

WILDLIFE BIOLOGY

Review

A global review of the conservation status of true quails (Families Odontophoridae and Phasianidae)

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Wildlife Biology

2025: e01449

doi: [10.1002/wlb3.01449](https://doi.org/10.1002/wlb3.01449)

Subject Editor:

Sonja Christine Ludwig

Editor-in-Chief: Ilse Storch

Accepted 30 April 2025



Understanding the conservation status of species is imperative to stem global declines. To better inform conservation, we summarized the global conservation status of New World (Family Odontophoridae) and Old World (Family Phasianidae) true quail species. We used data from the 2021 International Union for Conservation of Nature (IUCN) Red List of Threatened Species and list of threatened categories. We summarized information from the Red List relative to general habitat use, native geographic region, extent/quality of habitat, primary and secondary threats to the population, and reported population trends. We also conducted a literature review for species/genus/families of true quails across a 20-year (2000–2020) timescale to summarize available information. Native ranges for the 47 species of true quail include 21 in South America, 14 in North America, nine in Asia, three in Australia, and two in Africa. The common quail *Coturnix coturnix* is the most widespread quail species, with a migratory range spanning Europe, Asia, and Africa. According to the 2021 IUCN assessment, 34 species (72.3%) are classified as Least Concern, while others are at greater risk, including the Endangered Manipur bush-quail *Perdica manipurens* and the Extinct New Zealand quail *Coturnix novaezelandiae*. Five species each (21.3% total) were recognized as Vulnerable or Near Threatened, and one (2.1%; Himalayan quail *Ophrysia superciliosa*) was Critically Endangered. Habitat quality and quantity are declining for 11 (23.4%) true quail, with IUCN noting habitat quality and quantity as ‘unknown’ for the remaining 36 (76.6%) species. Threats to most populations are unknown, but intensive agricultural and biological resource use affected half of true quail species. The three most extensively studied genera – *Coturnix*, *Odontophorus*, and *Colinus* – accounted for 99.5% of all publications between 2000 and 2020. This disparity highlights the need for increased conservation-focused research on true quails, particularly those that are less studied outside of game management contexts.

Keywords: conservation status, data deficiency, Odontophoridae, Phasianidae, quails, threats



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Introduction

Status assessments provide species status information and are thus a valuable tool to inform conservation practices for declining species. Status information reported often includes species distributions, population status and trends, and threats. Conservation status assessments have been published for individual species (Schroeder et al. 2000, Beck et al. 2003) as well as for broad taxonomic groups ranging from bats (Mickleburgh et al. 2002), to reptiles (Böhm et al. 2013), to grouse (Storch 2007), to large carnivores (Jhala et al. 2020, 2021). Population status and ecological threat assessment analysis on lesser-known species are rare, highlighting their priority in conservation assessments (Bland et al. 2017). Furthermore, understanding the context of conservation is equally important; due to the inheritance of the colonial past, most of the countries in the global south and Africa lost a significant amount of wildlife habitat, where conservation of these habitats and associated species came to the spotlight in recent years (Brockington and Igoe 2006). This focus is centered on charismatic fauna and megafauna, with limited attention extending to non-charismatic species (Ducarme et al. 2013). We reviewed the conservation status of true quail, which are lesser-known upland game birds (Butchart et al. 2004) found in both the New (Family Odontophoridae) and Old (Family Phasianidae) Worlds (Beauchamp 2004).

Morphological traits in New World quails that differ from Old World quails include stout bills with slightly serrated edges, long and slender toes, short tarsus, and lack of tarsal spurs in either sex, and most New World quail species sport a feather crest on their heads (Carroll 1994, Madge et al. 2002). Several quail species are popular game birds including the common quail *Coturnix coturnix* of the Old World and stubble quail *Coturnix pectoralis* in Australia and the six quail species found in the USA (California *Callipepla californica*, Gambels *Callipepla gambelii*, Montezuma *Cyrtonyx montezumae*, mountain *Oreortyx pictus*, northern bobwhite *Colinus virginianus*, and scaled *Callipepla squamata*).

Quails play a vital ecological role, serving as ecosystem indicators of environmental health due to their sensitivity to habitat changes (Brennan 1994, Reese et al. 2005). Habitat occupancy by quail is often closely tied to the condition of forests, grasslands, and shrublands, making them valuable for monitoring ecosystem dynamics. As ground-nesting birds, quails contribute to seed dispersal and help regulate insect populations, supporting the top-down ecological balance of their habitats (Beauchamp 2004). Additionally, quails are essential prey (bottom-up) for various predators, including raptors, mammals, and reptiles, which positions them as integral components of terrestrial food webs (Carroll 1994). The conservation of quail habitats, therefore, not only benefits these birds but also helps maintain broader biodiversity, as their habitat requirements often overlap with those of other threatened species (Bland et al. 2017).

Beyond their ecological significance, true quails hold substantial cultural and economic value. They are popular game birds in many regions, with species such as the northern

bobwhite, California quail, and Gambel's quail being highly sought after for hunting (Downey et al. 2023). Hunting activities associated with quail generate economic benefits for rural communities by supporting local businesses, tourism, and conservation programs funded through hunting licenses and related fees (Calkins et al. 2020, Downey et al. 2023). Additionally, quails have deep-rooted cultural importance, with their calls and presence woven into local traditions, folklore, and regional identities (Ducarme et al. 2013). This dual role as both ecological indicators and cultural symbols underscores the importance of their conservation, particularly in landscapes undergoing rapid environmental changes. Despite their widespread distribution, quails face numerous global threats, primarily driven by anthropogenic activities. Habitat destruction due to agricultural expansion, logging, and linear infrastructure development is the leading cause of population declines, particularly in regions with intensive land-use practices (Canteri et al. 2021). Climate change further exacerbates these challenges by altering habitat availability, disrupting breeding cycles, and reducing food resources, especially in arid and semi-arid regions where many quail species reside (Brennan 1994). The use of pesticides in agricultural landscapes has also diminished insect populations, a critical food source for quails during the breeding season (Carroll 1994). Although hunting is not a primary threat for most quail species, localized overharvesting can still negatively impact populations, particularly where regulatory enforcement is weak (Canteri et al. 2021). The manifestation of these threats varies by region, with land-use conversion for cattle grazing and monocultures particularly prevalent in South American and sub-Saharan quail habitats (Asner et al. 2004). Intensive rice cultivation and pesticide use in Southeast Asia present persistent challenges. Moreover, synergistic interactions between climate-induced droughts and habitat fragmentation may exacerbate population declines in arid landscapes, underscoring the need for localized, adaptive conservation responses. The differential intensity and nature of these threats across regions demand region-specific conservation strategies that are ecologically informed and culturally sensitive.

Given these diverse and interconnected threats, a comprehensive review of quail conservation status is essential. While previous studies have assessed individual species and taxonomic groups, a global synthesis focused specifically on true quails is lacking. Our review fills that gap by using standardized data from the IUCN Red List of Threatened Species, which consistently assesses species status, population trends, and threats across regions (Butchart et al. 2004). The Red List's comprehensive dataset enables robust comparisons and helps identify priority species and regions for conservation action, making it a valuable tool for guiding both research and policy initiatives aimed at sustaining quail populations worldwide. Our main objective was to summarize the global conservation status of New World (Family Odontophoridae) and Old World (Family Phasianidae) true quail species. We used the 2021 IUCN Red List of Threatened Species (www.iucnredlist.org), and IUCN-denoted threatened categories to conduct our review. Our secondary objective was to

perform a literature review to summarize published research for species, genus, and families of true quails across a 20-year (2000–2020) timescale. Additionally, our review provides insights into the population status, differential conservation challenges, ecological threats, and need for transboundary collaboration for true quails (Van der Linde et al. 2001).

Material and methods

We focused our review on the 47 unique species of true quail identified in Madge et al. (2002) and did not consider subspecies of true quail. Although they resemble true quails in appearance, we did not include the buttonquails (Family Turnicidae) because they are not related. We also did not include Nahan's partridge *Ptilopachus nahani* or stone partridge *P. petrosus*, which are sister species from Africa and distantly related sister taxon to true quail in the Odontophoridae Family of the western hemisphere (Cohen et al. 2012). Lastly, we did include the arboreal tree-quail (*Dendrortyx* spp.) of Mexico and Central America in our review, even though they are also commonly known as wood-partridge (Carroll 1994, Carroll et al. 2020; Table 1).

Species distribution

We obtained access from the IUCN to acquire spatial layers (shapefiles) of species distribution. These shapefiles project resident population distribution, introduced population extent, and removed outlier locations where the origin of species was uncertain. Due to relevancy and misleading information about its distribution, we did not request the shapefile for New Zealand quail *Coturnix novaezelandiae*, which are extinct. Finally, we plotted the distribution of all 47 true quail species on four maps, ordered alphabetically. We projected the political boundaries of countries to identify endemism, and the transboundary nature of the distribution observed for many true quail species. We performed all analyses in Q-GIS ver. 3.22.0 open-source software (Rosas-Chavoya et al. 2022).

Global conservation status of quails

We categorized the Odontophoridae and Phasianidae quail species into six IUCN population status categories: CEN=Critically Endangered; EN=Endangered; Ext=Extinct; NT=Near Threatened; VU=Vulnerable; and LC=Least Concern. We compiled information from the IUCN Red List including general habitat use, native geographic region, extent/quality of habitat, and primary and secondary threats to the population. We summarized information from the IUCN Red List website (www.iucnredlist.org) relative to population trend and classified trends as D=Decreasing, I=Increasing, and S=Stable in 2022.

Data deficiency

To assess the extent of data deficiency for true quail, we conducted a literature search for all 47 species across a 20-year (2000–2020) timescale, divided into four unique half decades

(2000–2005, 2006–2010, 2011–2015, and 2016–2020) to tabulate numbers of scientific papers for species/genus/families of quail. We truncated this timescale because earlier non-informal publications (news reports, Shikar documents, and natural history observations) may not appear in a contemporary literature search. Using Web of Science and Scopus we searched quail scientific species name (e.g. '*Callipepla*' and '*californica*') in the fields 'Title', 'Abstract', or 'Keywords'. For every species, we tabulated the number of publications including book chapters, early-access publications, conference proceedings, published journal articles, books, reports, university published theses and dissertations, and laws. We provide this information by genus for each half-decade.

Results

To assess research efforts on true quails, we reviewed literature spanning two decades (2000–2020), analyzing publications at the species, genus, and family levels. This analysis provided critical insights into the distribution of research focus, prevailing conservation threats, and gaps in existing knowledge. The findings highlight disparities in research attention among genera and emphasize the need for increased studies on underrepresented species to inform future conservation efforts.

Species distribution

True quail are well distributed across diverse habitats, including agricultural areas, deserts, forests, grasslands, savannas, and shrublands. Of the 47 species reviewed, 34 (72.3%) are found in the Southern Hemisphere, while 14 (29.8%) occur in the Northern Hemisphere (Table 1, Fig. 1–4). South America hosts the highest species richness, with 21 species, followed by North America (14 species), Asia (9 species), Africa (2 species), and Australia (2 species). The common quail *Coturnix coturnix* is the only migratory species, with a range spanning Europe, Asia and Africa (McGowan et al. 2023). In addition, mountain quail *Oreortyx pictus* migrate altitudinally in some mountain ranges from higher-elevation breeding habitat to lower-elevation winter habitat (Gutiérrez and Delehanty 2020). New World quails (Family Odontophoridae) comprise 63.1% of species, with the *Odontophorus* genus representing the highest species diversity (15 species). Among Old World quails (Family Phasianidae), the *Coturnix* genus is the most diverse, with six species (Table 1).

Global conservation status

According to the 2021 IUCN assessment, 34 species (72.3%) are classified as Least Concern, while 12 species (25.5%) are categorized as Near Threatened, Vulnerable, Endangered, or Critically Endangered. Notably, the Manipur bush-quail *Perdica manipurensis* is Endangered, and the Himalayan quail *Ophrysia superciliosa* is Critically Endangered. The New Zealand quail *Coturnix novaezelandiae* is the only species classified as Extinct (Table 1). Population trends indicate that 31 species (66.0%) are declining, 11 species (23.4%) are

Table 1. Conservation status of global true quail species from 2021 IUCN Red List of Threatened Species.

Family	Scientific name	Common name	Native geographic range	Habitat(s)	Red List assessment ¹
Odontophoridae	<i>Callipepla californica</i>	California quail	Canada, Mexico, USA	Forest, shrubland, grassland, desert, artificial/terrestrial	LC
	<i>Callipepla douglasii</i>	Elegant quail	Mexico, USA	Forest, shrubland, artificial/terrestrial	LC
	<i>Callipepla gambelii</i>	Gambel's quail	Mexico, USA	Shrubland, desert, artificial/terrestrial	LC
	<i>Callipepla squamata</i>	Scaled quail	Mexico, USA	Shrubland, grassland	LC
	<i>Colinus cristatus</i>	Crested bobwhite	Aruba, Bonaire, Sint Eustatius and Saba, Brazil, Colombia, Costa Rica, Curaçao, French Guiana, Guyana, Panama, Suriname, Venezuela	Savanna, shrubland, artificial/terrestrial	LC
	<i>Colinus virginianus</i>	Northern bobwhite	Canada, Cuba, Guatemala, Mexico, USA	Forest, shrubland, grassland, artificial/terrestrial	NT
	<i>Colinus leucopogon</i>	Spot-bellied bobwhite	Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua	Savanna, shrubland, artificial/terrestrial	LC
	<i>Colinus nigrogularis</i>	Yucatan bobwhite/black-throated bobwhite	Belize, Guatemala, Honduras, Mexico, Nicaragua	Savanna, shrubland, artificial/terrestrial	LC
	<i>Cyrtonyx</i>	Montezuma quail	Mexico, USA	Forest, shrubland	LC
	<i>montezumae</i>				
	<i>Cyrtonyx ocellatus</i>	Ocellated quail	El Salvador, Guatemala, Honduras, Mexico, Nicaragua	Forest, shrubland	VU
	<i>Dactylortyx thoracicus</i>	Singing quail	Belize, El Salvador, Guatemala, Honduras, Mexico	Savanna, shrubland, artificial/terrestrial	LC
	<i>Dendroctyx barbatus</i>	Bearded tree-quail/bearded wood-partridge	Mexico	Forest, artificial/terrestrial	VU
	<i>Dendroctyx leucophrys</i>	Buffy-crowned tree-quail/buffy-crowned wood-partridge	Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua	Forest, artificial/terrestrial	LC
	<i>Dendroctyx macroura</i>	Long-tailed tree-quail/long-tailed wood-partridge	Mexico	Forest	LC
	<i>Odontophorus leucolaemus</i>	Black-breasted wood-quail	Costa Rica, Panama	Forest, artificial/terrestrial	LC
	<i>Odontophorus melanotis</i>	Black-eared wood-quail	Costa Rica, Honduras, Nicaragua, Panama	Forest, artificial/terrestrial	LC
	<i>Odontophorus atrifrons</i>	Black-fronted wood-quail	Colombia, Venezuela	Forest	VU
	<i>Odontophorus hyperythrus</i>	Chestnut wood-quail	Colombia	Forest, artificial/terrestrial	LC
	<i>Odontophorus melanotus</i>	Dark-backed wood-quail	Colombia, Ecuador	Forest	VU
	<i>Odontophorus strophium</i>	Gorgeted wood-quail	Colombia	Forest, artificial/terrestrial	VU
	<i>Odontophorus gujanensis</i>	Marbled wood-quail	Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname, Venezuela	Forest, artificial/terrestrial	LC
	<i>Odontophorus speciosus</i>	Rufous-breasted wood-quail	Bolivia, Ecuador, Peru	Forest	NT

(continued)

Table 1. Continued.

Family	Scientific name	Common name	Native geographic range	Habitat(s)	Red List assessment ¹
Phasianidae	<i>Odontophorus erythrops</i>	Rufous-fronted wood-quail	Colombia, Costa Rica, Ecuador, Honduras, Nicaragua, Panama	Forest	LC
	<i>Odontophorus guttatus</i>	Spotted wood-quail	Brazil, Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, Panama	Forest, artificial/terrestrial	LC
	<i>Odontophorus capueira</i>	Spot-winged wood-quail	Argentina, Brazil, Paraguay	Forest, artificial/terrestrial	LC
	<i>Odontophorus stellatus</i>	Starred wood-quail	Bolivia, Brazil, Ecuador, Peru	Forest	LC
	<i>Odontophorus balliviani</i>	Striped-faced wood-quail	Bolivia, Peru	Forest	LC
	<i>Odontophorus dialeucos</i>	Tacarcuna wood-quail	Colombia, Panama	Forest	LC
	<i>Odontophorus columbianus</i>	Venezuelan wood-quail	Venezuela	Forest	NT
	<i>Oreortyx pictus</i>	Mountain quail	Mexico, USA	Forest, shrubland, artificial/terrestrial	LC
	<i>Philortyx fasciatus</i>	Banded quail	Mexico	Shrubland, artificial/terrestrial	LC
	<i>Rhynchortyx cinctus</i>	Tawny-faced quail	Colombia, Costa Rica, Ecuador, Honduras, Nicaragua, Panama	Forest	LC
	<i>Anurophasis monorthonyx</i>	Snow mountain quail	Indonesia	Shrubland, grassland	NT
	<i>Coturnix coturnix</i>	Common quail	Africa, Cyprus, Middle East, Nepal	Grassland, artificial/terrestrial	LC
	<i>Coturnix delegorguei</i>	Harlequin quail	Botsswana, Burundi, Cameroon, Central African Republic, Chad, Comoros, Côte d'Ivoire, Eritrea, Eswatini, Ethiopia, Gabon, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Somalia, South Africa, Sudan, Congo, Tanzania, Uganda, Zambia, Zimbabwe	Savanna, grassland, artificial/terrestrial	LC
	<i>Coturnix japonica</i>	Japanese quail	China, Japan, Korea, Mongolia, Myanmar, Russian Federation (Eastern-Asian Russia)	Grassland, artificial/terrestrial	NT
	<i>Coturnix novaezelandiae</i>	New Zealand quail	New Zealand	Grassland	Ext
	<i>Coturnix coromandelica</i>	Rain quail	Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam	Shrubland, grassland, artificial/terrestrial	LC
	<i>Coturnix pectoralis</i>	Stubble quail	Australia	Grassland, artificial/terrestrial	LC
	<i>Ophrysia superciliosa</i>	Himalayan quail	India	Shrubland, grassland	CEN
	<i>Perdicula asiatica</i>	Jungle bush-quail	India, Sri Lanka	Forest, shrubland, grassland	LC
	<i>Perdicula erythrorhyncha</i>	Painted bush-quail	India	Forest, shrubland, grassland	LC

(continued)

Table 1. Continued.

Family	Scientific name	Common name	Native geographic range	Habitat(s)	Red List assessment ¹
	<i>Perdicula manipurensis</i>	Manipur bush-quail	India	Forest, shrubland, grassland	CEN
	<i>Synoicus ypsilophorus</i>	Brown quail	Australia, Indonesia, Papua New Guinea	Shrubland, grassland, wetlands (inland), artificial/terrestrial	LC
	<i>Synoicus adansonii</i>	African blue quail	Angola, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe	Shrubland, grassland, wetlands (inland), artificial/terrestrial	LC
	<i>Synoicus chinensis</i>	Asian blue quail	Australia, Brunei Darussalam, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Timor-Leste, Vietnam	Shrubland, grassland, wetlands (inland), artificial/terrestrial	LC

¹IUCN Red List terms: CEN = Critically Endangered; EN = Endangered; Ext = Extinct; NT = Near Threatened; VU = Vulnerable; LC = Least Concern.

stable, and only two species (4.3%) – the California quail *Callipepla californica* and stubble quail *Coturnix pectoralis* – show increasing populations (Table 2).

Primary threats

Habitat loss and fragmentation, driven by agricultural expansion, logging, and urban development, are the primary threats affecting quail populations globally (IUCN 2021). Climate change further exacerbates these pressures by altering habitat availability and food resources. Intensive agricultural practices, including pesticide use, negatively impact insect populations, reducing food availability during critical breeding periods. Additionally, invasive species such as feral cats and dogs increase predation pressure on ground-nesting quails, while hunting, although regulated in some regions, remains a localized threat where enforcement is limited.

Data deficiency

Research efforts have predominantly focused on genera with high species richness and economic significance. Most publications on true quail between 2000 and 2020 were concentrated on a few genera with the highest abundance. The three most extensively studied genera – *Coturnix*, *Odontophorus*, and *Colinus* – accounted for 99.5% of all publications, with *Coturnix* leading at 2233 publications, followed by *Odontophorus* (578), and *Colinus* (515) (Table 3). In contrast, the remaining nine genera received notably less research attention, with publication counts ranging from 0 to 7 during this period. This disparity highlights a concentrated research focus on a select few genera while many others remain underrepresented in scientific studies. Given the importance of the ecological and conservation status of true quails, it is crucial to expand research efforts beyond game species to include lesser-studied taxa. Other genera collectively represented less than 3% of scientific literature (Table 3). This research imbalance underscores the need for targeted studies on underrepresented species and regions, particularly in Asia, Africa, and South America where data deficiencies are most pronounced.

Discussion

Our research highlights the critical need for tailored conservation strategies to address threats to true quail species, particularly habitat loss driven by agriculture, logging, and infrastructure development. The uneven research focus on a few genera, such as *Coturnix* and *Odontophorus*, underscores the importance of expanding studies to less-represented species, many of which face significant conservation pressures. Localized studies are essential to uncover finer-scale threats and inform targeted conservation actions, such as habitat restoration and sustainable land use practices. Furthermore, the migratory nature of the common quail as well as other species that are native to many countries and introduced to other countries such as Japanese quail *Coturnix japonica* (McGowan and Kirwan 2020a) emphasizes the need for transboundary collaboration to address conservation challenges across

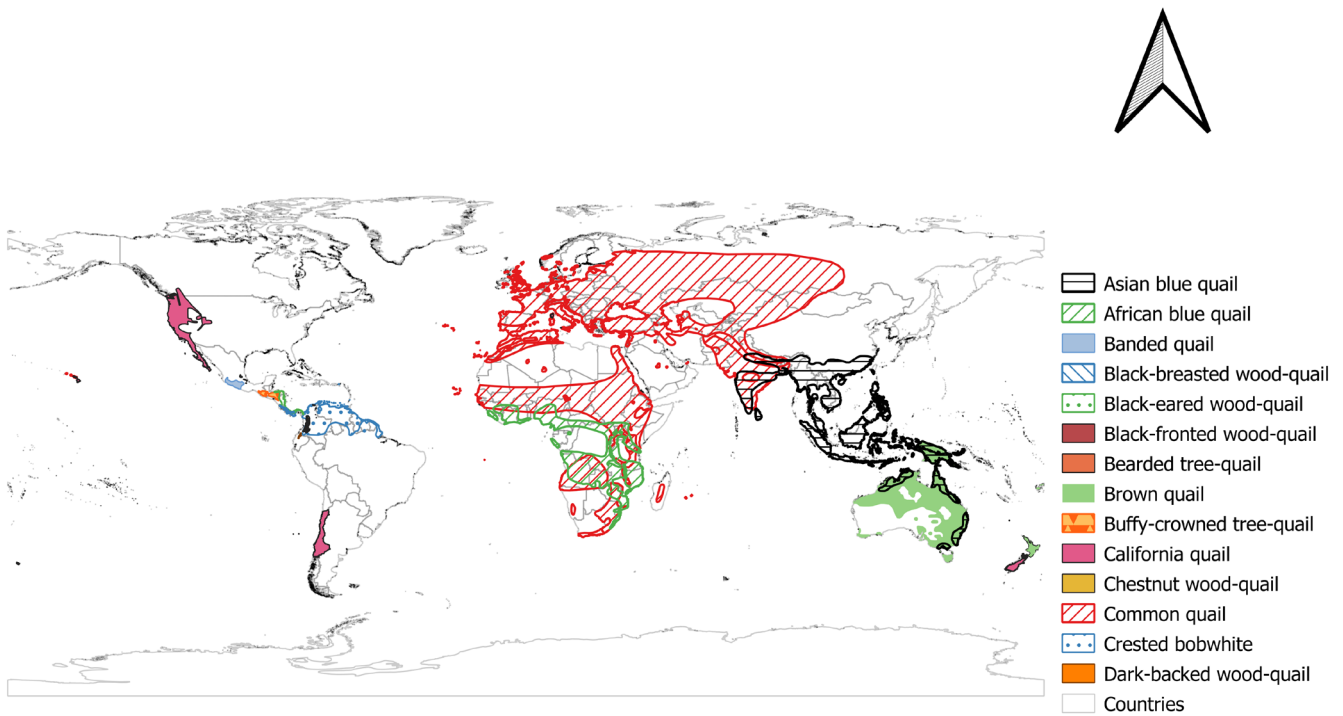


Figure 1. Distribution of African blue quail, Asian blue quail, banded quail, bearded tree quail, black-breasted wood-quail, black-eared wood-quail, black-fronted wood-quail, brown quail, buffy-crowned tree quail, California quail, chestnut wood-quail, common quail, crested bobwhite, and dark-backed wood-quail based on presence obtained by secondary data and prior research.

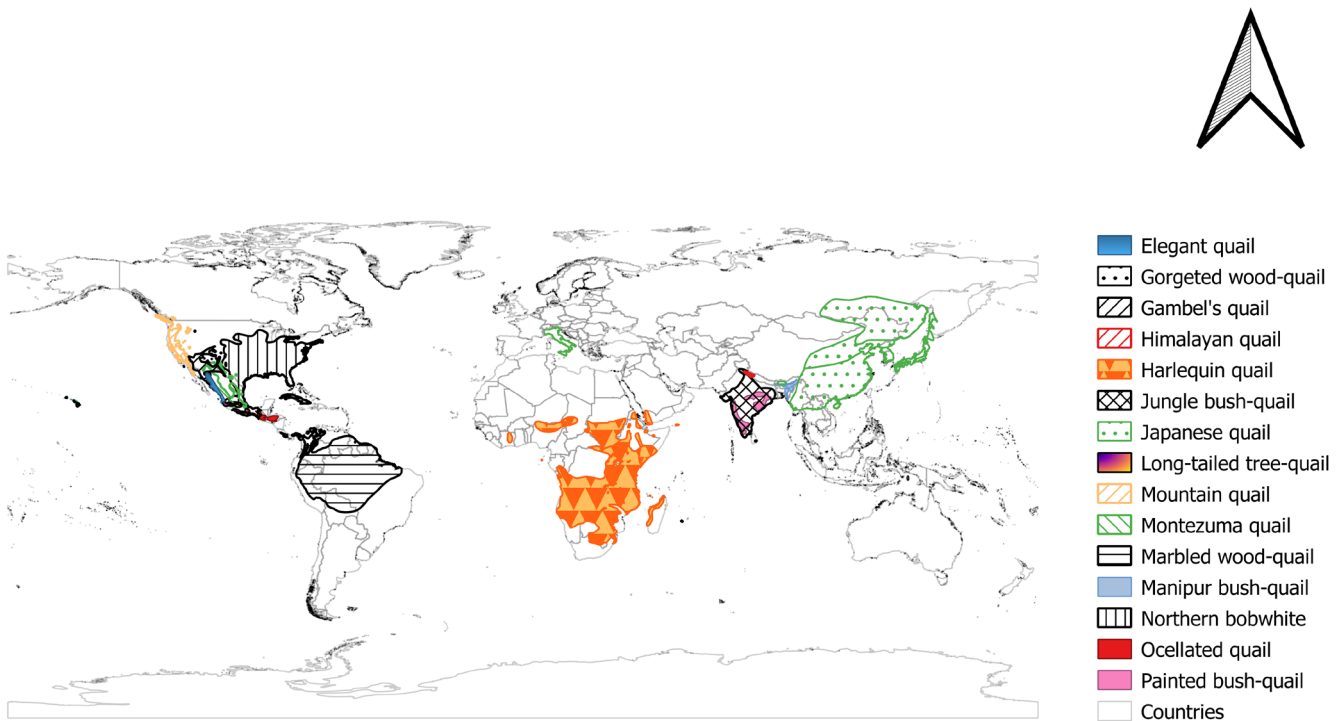


Figure 2. Distribution of elegant quail, Gambel's quail, gorgeted wood-quail, harlequin quail, Himalayan quail, Japanese quail, jungle bush-quail, long-tailed tree-quail, Manipur bush-quail, marbled quail, Montezuma quail, mountain quail, northern bobwhite, ocellated quail, and painted bush-quail based on presence obtained by secondary data and prior research.

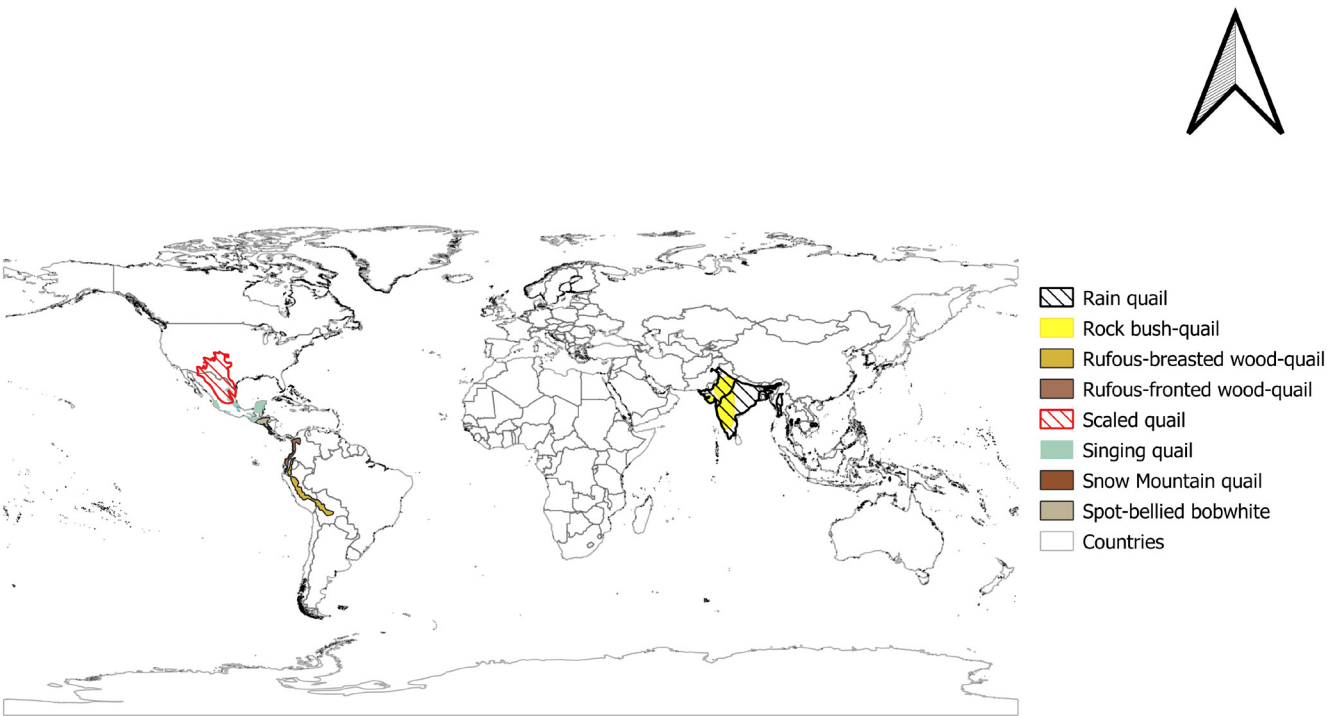


Figure 3. Distribution of rain quail, rock bush-quail, rufous-breasted quail, rufous-fronted quail, scaled quail, singing quail, snow mountain quail and spot-bellied quail based on presence obtained by secondary data and prior research.

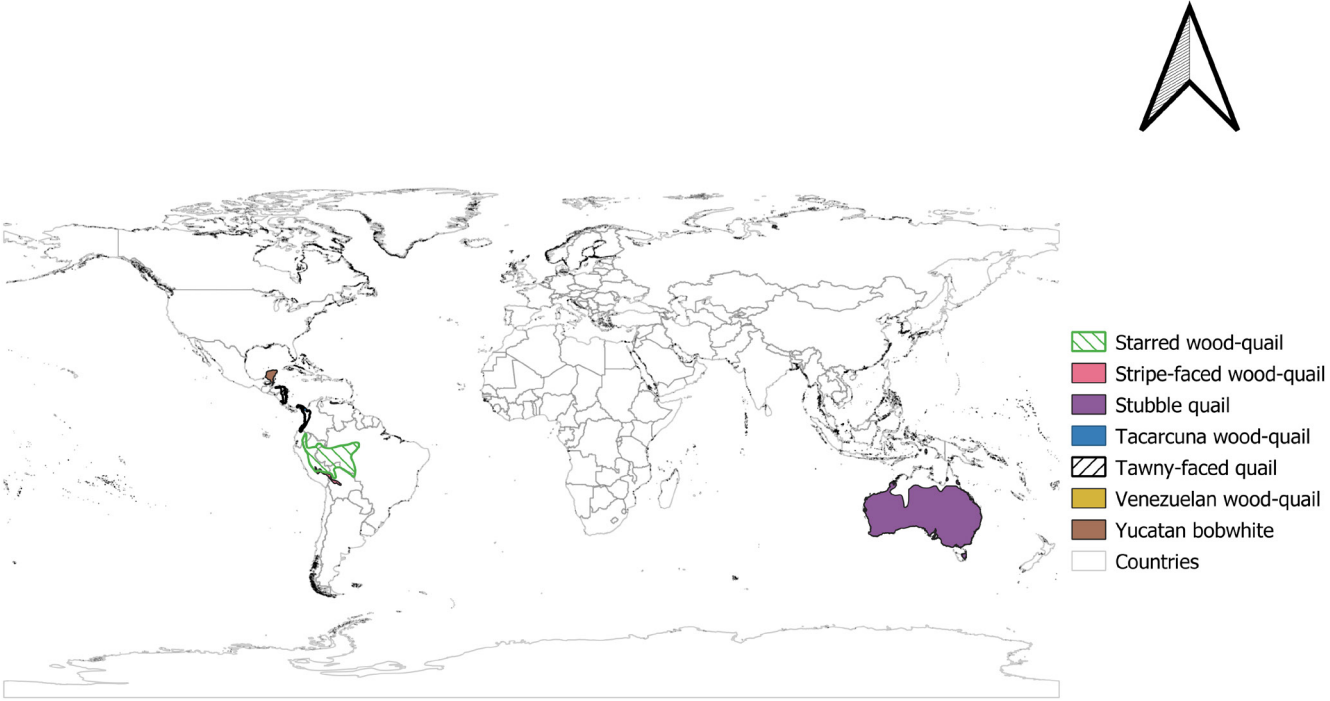


Figure 4. Distribution of starred wood-quail, stripe-faced wood-quail, stubble quail, Tacarcuna wood-quail, tawny-faced quail, Venezuelan wood-quail, and Yucatan bobwhite based on presence obtained by secondary data and prior research.

Table 2. Population trends, upper and lower population sizes, and primary and secondary threats to global true quail species. Data from 2022 IUCN Red List of Threatened Species. ^aIUCN Red List terms for population status: S=stable; D=decreasing; I=increasing; U=unknown; UNS=unspecified. ^bIUCN threats to quail species denoted as: AQUA/Agri=aquaculture and agriculture; BRU=biological resource use; CC/SW= climate change and severe weather; EP/Min=energy production and mining; HT=horticulture; Hun=hunting; HJQ=hybridization with the Japanese quail; IA=intensive agriculture; IHI=increase in the use of herbicides and insecticides; IPSG/DIS=invasive species and other problematic species and diseases; IS/DIS=invasive species and diseases; LTCF/DRO=long-term climate modification and drought; NSM=natural system modification; Pol=pollution; PT/Dis=pets/display animals; RES/CD=residential and commercial development; and TSC=transportation and service corridor.

Taxa	Population trend ^a	Lower population	Upper population	Continuing decline in area, extent and/or quality of habitat	Primary threats ^b	Secondary threats ^b
Family Odontophoridae						
<i>Callipepla</i>						
California quail	I	5 800 000	5 800 000	U	U	U
Elegant quail	D	500 000	4 999 999	U	U	U
Gambel's quail	S	5 800 000	5 800 000	U	U	U
Scaled quail	D	5 100 000	5 100 000	U	U	U
<i>Colinus</i>						
Crested bobwhite	S	5 000 000	49 999 999	U	U	U
Northern bobwhite	D	5 800 000	5 800 000	Yes	IA, BRU	NSM
Spot-bellied bobwhite	S	100 000	499 999	U	U	U
Yucatan bobwhite/black-throated bobwhite	D	50 000	499 999	U	U	U
<i>Cyrtonyx</i>						
Montezuma quail	D	U	U	U	BRU, IA	U
Ocellated quail	D	1500	7000	Yes	IA, BRU	EP/MIN, HI/DIS
<i>Dactylortyx</i>						
Singing quail	D	50 000	499 999	U	U	U
<i>Dendrortyx</i>						
Bearded tree quail	D	3600	3600	Yes	RES/CD, AQUA/AGRI	TSC, BRU
Buffy-crowned tree-quail	D	50 000	499 999	U	U	U
Long-tailed tree-quail	D	20 000	49 999	U	BRU	U
<i>Odontophorus</i>						
Black-breasted wood-quail	D	50 000	499 999	U	U	U
Black-eared wood-quail	D	50 000	499 999	U	U	U
Black-fronted wood-quail	D	50 000	99 999	Yes	AQUA/AGRI; BRU	Pol
Chestnut wood-quail	D	150 000	500 000	Yes	RES/CD, AQUA/AGRI	BRU, IS/DIS
Dark-backed wood-quail	D	9200	13 800	Yes	RES/CD, AQUA/AGRI	BRU, EP/Min
Gorgeted wood-quail	D	2500	9999	Yes	RES/CD, AQUA/AGRI	BRU, TSC
Marbled wood-quail	D	U	U	Yes	AQUA/AGRI, BRU	U
Rufous-breasted wood-quail	D	100 000	499 999	U	AQUA/AGRI, BRU	U
Rufous-fronted wood-quail	D	U	U	U	U	U
Spotted wood-quail	D	50 000	499 999	Yes	U	U
Spot-winged wood-quail	D	U	U	U	U	U
Starred wood-quail	D	U	U	U	U	U
Stripe-faced wood-quail	D	U	U	U	U	U
Tacarcuna wood-quail	S	1400	1400	U	AQUA/AGRI, BRU	EP/MIN
Venezuelan wood-quail	D	U	U	U	AQUA/AGRI, BRU	U
<i>Oreortyx</i>						
Mountain quail	D	260 000	260 000	U	U	U
<i>Philortyx</i>						
Banded quail	S	50 000	499 999	U	U	U
<i>Rhynchortyx</i>						
Tawny-faced quail	D	50 000	499 999	U	U	U
Family Phasianidae						
<i>Anurophasis</i>						
Snow mountain quail	D	U	U	Yes	EP/MIN, TSC	BRU, CC/SW

(continued)

Table 2. Continued.

Taxa	Population trend ^a	Lower population	Upper population	Continuing decline in area, extent and/or quality of habitat	Primary threats ^b	Secondary threats ^b
<i>Coturnix</i>						
Common quail	D	15 000 000	35 000 000	U	IHI, HJQ	Hun, LTCF/Dro
Harlequin quail	S	U	U	U	U	U
Japanese quail	D	U	U	U	BRU	U
New Zealand quail	UNS	U	U	U	IPSG/DIS, NSM	U
Rain quail	S	U	U	U	U	U
Stubble quail	I	U	U	U	U	U
<i>Ophrysia</i>						
Himalayan quail	S	1	49	EP/Min, BRU	CC/SW	U
<i>Perdica</i>						
Jungle bush-quail	S	U	U	U	PT/Dis, HT	U
Manipur bush-quail	U	1	200	U	AQUA/AGRI, BRU	NSM
Painted bush-quail	S	U	U	U	PT/Dis, HT	U
Rock bush-quail	D	U	U	U	U	U
<i>Synoicus</i>						
African blue quail	S	U	U	U	U	U
Asian blue quail	S	U	U	U	U	U
Brown quail	D	U	U	U	U	U

regions. These findings advocate for a balanced approach that integrates ecological sustainability with cultural and economic interests. Quail represent lesser-known faunal assemblages of desert, grassland, savanna, and forest ecosystems that require long-due attention from researchers and practitioners alike in knowledge gaps, conservation threats, and regional conservation policies and ecological dynamics.

Knowledge gaps

Despite their ecological and economic importance, substantial knowledge gaps persist in terms of the conservation status and ecological dynamics of true quails, particularly among Old World species. While genera such as *Coturnix*

and *Cyrtonyx* have received extensive research attention, many species within the *Odontophorus* genus and other lesser-known taxa remain underrepresented in scientific literature (IUCN 2021, Downey et al. 2023). Geographic research disparities are also evident, with North American and European quail populations being more thoroughly studied compared to those in South America, Asia, and Africa. Furthermore, limited data on population trends, breeding biology, and habitat requirements hinder conservation planning for many species, especially those categorized as Near Threatened or Vulnerable. Addressing these knowledge gaps is essential for developing evidence-based conservation strategies, particularly in regions where habitat loss and climate change pose

Table 3. Summary of publications for all true quail species (by genus) in four half-decades (2000–2005, 2006–2010, 2011–2015, 2016–2020) from 2000 to 2020.

Family	Genus	2000–2005		2006–2010		2011–2015		2016–2020		Total
		n	%	n	%	n	%	n	%	
Phasianidae	<i>Anurophasis</i>	0	0	0	0	1	0.12	0	0	1
Odontophoridae	<i>Callipepla</i>	4	0.52	2	0.26	0	0	0	0	6
Odontophoridae	<i>Colinus</i>	127	16.57	107	14.40	122	14.95	159	15.42	515
Phasianidae	<i>Coturnix</i>	477	62.27	524	70.52	555	68.01	677	65.66	2233
Odontophoridae	<i>Cyrtonyx</i>	3	0.39	0	0	0	0	4	0.38	7
Odontophoridae	<i>Dactylortyx</i>	0	0	0	0	0	0	0	0	0
Odontophoridae	<i>Dendrortyx</i>	3	0.39	0	0	1	0.12	3	0.29	7
Odontophoridae	<i>Odontophorus</i>	150	19.58	110	14.80	132	16.17	186	18.04	578
Phasianidae	<i>Ophrysia</i>	0	0	0	0	1	0.12	0	0	1
Odontophoridae	<i>Oreortyx</i>	2	0.26	0	0	3	0.36	0	0	5
Phasianidae	<i>Perdica</i>	0	0	0	0	0	0	0	0	0
Phasianidae	<i>Synoicus</i>	0	0	0	0	1	0.12	2	0.19	3
Odontophoridae	<i>Philortyx</i>	0	0	0	0	0	0	0	0	0
Odontophoridae	<i>Rhynchortyx</i>	0	0	0	0	0	0	0	0	0
Total		766	100	743	100	816	100	1031	100	3356

significant threats. Conservation is a critical focus of research on true quail. While several are sporting species, most are non-game species that are highly prized for other non-consumptive reasons.

Conservation threats

True quails face a range of threats that vary by context and region, driven primarily by habitat loss, climate change, hunting, and agricultural intensification. Human-mediated habitat destruction and fragmentation are the most pervasive threats globally, caused by agricultural expansion, urban development, and logging (Brennan 1994, Reese et al. 2005, IUCN 2021). In grassland and shrubland ecosystems, land conversion for crops and grazing reduces nesting and foraging habitats, while infrastructure development fragments populations, limiting gene flow (Beck et al. 2003, Downey et al. 2023).

Climate change exacerbates habitat loss by altering temperature and precipitation patterns, affecting food availability and breeding success, particularly in arid and semiarid regions where quail live near their physiological limits (Downey et al. 2023). In arid regions, prolonged droughts reduce vegetation cover and insect abundance, critical for chick survival (Brennan 1994). Pesticide use in agricultural landscapes further impacts quail populations by depleting insect populations and reducing food availability during breeding seasons (Gobeli et al. 2017). Additionally, invasive species such as feral cats, dogs, and non-native predators increase predation pressure and disease on ground-nesting quails, especially in fragmented habitats (Beauchamp 2004).

Overhunting and poaching pose localized threats, particularly in regions with limited regulation or enforcement. Although hunting is often regulated in North America and Europe, unsustainable harvesting persists in parts of Africa and Asia (IUCN 2021). Quails are also vulnerable to disease outbreaks, which can rapidly decimate populations in both wild and captive settings (McGowan et al. 2023). Additionally, the introduction of non-native quail species, such as Japanese quail *Coturnix japonica*, can lead to genetic hybridization, altering the genetic integrity of native populations (McGowan and Kirwan 2020a).

Regional conservation policies and ecological dynamics

Conservation policies and ecological dynamics vary by region, influencing the effectiveness of quail conservation efforts. In North America, organizations like Quail Forever and state wildlife agencies implement habitat restoration projects to support declining species such as the northern bobwhite *Colinus virginianus* (Downey et al. 2023). In the European Union, the Birds Directive (2009/147/EC) protects quail habitats and regulates hunting to ensure sustainable populations (Butchart et al. 2004). Australia focuses on conserving grassland and savanna ecosystems critical for species like the stubble quail *Coturnix pectoralis* through habitat restoration and fire management (McGowan and Kirwan 2020b).

In Africa and Asia, conservation efforts are more fragmented due to limited resources and competing land-use priorities. Transboundary collaboration is essential, particularly for migratory species like the common quail *Coturnix coturnix*, which crosses multiple countries during seasonal movements (McGowan et al. 2023). Fenced protected areas may play a crucial role, but many quail species inhabit landscapes outside these reserves, making sustainable land management practices essential for long-term conservation.

Future conservation strategies

Effective conservation of quails requires a multifaceted approach that integrates habitat preservation, sustainable land management, and climate adaptation. Habitat restoration initiatives, such as invasive species removal (Mungi et al. 2023), reforestation, and grassland rehabilitation, are crucial for mitigating the effects of habitat loss and fragmentation. Sustainable agricultural and wildland management practices, including reduced pesticide use, can help maintain insect populations essential for quail survival (Black et al. 2011). Climate adaptation strategies, such as creating climate-resilient habitats and enhancing habitat connectivity, are vital for ensuring long-term population viability. Additionally, transboundary collaboration is essential for migratory species like the common quail *Coturnix coturnix*, whose conservation requires coordinated efforts across multiple countries (McGowan et al. 2023). Strengthening international partnerships, harmonizing conservation policies, and fostering community engagement are critical for addressing the complex conservation challenges facing quails globally.

Acknowledgements – We thank I. Storch and J. Carroll for their comments that markedly improved our manuscript.

Funding – We received no funding to conduct this research. However, the authors were supported by the University of Wyoming to conduct this research.

Author contributions

Kathan Bandyopadhyay: Conceptualization (equal); Data curation (lead); Formal analysis (lead); Investigation (equal); Methodology (equal); Visualization (lead); Writing – original draft (lead); Writing – review and editing (equal). **Jeffrey L. Beck:** Conceptualization (equal); Investigation (supporting); Methodology (supporting); Project administration (lead); Supervision (lead); Validation (lead); Writing – original draft (supporting); Writing – review and editing (equal).

Transparent peer review

The peer review history for this article is available at <https://www.webofscience.com/api/gateway/wos/peer-review/wlb.3.01449>.

Data availability statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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