society Bulletin* 16: 132–141.
- Gauthier, G.** 2014. Bufflehead (*Bucephala albeola*). In *The Birds of North America*. Edited by P. G. Rodewald. Cornell Lab of Ornithology, Ithaca, New York, USA. Accessed 21 September 2017. <https://birdsna.org/Species-Account/bna/species/buffle>.
- Giudice, J. H.** 2001. Visibility bias in waterfowl brood surveys and population ecology of dabbling ducks in central Washington. Ph.D. thesis, University of Idaho, Moscow, Idaho, USA.
- Hammond, M. C.** 1969. Notes on conducting waterfowl breeding pair surveys. Pages 238–258 in *Saskatoon wetlands seminar*. Canadian Wildlife Service report series 6, Environment Canada, Ottawa, Ontario, Canada.
- Heidel, K.** 1983. Bufflehead and ducklings found in Carver Park Reserve. *The Loon* 55: 123–124.
- Janssen, R. B.** 1987. *Birds in Minnesota*. University of Minnesota Press for the James Ford Bell Museum of Natural History, Minneapolis, Minnesota, USA.
- Knutsen, G. A., and J. C. King.** 2004. Bufflehead breeding activity in south-central North Dakota. *Prairie Naturalist* 36: 187–190.
- Martin, K., K. E. H. Aitken, and K. L. Wiebe.** 2004. Nest sites and nest webs for cavity-nesting communities in interior British Columbia, Canada: nest characteristics and niche partitioning. *Condor* 106: 5–19. <http://doi.org/10.1650/7482>
- MacKenzie, D. I., J. Nichols, J. Royle, K. Pollock, J. E. Hines, and L. L. Bailey.** 2006. *Occupancy Estimation and Modeling: Inferring Patterns and Dynamics of Species*. Academic Press, Burlington, Massachusetts, USA.
- Mattsson, J.** 1986. Another Bufflehead brood at Agassiz NWR. *The Loon* 58: 140.
- Millet, B., W. C. Johnson, and G. Guntenspergen.** 2009. Climate trends of the North American prairie pothole region 1906–2000. *Climatic Change* 93: 243–267. <https://doi.org/10.1007/s10584-008-9543-5>
- Pandolfino, E. R., J. Kwolek, and K. Kreitinger.** 2006. Expansion of the breeding range of the Hooded Merganser within California. *Western Birds* 37: 228–236.
- Pardieck, K. L., D. J. Ziolkowski, Jr., M.-A. R. Hudson, and K. Campbell.** 2016. North American Breeding Bird Survey Dataset 1966–2015, version 2015.1. U.S. Geological Survey, Patuxent Wildlife Research Center. <https://doi.org/10.5066/F7C53HZN>
- Pfannmuller, L., G. Niemi, J. Green, B. Sample, N. Walton, E. Zlonis, T. Brown, A. Bracey, G. Host, J. Reed, K. Rewinkel, and N. Will.** 2017. Minnesota Breeding Bird Atlas (2009–2013). Accessed 13 March 2018. <https://mnbirdatlas.org/species/bufflehead>.
- Richardson, T. W.** 2004. Expansion of the breeding range of the Bufflehead in California. *Western Birds* 35: 168–172.
- Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link.** 2011. The North American Breeding Bird Survey, results and analysis 1966–2010. Version 12.07.2011. USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA.
- USFWS (U.S. Fish and Wildlife Service).** 1978. Agassiz National Wildlife Refuge, master plan. U.S. Department of the Interior, Fish and Wildlife Service, Middle River, Minnesota, USA.
- USFWS (U.S. Fish and Wildlife Service).** 2005. Agassiz National Wildlife Refuge, comprehensive conservation plan. U.S. Department of the Interior, Fish and Wildlife Service, Middle River, Minnesota, USA.
- USFWS (U.S. Fish and Wildlife Service).** 2008. Agassiz National Wildlife Refuge wildlife inventory and monitoring plan. U.S. Department of the Interior, Fish and Wildlife Service, Middle River, Minnesota, USA.
- Whitaker, D.** 2017. Expanded range limits of boreal birds in the Torngat Mountains of Northern Labrador. *Canadian Field-Naturalist* 131: 55–62. <https://doi.org/10.22621/cfn.v131i1.1957>
- Whitt, M. B.** 1999. Bufflehead brood in northeastern South Dakota. *Prairie Naturalist* 31: 119–120.
- Zimpher, N., W. Rhodes, E. D. Silverman, G. Zimmerman, and M. D. Koneff.** 2010. Trends in duck breeding populations, 1955–2010. U.S. Fish and Wildlife Service Publication 417, Laurel, Maryland, USA.
- Zuckerberg, B., A. M. Woods, and W. F. Porter.** 2009. Poleward shifts in breeding bird distributions in New York State. *Global Change Biology* 15: 1866–1883. <https://doi.org/10.1111/j.1365-2486.2009.01878.x>

Received 25 June 2017

Accepted 4 January 2018