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Ecosystems Mission Area—Species Management Research Program

Prepared in cooperation with the U.S. Department of Agriculture Farm Service Agency, the U.S. Fish and Wildlife Service, and the Prairie Pothole Joint Venture

Seasonal and Breeding Phenologies of 38 Grassland Bird Species in the Midcontinent of North America

Open-File Report 2024–1002

U.S. Department of the Interior
U.S. Geological Survey

Cover: Grassland landscape in Sheridan County, Montana, July 4, 2013. Photograph by Lawrence D. Igl, U.S. Geological Survey.

Inset #1 (left): Clay-colored Sparrow nest with eggs in Hettinger County, North Dakota, June 8, 2011. Photograph by Lawrence D. Igl, U.S. Geological Survey.

Inset #2 (right): Wilson's Phalaropes in Eddy County, North Dakota, June 22, 2009. Photograph by Lawrence D. Igl, U.S. Geological Survey.

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
hectare (ha)	2.471	acre
hectare (ha)	0.003861	square mile (mi^2)

Seasonal and Breeding Phenologies of 38 Grassland Bird Species in the Midcontinent of North America

By Garrett J. MacDonald,[1] Michael J. Anteau,[1] Kristen S. Ellis,[1] Lawrence D. Igl,[1] Neal D. Niemuth,[2] and Josh L. Vest[2]

Abstract

Grasslands in the midcontinent of North America are highly imperiled, and grassland birds have suffered the largest bird declines of any terrestrial biome in North America in the last 50 years. Consequently, the conservation and management of grasslands, as well as their associated avian communities, are major priorities for the State, Provincial, and Federal agencies; non-governmental organizations; and private entities that influence the millions of hectares of grasslands in the midcontinent. Resource managers often deploy disturbances to grasslands (for example, grazing, haying, and burning) to maintain or enhance their quality or structure, but the timing of these disturbances has the potential to disrupt the nesting activities of grassland birds. In this report, we compiled two types of phenology information for 38 species of nonwaterfowl, grassland-nesting birds across four author-defined regions in the midcontinent of North America: (1) species- and region-specific arrival and departure dates from the eBird database, which indicate when a species may be assumed to be present in a region; and (2) reported dates of nesting activity for each species (start and end dates of nesting as well as total duration) from published bird distribution and occurrence books and breeding bird atlases, which indicate when nesting by a species may be assumed. This previously available but widely dispersed information, compiled for the first time, will aid resource managers and inform their decisions about the timing of disturbances while minimizing grassland management effects on nesting birds.

Introduction

Grasslands in the midcontinent of North America have been lost or degraded by numerous factors, including agricultural conversion, energy development and other human activities, and invasion by woody vegetation and exotic species, leading to long-term declines in the amount of grassland on the landscape (Bernath-Plaisted and Koper, 2016; Carbutt and others, 2017; Scholtz and Twidwell, 2022). More than 80 percent of the historical extent of grasslands in this region has been converted to other uses since Euro-American settlement (Samson and Knopf, 1994; Niemuth and others, 2022). Remaining grasslands support a large suite of avian species that are undergoing long-term population declines. In North America, grassland birds as a group are declining more than birds that use other habitats (for example, forests, wetlands, and so forth) (Rosenberg and others, 2019). Consequently, an array of State, Provincial, and Federal agencies; non-governmental conservation organizations; and private entities in the North American midcontinent have prioritized the conservation and management of grasslands and their associated bird communities by enacting conservation and management programs that aim to sustain wildlife populations and the habitats they use (Askins and others, 2007; Bernath-Plaisted and others, 2023).

Grassland habitats are periodically managed with disturbance (for example, grazing, haying, and burning) to maintain desired grassland species composition and structure, control noxious weeds and woody vegetation, and provide forage for livestock (Herkert and others, 1996; Askins and others, 2007). However, the annual timing of these practices has the potential to disrupt the nesting activities of grassland birds, which is an especially important concern for birds nesting on conservation program lands. Throughout the midcontinent, land-management agencies strive to use the best available information to time grassland management actions to avoid adversely affecting birds nesting in these habitats (for example, through nest abandonment, destruction of nests, or mortality of chicks or adults). Consequently, information about when grassland birds are actively nesting is needed to inform decisions about the timing of these management actions. Species-specific differences in life-history strategies, abundance or rarity, location and extent of breeding ranges, and other factors have resulted in nesting phenologies that vary greatly among different species of grassland-nesting birds and in different regions of the midcontinent (Johnson and others, 2019). To our knowledge, this phenological information has not been compiled throughout this entire region in a manner that will be useful to wildlife and grassland resource managers.

[1]U.S. Geological Survey.

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The purpose of this report is to compile information on the seasonal occurrence (that is, the duration of presence during the annual cycle) and nesting phenology (that is, the time from the first egg laid to the last young fledged from a nest in a region) for 38 species of nonwaterfowl, grassland-nesting birds across a broad swath of the North American grassland biome. We summarize when each species is present in a location, as well as when each species generally nests. The information is organized by taxonomic groups and summarized for broad regions of the midcontinent of North America. Although this published information was sometimes incomplete at the individual State or Provincial level, we provide available information for each focal State and Province in appendix 1. This summarized information can be used by managers who make decisions that balance the health of grassland habitats with the needs of agricultural producers and the birds nesting in these habitats.

Methods

Study Area and Focal Species

The study area encompasses seven Bird Conservation Regions associated with grassland and grassland-sage ecosystems in the midcontinent of North America (fig. 1; North American Bird Conservation Initiative, 2014). This expansive region intersects 18 States and 3 Provinces and represents the approximate extent of the short-, mixed-, and tallgrass prairie ecosystems of North America. This region was historically dominated by grassland land cover, but currently most of it has been converted for agricultural land uses, especially in grasslands in the eastern portion of this region (Samson and Knopf, 1994; Niemuth and others, 2022).

We selected a suite of 38 nonwaterfowl bird species representing five taxonomic groups (that is, upland gamebirds, shorebirds, herons, raptors and owls, and passerines) that nest in grassland habitats in the midcontinent (table 1); waterfowl were excluded because they are being addressed in a companion study. The list of species is representative of the broad range of grassland habitats present in the midcontinent of North America, and it was informed by the species included in Johnson and others (2019), with a few modifications. The list includes obligate grassland birds (that is, species that are exclusively adapted to and entirely dependent on grassland habitats) and facultative grassland birds (that is, species that use grasslands as part of a wider array of habitats) (Vickery and others, 1999). Although the focus in this report is to inform habitat management decisions for a diverse assemblage of grassland bird species, there is considerable variation in the population status and conservation attention among the focal species (Fields, 2017; Sauer and others, 2020). Additionally, these species vary widely in life-history characteristics that could affect the phenology of their nesting (Winter and others, 2004; Jones and others, 2010), such as affinities for specific habitat structures (Perlut and others, 2006; Churchwell and others, 2008), precocial versus altricial chick development, migration distance or year-round residency, and the propensity to renest or attempt multiple broods (Lloyd and Martin, 2005).

Review of Phenology Information

We searched more than 50 sources of compiled avian phenology information (that is, published books and breeding bird atlases containing information on avian distribution and occurrence; appendix 2), as well as the eBird database, an online citizen-science database of global bird observations (Sullivan and others, 2009). From those sources, the following information was compiled for each of the 38 focal species in each of four author-defined regions in the midcontinent of North America (fig. 2): (1) species- and region-specific arrival and departure dates from the eBird database (that is, "seasonal occurrence"), and (2) species- and region-specific reported start and end dates of nesting activity and the duration of the nesting period (that is, "nesting phenology").

For seasonal occurrence information, we accessed line graphs of frequency from the eBird database (eBird, 2023; that is, the frequency with which a species was reported to eBird within a region, measured by the percent of eBird checklists reporting the species during each week of the year) for each of the 38 species in our regions of interest. We considered eBird data from the past 50 years (that is, 1973–2023), because these five decades approximated the period of most of the nesting phenology information. We visually assessed and disregarded extreme outliers in the data. For migratory species, we assessed the graphs and recorded the approximate date (that is, the week) that a species arrived on its breeding grounds and the week that a species departed its breeding grounds for each region. A species was recorded as being a year-round resident (that is, nonmigratory) in a region if the eBird frequency graph did not show distinct periods of arrival and departure. An example for a migratory species, the Baird's sparrow [*Centronyx bairdii*], in North Dakota, is shown in figure 3. In this example, the species' arrival and departure dates in North Dakota, respectively, were recorded as May 1 and August 31.

For nesting phenology information, we reviewed available books and breeding bird atlases, including some sources that were available only online, for the 18 States and 3 Provinces in the study area. Books and atlases were searched for information on nesting phenology; such information often included extreme nesting dates (beginning and end dates), egg dates (dates when nests with eggs have been known to occur), as well as qualitative statements by the author(s) about when the species is likely to be nesting based on the authors' experiences or based on unknown sources. Occasionally, publications summarized rigorously collected information from a breeding bird atlas (for example,

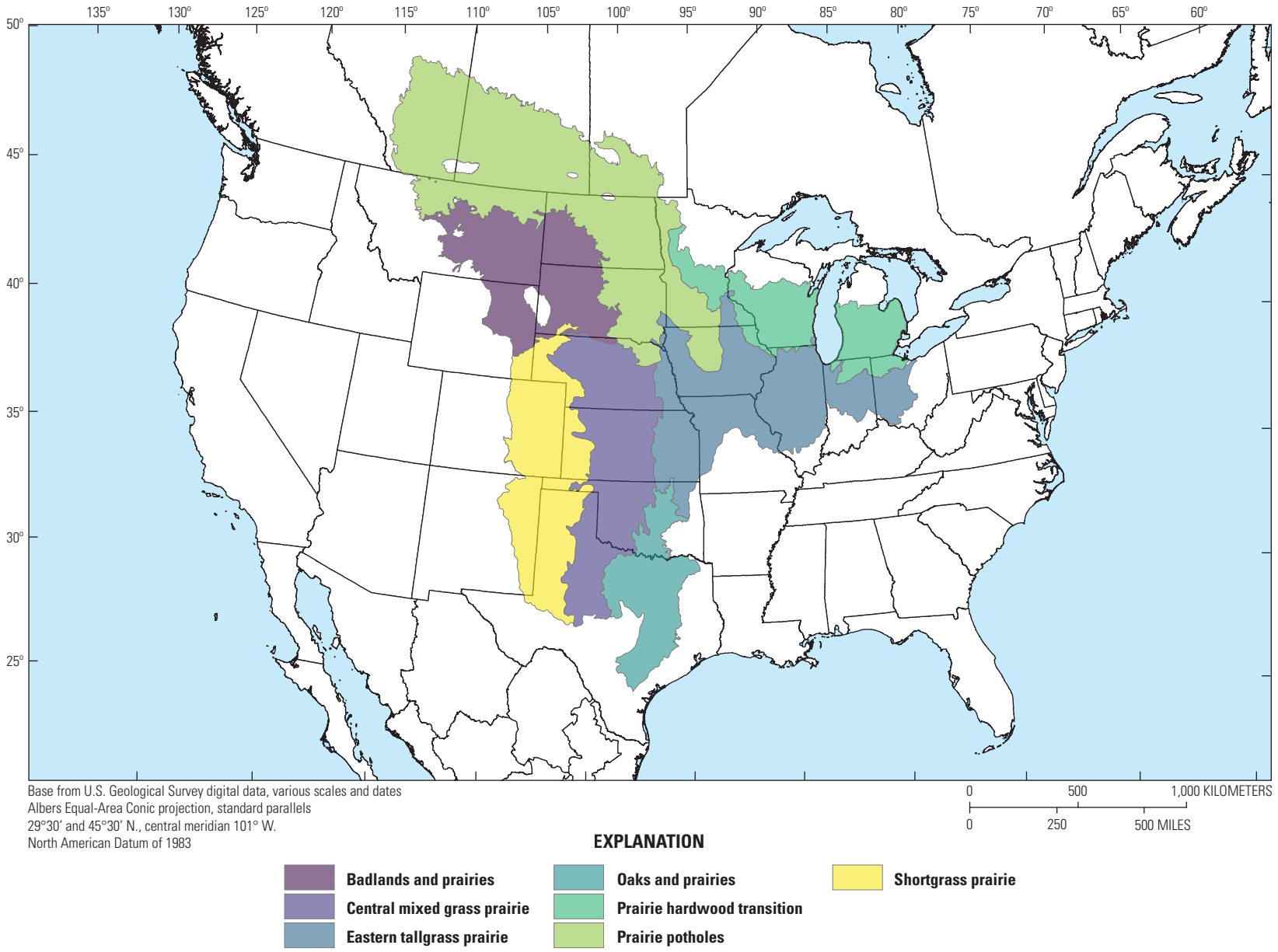

Figure 1. Project study area in the midcontinent of North America consisting of seven Bird Conservation Regions (North American Bird Conservation Initiative, 2014) associated with grassland ecosystems.

Table 1. Alpha codes, common and scientific names, and taxonomic group membership of 38 focal grassland bird species nesting in the midcontinent of North America. Vernacular and scientific names follow Chesser and others (2023), and species are listed in taxonomic order.

Alpha code	Common name	Scientific name
	Upland gamebirds	
NOBO	Northern bobwhite	*Colinus virginianus*
GRSG	Greater sage-grouse	*Centrocercus urophasianus*
STGR	Sharp-tailed grouse	*Tympanuchus phasianellus*
GRPC	Greater prairie-chicken	*Tympanuchus cupido*
LEPC	Lesser prairie-chicken	*Tympanuchus pallidicinctus*
GRAP	Gray partridge	*Perdix perdix*
RNEP	Ring-necked pheasant	*Phasianus colchicus*
	Shorebirds	
MOPL	Mountain plover	*Charadrius montanus*
UPSA	Upland sandpiper	*Bartramia longicauda*
LBCU	Long-billed curlew	*Numenius americanus*
MAGO	Marbled godwit	*Limosa fedoa*
WILL	Willet	*Tringa semipalmata*
WIPH	Wilson's phalarope	*Phalaropus tricolor*
	Herons	
AMBI	American bittern	*Botaurus lentiginosus*
	Raptors and owls	
NOHA	Northern harrier	*Circus hudsonius*
SEOW	Short-eared owl	*Asio flammeus*
	Passerines	
HOLA	Horned lark	*Eremophila alpestris*
SEWR	Sedge wren	*Cistothorus stellaris*
SPPI	Sprague's pipit	*Anthus spragueii*
CCLO	Chestnut-collared longspur	*Calcarius ornatus*
TBLO	Thick-billed longspur	*Rhynchophanes mccownii*
GRSP	Grasshopper sparrow	*Ammodramus savannarum*
LASP	Lark sparrow	*Chondestes grammacus*
LARB	Lark bunting	*Calamospiza melanocorys*
CCSP	Clay-colored sparrow	*Spizella pallida*
FISP	Field sparrow	*Spizella pusilla*
BRSP	Brewer's sparrow	*Spizella breweri*
VESP	Vesper sparrow	*Pooecetes gramineus*
LCSP	LeConte's sparrow	*Ammospiza leconteii*
NESP	Nelson's sparrow	*Ammospiza nelsoni*
BAIS	Baird's sparrow	*Centronyx bairdii*
HESP	Henslow's sparrow	*Centronyx henslowii*
SAVS	Savannah sparrow	*Passerculus sandwichensis*
BOBO	Bobolink	*Dolichonyx oryzivorus*
CHME	Chihuahuan meadowlark	*Sturnella lilianae*
EAME	Eastern meadowlark	*Sturnella magna*
WEME	Western meadowlark	*Sturnella neglecta*
DICK	Dickcissel	*Spiza americana*

they provided histograms of nesting dates for nests that were reported by atlas observers). All information available in these books and atlases was compiled. In some cases, exact dates were provided (for example, "May 16 to July 14"). Other times, the information was less precise (for example, "mid-May to mid-July") or the information was presented in a histogram or other graphic presentation. In the latter situation, we summarized the information using common decision rules to aggregate information at the level of the week (for example, "first week of May" became May 1, "mid-May" became May 15, and "third week of May" became May 22). Sources of phenology information were based on the entire State or Province, rather than just the grassland portions illustrated by the study area boundary in figure 2.

Overall, published nesting phenology information was located for 19 of the 21 States and Provinces in the study area: Alberta, Saskatchewan, Manitoba, Montana, North Dakota, South Dakota, Minnesota, Colorado, Nebraska, Kansas, Iowa, Missouri, Wisconsin, Illinois, Indiana, Ohio, Michigan, Oklahoma, and Texas. We lacked nesting phenology information for New Mexico and Wyoming. In the case of New Mexico, the book written on the State's birdlife (Bailey, 1928) contained no nesting phenology information, and a breeding bird atlas from the early 2000s was not completed (Dave Krueper, U.S. Fish and Wildlife Service, retired, written commun., 2023). In the case of Wyoming, two books have been written about the State's birdlife (Knight, 1902; Faulkner, 2010), but neither contained nesting phenology information. A formal breeding bird atlas also has not been published for Wyoming.

Because not all States and Provinces had nesting phenology information, we aggregated information into four larger regions that were defined based on similarities in latitude, comparable species-specific arrival and departure dates from the eBird database, and personal knowledge of avian phenology in each location. The four regions were defined as Canadian grasslands (Alberta, Saskatchewan, and Manitoba), northern U.S. grasslands (Montana, North Dakota, South Dakota, Wyoming, and Minnesota), central U.S. grasslands (Nebraska, Colorado, Kansas, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio), and southern U.S. grasslands (New Mexico, Oklahoma, and Texas) (fig. 2). We compiled existing phenology information for the constituent States or Provinces in a region and calculated the median dates for the start and end of nesting, which are the dates reported in the figures.

Results and Discussion

In this report, two types of phenology information (that is, seasonal occurrence and nesting phenology) are summarized for four regions consisting of 18 States and 3 Provinces in the North American midcontinent (figs. 4–7; table 2). The phenology information available at the level of the individual State or Province is also summarized and is provided in appendix 1 (figs. 1.1–1.21). These summaries provide information about relative differences in timing and duration of a species' occurrence in a region as well as when a species is likely to be nesting. This information will help resource managers better understand when grassland species are likely to be present and nesting in the grasslands they manage throughout the midcontinent.

The published nesting dates and nesting durations for the 38 species of nonwaterfowl grassland birds in the four regions in the midcontinent are summarized in table 2. For all species combined in a region, the total nesting durations were 149 days (March 24 to August 19) for Canadian grasslands, 173 days (March 25 to September 13) for northern U.S. grasslands, 189 days (March 13 to September 17) for central U.S. grasslands, and 164 days (March 2 to August 12 for southern U.S. grasslands. These dates extend beyond and comprise longer durations than those of the primary nesting seasons set by the U.S. Department of Agriculture to avoid disturbance to nesting cover and nesting birds in grasslands enrolled in the Conservation Reserve Program (Farm Service Agency, 2020), but it is important to note that the current primary nesting season dates for individual States are based on the species selected by the State technical committees of the U.S. Department of Agriculture. Nesting dates reported here, however, can be interpreted as likely minimum and maximum nesting dates. Information is currently lacking to estimate the proportion of active nests throughout the breeding season, which could help managers evaluate tradeoffs in timing of grassland managements actions.

Compiling this information provided a unique opportunity to examine patterns in nesting phenology across species and guilds. In general, native upland gamebirds (northern bobwhite [*Colinus virginianus*], sharp-tailed grouse [*Tympanuchus phasianellus*], greater prairie-chicken [*Tympanuchus cupido*], lesser prairie-chicken [*Tympanuchus pallidicinctus*]) tended to begin nesting later and (or) had shorter nesting durations in northern areas compared to southern areas. The ring-necked pheasant (*Phasianus colchicus*), a non-native upland gamebird, begins nesting in mid-April throughout its range in the United States but shows an opposite pattern to its native counterparts, with a longer nesting duration in northern areas than in southern areas. Most shorebirds show a different pattern from those exhibited by native upland gamebirds. Upland sandpiper (*Bartramia longicauda*), marbled godwit (*Limosa fedoa*), willet (*Tringa semipalmata*), and Wilson's phalarope (*Phalaropus tricolor*) tended to begin nesting earlier and (or) had longer nesting durations in northern areas than in southern areas. There were few noteworthy patterns for passerines. The eastern meadowlark (*Sturnella magna*) and dickcissel (*Spiza americana*) tended to begin nesting later and (or) had shorter nesting durations in northern areas compared to southern areas, which is similar to the pattern shown for native upland gamebirds. For some passerine species (for example, vesper sparrow [*Pooecetes gramineus*], Savannah sparrow [*Passerculus sandwichensis*], and bobolink [*Dolichonyx*

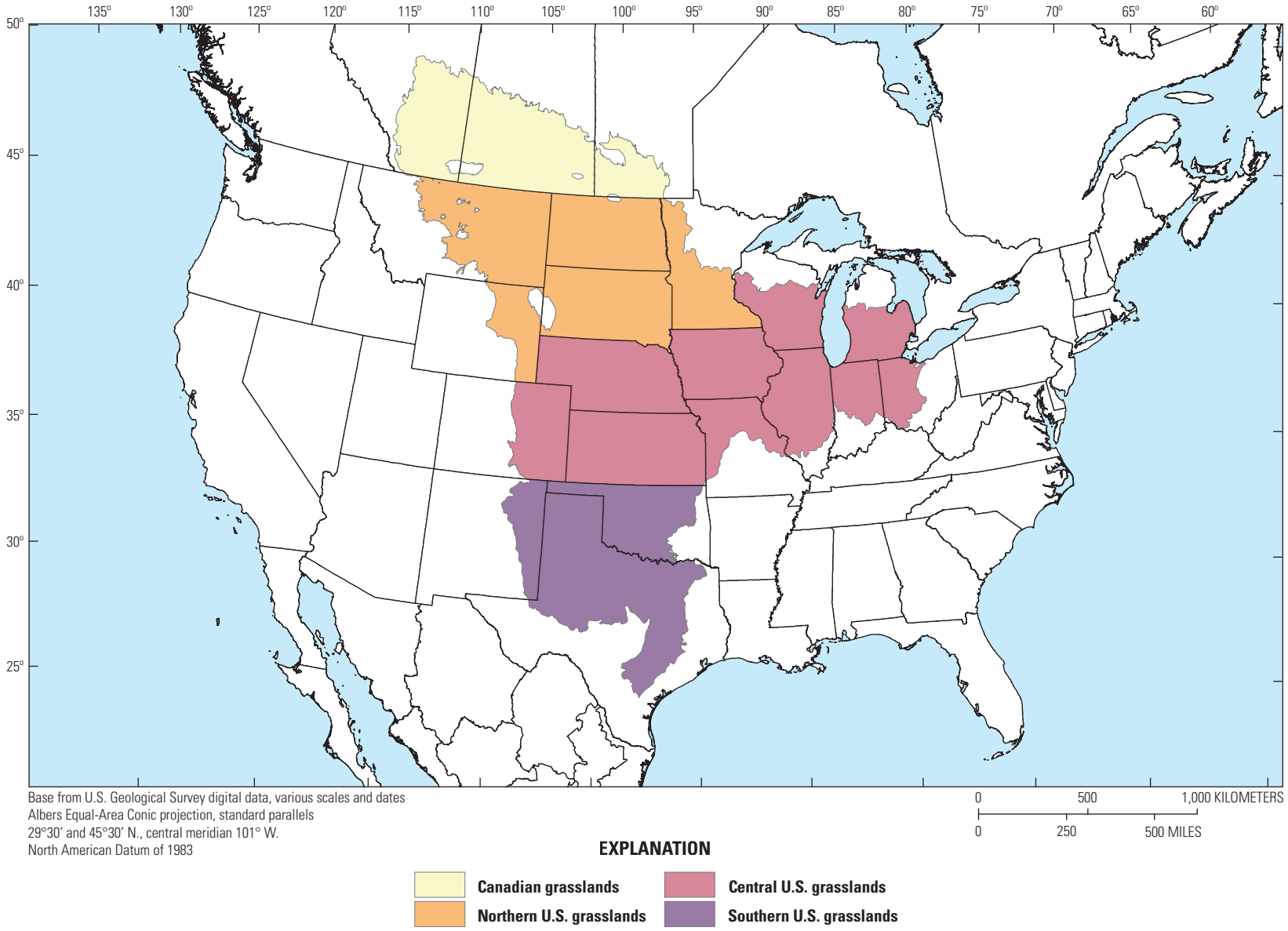

Figure 2. The four author-defined regions used to summarize seasonal occurrence and nesting phenology information for 38 species of nonwaterfowl grassland birds in the midcontinent of North America.

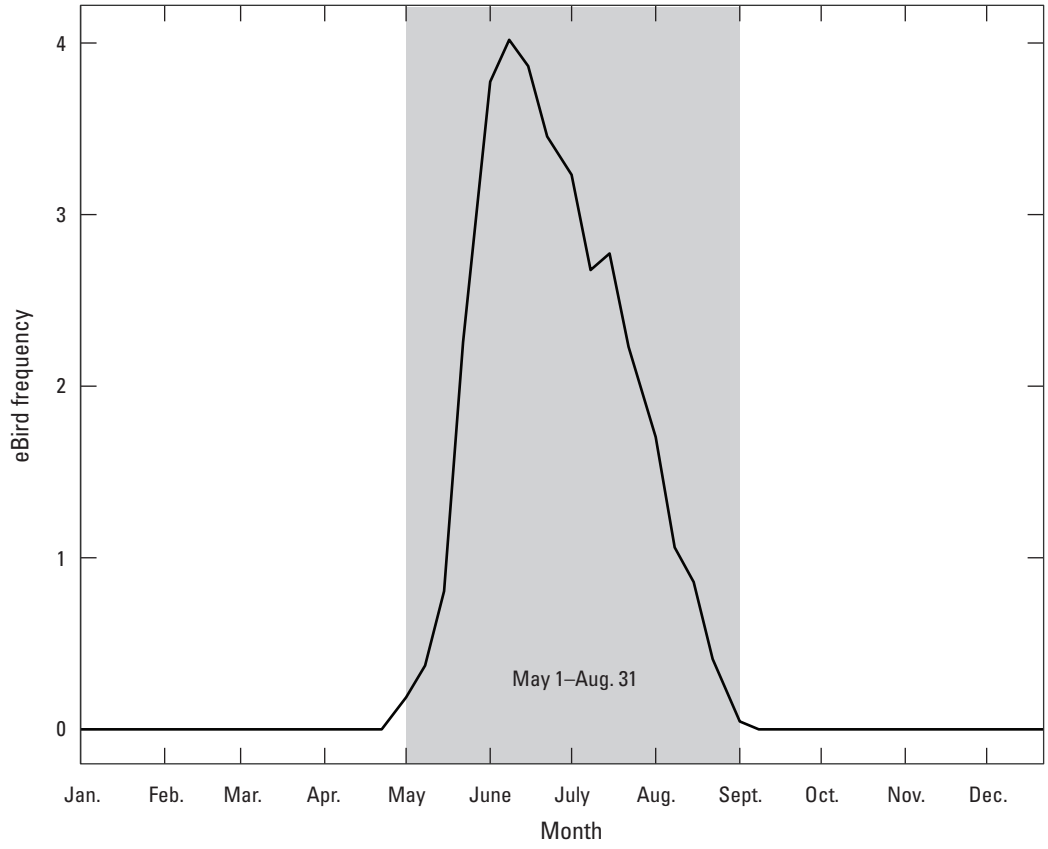

Figure 3. eBird frequency for Baird's sparrow (*Centronyx bairdii*) in North Dakota with the species' arrival and departure dates (May 1 and August 31, respectively) used in this report (eBird, 2023).

oryzivorus]), it was noteworthy that the beginning of their nesting seasons and their nesting durations were consistent in all regions in which the species were present (table 2). Patterns between or among species in this report could be coupled with results from Anteau and others (2023) to help managers make species- or guild-oriented management decisions.

The amount and type of nesting phenology information from the above publications varied tremendously. For example, some authors summarized information rigorously collected by citizen scientists and researchers as part of an official breeding bird atlas (for example, Kingery, 1998). Such information often was presented in the form of histograms of nesting activity. Also commonly reported were start and end dates of nesting or a list of dates when nests or nests with eggs were discovered (for example, Stewart, 1975). Even when such information was reported, the number of nests present for each species with phenology information was often limited (less than 30 nests in a single year or during 2–3 years). However, most of the nesting phenology information was coarser, consisting of qualitative statements by the author(s) that reflected expert opinion or unknown sources.

Figures presented in this report that summarize phenology information should be interpreted and used with caution for several reasons. First, the amount and level of detail on phenology provided in the published literature varied among sources. The data in some sources were collected with rigor (for example, breeding bird atlases), whereas data in other sources represented estimates from unknown sources or opinions of the expert(s) that authored the species account(s). Expert estimates or opinions can be affected by information available at the time of publication or the individual experiences of the author(s), which could be subject to bias. Second, some of the published information in books and breeding bird atlases was collected or published decades ago, and the breeding phenology of certain species of North American birds may have changed over time with land use and land cover change, climate change (Knudsen and others, 2011), and shifts in breeding ranges (Langham and others, 2015). Third, apparent trends in spring arrival or fall departures dates, start or end of nesting, and nesting duration may be artifacts of the information that was reported in the books and atlases (that is, the lack of data in some locations and the varying level of precision in how dates were reported) rather than representative of precise biological patterns. This is true even for the seasonal occurrence data from eBird. Fourth, the published nesting phenology information includes only those dates a nest was determined to be active and may not be wholly representative of a species' entire nesting season or when young may be vulnerable outside of a nest. And finally, phenology can

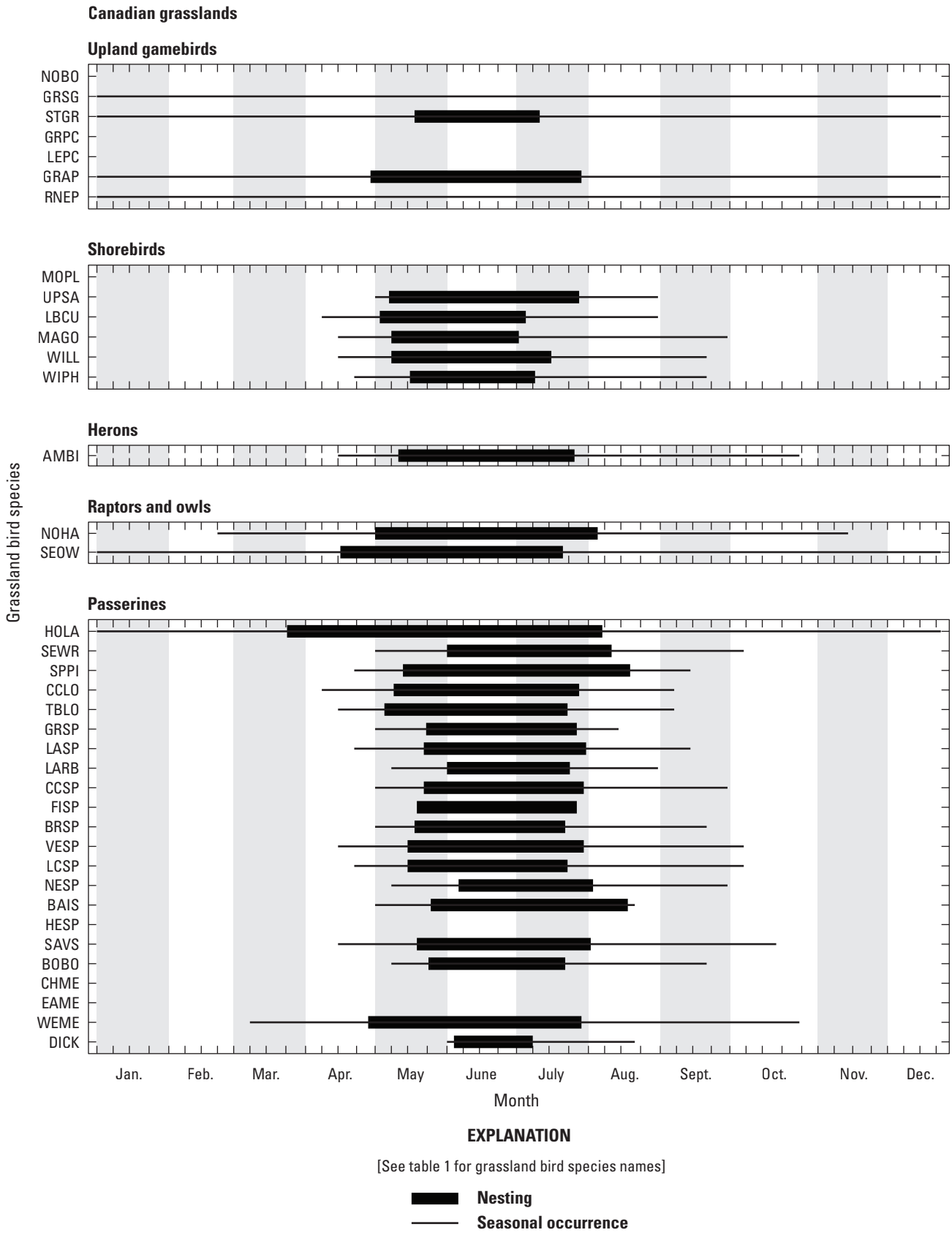

Figure 4. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in the Canadian grasslands (Manitoba Avian Research Committee, 2003; Rousseu and Drolet, 2015; eBird, 2023).

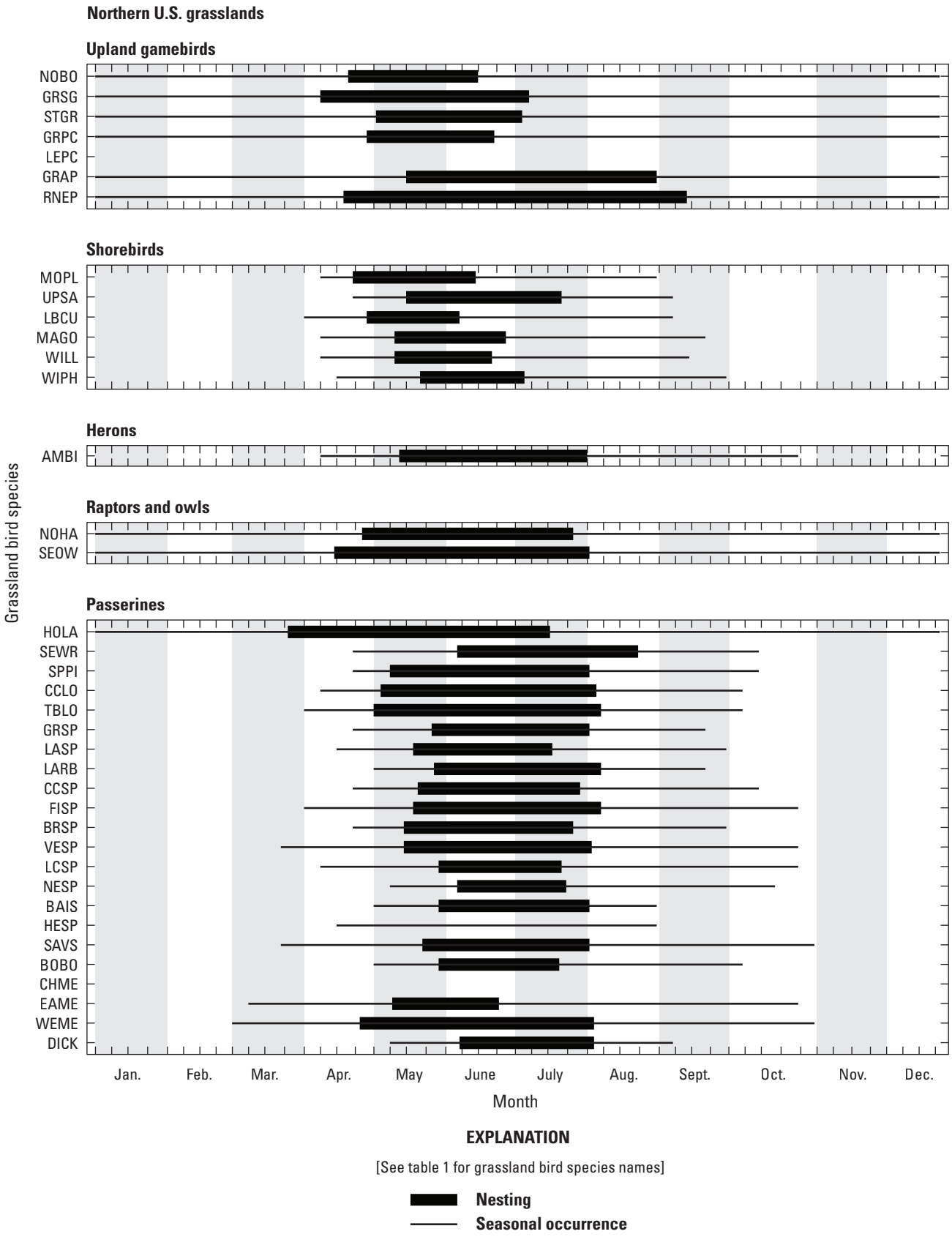

Figure 5. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in the northern U.S. grasslands (Roberts, 1932a, b; Stewart, 1975; Whitney, 1978; South Dakota Ornithologists' Union, 1991; Peterson, 1995; Tallman and others, 2002; Marks and others, 2016; eBird, 2023).

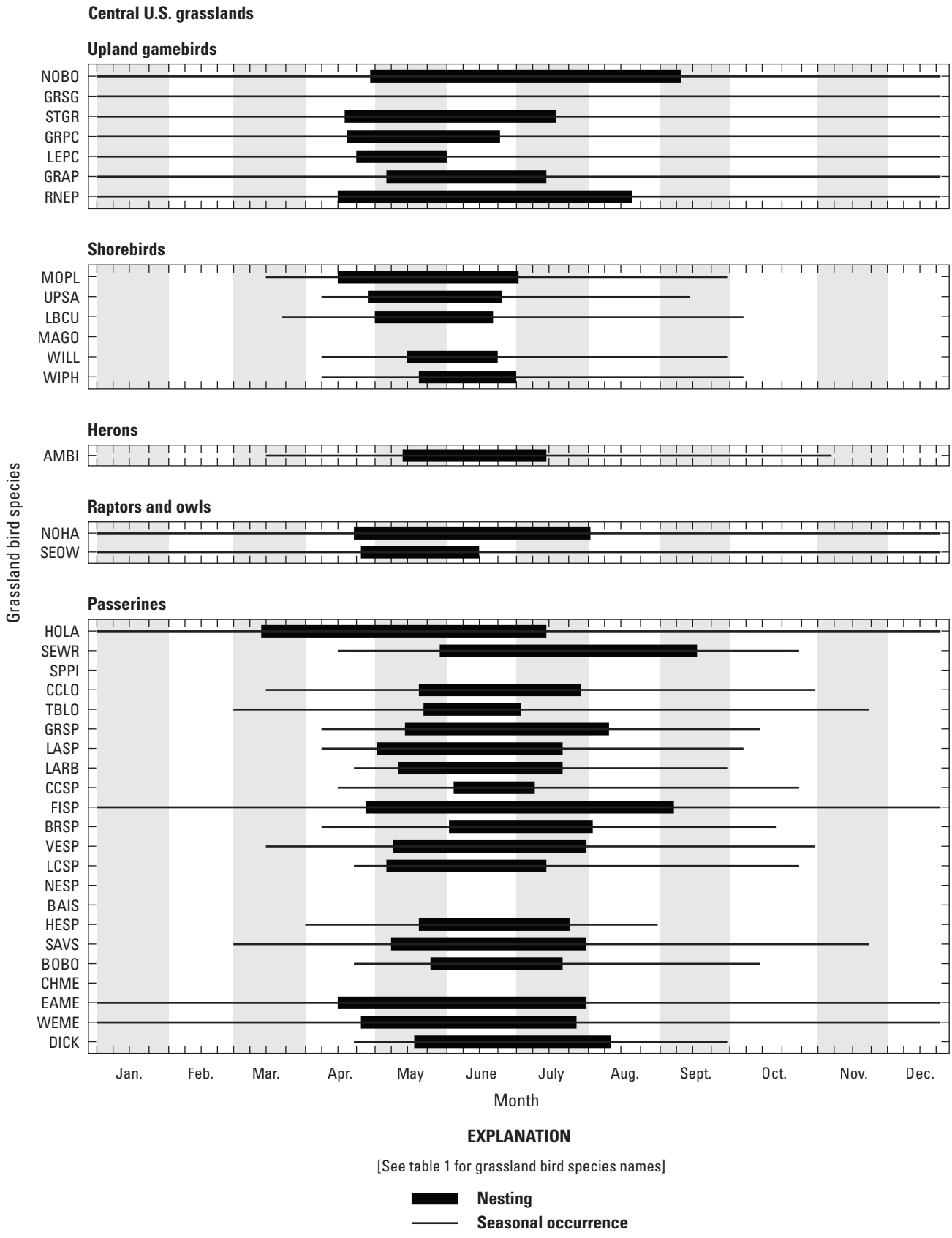

Figure 6. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in the central U.S. grasslands (Johnston, 1965; Dinsmore and others, 1984; Mumford and Keller, 1984; Bohlen, 1989; Thompson and Ely, 1989; Brewer and others, 1991; Robbins, 1991; Thompson and Ely, 1992; Granlund and McPeek, 1994; Jackson and others, 1996; Jacobs and Wilson, 1997; Kingery, 1998; Peterjohn, 2001; Cutright and others, 2006; Thompson and others, 2011; Chartier and others, 2013; Mollhoff, 2022; eBird, 2023).

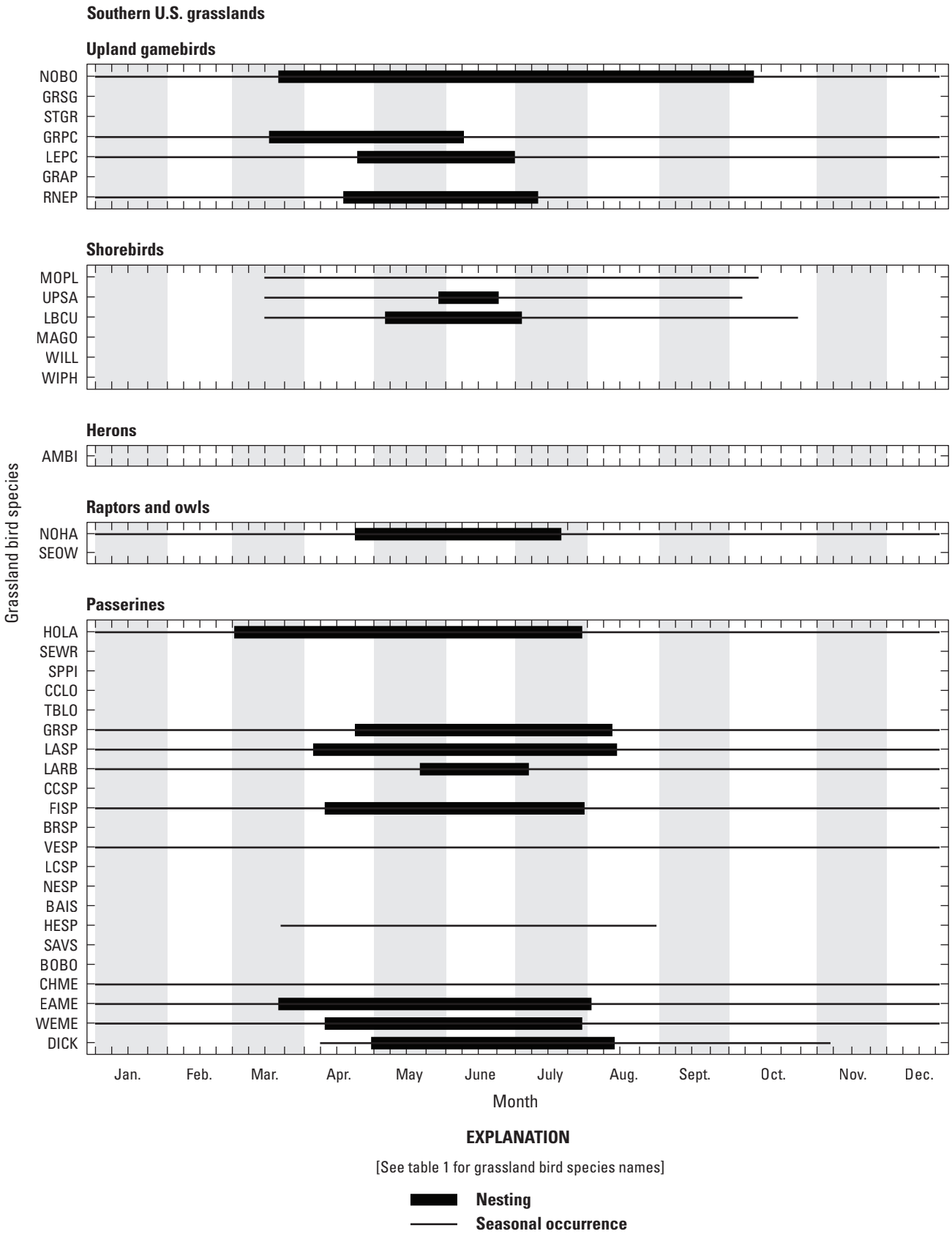

Figure 7. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in the southern U.S. grasslands (Oberholser, 1932; Baumgartner and Baumgartner, 1992; Benson and Arnold, 2001; eBird, 2023).

Table 2. Maximum published nesting dates and nesting durations for 38 species of nonwaterfowl grassland birds in four author-defined regions in the midcontinent of North America. Species are organized by taxonomic group, and species listed are in taxonomic order (Chesser and others, 2023).

[No., number; --, no data]

Alpha code (table 1)	Canadian grasslands		Northern U.S. grasslands		Central U.S. grasslands		Southern U.S. grasslands	
	Nesting range	No. days	Nesting range	No. days	Nesting range	No. days	Nesting range	No. days
Upland gamebirds								
NOBO	--	--	April 20–June 15	56	April 29–September 10	134	March 21–October 12	205
GRSG	--	--	April 8–July 7	90	--	--	--	--
STGR	May 18–July 11	54	May 2–July 4	63	April 18–July 18	91	--	--
GRPC	--	--	April 28–June 22	55	April 19–June 24	66	March 17–June 9	84
LEPC	--	--	--	--	April 23–June 1	39	April 24–July 1	68
GRAP	April 29–July 29	91	May 15–August 31	108	May 6–July 14	69	--	--
RNEP	--	--	April 18–September 13	148	April 15–August 20	127	April 18–July 11	84
Shorebirds								
MOPL	--	--	April 22–June 14	53	April 15–July 2	78	--	--
UPSA	May 7–July 28	82	May 15–July 21	67	April 28–June 25	58	May 29–June 24	26
LBCU	May 3–July 5	63	April 28–June 7	40	May 1–June 21	51	May 6–July 4	59
MAGO	May 8–July 2	55	May 10–June 27	48	--	--	--	--
WILL	May 8–July 16	69	May 10–June 21	42	May 15–June 23	39	--	--
WIPH	May 16–July 9	54	May 21–July 5	45	May 20–July 1	42	--	--
Herons								
AMBI	May 11–July 26	76	May 12–August 1	81	May 13–July 14	62	--	--
Raptors and owls								
NOHA	May 1–August 5	96	April 26–July 26	91	April 22–August 2	102	April 23–July 21	89
SEOW	April 16–July 21	96	April 14–August 2	110	April 25–June 15	51	--	--
Passerines								
HOLA	March 24-August 7	136	March 25–July 16	113	March 13–July 14	123	March 2–July 30	150
SEWR	June 1–August 11	71	June 6–August 23	78	May 29–September 17	111	--	--
SPPI	May 13-–August 19	98	May 8–August 2	86	--	--	--	--
CCLO	May 9–July 28	80	May 4–August 5	93	May 20–July 29	70	--	--
TBLO	May 5–July 23	79	May 1–August 7	98	May 22–July 3	42	--	--
GRSP	May 23–July 27	65	May 26–August 2	68	May 14–August 10	88	April 23–August 12	111
LASP	May 22–July 31	70	May 18–July 17	60	May 2–July 21	80	April 5–August 14	131
LARB	June 1–July 24	53	May 27–August 7	72	May 11–July 21	71	May 21–July 7	47

Table 2. Maximum published nesting dates and nesting durations for 38 species of nonwaterfowl grassland birds in four author-defined regions in the midcontinent of North America. Species are organized by taxonomic group, and species listed are in taxonomic order (Chesser and others, 2023).—Continued

[No., number; --, no data]

Alpha code (table 1)	Canadian grasslands		Northern U.S. grasslands		Central U.S. grasslands		Southern U.S. grasslands	
	Nesting range	No. days	Nesting range	No. days	Nesting range	No. days	Nesting range	No. days
Passerines—Continued								
CCSP	May 22–July 30	69	May 20–July 29	70	June 4–July 9	35	--	--
FISP	May 19–July 27	69	May 18–August 7	81	April 27–September 7	133	April 10–July 31	112
BRSP	May 18–July 22	65	May 14–July 26	73	June 2–August 3	62	--	--
VESP	May 15–July 30	76	May 14–August 3	81	May 9–July 31	83	--	--
LCSP	May 15–July 23	69	May 29–July 21	53	May 6–July 14	69	--	--
NESP	June 6–August 3	58	June 6–July 23	47	--	--	--	--
BAIS	May 25–August 18	85	May 29–August 2	65	--	--	--	--
HESP	--	--	--	--	May 20–July 24	65	--	--
SAVS	May 19–August 2	75	May 22- August 2	72	May 8–July 31	84	--	--
BOBO	May 24–July 22	59	May 29–July 20	52	May 25–July 21	57	--	--
CHME	--	--	--	--	--	--	--	--
EAME	--	--	May 9–June 24	46	April 15–July 31	107	March 21–August 3	135
WEME	April 28–July 29	92	April 25–August 4	101	April 25–July 27	93	April 10–July 30	111
DICK	June 4–July 8	34	June 7–August 4	58	May 18–August 11	85	April 30–August 13	105

vary considerably within or among a region, State, or Province based on local climatic conditions, elevation, and many other factors (Anteau and others, 2023).

This project revealed notable gaps in the understanding of avian phenology in the grasslands of the midcontinent of North America and the need for better reporting and data availability of nest phenology information by researchers. Given that much of the available nesting phenology information was published decades ago and that the timing of nesting and migration may have changed for some species (for example, Bates and others, 2023), updating this information at State and Provincial levels would be prudent, especially considering a changing climate (Langham and others, 2015). Additionally, the available nesting information defined nesting as ending when young leave the nest bowl, but that definition misses a critical window of vulnerability for many bird species in which the young are still dependent on parental care and may have home ranges that extend well beyond the adults' breeding territory. For example, Suedkamp Wells (2005) reported that postfledging resource use differed from adult resource use for dickcissels and eastern meadowlarks. There is growing interest in developing realistic guidelines for grassland management that incorporate adult and juvenile life-history needs on public and private lands (for example, Suedkamp Wells and others, 2008; Wolcott and others, 2023). The lack of information in the literature on the duration of the postfledging period, as well as minimum area requirements of fledglings for most grassland bird species, is an important gap that should be considered when making decisions about the timing of management actions in grasslands.

Despite the above limitations, this report unifies and summarizes disparate sources of nesting phenology information for many grassland-nesting bird species of the North American midcontinent for the first time and provides resource managers with a single source of the best currently available information (as of 2023) about the timing and duration of the nesting period. We encourage grassland bird researchers to collect and make available nesting data that would improve the understanding of nesting phenology for grassland birds in the midcontinent.

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Appendix 1. State- and Province-Level Summaries of Grassland Bird Phenology

Summaries of seasonal occurrence and nesting phenology for the 18 States and 3 Provinces in the study area are provided in figures 1.1–1.21.

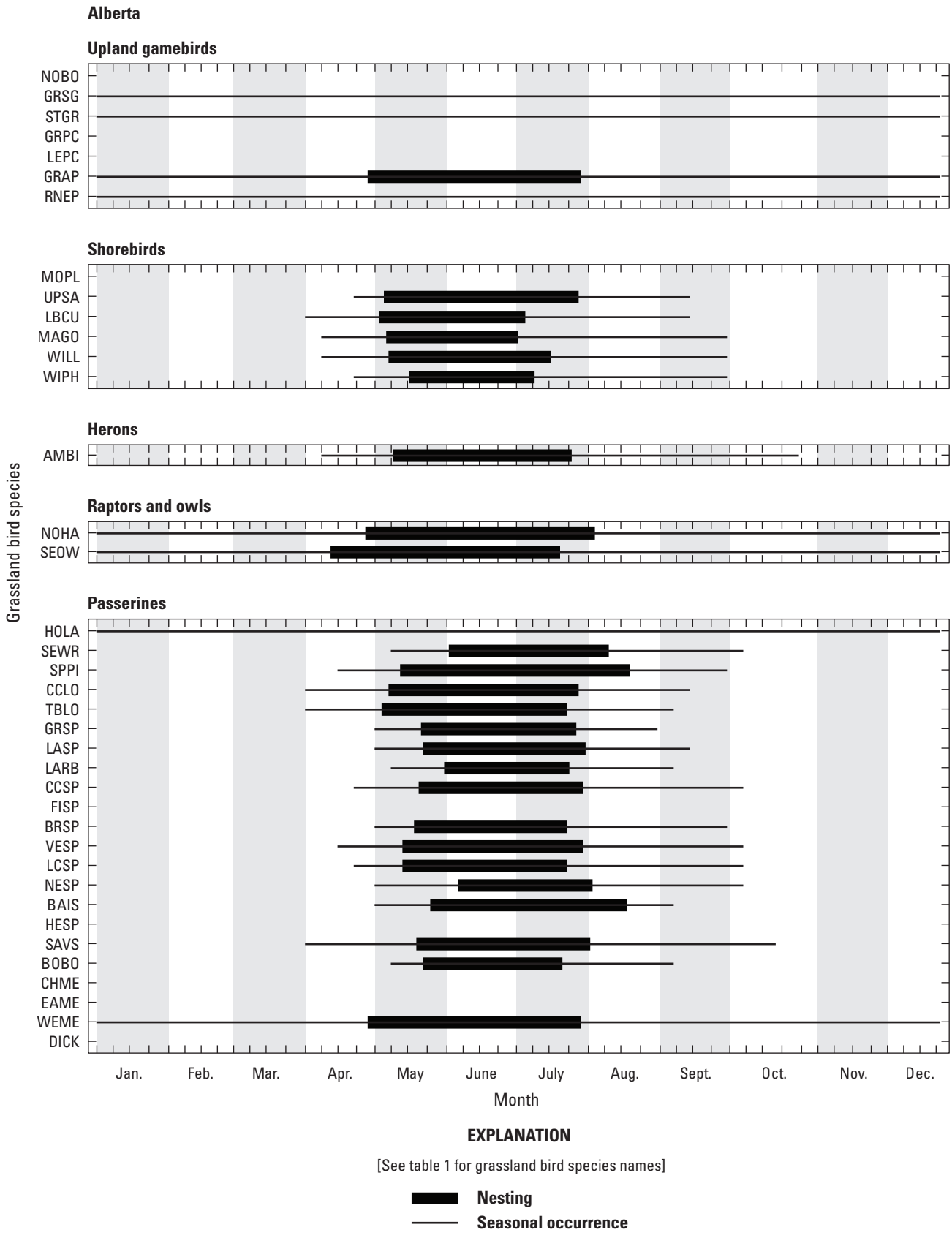

Figure 1.1. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Alberta, Canada (Rousseu and Drolet, 2015; eBird, 2023).

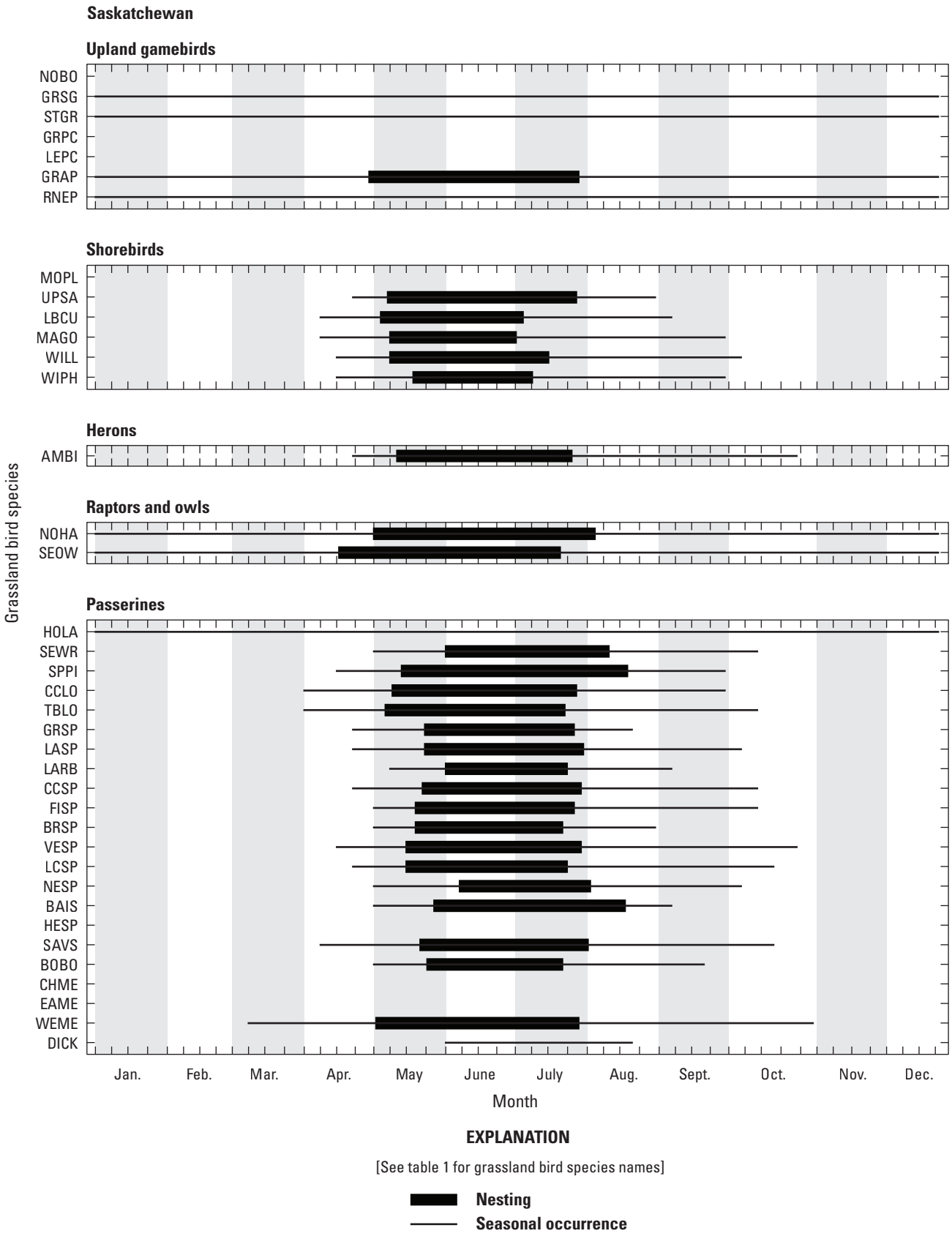

Figure 1.2. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Saskatchewan, Canada (Rousseu and Drolet, 2015; eBird, 2023).

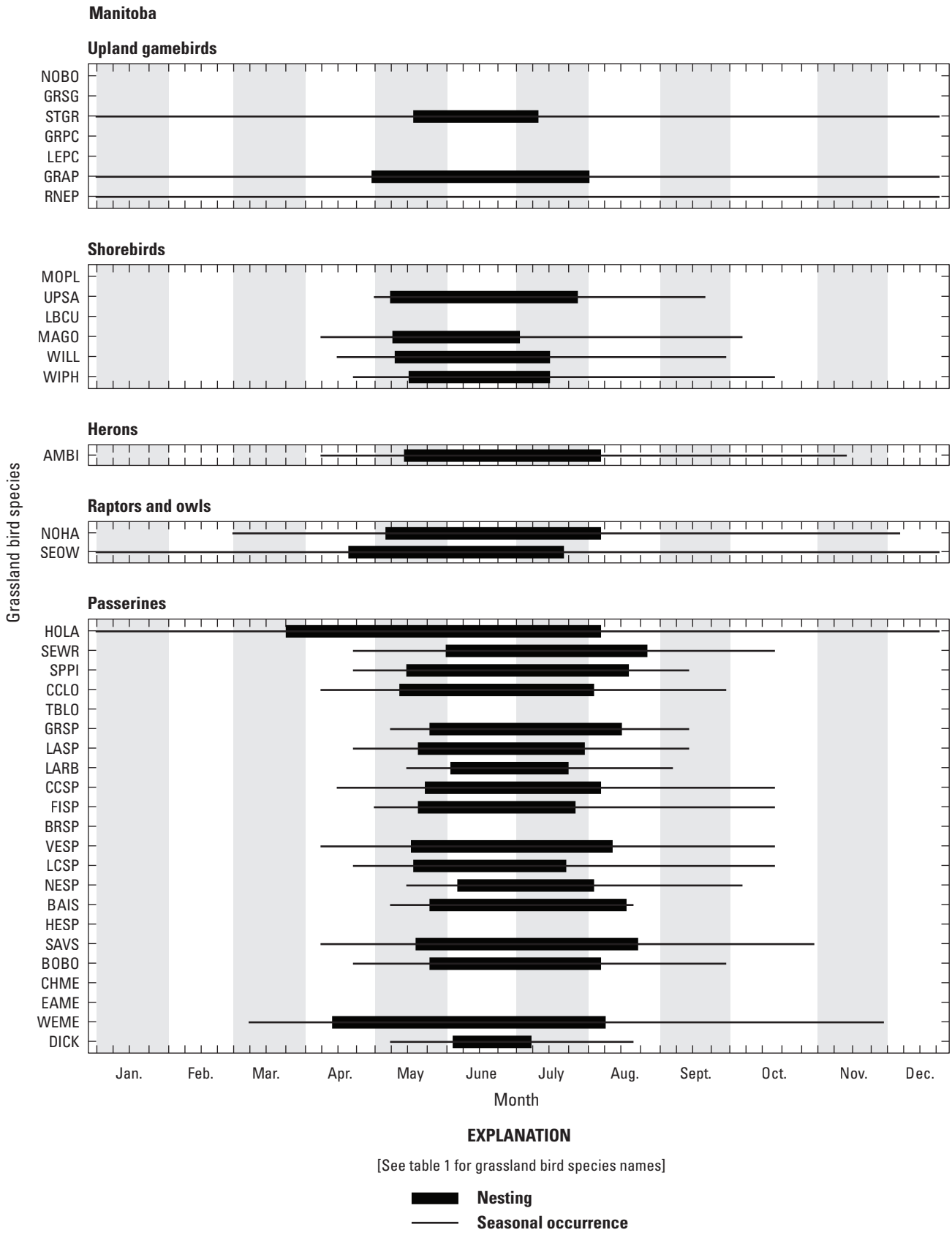

Figure 1.3. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Manitoba, Canada (Manitoba Avian Research Committee, 2003; Rousseu and Drolet, 2015; eBird, 2023).

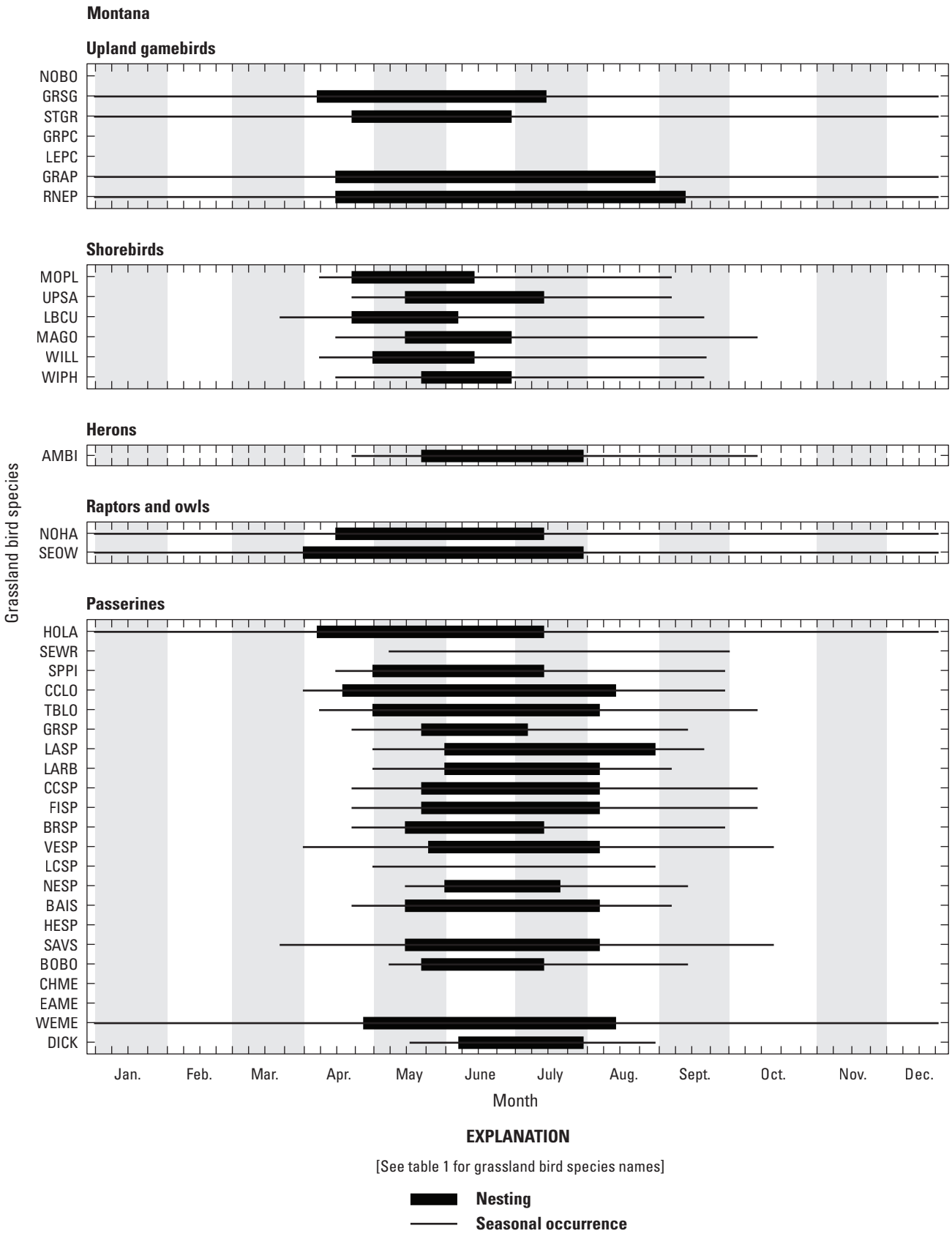

Figure 1.4. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Montana, United States (Marks and others, 2016; eBird, 2023).

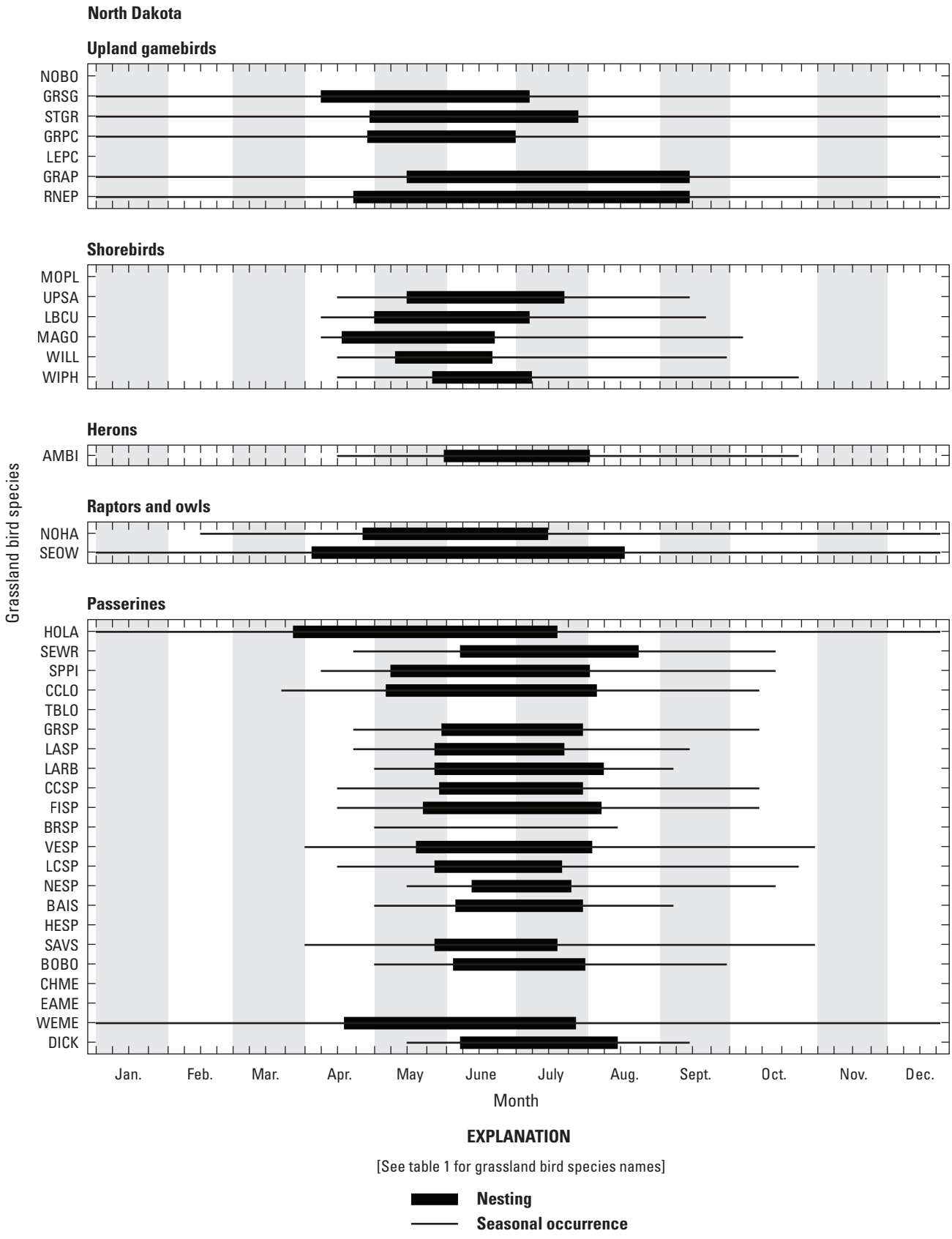

Figure 1.5. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in North Dakota, United States (Stewart, 1975; eBird, 2023).

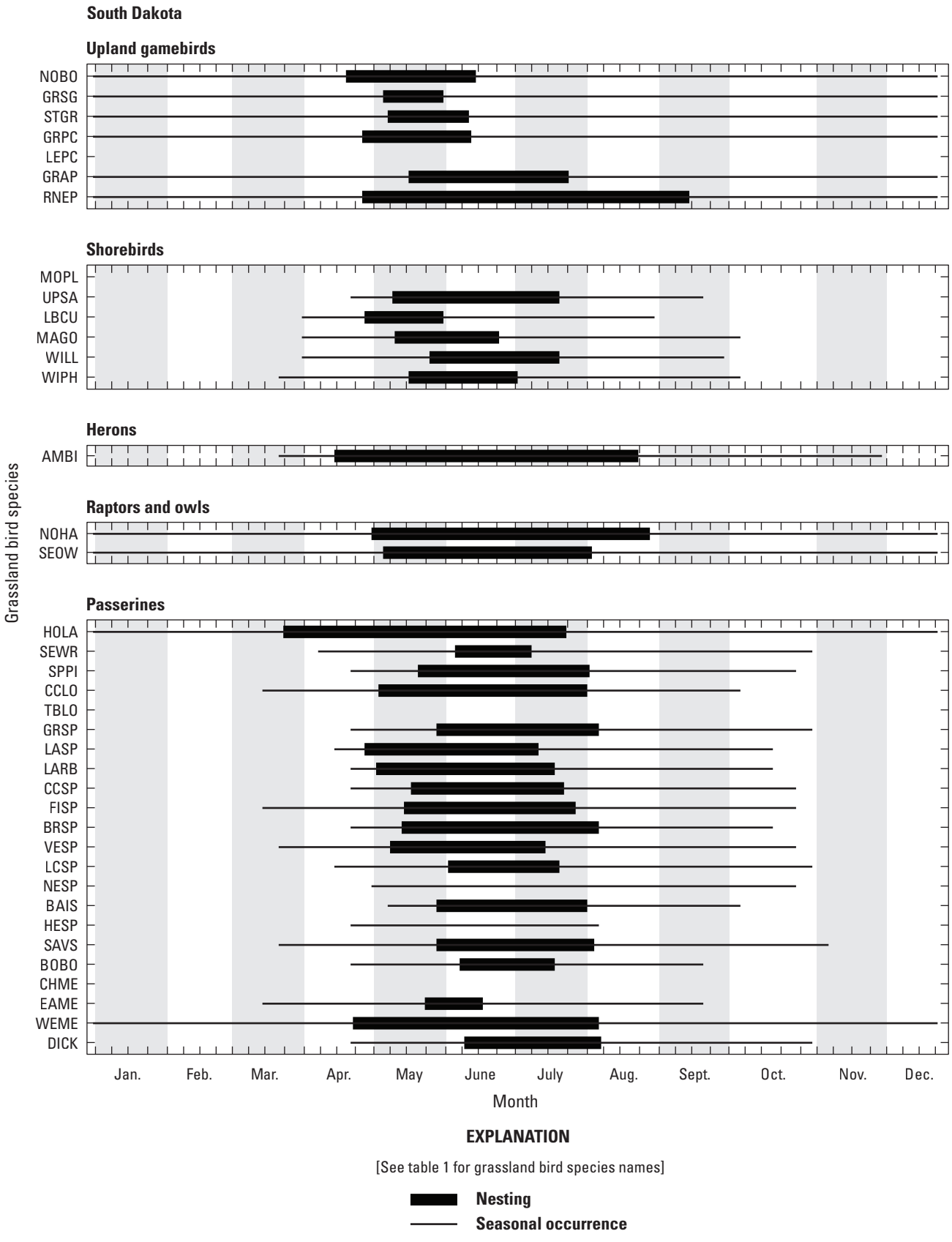

Figure 1.6. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in South Dakota, United States (Whitney, 1978; South Dakota Ornithologists' Union, 1991; Peterson, 1995; Tallman and others, 2002; eBird, 2023).

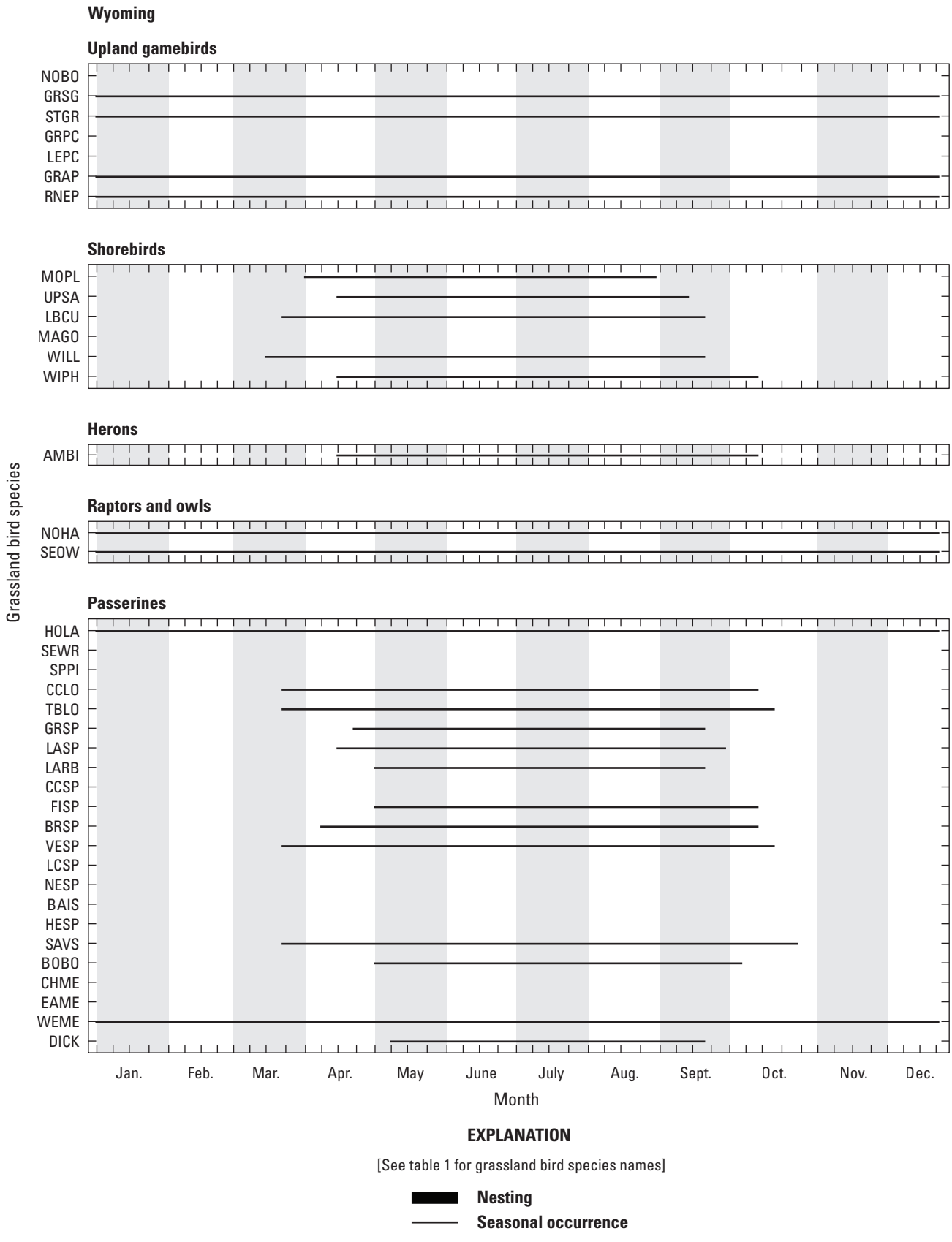

Figure 1.7. Seasonal occurrence information for 38 species of grassland birds in Wyoming, United States (eBird, 2023).

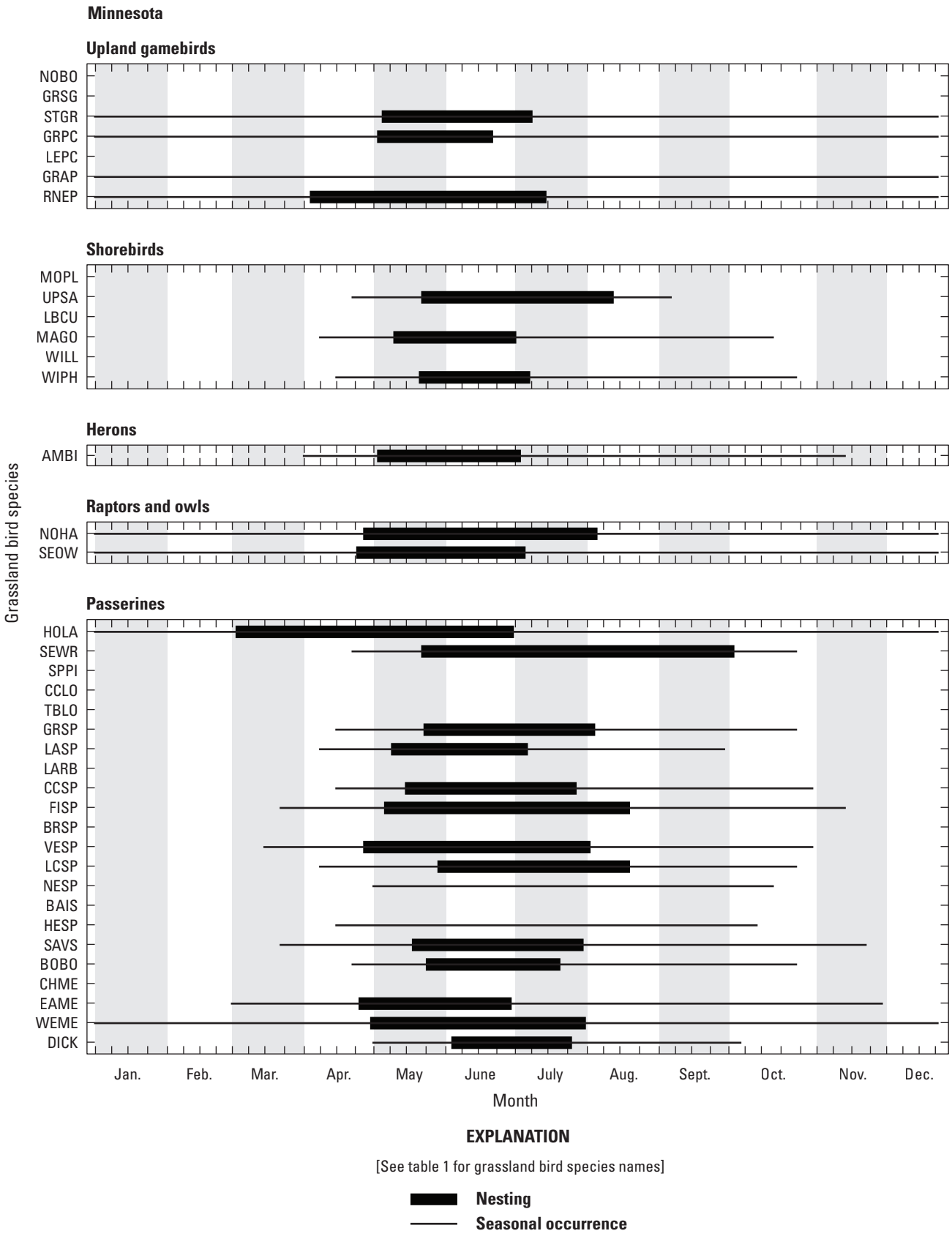

Figure 1.8. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Minnesota, United States (Roberts, 1932a, b; eBird, 2023).

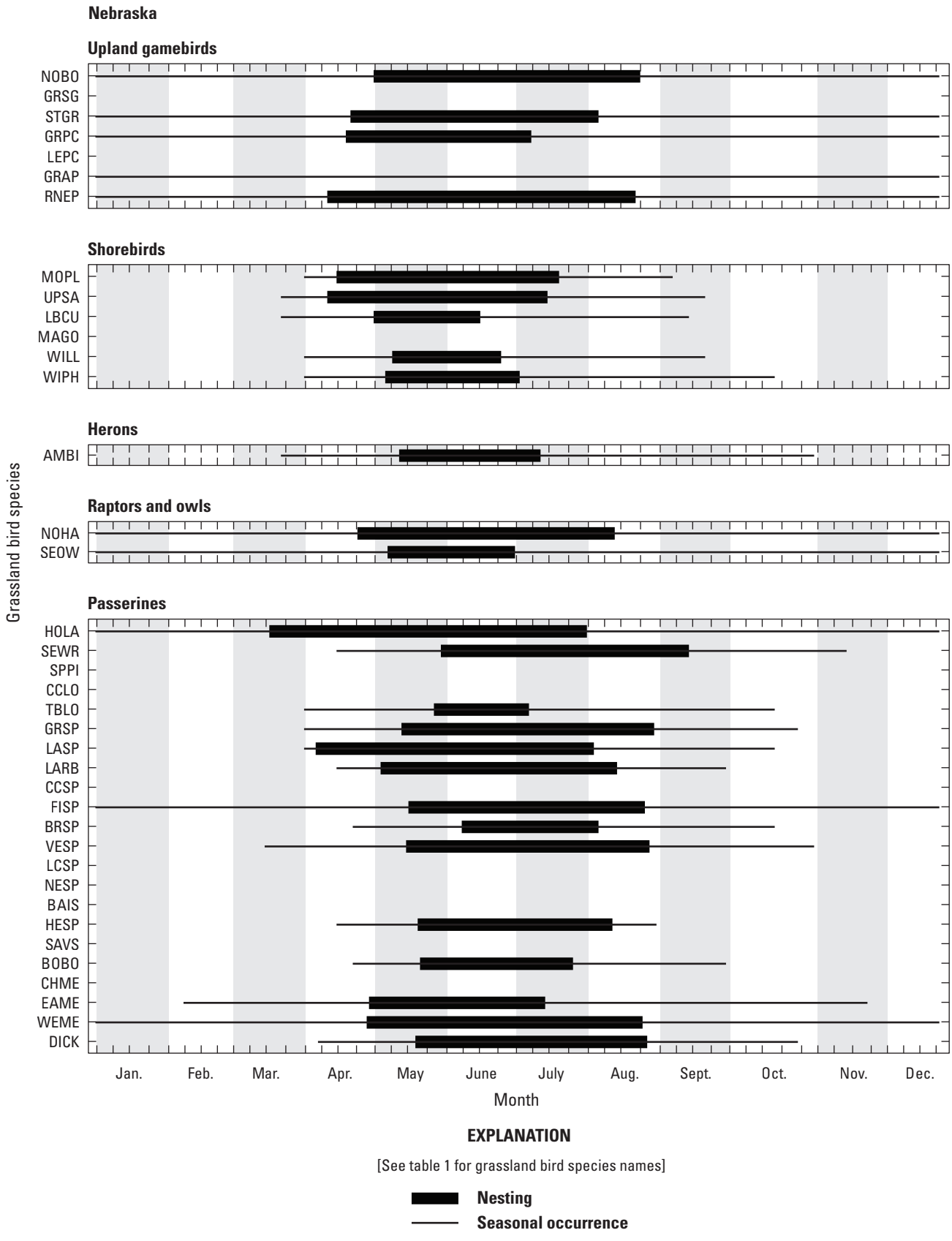

Figure 1.9. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Nebraska, United States (Mollhoff, 2022; eBird, 2023).

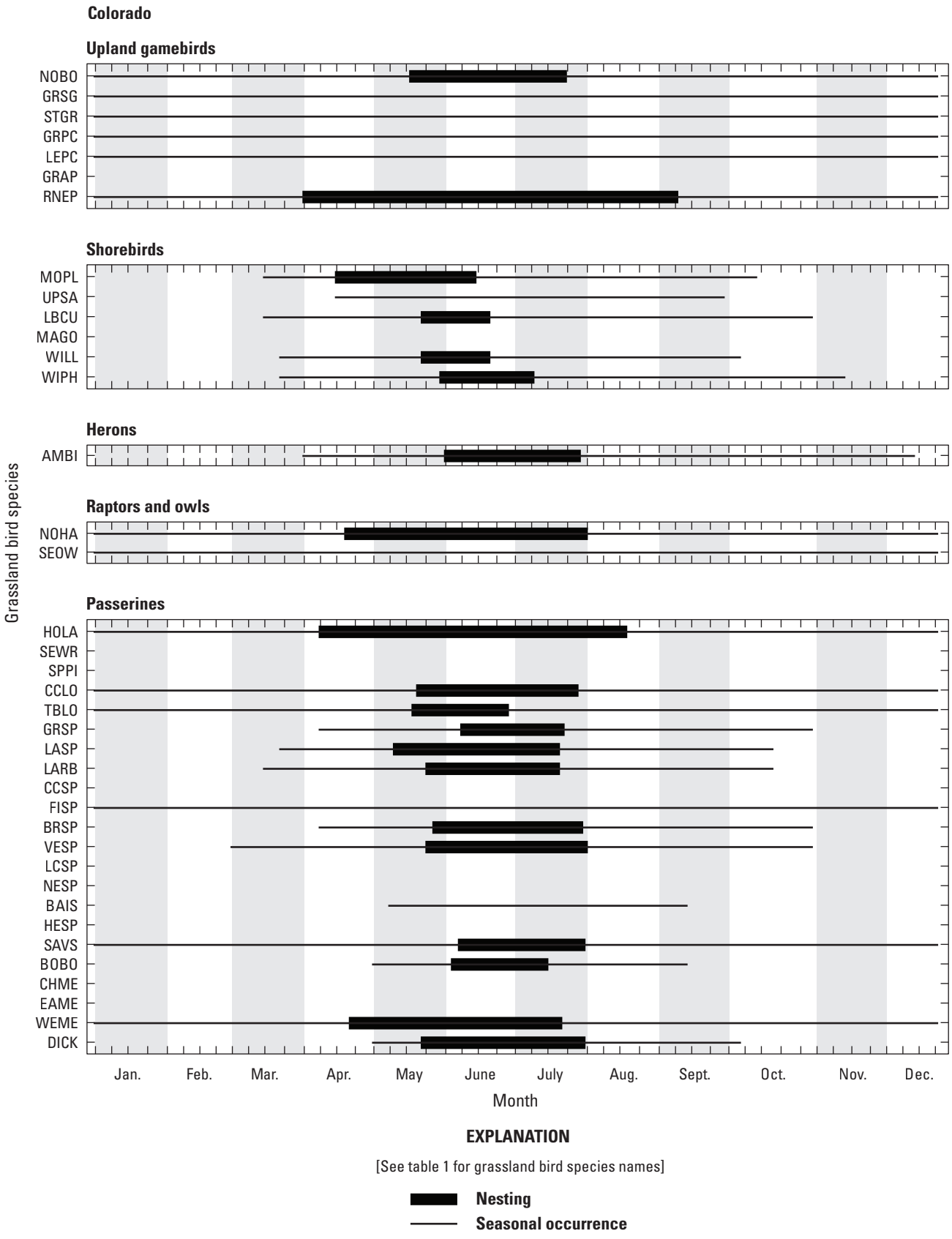

Figure 1.10. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Colorado, United States (Kingery, 1998; eBird, 2023).

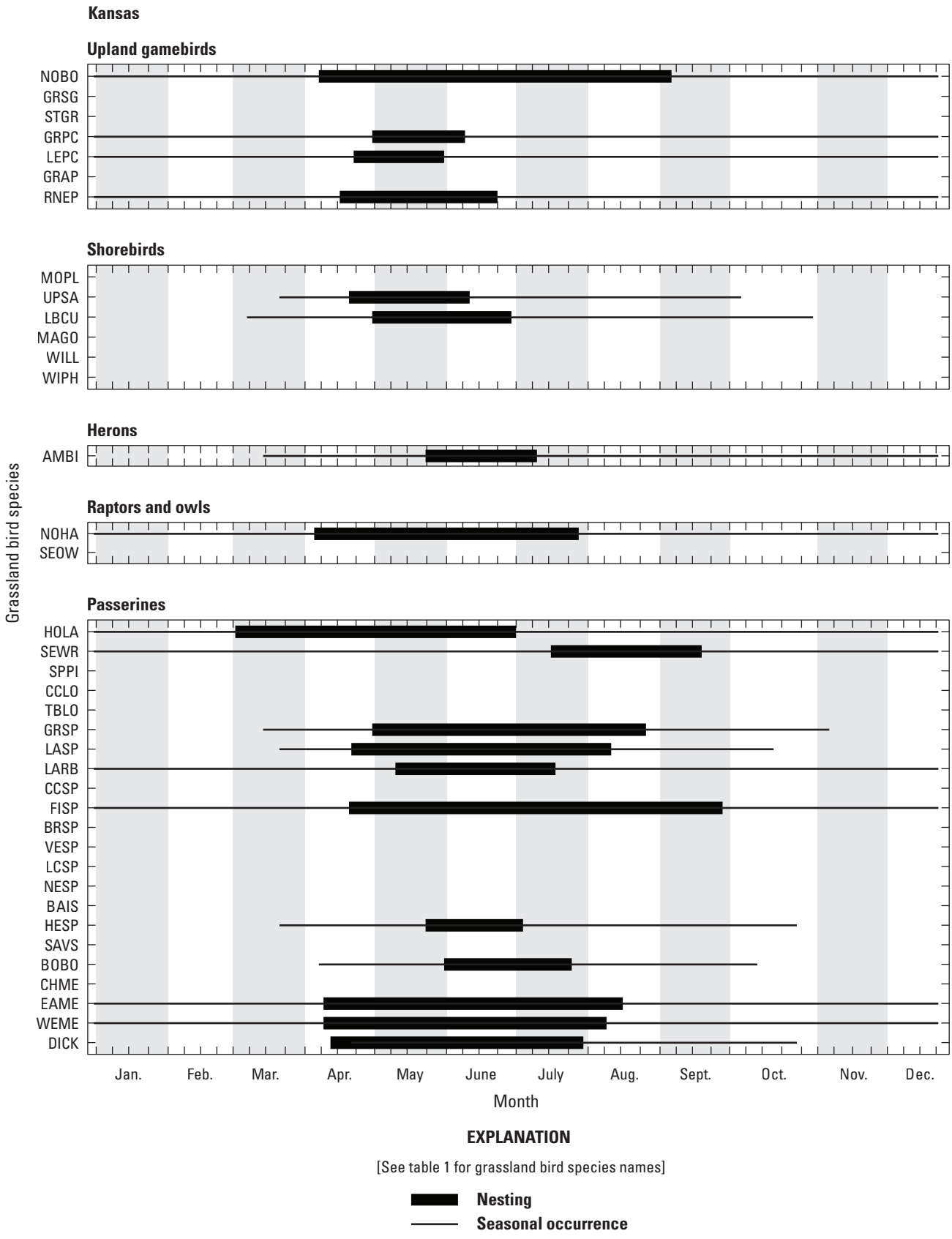

Figure 1.11. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Kansas, United States (Johnston, 1965; Thompson and Ely, 1989; Thompson and Ely, 1992; Thompson and others, 2011; eBird, 2023).

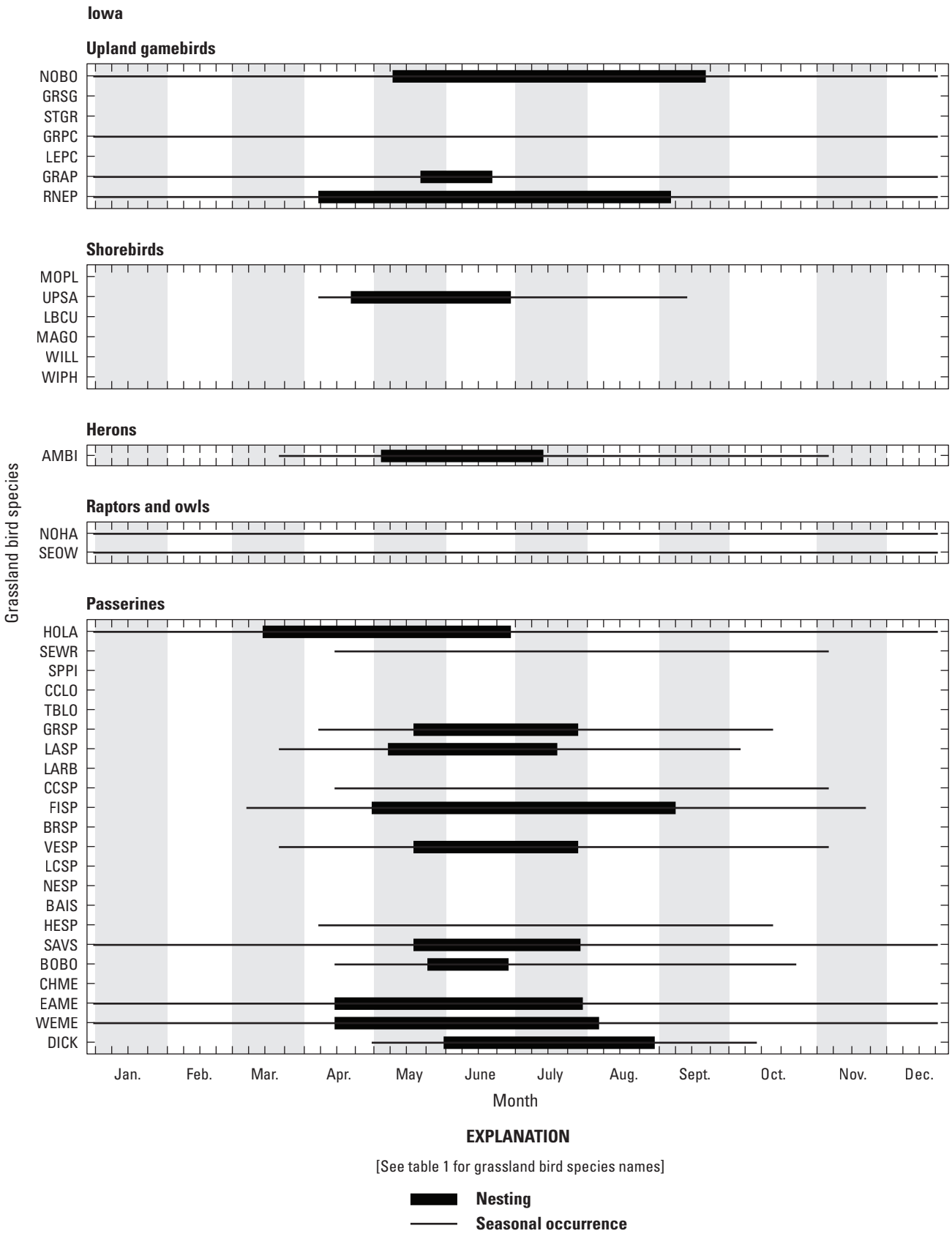

Figure 1.12. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Iowa, United States (Dinsmore and others, 1984; Jackson and others, 1996; eBird, 2023).

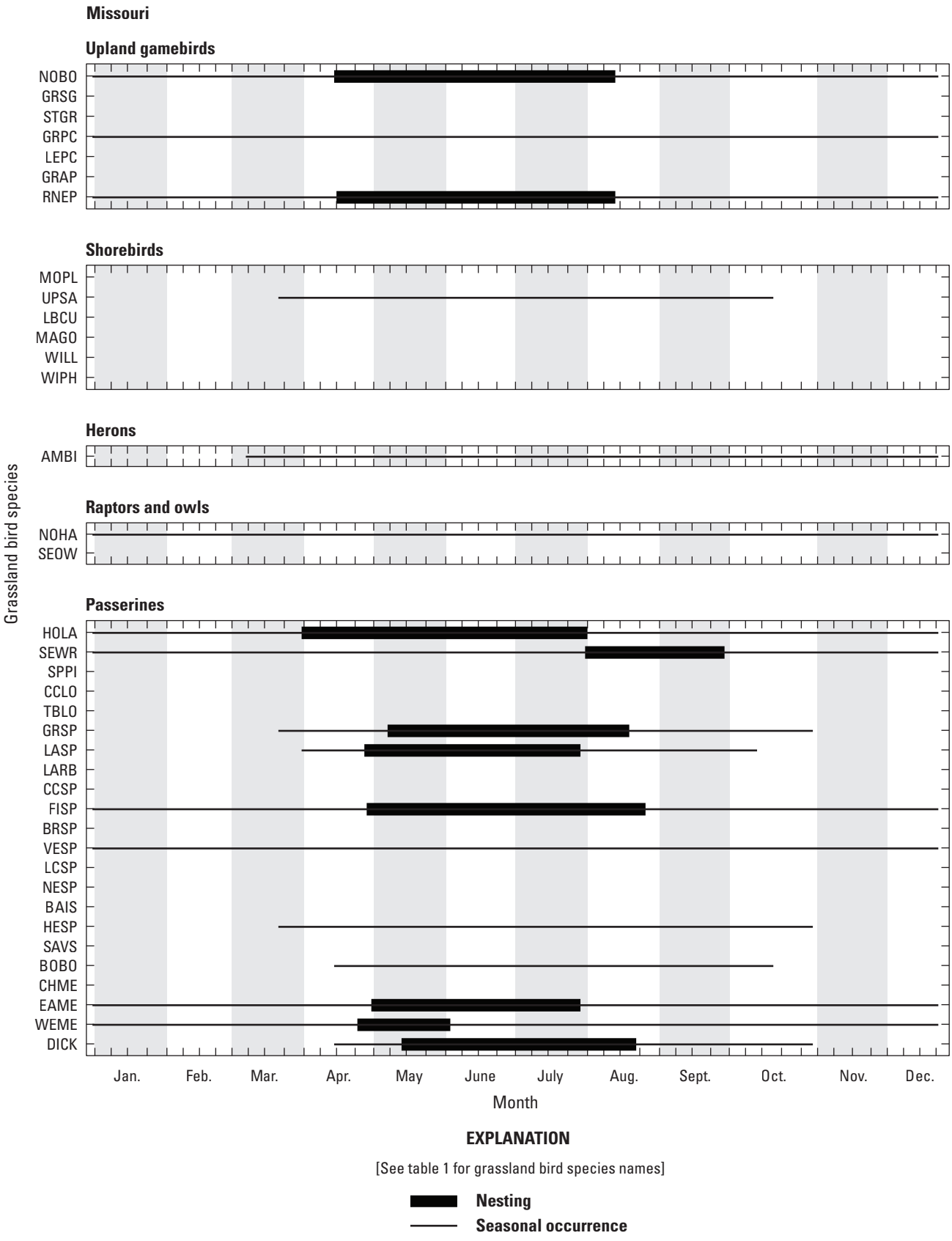

Figure 1.13. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Missouri, United States (Jacobs and Wilson, 1997; eBird, 2023).

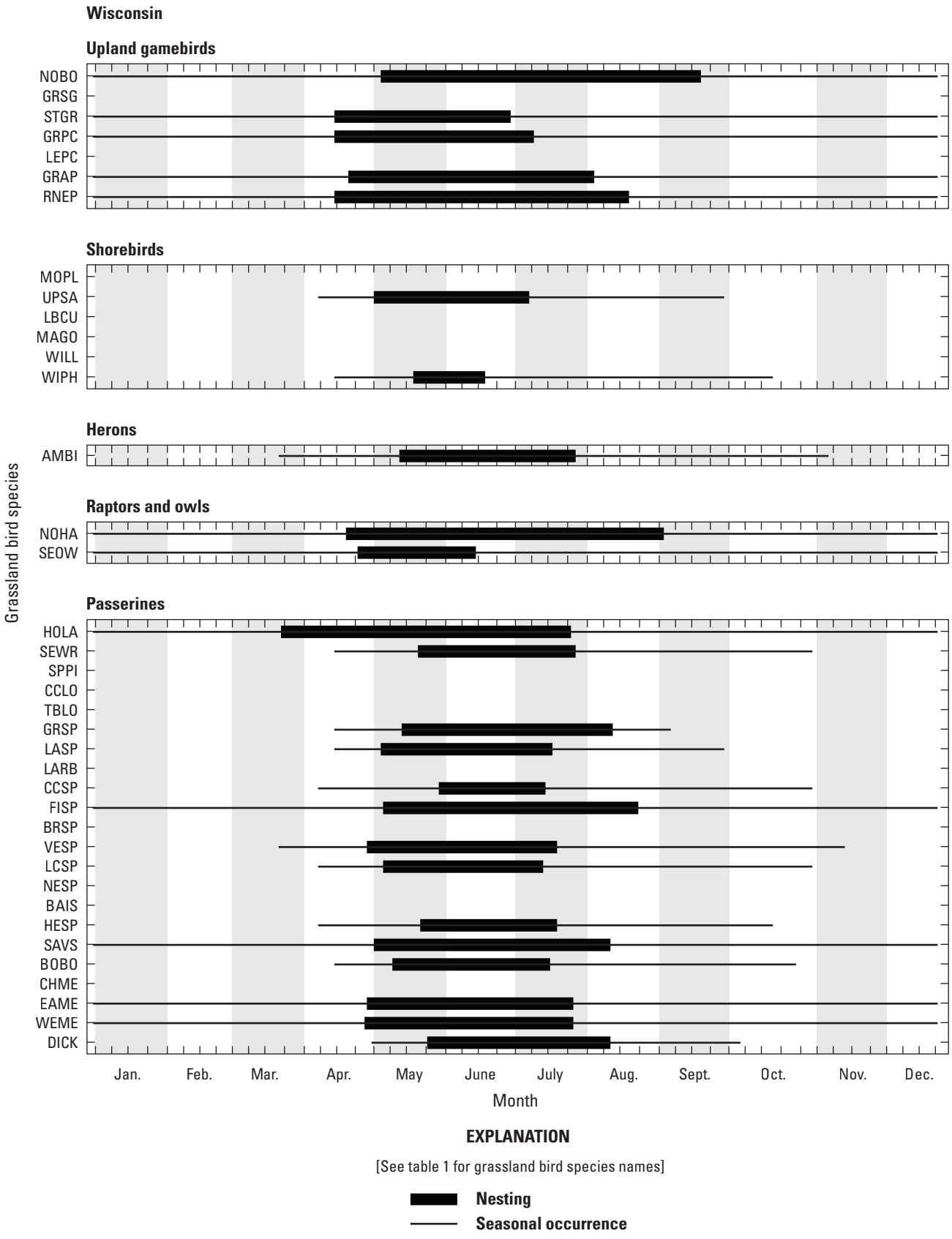

Figure 1.14. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Wisconsin, United States (Robbins, 1991; Cutright and others, 2006; eBird, 2023).

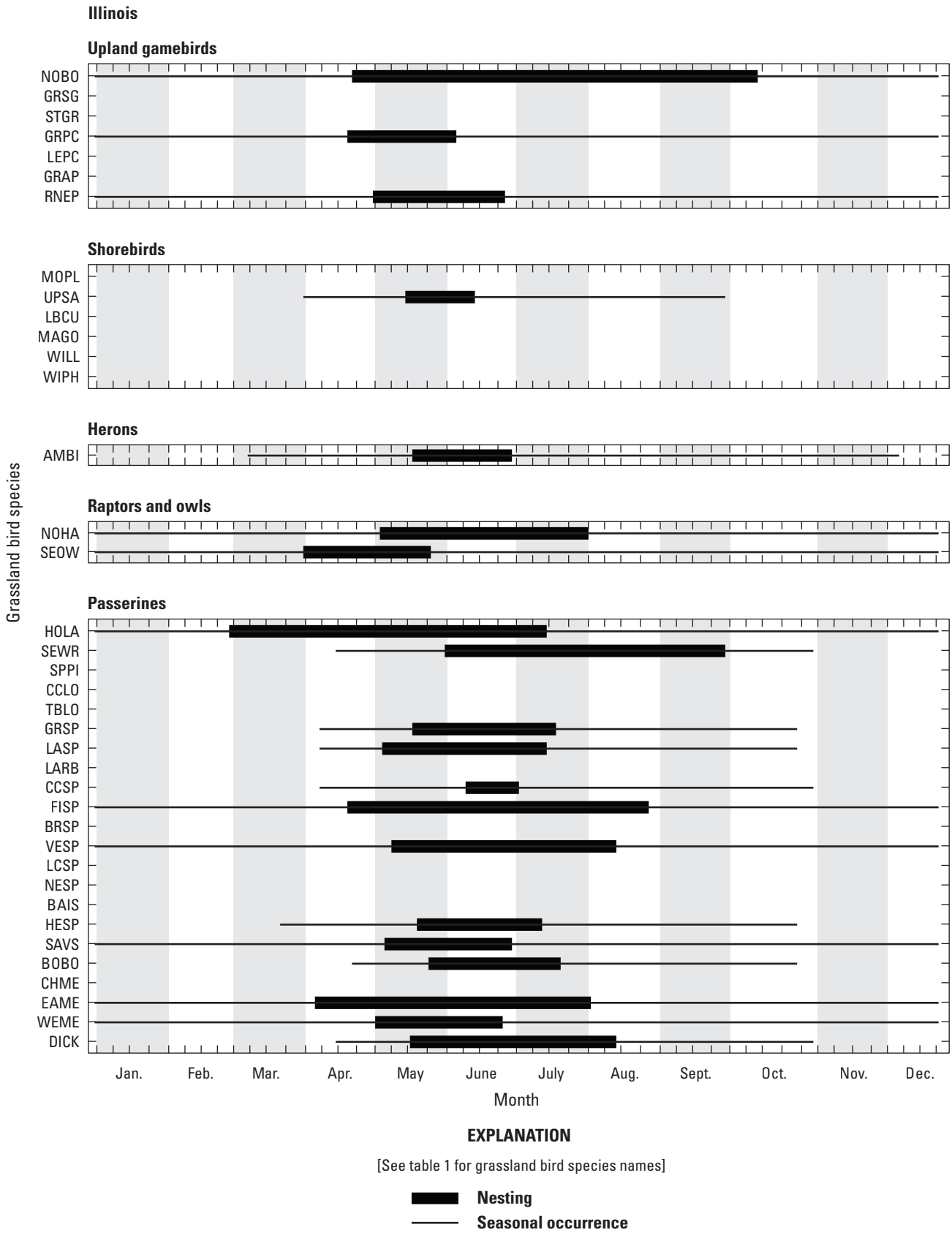

Figure 1.15. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Illinois, United States (Bohlen, 1989; eBird, 2023).

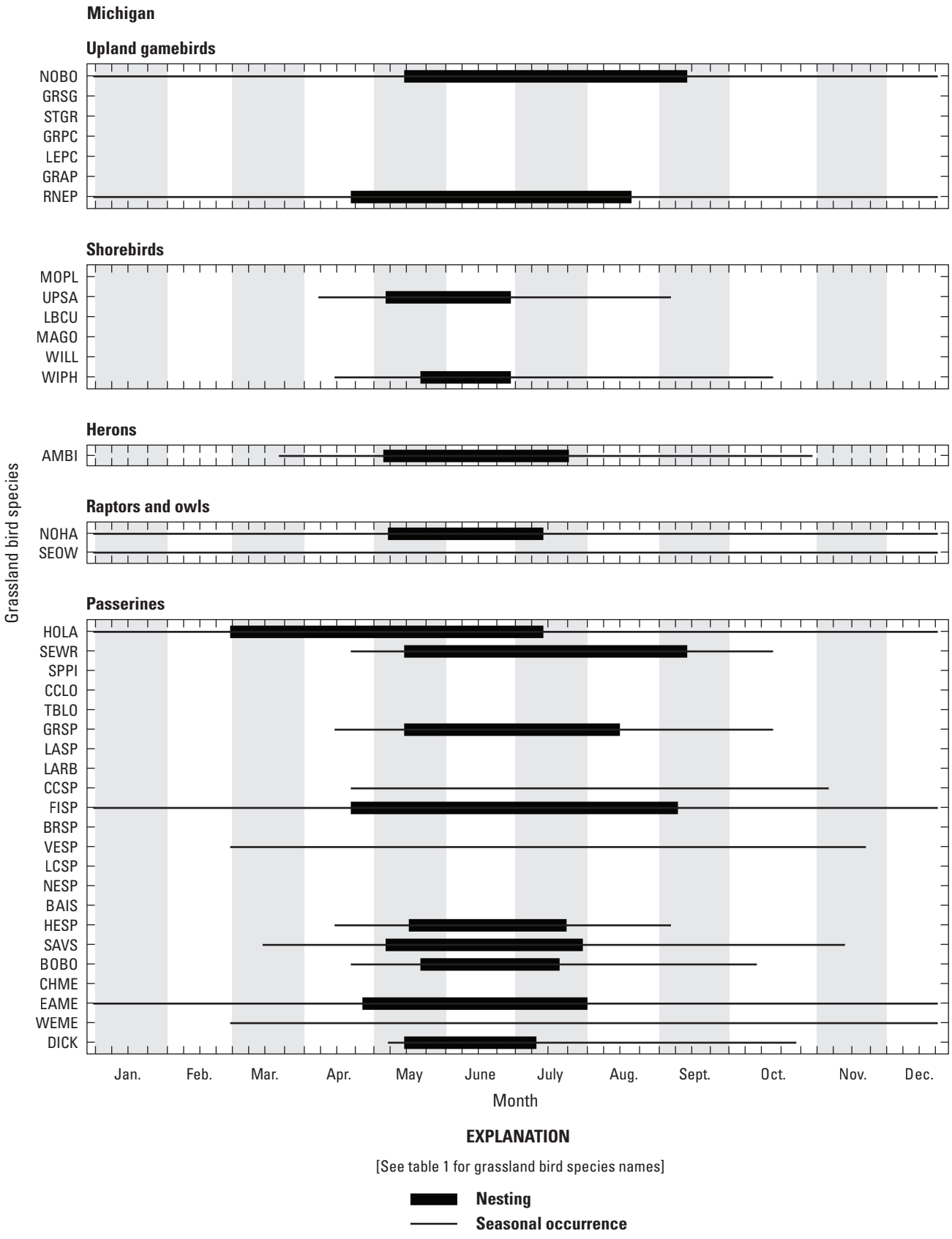

Figure 1.16. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Michigan, United States (Brewer and others, 1991; Granlund and McPeek, 1994; Chartier and others, 2013; eBird, 2023).

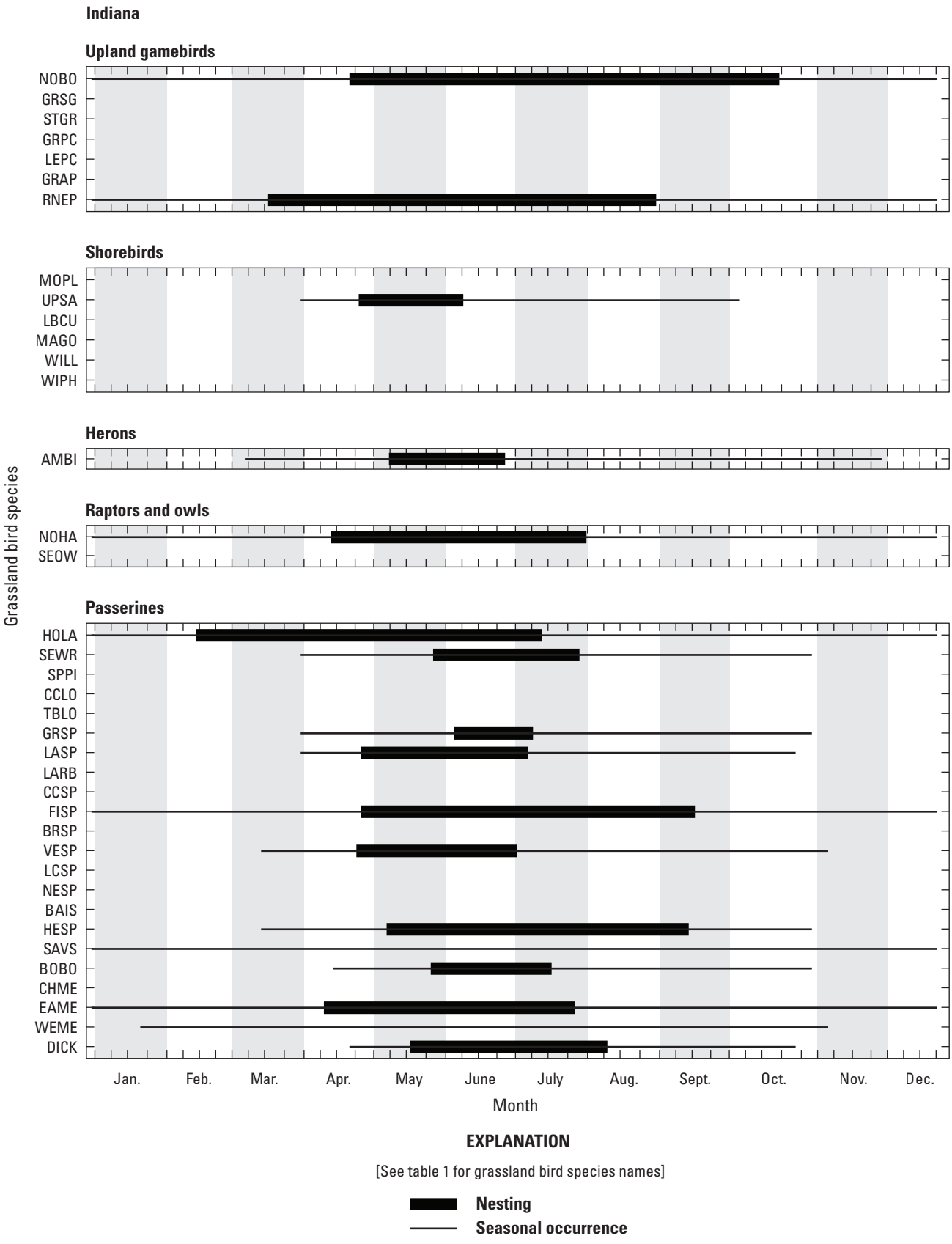

Figure 1.17. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Indiana, United States (Mumford and Keller, 1984; eBird, 2023).

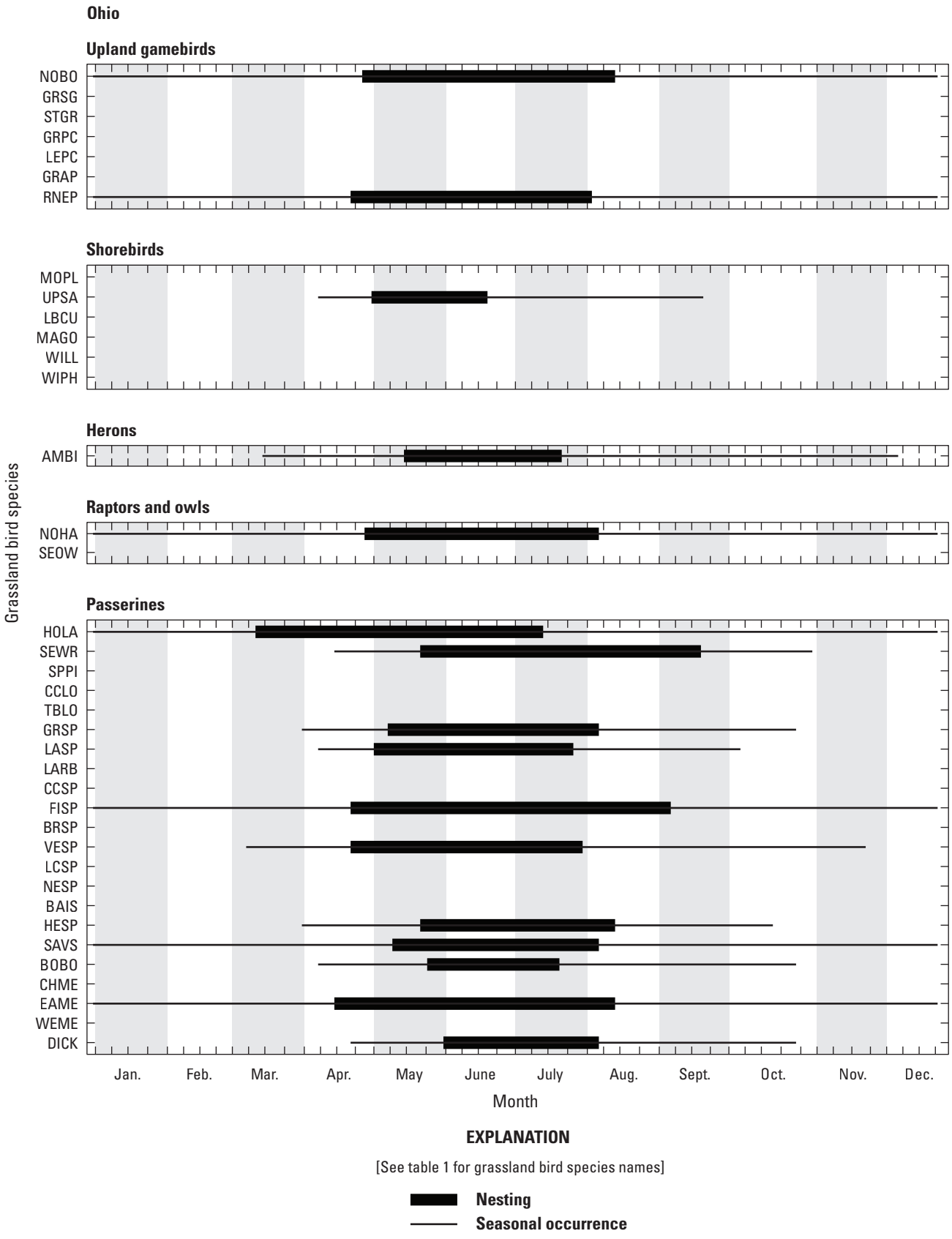

Figure 1.18. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Ohio, United States (Peterjohn, 2001; eBird, 2023).

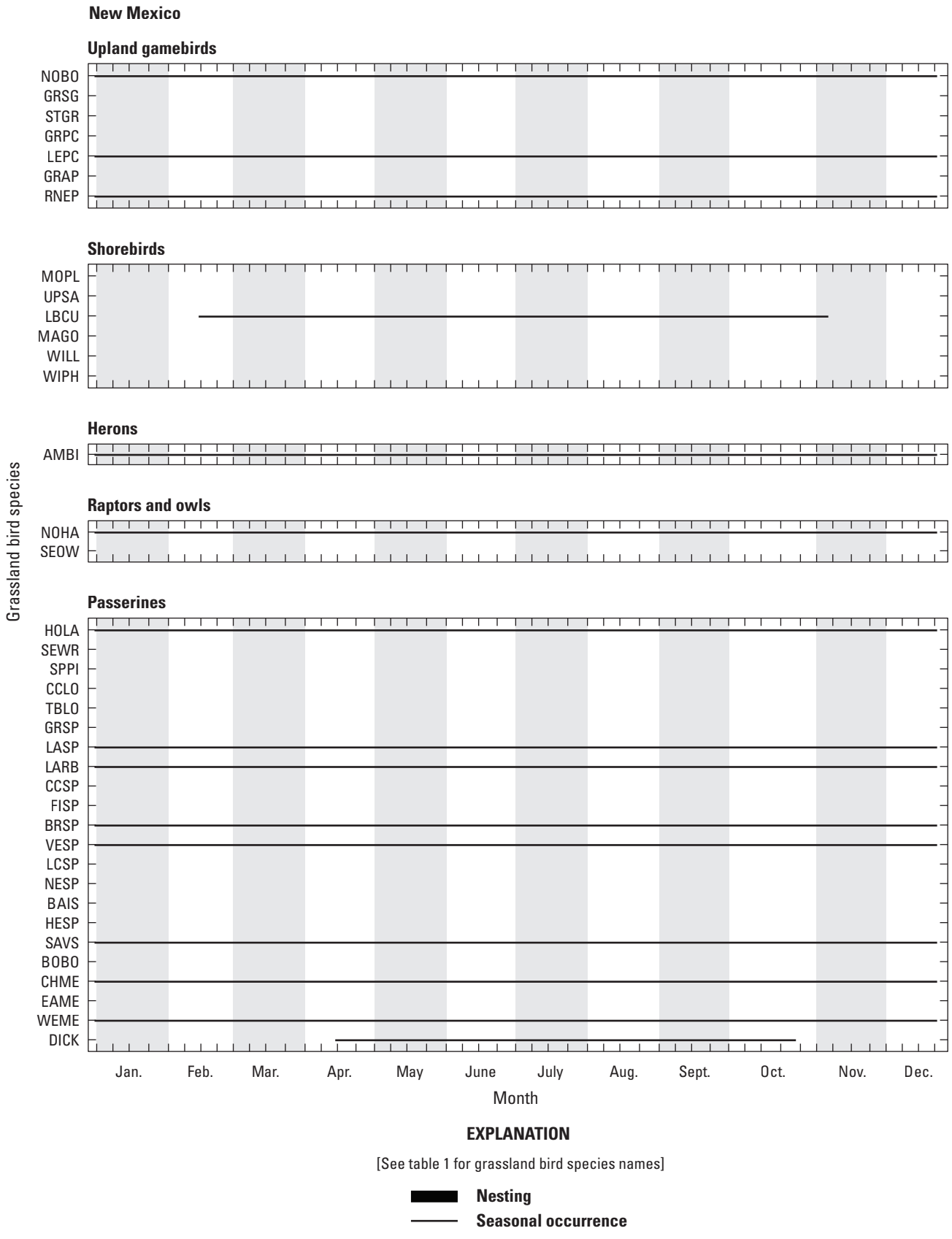

Figure 1.19. Seasonal occurrence information for 38 species of grassland birds in New Mexico, United States (eBird, 2023).

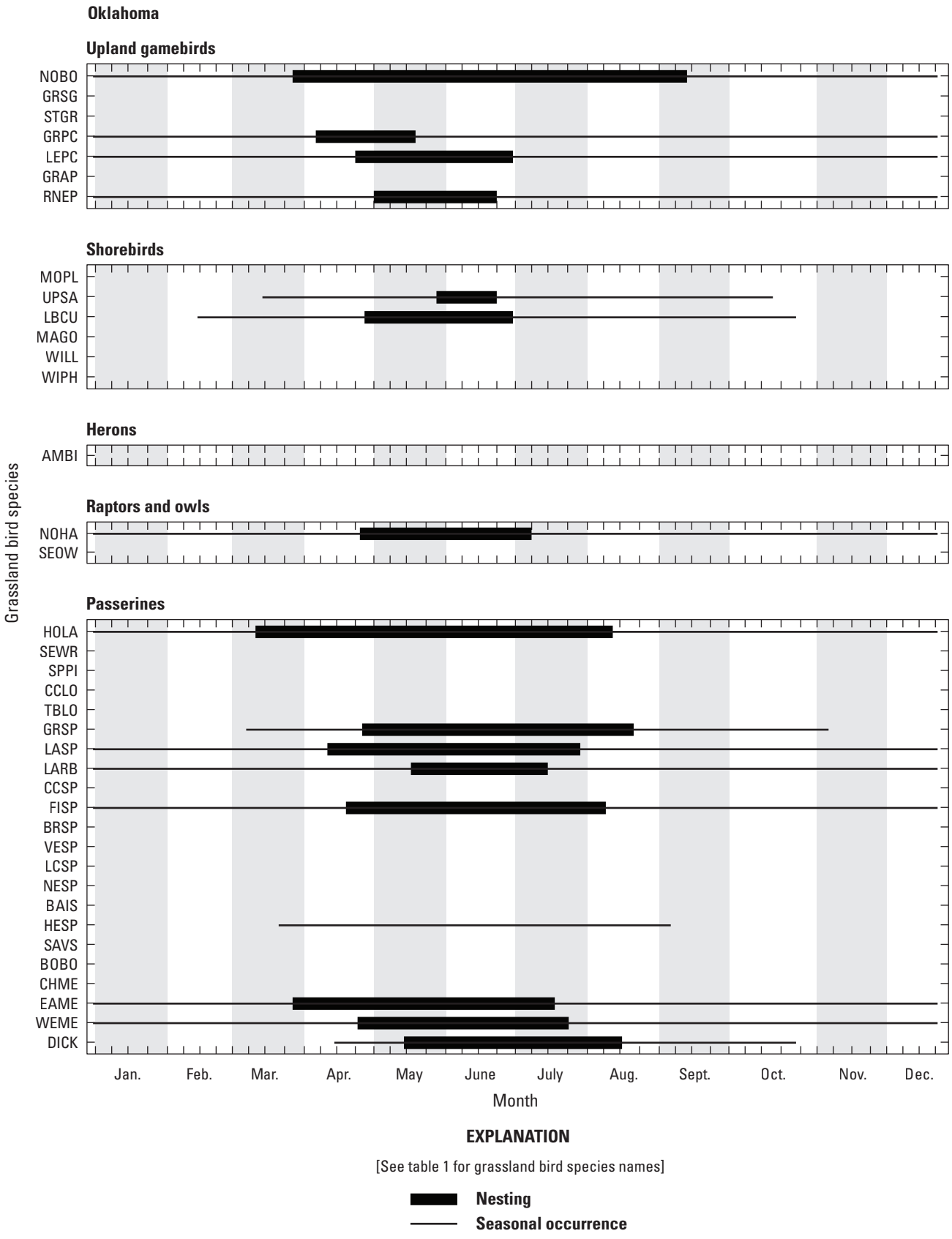

Figure 1.20. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Oklahoma, United States (Baumgartner and Baumgartner, 1992; eBird, 2023).

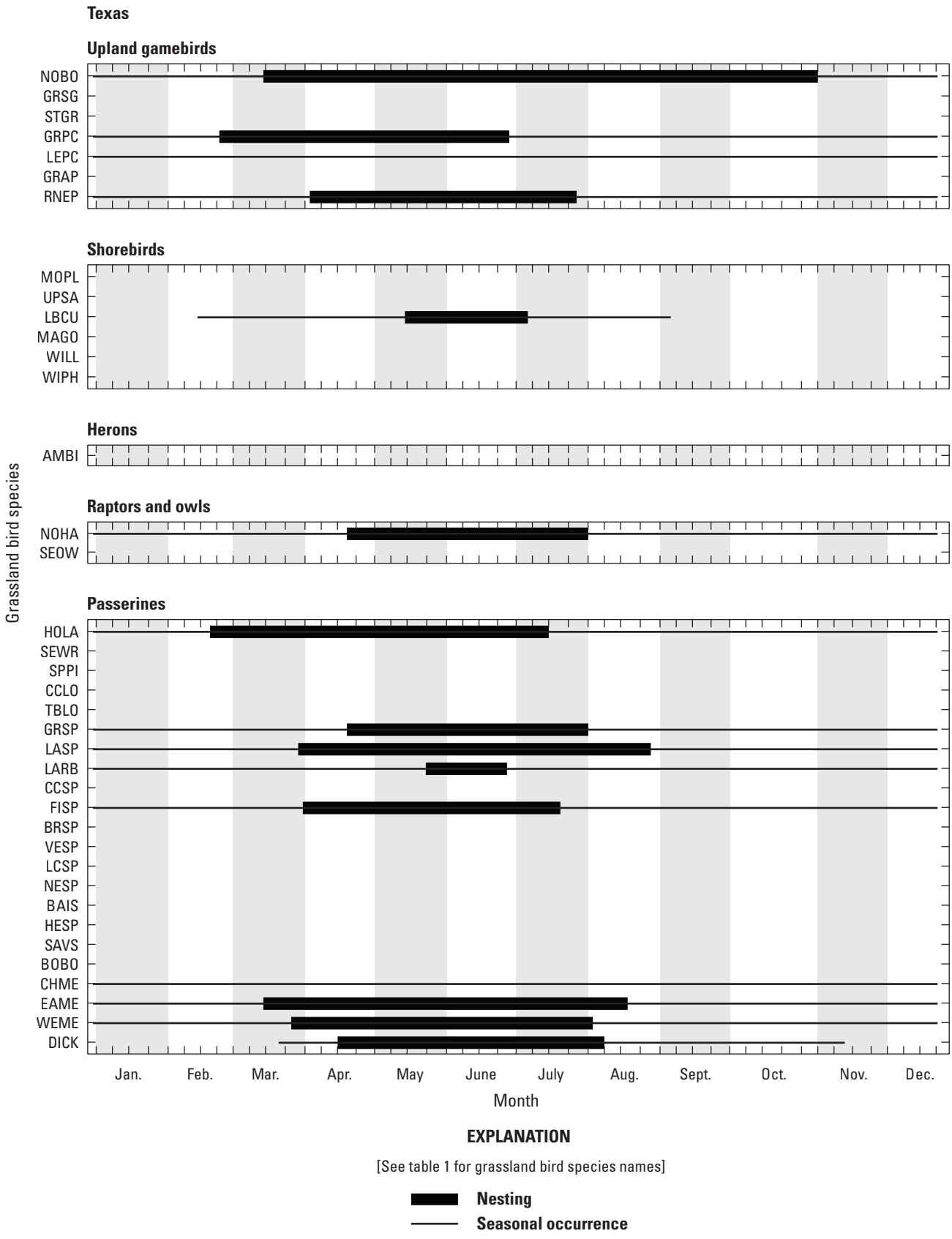

Figure 1.21. Seasonal occurrence and nesting phenology information for 38 species of grassland birds in Texas, United States (Oberholser, 1932; Benson and Arnold, 2001; eBird, 2023).

Appendix 2. List of Published Resources Searched for Nesting Phenology Information

A list of published resources searched for nesting phenology information for 38 species of grassland birds in 18 States and 3 Provinces in the midcontinent of North America is provided in table 2.1.

Table 2.1. List of published resources searched for nesting phenology information for 38 species of grassland birds in 18 States and 3 Provinces in the midcontinent of North America.

Resource
Alberta
Federation of Alberta Naturalists, 2007
Rousseu and Drolet, 2015
Salt and Salt, 1976
Salt and Wilk, 1958
Semenchuk, 1992
Colorado
Andrews and Righter, 1992
Kingery, 1998
Wickersham, 2016
Illinois
Bohlen, 1989
Kleen and others, 2004
Indiana
Castrale and others, 1998
Castrale, 2023
Mumford and Keller, 1984
Iowa
Dinsmore and others, 1984
Jackson and others, 1996
Kent and Dinsmore, 1996
Iowa Ornithologists' Union, 2020
Kansas
Busby and Zimmerman, 2001
Johnston, 1965
Thompson and Ely, 1989
Thompson and Ely, 1992
Thompson and others, 2011
Manitoba
Rousseu and Drolet, 2015
Manitoba Avian Research Committee, 2003
Michigan
Brewer and others, 1991
Chartier and others, 2013
Granlund and McPeek, 1994
Minnesota
Janssen, 1987
Janssen, 2019
Pfannmuller and others, 2017
Roberts, 1932a, b
Missouri
Jacobs and Wilson, 1997
Robbins and Easterla, 1992

Table 2.1. List of published resources searched for nesting phenology information for 38 species of grassland birds in 18 States and 3 Provinces in the midcontinent of North America. —Continued

Resource
Montana
Marks and others, 2016
Nebraska
Johnsgard, 2018
Mollhoff, 2001
Mollhoff, 2016
Mollhoff, 2022
Sharpe and others, 2001
New Mexico
Bailey, 1928
U.S. Geological Survey, 2014
North Dakota
Stewart, 1975
Ohio
Peterjohn, 2001
Oklahoma
Baumgartner and Baumgartner, 1992
Saskatchewan
Rousseu and Drolet, 2015
Smith, 1996
Smith and others, 2019
South Dakota
Drilling and others, 2016
Peterson, 1995
South Dakota Ornithologists' Union, 1991
Tallman and others, 2002
Whitney, 1978
Texas
Benson and Arnold, 2001
Oberholser, 1932
Wisconsin
Cutright and others, 2006,
Robbins, 1991
Wyoming
Faulkner, 2010
Knight, 1902

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