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MICHAEL EVANS

ZUHAIR SAMI AMR

RATIB M. AL-ORAN

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# The Status of Birds in the Proposed Rum Wildlife Reserve, Southern Jordan

Michael EVANS

The Royal Society for Conservation of Nature, Amman, JORDAN

Zuhair AMR

Department of Biology, Jordan University of Science & Technology, P.O. Box 3030, Irbid, JORDAN

Ratib M. AL-ORAN

Department of Biology, Mutah University, P.O. Box 7, Mutah, JORDAN

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**Abstract:** The Royal Society for the Conservation of Nature officially proposed the creation of the Rum Wildlife Reserve, in the extreme south of Jordan, in 1979. We present the first review of the birds of the proposed reserve and its environs, drawing upon published and unpublished records as well as a short field survey from June, 1996. A total of 142 species have been recorded, of which at least 34 species actually breed and another 14 probably do so. Most breeding species are (a) Saharo-Arabian desertic species, or (b) non-desertic species which have colonised the area due to the advent of irrigated agriculture since the 1970s. The area is rich in breeding birds of prey, and this is the main ornithological justification for the proposed reserve. Major potential threats to these raptors, unconfirmed as yet, include intensive pesticide use on irrigated farms, the poisoning of scavenging species, and human disturbance at nest sites. If proven to be operating, these threats should be addressed by the competent management authorities.

**Key Words:** Avifauna, wildlife, reserve, conservation, Rum, Jordan

## Introduction

The proposed Wadi Ramm reserve is a tract of extremely precipitous sandstone and granite mountains, which are isolated from one another by flat corridors covered in mobile sand dunes. It spans 800-1750 m in altitude, including the second and third highest peaks in the country, and its proposed boundary is 110 km long. The general area of the reserve, including the nearby settlement of Disi, is often referred to in the literature as the "Hisma (drainage) basin". The vegetation is typical of sandy Saharo-Arabian desert, dominated by a sparse scattering of saxaul *Haloxylon persicum* bushes up to 2 m high. Rainfall is low, scarce and irregular, and cannot support agriculture (less than 200 mm annually), but in good years can produce a flush of annual herbs and grasses in the desert. The high mountains look rather barren but harbour a relict Irano-Turanian/Mediterranean flora, with large but very scattered juniper *Juniperus phoenicea* trees. There are numerous points of ground water seepage around the bases of some of the mountains, which support small patches of trees and bushes such as *Acacia*, *Ziziphus*, *Retama*, and *Phoenix* (Barsotti and Cavalli, 1989).

Since the 1970s, tourism and irrigated agriculture have both been increasing in scale in this region. These developments seem set to continue, and may have already caused some damage to the ecological fabric and character of the landscape, and so they may need to be more closely regulated. One prerequisite for such regulation, and for the establishment of a nature reserve in the area, is the compilation and publication of all relevant background data on the natural resources and biodiversity of the area. Woodford (1991) and Borzatti Von Lowenstern (1992) have provided evidence and justification for the reserve in general terms, and the status of the larger, rarer mammals has also been reviewed (Masseti, 1990; Masseti and Covarelli, 1991). As a contribution to this goal of documentation, we present here a summary and analysis of the status of the birds of the area, with emphasis on nature conservation.

## Methods

Given the mobility of birds, we researched not only the proposed reserve itself but also its surroundings, since new ornithological findings or socio-economic developments since 1979 might make it necessary or opportune to re-draw the boundary when the reserve is

established. Our study area of about 4675 km<sup>2</sup> encompassed the whole "Rum Desert" avifaunal region, and the adjacent western half of the "Mudawwara Desert" avifaunal region, as defined and mapped by Andrews (1995).

MIE carried out a 10-day survey of the area, mainly on foot, during 10-18 June, 1996, and was assisted by ZA with vehicle transport during 14-15 June. A more comprehensive field survey was not possible due to constraints of transport and time, but it is hoped that the RSCN will carry out a more focused and comprehensive field survey of the avifauna in the future, guided by the recommendations of this report.

We reviewed all previous literature on the avifauna of the locality for significant records, including Wallace (1984), Masseti (1990) and Mountfort (1995). In addition, unpublished sources were searched, including the unpublished data of M. Masseti (in litt. to BirdLife International, 1993), as well as about 500 bird records from the area since the late 1980s which were provided by I.J. Andrews, consisting mainly of his own data, but also the unpublished (often privately circulated) observations of several other visiting birdwatchers (see acknowledgements). Taken altogether, this body of knowledge allowed us to establish or estimate the local status and relative abundance of bird species in the area, although in some cases this was a tentative judgment, pending future work.

Scientific names of bird species are given in the Table, unless otherwise stated; taxonomic order and nomenclature follow Andrews (1995).

## Result

The table lists all 142 bird species certainly recorded in the study area by the present field survey and by previous observers (as far as is known), together with (a) each species' need for nature-conservation measures at international, regional and national level (Evans 1994), (b) our assessment of its status and abundance in the study area, and (c) its local breeding status.

Most of the species are uncommon or rare passage migrants, and resident species greatly outnumber breeding summer visitors. At least 34 species breed, with another 14 probably doing so, and possibly another 11 (Table). Future field surveys should attempt to clarify this situation. Few species have been recorded in winter,

when almost none are common, which may indicate that the cold weather on this high-altitude desert plateau does not favour a large and diverse bird community this season. However, little fieldwork has been carried out during this period.

### The field survey in June 1996

A total of 142 species were observed in the study area (Table), of which 3 had apparently not been recorded previously (*Gallinula chloropus*, *Charadrius dubius* and *Streptopelia decaocto*). In addition, 1 previously unrecorded species (*Himantopus himantopus*) was reliably reported by a farmworker.

Indications of local breeding (possible, probable or certain) were found for 37 of the 42 species, of which the following 9 were not previously known or suspected to breed in the area: *Ardeola ralloides*, *Bubulcus ibis*, *Gallinula chloropus*, *Charadrius dubius*, *Streptopelia turtur*, *Streptopelia decaocto*, *Upupa epops*, *Acrocephalus scirpaceus* and *Passer hispaniolensis*.

In addition, 5 species which had previously been recorded only a few times from the study area at 1 or 2 localities during the breeding season were found to be more widespread and common breeding species than these previous data had indicated (palm dove, crested lark, orange-tufted sunbird, goldfinch, desert finch). All 14 of these new or "much increased" breeding species have colonised the area, or may be in the process of doing so, due to the advent and expansion of irrigated agriculture in the region.

### Selected field observations

Here we give details of the more unusual or significant records made during our field survey, as judged after perusal of Andrews (1995).

Squacco heron: Three at a 10-year-old, bounded pool (0.75 ha) which was fringed by mature *Casuarina* trees and full of tall *Phragmites* reeds, at Sahl as Suwwan on 14 June. One in non-breeding plumage had an injured wing and could not fly, but the other 2 were a pair in breeding plumage. Local breeding, at such a small site, seems unlikely but not impossible. Previously, there have been no indications of breeding in Jordan since the late 1960s, at Azraq.

Cattle egret: Two in breeding plumage feeding in a field of alfalfa at Sahl as Suwwan on 14 June. A worker reported that there had been 4 birds there 2 days before.

Table. Checklist of the bird of the proposed Rum Wildlife Reserve and environs, southern Jordan.

The study area is the 'Rum Desert avifaunal region' and the western half of the 'Mudawwara Desert avifaunal region' (following the boundaries of Andrews, 1995).

\*= recorded during our field survey (10-18 June 1996).

Key	<i>Conservation importance</i>
G	Globally threatened species
R	Regionally threatened species (in the Middle East)
N	Species of national conservation concern
!	Population size is significant (? denotes uncertainty)

*local status*

Ext	Extinct (former local status in brackets)
R	Resident S Summer visitor
P	Passage migrant
W	Winter visitor
?	Status uncertain
V	Vagrant/accidental
1	Common
2	Uncommon
3	Rare

*Breeding Status*

B	Breeding confirmed, or assumed with 100% certainty
b	Probably breeds
?	Possibly breeds

English name	Scientific name	Conservation importance	Local status	Breeding status
Little Bittern	<i>Ixobrychus minuttus</i>	.	P3	.
Squacco Heron*	<i>Ardeola ralloides</i>	.	S3	?
Cattle Egret*	<i>Bubulcus ibis</i>	.	S3	?
Little Egret	<i>Egretta garzetta</i>	.	P3	.
Black Stork	<i>Ciconia nigra</i>	N	P3	.
Wigeon	<i>Anas penelope</i>	.	P3	.
Garganey	<i>Anas querquedula</i>	.	P3	.
Shoveler	<i>Anas clypeata</i>	.	P3	.
Black Kite	<i>Milvus migrans</i>	.	P2	.
Lammergeier	<i>Gypaetus barbatus</i>	R	Ext(R3)	(B)
Egyptian Vulture*	<i>Neophron percnopterus</i>	RI	S2,P2	b
Griffon Vulture	<i>Gyps fulvus</i>	RI	R3	b
Short-Toed Eagle	<i>Circaetus gallicus</i>	R	S3	B
Marsh Harrier	<i>Circus aeruginosus</i>	.	P2	.
Pallid Harrier	<i>Circus macrourus</i>	R	P3,W3	.
Common Buzzard	<i>Buteo buteo</i>	.	P1	.
Long-Legged Buzzard*	<i>Buteo rufinus</i>	.	R1	B
Steppe Eagle	<i>Aquila nipalensis</i>	.	P1	.
Imperial Eagle	<i>Aquila heliaca</i>	GI	P3	.
Golden Eagle	<i>Aquila chrysaetos</i>	R	R3?	?
Verreaux's Eagle*	<i>Aquila verreauxii</i>	RI	R3	B

Table. Continued.

Booted Eagle	<i>Hieraaetus pennatus</i>	.	P3	.
Bonelli's Eagle	<i>Hieraaetus fasciatus</i>	RI	R3	b
Lesser Kestrel (*?)	<i>Falco naumanni</i>	G	P3,S3	?
Common Kestrel*	<i>Falco tinnunculus</i>	.	R1	B
Sooty Falcon*	<i>Falco concolor</i>	RI	S2	B
Lanner	<i>Falco biarmicus</i>	R(!?)	R3	?
Saker	<i>Falco cherrug</i>	R(!?)	P3,W3?	.
Barbary Falcon*	<i>Falco pelegrinoides</i>	.	R2	B
Chukar*	<i>Alectoris chukar</i>	.	R2	B
Sand Partridge*	<i>Ammoperdix heyi</i>	N	R1	B
Quail	<i>Coturnix coturnix</i>	.	P2,S3?	?
Corncrake	<i>Crex crex</i>	G	P3	.
Moorhen*	<i>Gallinula chloropus</i>	.	S3,W3?	b
Common Crane	<i>Grus grus</i>	N	W3	.
Black-Winged Stilt*	<i>Himantopus himantopus</i>	.	P3	.
Stone Curlew*	<i>Burhinus oedicnemus</i>	.	P3	.
Little Ringed Plover*	<i>Charadrius dubius</i>	N	S3	B
Spur-Winged Plover	<i>Hoplopterus spinosus</i>	.	P3	.
Common Snipe	<i>Gallinago gallinago</i>	.	P3	.
Greenshank	<i>Tringa nebularia</i>	.	P3	.
Green Sandpiper	<i>Tringa ochropus</i>	.	P3	.
Wood Sandpiper	<i>Tringa glareola</i>	.	P3	.
Common Sandpiper	<i>Actitis hypoleucos</i>	.	P3	.
Black-Headed Gull	<i>Larus ridibundus</i>	.	P3	.
Rock Dove*	<i>Columba livia</i>	.	R1	B
Eurasian Collared Dove*	<i>Streptopelia decaocto</i>	.	R2	B
Turtle Dove*	<i>Streptopelia turtur</i>	.	S1	B
Palm Dove*	<i>Streptopelia senegalensis</i>	.	R1	B
Namaqua Dove	<i>Oena capensis</i>	.	V	.
Striated Scops Owl	<i>Otus brucei</i>	R	P3	.
Eagle Owl	<i>Bubo bubo</i>	RI	R3	B
Little Owl	<i>Athene noctua</i>	.	R1	B
Hume's Tawny Owl	<i>Strix butleri</i>	RI	R3	B
European Nightjar	<i>Caprimulgus europaeus</i>	.	P3	.
Egyptian Nightjar	<i>Caprimulgus aegyptiacus</i>	.	P3,S3?	?
Common Swift	<i>Apus apus</i>	.	P2	.
Pallid Swift	<i>Apus pallidus</i>	.	P2,S2	?
European Bee-Eater*	<i>Merops apiaster</i>	.	P1,S3	?
European Roller	<i>Coracias garrulus</i>	.	P3	.
Hoopoe*	<i>Upupa epops</i>	.	P2,S2	b
Bar-Tailed Desert Lark	<i>Ammomanes cincturus</i>	.	R2	b
Desert Lark*	<i>Ammomanes deserti</i>	.	R1	B
Hoopoe Lark	<i>Alaemon alaudipes</i>	.	W2	.
Lesser Short-Toed Lark	<i>Calandrella rufescens</i>	.	R2	b
Crested Lark*	<i>Galerida cristata</i>	.	R1	B
Temminck's Horned Lark	<i>Eremophila bilopha</i>	.	R3?	b
Sand Martin	<i>Riparia riparia</i>	.	P2	.
Rock Martin*	<i>Ptyonoprogne fuligula</i>	.	R1	B

Table. Continued.

Crag Martin	<i>Ptyonoprogne rupestris</i>	.	P3	.
Barn Swallow*	<i>Hirundo rustica</i>	.	P1	.
Red-Rumped Swallow	<i>Hirundo daurica</i>	.	P	.
House Martin	<i>Delichon urbica</i>	.	P2	.
Long-Billed Pipit	<i>Anthus similis</i>	R	R3?	?
Tree Pipit	<i>Anthus trivialis</i>	.	P2	.
Red-Throated Pipit	<i>Anthus cervinus</i>	.	P3	.
Yellow Wagtail	<i>Motacilla flava</i>	.	P2	.
Grey Wagtail	<i>Motacilla cinerea</i>	.	W2	.
White Wagtail	<i>Motacilla alba</i>	.	W2,P2	.
Yellow-Vented Bulbul*	<i>Pycnonotus xanthopygos</i>	.	R2	B
Rufous Bush Robin*	<i>Cercotrichas galactotes</i>	.	S2,P2	B
Thrush Nightingale	<i>Luscinia luscinia</i>	.	P1	.
Black Redstart	<i>Phoenicurus ochruros</i>	.	W1	.
Common Redstart	<i>Phoenicurus phoenicurus</i>	.	P1	.
Blackstart	<i>Cercomela melanura</i>	.	R3	b
Whinchat	<i>Saxicola rubetra</i>	.	P2	.
Isabelline Wheatear	<i>Oenanthe isabellina</i>	.	P1,W3?	.
Common Wheatear	<i>Oenanthe oenanthe</i>	.	P2	.
Black-Eared Wheatear	<i>Oenanthe hispanica</i>	.	P2	.
Desert Wheatear	<i>Oenanthe deserti</i>	.	R2	B
Finsch's Wheatear	<i>Oenanthe finschii</i>	R	W3	.
Red-Rumped Wheatear	<i>Oenanthe moesta</i>	N(!?)	R3?	?
Mourning Wheatear*	<i>Oenanthe lugens</i>	.	R1	B
Hooded Wheatear*	<i>Oenanthe monacha</i>	R!	R2	B
White-Crowned Black Wheatear*	<i>Oenanthe leucopyga</i>	.	R1	B
Rock Thrush	<i>Monticola saxatilis</i>	.	P1	.
Blue Rock Thrush	<i>Monticola solitarius</i>	.	W2	.
Song Thrush	<i>Turdus philomelos</i>	.	W2	.
Scrub Warbler*	<i>Scotocerca inquieta</i>	.	R1	B
River Warbler	<i>Locustella fluviatilis</i>	.	P3	.
Reed Warbler*	<i>Acrocephalus scirpaceus</i>	.	S2,P2	b
Olivaceous Warbler	<i>Hippolais pallida</i>	.	P1	.
Upcher's Warbler	<i>Hippolais languida</i>	R	P2	.
Olive-Tree Warbler	<i>Hippolais olivetorum</i>	R	P3	.
Subalpine Warbler	<i>Sylvia cantillans</i>	.	P2	.
Desert Warbler	<i>Sylvia nana</i>	.	W	.
Orphean Warbler	<i>Sylvia hortensis</i>	.	P1	.
Barred Warbler	<i>Sylvia nisoria</i>	.	P2	.
Lesser Whitethroat	<i>Sylvia curruca</i>	.	P1	.
Whitethroat	<i>Sylvia communis</i>	.	P2	.
Garden Warbler	<i>Sylvia borin</i>	.	P2	.
Blackcap	<i>Sylvia atricapilla</i>	.	P1	.
Chiffchaff	<i>Phylloscopus collybita</i>	.	P2	.
Willow Warbler	<i>Phylloscopus trochilus</i>	.	P2	.
Wood Warbler	<i>Phylloscopus sibilatrix</i>	.	P2	.
Spotted Flycatcher	<i>Muscicapa striata</i>	.	P2	.
Semi-Collared Flycatcher	<i>Ficedula semitorquata</i>	.	P2	.
Arabian Babbler	<i>Turdoides squamiceps</i>	R	R3	b

Table. Continued.

Orange-Tufted Sunbird*	<i>Nectarinia osea</i>	.	R2	b
Golden Oriole	<i>Oriolus oriolus</i>	.	P3	.
Isabelline Shrike	<i>Lanius isabellinus</i>	.	P3	.
Red-Backed Shrike*	<i>Lanius collurio</i>	.	P1	.
Great Grey Shrike	<i>Lanius excubitor</i>	.	W2	.
Woodchat Shrike	<i>Lanius senator</i>	.	P2	.
Masked Shrike*	<i>Lanius nubicus</i>	.	P1	.
Indian House Crow	<i>Corvus splendens</i>	.	V	.
Brown-necked Raven*	<i>Corvus ruficollis</i>	.	R1	B
Fan-Tailed Raven*	<i>Corvus rhipidurus</i>	.	R2	b
Tristram's Grackle*	<i>Onychognathus tristramii</i>	R	R1	B
European Starling	<i>Sturnus vulgaris</i>	.	W3	.
House Sparrow*	<i>Passer domesticus</i>	.	R1	B
Spanish Sparrow	<i>Passer hispaniolensis</i>	.	R1	B
Pale Rock Sparrow	<i>Petronia brachydactyla</i>	R	P3	.
Chaffinch	<i>Fringilla coelebs</i>	.	W2	.
Goldfinch*	<i>Carduelis carduelis</i>	.	R2	B
Linnet	<i>Carduelis cannabina</i>	.	W3	.
Desert Finch*	<i>Rhodospiza obsoleta</i>	.	R2	B
Trumpeter Finch*	<i>Bucanetes githagineus</i>	.	R2	b
Sinai Rosefinch*	<i>Carpodacus synoicus</i>	R!	R1	B
House Bunting*	<i>Emberiza striolata</i>	.	R	B
Cinereous Bunting	<i>Emberiza cineracea</i>	R	P3	.
Ortolan Bunting	<i>Emberiza hortulana</i>	.	P1	.
Black-Headed Bunting	<i>Emberiza melanocephala</i>	.	P2	.

Not known to breed in Jordan, and local breeding seems unlikely although not impossible. Not previously known to over-summer away from the Jordan Valley.

Egyptian vulture: An adult at Jebel Sa'yfan Kabir on 12 June. An adult pair and a subadult playing in the wind over the summit of Jebel Um Ishrin in the late afternoon, no doubt preparatory to roosting nearby, on 16 June. This species is very likely to breed within the proposed reserve. In addition, the area appears to be an important over-summering site for non-breeding immature birds (I.J. Andrews pers. comm.).

Verreaux's eagle: adult pair, the only known breeding pair in Jordan, was seen on 14, 15 and 16 June, over Wadi Shallalah (Jebel Rum) and over Jebel Shallalah Kebir (where they perched for a few minutes).

Lesser kestrel: A possible male feeding at Rum village on 11 June - it was not observed long enough to confirm the identification. In the light of a previous observation of

a pair at Jabal Khazali (Wadi Rum) on the late date of 23 May, 1994, (R. Hofland per I.J. Andrews), it is possible that the lesser kestrel may breed at this locality. Such a habitat would be highly unusual for this species, which prefers to breed in Mediterranean or Irano-Turanian steppe/cereal mosaic.

Sooty falcon: A pair display-chasing along a huge cliff in the Jebel Rum (overlooking Rum village) on 11 June, and singles at the Disi Agricultural Station and over the south-western cliffs of Jebel Um Ishrin on 13 and 14 June, respectively.

Barbary falcon: One or two adults at Jebel Sa'fan Kebir on 12 June, and 2 birds at Jebel Nasraniyah (southern end of Jebel Um Ishrin) on 14 and 17 June. On the latter date, the birds were both juveniles in very fresh plumage; successful breeding was also indicated for this site on 23 May 1994, when an adult pair with a juvenile were seen (R. Hofland per I.J. Andrews).

Moorhen: At least 2 heard calling from Suwwan pool (see Squacco Heron) on 14 June. Breeding in Jordan not certainly recorded away from Azraq.

Black-winged stilt: A farm worker on 14 June said he had shot one at a pool at Sahl as Suwwan in the previous week. His description of the bird left no doubt as to its identity. Not previously recorded in the study area.

Little ringed plover: An adult with an almost fully fledged juvenile (still a little smaller than adult) on a silt-flat next to waste water pools at Sahl as Suwwan on 14 June. Not previously recorded in the study area, and breeding in Jordan has not been certainly recorded away from Azraq before.

Eurasian collared dove: A total of 10 in farmland at Sahl as Suwwan on 14 June. A new colonist, not previously recorded in the study area.

Turtle dove: Up to 3 per day heard singing at the Disi Agricultural Station. A new colonist, not previously suspected to breed this far south in Jordan.

Palm dove: Frequent to common in all settlements and agricultural areas visited, with up to 67 per day counted. Previously described as rather local in the Rum Desert region, therefore the population size seems to have increased recently.

European bee-eater: One on 14 June in fruit orchards at Sahl as Suwwan. This species was said by farmworkers to be still frequent in the orchards, even during this field survey in June, and thus it is possible that it is breeding locally. The nearest known breeding locality is in the Sharrah Highlands to the north-west, in a much less desertic habitat.

Hoopoe: One in Wadi Rum about 1 km north of Rum village on 16 June, and on 14 June farmworkers reported its regular and continuing presence in cultivated areas of Sahl as Suwwan. It seems highly likely that it has colonised the area as a breeding species.

Crested lark: Fairly common in irrigated cultivation at Disi and Sahl as Suwwan - the maximum number seen in 1 day was 18 -where it had previously been considered to be scarce.

Rufous bush robin: Two at Al Ghal village on 15 June and 2 at Disi on 18 June; males were singing, and all were in suitable breeding habitat (densely bushy, irrigated orchard areas). Not previously known to breed in the study area.

Reed warbler: At least 4 males singing at Sahl as Suwwan pool (see Squacco heron) on 14 June. In Jordan, not previously suspected of breeding any where nearer than Wadi Zarqa Ma'in, more than 200 km to the north.

Orange-tufted sunbird: While previously there were only 4 records for the study area, all from Wadi Rum, during this survey the species was found at Disi and Al Ghal villages, as well as Rum village, with up to 13 seen per day. The species was found mainly in irrigated areas with a high density of trees, and is clearly benefiting from the creation of gardens and small orchards following settlement and irrigation.

Spanish sparrow: On 14 June, a total of at least 300 birds and at least 130 nests were recorded in 3 colonies (1 at Disi, 2 at Sahl as Suwwan) in rows of tall *Eucalyptus* and *Casuarina* trees in areas of irrigated wheat fields (just harvested). Breeding in Jordan had previously only been recorded as far south as Wadi al Hasa, 150 km to the north.

Goldfinch: Small numbers at the Disi Agricultural Station (daily maximum count was 4). It seems likely that the species bred here, as there is a large expanse of suitable breeding habitat (olive trees, irrigated cultivation, gardens, lawns, water-sprinklers), although breeding has not been recorded previously anywhere nearer than the Sharrah highlands.

Desert finch: Noted every day at the Disi Agricultural Station (daily maximum 8), and on 18 June in nearby irrigated cultivation, breeding anywhere in southern Jordan.

Unfortunately, lack of space and time mean that we cannot give details of interesting but unpublished observations made by other observers, which we have used in compiling this review.

## Discussion

### Extinct species

The ostrich *Struthio camelus* is considered by local people to have become extinct in the area of Rum and Disi around 1890-1900 (Masseti, 1990), and the lammergeier (the only known breeding pair in Jordan) became extinct here some time after 1963 (Andrews, 1995). According to the local people, when interviewed by Masseti (1990) and ourselves, the regionally threatened Houbara bustard *Chlamydotis undulata* may



still survive (migratory status uncertain) in the low-lying plains of the Mudawwara Desert, to the east of Rum and Disi. However, there are no certain records from the reserve area, at least since the 1980s, and it is not considered further in this report.

### Completeness of inventory

Before the advent of widespread irrigated agriculture, the originally desertic avifauna of the study area is likely to have included relatively few breeding species. We suspect that virtually all potential breeding species of the original desert avifauna have already been recorded. The species-distribution maps in Andrews (1995) and Jennings (1995) do not reveal any other unrecorded species that could potentially be present - the most likely candidates being Liechtenstein's sandgrouse *Pterocles lichtensteinii*, the crowned sandgrouse *Pterocles coronatus* and the thick-billed lark *Ramphocoris clotbey*. However, the first species probably prefers lower, warmer, rockier desert with more cover of trees and shrubs (especially acacia), and the latter 2 (nomadic) species prefer gravel plains to sand dunes.

For similar habitat preferences, it seems that certain desert species do not breed in the Rum Desert avifaunal region, although they do in immediately adjacent desert regions of Jordan (Andrews, 1995); the cream-coloured courser *Cursor cursorius*, spotted sand grouse *Pterocles senegallus*, Temminck's horned lark *Eremophila bilopha*, blackstart *Cercomela melanura* and great grey shrike *Lanius excubitor*. The first 3 species breed in the adjacent areas of the Mudawwara Desert region (i.e. immediately to the east), which is flatter, less mountainous and less dominated by mobile sand dunes, being more characterised by chert plains, shallow wadis and small sandstone outcrops. The last 2 species are found further to the west of the study area, nearer the Rift Valley, at lower altitudes and in areas where acacia trees are more common.

The seasonal coverage of the study area by observers is uneven, with a major bias towards the spring. More observations in the less studied seasons (especially May-June and August-November) are needed in order to clarify the uncertain status of some species; these uncertainties are highlighted in the Table. Many more migrating species are likely to be recorded in the study area in the future, given further surveys.

### Conservation of key species

At least 10 species, of conservation concern at a global or Middle Eastern level, have significant populations in the study area (Table). This is a high concentration at the Middle Eastern level, and is the main reason why the proposed reserve and its environs were identified as an 'Important Bird Area' in the Middle East context (Evans, 1994), being one of the most important sites for the conservation of birds in the region. Most of these key species are breeding birds of prey, and the main threats to them are discussed below.

### Threats to key species

Wadi Rum has been a tourist destination for 'wilderness' trekking and rock-climbing since the mid 1970s at least, and the number of visitors to the area of the proposed wildlife reserve has been increasing steadily since then, especially with the advent of the peace treaty with Israel in 1994. Mass tourism by coach has reached the most popular sites (Rum village and its environs), where up to 250 or more tourists per day currently visit at peak times, outside the hot summer months. Smaller, more specialised tours and many individual visitors go climbing with Bedouin guides in the mountains of the proposed reserve, or go on 'desert safaris' in off-road vehicles within the proposed reserve, for trips of a few hours to several days in length. Specialised rock-climbing expeditions also visit regularly.

Irrigated agriculture has developed during the last 15-20 years on the silt plains at Disi, Sahl as Suwwan and Al Mudawwara, which lie along the northern and eastern boundaries of the proposed reserve. These farms are said to cover more than 50 km<sup>2</sup> and are mainly large-scale, commercial enterprises which pump fossil water from huge aquifers to irrigate cereals, alfalfa, and fruit crops for export to the West and Far East, using intensive methods such as pivots, drip pipes and a high use of agro-chemicals.

The following threats to populations of key bird species are associated with these developments:

**Pesticides-** Pesticide poisoning is potentially a threat to Bonelli's eagle and other resident raptors which hunt on farmland due to the high concentrations of their preferred prey (e.g., the rock dove) which feed in this habitat (Frumkin, 1986).

Eagles tend to concentrate the pesticide residues from their prey internally, leading to secondary poisoning with lethal results or sub lethal depression of breeding success. The same process led to the extinction of this eagle over most of Israel during 1940-1976 (Frumkin, 1986). Hundreds of rock doves are known to concentrate to feed at the Disi farms, and given that Bonelli's eagle has been seen as close as 10 km from this area, this species and other raptors may be under threat. Pesticide use at the farms is likely to be intensive, this should be investigated and modified if necessary, through discussions with the farm managers or through the application of environmental laws if feasible.

**Poison-baiting Local livestock:** farmers probably poison carrion with strychnine and other available chemicals (e.g., agro-chemicals) in order to kill wolves (*Canis lupus*), as they do elsewhere. This puts scavenging birds (vultures, eagles, and ravens), as well as scavenging mammals, at risk of death or sublethal reduction in breeding success. The increasing wealth of the local Bedouin community, through increased tourism, farming and other employment, may translate into increased levels of livestock-herding, since a traditional form of investment of wealth is in the size of one's flocks. Increases in the mortality of livestock, through increased livestock density leading to higher levels of overcrowding, disease, starvation and neglect, are often blamed on predators, and the increasing availability of agro-chemicals locally may also lead to increased availability of poisons.

The intensity of poison-baiting may thus then increase. It is not known why the Lammergeier became extinct in the Rum area sometime during the late 1960s or 1970s, but poisoning is a strong candidate. The incidence of poison-baiting should be investigated, and combated, if necessary, by public-awareness activities and prosecution.

**Disturbance at raptor nests sites by rock-climbers:** Rock climbing at or near active raptor nests on cliffs can be very harmful, as the raptors can become very disturbed by such close human presence. Climbers approaching the nest site are demonstrating that the site is no longer inviolate and safe, and the birds will often abandon their nest site permanently if the disturbance is prolonged or repeated. Even outside the breeding season,

there is a risk of desertion, as the large eagles and vultures often roost at or near the nest site all year round. Despite appearances, the only massifs in the study area that have suitably tall and sheer cliffs for nesting by the larger, key raptors are concentrated at, and immediately around, Wadi Rum. Most other mountains in the study area are often very steeply sloping but their terrain is broken and there are no large expanses of vertical cliff (I.J. Andrews pers. comm.; pers. obs.). There are, therefore, few alternative nest sites available to key raptors if they abandon their traditional nest. This severely limits these species' future breeding success in the area. The nest sites of most of the larger raptors have still not been located, and this is an urgent priority of future bird surveys in the area, in order to manage this aspect of tourism more effectively.

All these impacts should be qualified and assessed as soon as possible, and halted or reduced or better regulated or monitored, if necessary, by the competent management authorities. Our field survey was unfortunately too brief and localised to enable us to make suggestions about the suitability of the proposed reserve boundary, and any possible realignments.

#### Impact of the expansion of irrigated agriculture

It is clear that new bird species are colonising the area in the wake of the irrigated agriculture that has sprung up in the area during the last decade. The same phenomenon has already occurred in adjacent parts of north-west and north-central Saudi Arabia, where the discovery of vast fossil water reserves and the advent of these irrigation techniques in the 1970s allowed the heavily subsidised conversion to wheat cultivation of virtually all suitable land in this vast territory. This allowed colonisation and/or dramatic population increase by the following species over the last 2 decades in Saudi Arabia (Jennings, 1995): kestrel, quail, rock dove, Eurasian collared dove, palm dove, namaqua dove, barn owl, *Tyto alba*, crested lark, black bush robin *Cercotrichas podobe*, house sparrow and desert finch. Most of these species have also recently colonised our study area, or are increasing there (see Results), and it is interesting to speculate that some of the remaining non-breeding species or unrecorded species may soon also colonise the Rum-Disi area (i.e. quail, namaqua dove, barn owl and black bush robin).

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