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Vagrancy Occurrences in Sora (*Porzana Carolina)*

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Abstract.—Observations of individuals in unexpected places, often outside their known geographic range or in an unexpected part of their range seasonally, help better understand how individuals move across and use the landscape. Rallids (Family Rallidae) are a globally distributed family of birds which are well known for having vagrant individuals and to undertake mixed migration strategies. In this study, museum specimens and other records of Sora (*Porzana carolina*) outside of the western hemisphere are examined, along with individuals recovered outside of the breeding geographic range during Sora's typical breeding season (June–July). There were 5 museum specimens found outside the typical breeding range during the typical breeding season, 30 records from outside the typical breeding range during the typical breeding season, and 3 records outside of the Americas. Vagrancy and changes are possible pathways through which bird species may adapt to a changing climates and environments. Therefore, documentation and study of these vagrant movements is important to our overall understanding of rallid biology and will contribute to their conservation in the future. *Received 8 November 2019, accepted 30 December 2020.*

Keywords.—migration; museum specimen; natural history collections; *Porzana carolina*; Sora; vagrancy.

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Understanding where species occur in space and time is a fundamental biological question, from how animals move across and use the landscape throughout the year (Alerstam and Hedenstrom 1998; Bairlein and Coppack 2006; Gill *et al.* 2013), to how their geographic ranges shift in response to changing climate or human disturbance (Davis and Shaw 2001; Thuiller 2004). Museum collections are often used to study the geographic ranges and range shifts of species (Suarez and Tsutsui 2004; Tingley and Beissinger 2009; Johnson *et al.* 2011), and they can be rich sources of information about species vagrancy (Remsen and Parker 1990; Sealy and Carter 2012). Vagrancy (individuals found at a location well outside their known or typical geographic range) has been attributed to a wide variety of underlying factors, from individuals making mistakes in flight, and getting caught up in strong weather, to juveniles dispersing more widely than their adult counterparts. The role that individual vagrants play in long-term geographic range expansion is not well understood, but frequent vagrancy is put forward as a mechanism for their establishment on remote islands globally (Ripley 1977; Taylor 2019).

Members of the Family Rallidae are a globally distributed taxon of birds often associated with wetland habitats and are frequently secretive in nature (Conway 2011; Melvin and Gibbs 2020). Rallids' secretive nature has led to large gaps in our knowledge of this family, even among widely encountered species like Sora (*Porzana carolina*). Many Rallid species frequently exhibit vagrant behavior based on known geographic range. Our classification of records of rallids as vagrants could be an artifact of the challenges of detecting them and has likely led to underestimates of known distributions. Vagrancy may also be an outcome of many rallids' reliance on ephemeral wetland habitats, leading to low site fidelity and high dispersal of individuals as wetlands dry (Remsen and Parker 1990). For example, the frequent vagrant behavior of juvenile Purple Gallinules (*Porphyrio martinicus*; Farnsworth A. and Iliff 2015) could indicate that vagrancy may be related to life stage, with juveniles becoming vagrants when they disperse from natal grounds. Vagrancy behavior may have aided in the formation of the global distribution of rallids, which includes many remote islands and six continents (Ripley 1977; Taylor 1998).

Sora are one of the most widely distributed and common rallids across the USA and Canada (Melvin and Gibbs 2020). Recent reports of extralimital individual Sora in Peru and Brazil could point to either an expansion of geographic range, or first documen-

tation in the scientific literature of vagrant individuals (Camacho and Accorsi 2016; Vallejos *et al.* 2017). While visiting museum collections, I noticed Sora specimens from places outside of the typical breeding range during the Northern Hemisphere summer, the typical Sora breeding season. Sora are thought to be strictly migratory, unlike other members of Rallidae, such as King Rail (*Rallus elegans*) and Eastern Black Rail (*Laterallus jamaicensis*), which have individuals who are fully resident in one place and other individuals who migrate annually (Eddleman *et al.* 2020; Pickens *et al.*2020). I wondered how many other Sora specimens from outside the breeding range during the typical breeding season existed. In this paper my objective is to document the prevalence and geographic scope of vagrant records of Sora.

METHODS

I completed a systematic search of VertNet (2019-07-10), Global Biodiversity Information Facility (GBIF; 2019), eBird (Sullivan *et al.* 2009), Handbook of the Birds of the World Alive (Taylor 2019) and the Internet Birding Archive (del Hoyo *et al.* 2014) for records of Sora outside of the Americas any time of year, and records outside of the USA and Canada (typical breeding range) during the typical breeding season (June and July). I selected June and July to define the breeding season because Sora can still be migrating in May (Pineda-Lopez and Arellano-Sanaphre 2010; Fournier *et al.* 2015), and their earliest seasonal records on the Yucatan Peninsula of Mexico are in autumn migration in early August (Dickerman 1971). I reviewed the GBIF and eBird records to remove any duplicates, since some eBird records are included in GBIF. Records were considered duplicates if they were from the same geographic region on the same calendar day. Given the preliminary nature of this exploration, I have chosen to describe them, and not perform any analysis for the records from any data sources.

RESULTS

I found 5 museum specimens from outside the USA and Canada, the Sora typical breeding range (Melvin and Gibbs 2020) during June and July (Sora typical breeding season; Table 1). I found 3 GBIF records from outside the Americas (1 in Norway and 2 in Sweden; Table 1). I found 30 GBIF records outside the USA and Canada in the Americas during June and July (Table 1). These vagrant records extend from 1880 to the present day.

DISCUSSION

Records of Sora outside of their breeding range during the breeding season may be the result of several factors, including the erratic dispersal of young birds (Farnsworth A. and Iliff 2015), potential for non-migratory Sora who are fully resident outside the currently defined breeding grounds, storm or weather impacted individuals, and birds which were too injured to migrate. With these data, I cannot differentiate between individuals who were too sick or injured to migrate and those who choose not to migrate or are otherwise resident or non-migratory. Other Railid species have sub-populations where one grouping is resident and the other migrates (Eddleman *et al.* 2020; Pickens *et al.* 2020). Given Sora's secretive nature, it is not outside the realm of possibility that there could be populations of Sora that are fully resident. The recent documentation of Sora across a wider range in South America during the non-breeding season (Camacho and Accorsi 2016; Vallejos *et al.* 2017) may represent a geographic range expansion or alteration of migratory behavior, or perhaps simply they reflect an increase in reporting in the peer-reviewed literature of a species already well known to local peoples. Further study is needed to fully understand the geographic range and migratory behavior of Sora across South and Central America.

Globally, rallids are among the least studied families of birds, and they are susceptible to a wide suite of natural and anthropogenic pressures, from weather and climate variability that can adversely impact their ephemeral wetland habitats to frequent collisions with towers and other tall structures (Avery *et al.* 1976; Taylor and Anderson 1973). As climate change makes their emergent wetland habitats more ephemeral (Burkett and Kusler 2000), and potentially results in geographic shifts in their ranges, rallids' vagrant tendencies

Table 1. Specific records either from museum collections, Global Biodiversity Information Facility (GBIF; 2019) or eBird (Sullivan *et al.* 2009), broken out into three categories, museum specimens, eBird and GBIF from outside the Americas, and eBird and GBIF from within the Americas, but outside the USA and Canada during June and July.

Category	Location	Month	Day	Year	Source	Accession Number
Museum Specimens	Bermuda	7		1979	National Museum of Natural History, Smithsonian Institution	3f4fc2ab9-ccd1- 43d8-9fa2-bb72f8908c5b
	Cayman Islands	7	30	1965	University of Florida	F0820F8D-B742-4C70-8E5B-838A9CE13CCC
	Cuba	6	20	1933	Field Museum	157464
	Mexico	7	3	1964	Moore Laboratory of Zoology	MLZ:Bird:65421?seid=1619375
	Belize	6		1880	Natural History Museum at Tring	89.11.20.86
Outside the Americas	Norway	6	16	2017	GBIF	URN:catalog:CLO:EBIRD:OBS514700366
	Sweden	6	14	1966	eBird	4a574677-dfb5-40a2-9dd7-e935866a6c93
	Sweden	6	3	1987	GBIF	urn:lsid:artportalen.se:Sighting:61913806
Within the Americas, but outside US and Canada during June and July	Aruba	7	19	2017	GBIF	URN:catalog:CLO:EBIRD:OBS519843548
	Aruba	7	25	2016	GBIF	URN:catalog:CLO:EBIRD_CB:OBS420197850
	Bahamas	7	22	2018	GBIF	URN:catalog:CLO:EBIRD:OBS642119379
	Bahamas	6	11	2016	GBIF	URN:catalog:CLO:EBIRD_CB:OBS411530231
	Belize	7	28	2015	GBIF	URN:catalog:CLO:EBIRD:OBS339506374
	Bermuda	6	1	2017	GBIF	URN:catalog:CLO:EBIRD:OBS507002467
	Caribbean Netherlands	6	24	1984	eBird	
	Caribbean Netherlands	7	14	2000	eBird	
	Colombia	7	12	2006	GBIF	CALIDRIS:CNAA:020216-110731:YCS3389
	Colombia	7	13	2008	GBIF	CALIDRIS:CNAA:020216-110731:YCS6137
	Colombia	7		1990	GBIF	IAvH:IAvH-A-7287
	Colombia	7	12	2006	GBIF	URN:catalog:CLO:EBIRD:OBS425809322
	Colombia	6	25	2006	GBIF	AVCO:RNOA:AVES:000006
	Colombia	7	29	1995	GBIF	AVCO:RNOA:AVES:167097
	Guatemala	7	18	2009	eBird	
	Mexico	6	10	2018	GBIF	URN:catalog:CLO:EBIRD:OBS631582281
	Mexico	7	3	1964	GBIF	MLZ:Bird:65421?seid=1619375
	Mexico	7	21	2011	GBIF	URN:catalog:CLO:EBIRD:OBS123346247

Table 1. (Continued) Specific records either from museum collections, Global Biodiversity Information Facility (GBIF; 2019) or eBird (Sullivan *et al.* 2009), broken out into three categories, museum specimens, eBird and GBIF from outside the Americas, and eBird and GBIF from within the Americas, but outside the USA and Canada during June and July.

Category	Location	Month	Day	Year	Source	Accession Number
	Mexico	6	18	2011	GBIF	URN:catalog:CLO:EBIRD_MEX:OBS121470410
	Mexico	6	10	2018	GBIF	URN:catalog:CLO:EBIRD:OBS629991765
	Mexico	6	2	1958	GBIF	urn:catalog:NO DISPONIBLE:NO DISPONIBLE:NO DISPONIBLE:252903
	Mexico	6	10	2018	GBIF	URN:catalog:CLO:EBIRD:OBS629789657
	Mexico	7	14	2007	GBIF	URN:catalog:CLO:EBIRD:OBS677501493
	Mexico	7	24	2018	GBIF	URN:catalog:CLO:EBIRD:OBS642857534
	Mexico	7	20	2018	GBIF	URN:catalog:CLO:EBIRD:OBS641381896
	Mexico	6	10	2018	GBIF	URN:catalog:CLO:EBIRD:OBS629919374
	Nicaragua	6	27	2014	eBird	
	Puerto Rico	6	15	2010	GBIF	URN:catalog:CLO:EBIRD:OBS94562125
	Puerto Rico	6	1	2013	GBIF	URN:catalog:CLO:EBIRD_PR:OBS199767078
	Virgin Islands	7	10	2007	GBIF	URN:catalog:CLO:EBIRD:OBS424657726

may provide an advantage as they disperse to new places. However, this aspect of their biology requires further study because it is not well understood how species that are partially-migratory and partially-resident respond to warming and more erratic climates. Vagrancy may have played a role in helping rallids become distributed across six continents and remote islands, and perhaps that vagrant behavior and dispersal to far flung habitats can help them adapt and thrive in a more extreme world.

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