APPENDICES

Appendix I: Avian species recorded on Sir Bani Yas Island during the study period (2014-2018)

S	Scientific name	Abbreviation	Order	Family	English name	Feeding guild	Red List status	Migratory /Resident
1	*Acridotheres tristis*	AcriTri	*Passeriformes*	Sturnidae	Common Myna	O	LC	R
2	*Acrocephalus stentoreus*	AcroSte	*Passeriformes*	Acrocephalidae	Clamorous Reed Warbler	I	LC	M
3	*Actitis hypoleucos*	ActHyp	*Charadriiformes*	Scolopacidae	Common Sandpiper	C	LC	R
4	*Alaemon alaudiopes*	AlaAla	*Passeriformes*	Alaudidae	Greater Hoopoe-Lark	I/G	LC	M
5	*Alauda arvensis*	AlaArv	*Passeriformes*	Alaudidae	Eurassian Skylark	G/I	LC	M
6	*Alcedo atthis*	AlcAtt	*Coraciiformes*	Alcedinidae	Common kingfisher	P	LC	M
7	*Alectoris chukar*	AleChuc	*Galliformes*	Phasianidae	Chukar Partridge	G	LC	R
8	*Alopochen aegyptiaca*	AloAeg	*Accipitriformes*	Anatidae	Egyptian Goose	O	LC	R
9	*Ammomanes deserti*	AmmoDes	*Passeriformes*	Alaudidae	Desert Lark	I/ G	LC	M
10	*Ammoperdix griseogularis*	AmmoGri	*Galliformes*	Phasianidae	See-see Partridge	I	LC	R
11	*Anas platyrhynchos*	AnaPla	*Accipitriformes*	Anatidae	Mallard	O	LC	M
12	*Anser albifrons*	AnsAlb	*Accipitriformes*	Anatidae	Greater White Fronted Goose	O	LC	M
13	*Anthus campestris*	AntCam	*Passeriformes*	Motacillidae	Tawny Pipit	I	LC	M
14	*Anthus cervinus*	AntCer	*Passeriformes*	Motacillidae	Red-throated Pipit	I	LC	M
15	*Anthus richardi*	AntRich	*Passeriformes*	Motacillidae	Richard's Pipit	I/ G	LC	M

16	*Anthus spinoletta*	AntSpi	*Passeriformes*	Motacillidae	Water Pipit	I	LC	M
17	*Anthus trivialis*	AntTri	*Passeriformes*	Motacillidae	Tree Pipit	I	LC	M
18	*Apus pallidus*	ApuPal	*Accipitriformes*	Apodidae	Pallid Swift	I	LC	M
19	*Aquila chrysaetos*	AquChry	*Accipitriformes*	Accipitridae	Golden Eagle	C	LC	M
20	*Aquila fasciata*	AquFas	*Accipitriformes*	Accipitridae	Bonelli's Eagle	C	LC	M
21	*Aquila heliaca*	AquHel	*Accipitriformes*	Accipitridae	Eastern imperial Eagle	C	VU	M
22	*Ardea alba*	ArdAlb	*Pelecaniformes*	Ardeidae	Great Egret	C	LC	M
23	*Ardea cinerea*	ArdCin	*Pelecaniformes*	Ardeidae	Grey Heron	C	LC	R
24	*Ardea purpurea*	ArdPur	*Pelecaniformes*	Ardeidae	Purple Heron	C	LC	M
25	*Arenaria interpres interpres*	AreInt	*Charadriiformes*	Scolopacidae	Ruddy Turnstone	I	LC	M
26	*Balearica regulorum*	BalReg	*Gruiformes*	Gruidae	Grey Crowned Crane	O	EN	R
27	*Bubulcus ibis*	BubIbi	*Pelecaniformes*	Ardeidae	Western Cattle Egret	C	LC	M
28	*Burhinus oedicnemus*	BurOed	*Charadriiformes*	Burhinidae	Eurasian Stone-Curlew	O	LC	M
29	*Butorides striata*	ButStr	*Pelecaniformes*	Ardeidae	Striated Heron	C	LC	M
30	*Calidris alba*	CalAlb	*Charadriiformes*	Scolopacidae	Sanderling	I	LC	M
31	*Calidris alpina*	CalAlp	*Charadriiformes*	Scolopacidae	Dunlin	I	LC	M
32	*Calidris falcinellus*	CalFal	*Charadriiformes*	Scolopacidae	Broad-billed Sandpiper	I	LC	M
33	*Calidris ferruginea*	CalFer	*Charadriiformes*	Scolopacidae	Curlew Sandpiper	I	LC	M
34	*Calidris minuta*	CalMin	*Charadriiformes*	Scolopacidae	Little Stint	C	LC	M
35	*Calidris pugnax*	CalPug	*Charadriiformes*	Scolopacidae	Ruff	I	LC	M
36	*Calidris temminckii*	CalTem	*Charadriiformes*	Scolopacidae	Temminck's Stint	C	LC	M
37	*Caprimulgus europaeus*	CapEur	*Caprimulgiformes*	Caprimulgidae	European Nightjar	I	LC	M

38	*Cercotrichas galactotes*	CerGal	*Passeriformes*	Muscicapidae	Rufous-tailed Scrub Robin	I	LC	M
39	*Cercropis daurica*	CerDau	*Passeriformes*	Hirundinidae	Red-rumped Swallow	I	LC	M
40	*Charadrius alexandrinus*	CharAle	*Charadriiformes*	Charadriidae	Kentish Plover	I	LC	M
41	*Charadrius dubius*	CharDub	*Charadriiformes*	Charadriidae	Little Ringed Plover	I	LC	M
42	*Charadrius hiaticula*	CharHia	*Charadriiformes*	Charadriidae	Common Ringed Plover	O	LC	M
43	*Charadrius leschenaultii*	CharLes	*Charadriiformes*	Charadriidae	Greater Sand Plover	I	LC	M
44	*Charadrius mongolus*	CharMon	*Charadriiformes*	Charadriidae	Lesser Sand Plover	I	LC	M
45	*Chlamydotis undulata*	ChlaUnd	*Otidiformes*	Otidae	Houbara bustard	O	VU	R
46	*Chlidonias hybrida*	ChliHyb	*Charadriiformes*	Laridae	Whiskered Tern	C	LC	M
47	*Chroicocephalus genei*	ChroGen	*Charadriiformes*	Laridae	Slender billed Gull	C	LC	M
48	*Chroicocephalus ridibundus*	ChrRid	*Charadriiformes*	Laridae	Black-headed Gull	C	LC	M
49	*Chroicocephalus saundersi*	ChroSau	*Charadriiformes*	Laridae	Saunder’s Tern	C	LC	M
50	*Cinnyris asiaticus*	CinAsi	*Passeriformes*	Nectariniidae	Purple Sunbird	N	LC	M
51	*Circus aeruginosus*	CirAer	*Accipitriformes*	Accipitridae	Western Marsh Harrier	C	LC	M
52	*Circus macrourus*	CirMac	*Accipitriformes*	Accipitridae	Pallid Harrier	C	NT	M
53	*Circus pygargus*	CirPyg	*Accipitriformes*	Accipitridae	Montagu’s Harrier	C	LC	M
54	*Clanga Clanga*	ClaCla	*Accipitriformes*	Accipitridae	Greater Spotted Eagle	C	VU	M
55	*Columba livia*	ColLiv	*Columbiformes*	Columbidae	Rock Dove	G	LC	R

56	*Coracias benghalensis*	CorBen	*Coraciiformes*	Coraciidae	Indian roller	C	LC	M
57	*Coracias garrulus*	CorGar	*Coraciiformes*	Coraciidae	European Roller	G/I	LC	M
58	*Corvus splendens*	CorSpl	*Passeriformes*	Corvidae	House Crow	S	LC	R
59	*Coturnix coturnix*	CotCot	*Galliformes*	Phasianidae	Common Quail	G	LC	R
60	*Delichon urbicum*	DelUrb	*Passeriformes*	Hirundinidae	Common House Martin	I	LC	M
61	*Egretta garzetta*	EgrGar	*Pelecaniformes*	Ardeidae	Litte Egret	C	LC	M
62	*Egretta gularis*	EgrGul	*Pelecaniformes*	Ardeidae	Western Reef Heron	C	LC	R
63	*Emberiza calandra*	EmbCal	*Passeriformes*	Emberizidae	Corn Bunting	G	LC	M
64	*Emberiza hortulana*	EmbHor	*Passeriformes*		Ortolan Bunting	I	LC	M
65	*Eremopterix nigriceps*	EreNig	*Passeriformes*	Alaudidae	Black-crowned sparrow-lark	I/G	LC	M
66	*Euodice malabarica*	EuoMal	*Passeriformes*	Estrildidae	Indian Silverbill	G	LC	M
67	*Falco naumanni*	FalNau	*Falconiformes*	Falconidae	Lesser Kestrel	C	LC	M
68	*Falco peregrinus*	FalPer	*Falconiformes*	Falconidae	Peregrine Falcon	C	LC	M
69	*Falco subbuteo*	FalSub	*Falconiformes*	Falconidae	Eurasian hobby	C	LC	M
70	*Falco tinnunculus*	FalTin	*Falconiformes*	Falconidae	Common Kestrel	C	LC	R
71	*Ficedula parva*	FicPar	*Passeriformes*	Muscicapidae	Red-breasted Flycatcher	I	LC	M
72	*Francolinus francolinus*	FraFra	*Galliformes*	Phasianidae	Black Francolin	I	LC	R
73	*Francolinus pondicerianus*	FraPon	*Galliformes*	Phasianidae	Grey Francolin	O	LC	R
74	*Fulica atra*	FulAtra	*Gruiformes*	Rallidae	Eurasian Coot	O	LC	M
75	*Galerida cristata*	GalChlo	*Passeriformes*	Alaudidae	Crested Lark	I/ G	LC	M
76	*Gallinago gallinago*	GalCri	*Charadriiformes*	Scolopacidae	Common Snipe	C	LC	M
77	*Gallinula chloropus*	GalGal	*Gruiformes*	Rallidae	Common Moorhen	O	LC	M
78	*Gelochelidon nilotica*	GelNil	*Charadriiformes*	Laridae	Gull-billed Tern	C	LC	M

79	*Glareola pratincola*	GlaPra	*Charadriiformes*	Glareolidae	Collared Pratincole	I	LC	M
80	*Haematopus ostralegus*	HaeOst	*Charadriiformes*	Haematopodidae	Eurasian Oystercatcher	I	LC	M
81	*Himantopus himantopus*	HimHim	*Charadriiformes*	Recurvirostridae	Black-winged Stilt	C	LC	M
82	*Hippolais languida*	HipLan	*Passeriformes*	Acrocephalidae	Upcher's Warbler	I	LC	M
83	*Hirundo rustica*	HirRus	*Passeriformes*	Hirundinidae	Barn Swallow	I	LC	M
84	*Hydroprogne caspia*	HydCas	*Charadriiformes*	Laridae	Caspian Tern	C	LC	M
85	*Ichthyaetus hemprichii*	IchtHem	*Charadriiformes*	Laridae	Sooty Gull	C	LC	M
86	*Iduna pallida*	IduPal	*Passeriformes*	Acrocephalidae	Eastern Olivaceous warbler	I/F	LC	M
87	*Ixobrychus mintus*	IxoMin	*Pelecaniformes*	Ardeidae	Little Bittern	C	LC	M
88	*Lanius collurio*	LanCol	*Passeriformes*	Laniidae	Red-backed Shrike	I	LC	M
89	*Lanius isabellinus*	LanIsa	*Passeriformes*	Laniidae	Isabelline Shrike	I	LC	M
90	*Lanius meridionalis aucheri*	LanMer	*Passeriformes*	Laniidae	Southern grey shrike	I	LC	M
91	*Lanius meridionalis pallidirostris*	LanMer2	*Passeriformes*	Laniidae	Steppe Grey Shrike	I	LC	M
92	*Lanius nubicus*	LanNub	*Passeriformes*	Laniidae	Masked Shrike	I	LC	M
93	*Lanius senator*	LanSen	*Passeriformes*	Laniidae	Woodchat Shrike	I	LC	M
94	*Larus cachinnans*	LarCach	*Charadriiformes*	Laridae	Caspian Gull	C	LC	M
95	*Larus fuscus barabensis*	LarFus1	*Charadriiformes*	Laridae	Lesser Black-backed Gull	C	LC	M
96	*Larus fuscus heuglini*	LarFus2	*Charadriiformes*	Laridae	Lesser Black-backed Gull (Heuglin's)	C	LC	M

97	*Limosa lapponica*	LimLap	*Charadriiformes*	Scolopacidae	Bar-tailed Godwit	I/F	NT	M
98	*Limosa limosa*	LimLim	*Charadriiformes*	Scolopacidae	Black-tailed Godwit	C	LC	M
99	*Luscinia megarhynchos*	LusMeg	*Passeriformes*	Muscicapidae	Common Nightingale	I	LC	M
100	*Luscinia svecica*	LusSve	*Passeriformes*	Muscicapidae	Bluethroat	I	LC	M
101	*Merops apiaster*	MerApi	*Coraciiformes*	Meropidae	European Bee-eater	I	LC	M
102	*Monticola saxatilis*	MonSax	*Passeriformes*	Muscicapidae	Common Rock Thrush	I/ G	LC	M
103	*Monticola solitarius*	MonSol	*Passeriformes*	Muscicapidae	Blue Rock Thrush	O	LC	M
104	*Motacilla alba*	MotAlb	*Passeriformes*	Motacillidae	White Wagtail	I	LC	M
105	*Motacilla cinerea*	MotCin	*Passeriformes*	Motacillidae	Grey Wagtail	I	LC	M
106	*Motacilla citreola*	MotCit	*Passeriformes*	Motacillidae	Citrine Wagtail	I	LC	M
107	*Motacilla flava*	MotFla	*Passeriformes*	Motacillidae	Western Yellow Wagtail	I	LC	M
108	*Muscicapa striata*	MusStr	*Passeriformes*	Muscicapidae	Spotted Flycatcher	I	LC	M
109	*Numenius arquata*	NumArq	*Charadriiformes*	Scolopacidae	Eurasian Curlew	G/I	LC	R
110	*Numenius phaeopus*	NumMel	*Charadriiformes*	Scolopacidae	Whimbrel	C	LC	M
111	*Numida meleagris*	NumPha	*Galliformes*	Numididae	Helmeted Guineafowl	I	LC	R
112	*Nycticorax nycticorax*	NycNyc	*Pelecaniformes*	Ardeidae	Black-crowned Night Heron	C	LC	M
113	*Oena capensis*	OenCap	*Columbiformes*	Columbidae	Namaqua dove	I/ G	LC	M
114	*Oenanthe chrysopygia*	OenChry	*Passeriformes*	Muscicapidae	Red-tailed Wheatear	I	LC	M
115	*Oenanthe deserti*	OenDes	*Passeriformes*	Muscicapidae	Desert Wheatear	I/ G	LC	M

116	*Oenanthe isabellina*	OenIsa	*Passeriformes*	Muscicapidae	Isabelline Wheatear	I	LC	M
117	*Oenanthe oenanthe*	OenOen	*Passeriformes*	Muscicapidae	Northren Wheatear	I	LC	M
118	*Oenanthe pleschanka*	OenPle	*Passeriformes*	Muscicapidae	Pied Wheater	I	LC	M
119	*Onychoprion anaethetus*	OnyAna	*Charadriiformes*	Laridae	Bridled Tern	O	LC	M
120	*Pandion haliaetus*	PanHal	*Accipitriformes*	Pandionidae	Osprey	C	LC	R
121	*Passer domesticus*	PasDom	*Passeriformes*	Passeridae	House Sparrow	O	LC	R
122	*Passer hispaniolensis*	PasHis	*Passeriformes*	Passeridae	Spanish Sparrow	I/ G	LC	M
123	*Pastor roseus*	PasRos	*Passeriformes*	Sturnidae	Rosy Starling	O	LC	M
124	*Pavo cristatus*	PavCri	*Galliformes*	Phasianidae	Indian Peafowl	O	LC	R
125	*Phalacrocorax Carbo*	PhaCar	*Suliformes*	Suliformes	Greater Cormorant	C	LC	M
126	*Phalacrocorax nigrogularis*	PhaNig	*Suliformes*	Suliformes	Socotra Cormorant	C	VU	M
127	*Phoenicopterus roseus*	PhoePh	*Phoenicopteriformes*	Phoenicopteridae	Greater Flamingo	C	LC	M
128	*Phoenicurus phoenicurus*	PhoRos	*Passeriformes*	Muscicapidae	Common Redstart	G/I	LC	M
129	*Phylloscopus collybita*	PhyCol	*Passeriformes*	Phylloscopidae	Common Chifchaff	I	LC	M
130	*Phylloscopus trochilus*	PhyTro	*Passeriformes*	Phylloscopidae	Willow Warbler	I	LC	M
131	*Pluvialis fulva*	PluFul	*Charadriiformes*	Charadriidae	Pacific Golden Plover	I	LC	M
132	*Pluvialis squatarola*	PluSqu	*Charadriiformes*	Charadriidae	Grey Plover	C	LC	M
133	*Prinia gracilis*	PriGra	*Passeriformes*	Cisticolidae	Graceful Prinia	I	LC	M
134	*Psittacula krameri*	PsiCra	*Psittaciformes*	Psittaculidae	Rose-ringed Parakeet	F	LC	R
135	*Pterocles exustus*	PteExu	*Pterocliformes*	Pteroclidae	Chestnut-bellied Sandgrouse	I	LC	M

136	*Ptyonoprogne obsolete*	PtyObs	*Passeriformes*	Hirundinidae	Pale Crag Martin	I	LC	M
137	*Pycnonotus leucotis*	PycLeu	*Passeriformes*	Pycnonotidae	White-eared Bulbul	O	LC	R
138	*Riparia riparia*	RipRip	*Passeriformes*	Hirundinidae	Sand Martin	I	LC	M
139	*Saxicola maurus*	SaxMau	*Passeriformes*	Muscicapidae	Siberian Stonechat	I	LC	M
140	*Saxicola rubetra*	SaxRub	*Passeriformes*	Muscicapidae	Whinchat	I	LC	M
141	*Saxicola rubicola*	SaxRubi	*Passeriformes*	Muscicapidae	European Stonechat	I	LC	M
142	*Spilopelia senegalensis*	SpiSen	*Columbiformes*	Columbidae	Laughing Dove	I/ G	LC	R
143	*Sterna hirundo*	SteHir	*Charadriiformes*	Laridae	Common Tern	C/I	LC	M
144	*Sterna repressa*	SteRep	*Charadriiformes*	Laridae	White-cheeked tern	C	LC	M
145	*Sternula albifrons*	SteAlb	*Charadriiformes*	Laridae	Little Tern	C	LC	M
146	*Streptopelia decaocto*	StrDec	*Columbiformes*	Columbidae	Eurasian Collared Dove	G	LC	R
147	*Streptopelia turtur*	StrTur	*Columbiformes*	Columbidae	European Turtle Dove	F/I	LC	M
148	*Sturnus vulgaris*	StuVul	*Passeriformes*	Sturnidae	Common Starling	O	LC	M
149	*Sylvia atricapilla*	SylAtr	*Passeriformes*	Sylviidae	Eurasian Blackcap	I/F	LC	M
150	*Sylvia communis*	SylCom	*Passeriformes*	Sylviidae	Common Whitethorat	I/ G	LC	M
151	*Sylvia minula*	SylMin	*Passeriformes*	Sylviidae	Desert Whitethroat	I/ G	LC	M
152	*Sylvia mystacea*	SylMys	*Passeriformes*	Sylviidae	Menetries' Warbler	I/F	LC	M
153	*Thalasseus bengalensis*	ThaBen	*Charadriiformes*	Laridae	Lesser Crested Tern	C	LC	M

154	*Thalasseus sandvicensis*	ThaSan	*Charadriiformes*	Laridae	Sandwich Tern	C	LC	M
155	*Tringa erythropus*	TriEry	*Charadriiformes*	Scolopacidae	Spotted Redshank	I	LC	M
156	*Tringa nebularia*	TrinNeb	*Charadriiformes*	Scolopacidae	Common Greenshank	C	LC	M
157	*Tringa ochropus*	TriOchr	*Charadriiformes*	Scolopacidae	Green Sandpiper	C	LC	M
158	*Tringa stagnatilis*	TriSta	*Charadriiformes*	Scolopacidae	Marsh Sandpiper	C	LC	M
159	*Tringa totanus*	TriTot	*Charadriiformes*	Scolopacidae	Common Redshank	I	LC	M
160	*Turdus philomelos*	TurPhi	*Passeriformes*	Turdidae	Song Thrush	O	LC	M
161	*Tyto alba*	TytAlb	*Strigiformes*	Tytonidae	Western Barn Owl	C	LC	R
162	*Upupa epops*	UpuEpo	*Bucerotiformes*	Upupidae	Hoopoe	O	LC	M
163	*Vanellus indicus*	VanInd	*Charadriiformes*	Charadriidae	Red-wattled Lapwing	O	LC	R
164	*Xenus cinereus*	XenCin	*Charadriiformes*	Scolopacidae	Terek Sandpiper	I	LC	M

Appendix II: Some aspects of breeding ecology and threats to Saunders's tern (*Sternula saundersi*) at an offshore island of United Arab Emirates.

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Breeding Behavior and Threats to Saunders's Tern (*Sternula saundersi*) at Sir Bani Yas Island, United Arab Emirates

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Abstract.—The numbers of Saunders's Tern (*Sternula saundersi*) are decreasing globally, and the species' biology remains poorly known. This study used camera traps to determine clutch size, incubation period, hatching and fledging success, and threats to breeding Saunders's Terns on Sir Bani Yas Island, United Arab Emirates. Six nests were selected in each breeding season (12 nests total) from April to June 2017 and 2018 (out of 9 and 8 nests, respectively). The mean clutch size during the two-year period was 1.50 ± 0.22 SE and 1.33 ± 0.21 eggs per nest in 2017 and 2018, respectively. The mean incubation period was 18.97 ± 0.33 days. The mean hatching success was 62.5% in 2017and 45% in 2018. Out of the 12 nests, three nests did not produce any successful chicks, as one nest failed due to predation by feral cats and two due to anthropogenic factors. The monitoring of chicks with camera traps was limited due to their active movement patterns after the third day, but 80-100% of chicks successfully departed nests, and the colony fledged 75-86% of known chicks. *Received 12 November 2019, accepted 29 January 2020.*

Key words.—Breeding success, disturbance, camera traps, incubation period, parental care, predation, Saunders's Tern, *Sternula saundersi*.

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Saunders's Tern (*Sternula saundersi*) is listed as Least Concern (LC) by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (BirdLife-International 2016). It is a small bird that is marginally larger than a swift and has a black bill, outer primaries and head. In breeding plumage, the species has a yellow bill that ends in a black tip and develops a white triangular forehead patch (Aspinall *et al.* 2011). The breeding range of Saunders's Tern includes the United Arab Emirates (UAE), Yemen, Sudan, Somalia, Sri Lanka, Saudi Arabia, Qatar, Pakistan, Oman, Maldives, Bahrain, India, and Madagascar (BirdLife-International 2016). In the UAE, it is a summer and autumn visitor along the eastern coast (Aspinall *et al.* 2011), and in particular, a summer breeder at Sir Bani Yas Island, UAE, where it breeds on the northern and eastern coastline. Saunders's Tern spends winters outside its breeding range (Burger and Gochfeld 1996). Although the species is poorly studied, significant threats that have been reported for Saunders's Tern include predation and anthropogenic factors (Burger and Gochfeld 1996).

Saunders's Tern usually breeds in non-social pairs or may breed in small, loose colonies that range from five to thirty pairs (Burger and Gochfeld 1996). Nests have been recorded up to 2 km inland and are usually small depressions on the bare surface of sand or dried mud. Preferred nesting sites are sand mounds near vegetation (Burger and Gochfeld 1996). Neighboring nests are approximately 20-100 m within these loose colonies. Nests lack any isolation materials (e.g., twigs, grass, and feathers) or cover and are entirely exposed to extreme environmental and ecological stressors. The breeding season usually lasts from March to June, during which both male and female partners participate in the incubation of the eggs (Shobrak and Aloufi 2014; AlRashidi and Shobrak 2015; Burger and Gochfeld 1996).

Breeding success is critical for the maintenance of viable populations. Decreasing trends in the numbers of breeding pairs of Saunders's Tern have been documented globally every year. Studies in Iran in the 1970s and in Bahrain from 1969 to 1981 suggested a substantial decrease in the numbers of breeding pairs (BirdLife-International 2016). This study provides insight into the breeding ecology and threats to breeding pairs of the species, and we assessed the incubation routine, threats and the breeding success of Saunders's Tern on Sir Bani Yas Island, UAE.

Methods

Study Area

Sir Bani Yas Island (24° 18′ 41.04′″ N 52° 35′ 45.24″ E) is considered the largest natural island in the Emirate of Abu Dhabi, UAE. The island is located 180 km southwest of Abu Dhabi and 8 km offshore from the city of Ruwais. Sir Bani Yas Island has arid habitat types (annual rainfall = 150 mm) and a varied topography with small mountains and coastal habitats. The coastal habitat is a mixture of intertidal mudflats, rocky shores, sandy beaches, and mangroves (Dhaheri *et al.* 2017a). It has a total area of 8700 ha, including the 4100 ha Arabian Wildlife Park in the center of the island (Dhaheri *et al.* 2017b).

Saunders's Terns start migrating into the island during March and depart for the winter in September. The primary breeding site was a 1-km coastal patch (a sandy, barren, flat area next to the beach) on the northern side of the island, with a loose colony of an average of twelve to fifteen pairs of Saunders's Tern. However, not all pairs exhibited courtship behaviors or constructed nests. The breeding site was characterized by open sandy gravel with or without scarce *Zygophyllum simplex* vegetation and was near five-star hotel properties with a service road adjacent to the nesting sites.

Data Collection

The study was conducted from April to June of 2017 and 2018. Breeding pairs were counted and monitored using binoculars (Steiner Skyhawk 10x42) and spotting scopes (Yukon 6-100x100; SKU2103IK) during preliminary field surveys to observe the selection of nesting sites. The nests were located, and their GPS locations were recorded (AlRashidi and Shobrak 2015).

One camera trap (ReconyxPC800 Hyperfire Professional IR) was installed approximately 1.5 m from each nest and was camouflaged to avoid distress to the birds (AlRashidi and Shobrak 2015). During camera installation, egg morphometrics were recorded carefully with a Vernier caliper without disturbing the nest. Cameras were programmed to take five photographs at an interval of one second after every detected movement. Date, time, and ambient temperature were recorded with each photograph. The night vision capacity of the cameras enabled monitoring of incubation activities even during the night. Incubation bout durations were determined using photographs to determine initiation and cessation times of each bout by a parent. The clutch size and number of hatchlings were recorded. After hatching, the duration of parental care of the chicks was recorded in minutes from beginning to end through photographs. Activities recorded under parental care included feeding chicks, brooding, chicks resting in the nest, and latent learning. Such behaviors were recorded for a maximum duration of 96 h after the last hatchling. Chicks could not be further monitored after this period due to their high mobility and frequent movement outside of the camera range. The mean time spent in each activity were then calculated for day and night. The photographs from the camera traps assisted in the detection of the total days of incubation and egg hatching success or failure of the nest.

Data Analysis

The density of nesting pairs at the breeding site was calculated by dividing the number of nesting pairs by the area of the breeding site. The fledging period was determined as the number of days from the hatching of the first eggs until chicks were able to fly in the colony. The disturbance frequency was calculated by counting the number of times the birds were disturbed out of the nests due to the movement of vehicles through the photographs.

Correlations between hatching success and the distances of nests from the sea and service road were analyzed using Minitab® 18.1 (Minitab Inc., Pennsylvania, United States). Hatching success was calculated as the percentage of eggs that successfully hatched, and chick success was calculated as percentage of hatchlings that successfully left nests. Colony fledging success was calculated as the percentage of known chicks that successfully fledged (observed flying in the colony). Means are reported ± SE.

The diurnality index of the parental care activities, such as feeding, the time spent by the chicks under the wings of the parents, and exploration and resting by the chick in the presence and absence of parents, were calculated using the formula (Hoogenboom *et al.* 1984):

$$\text{Diurnality index} = (cd / td - cn / tn) / (cd / td + cn / tn)$$

Where cd = sum of the activity values during the day; cn = sum of the activity values during the night; td = numbers of sample intervals during the day; and tn = numbers of sample intervals during the night. The resulting value of the diurnality index is from -1 to +1; negative values suggest nocturnal activity, positive values suggest diurnal activity, and a value of 0 suggests similar proportions of nocturnal and diurnal activities.

Results

We analyzed 51,942 photographs from 12 (71%) of 17 total nests (Table 1). Density of breeding pairs was 0.94 pairs/ha in 2017 and 0.68 pairs/ha in 2018 (nest area in Table 1). Nest initiation and first egg-laying occurred in the first week of April. The eggs were pale

Table 1. Breeding performance of Saunders's Terns (*Sternula saundersi*) at Sir Bani Yas Island, UAE, April-June 2017 and 2018 (mean ± SE). Differences between neighboring nests were significantly larger in 2018 than in 2017 (Mann-Whitney test, $P < 0.05$); no other differences between 2017 and 2018 were statistically significant.

Parameter	2017	2018
Nesting area (ha)	11.7	11.7
Number of nests	9[a]	8
Nests studied	6	6
Distance from sea (m)	56 ± 10	76 ± 15
Distance from service road (m)	28 ± 8	40 ± 12
Distance from nearest neighboring nest (m)	28 ± 5	60 ± 6
Clutch size (eggs)	1.33 ± 0.21	1.50 ± 0.22
Egg length (mm)	32.1 ± 0.16	32.1 ± 0.08
Egg breadth (mm)	23.9 ± 0.08	24.0 ± 0.05
Incubation period (A-egg) (d)	19.2 ± 0.45	18.8 ± 0.51
Hatching success (% of eggs)	62.5	45
Chick success (% of chicks departing nests)	80	100
Fledging period (d)	25.6 ± 3.7	27.2 ± 1.4
Colony fledging success (% of known chicks)	75	86

[a]Excluding two nests deserted soon after nest construction

colored with dark brownish spots for camouflage. Nests were nearer the sea and service road in 2017, and egg measurements were consistent between years (Table 1).

The mean clutch size was 1.50 ± 0.22 and 1.33 ± 0.21 eggs per nest in 2017 and 2018, respectively (Table 1). The mean incubation period was 18.97 ± 0.33 days (Table 1). The mean hatching success was 62.5% in 2017 and 45% in 2018, and 80-100% of chicks successfully departed nests (Table 1). The colony fledged 75-86% of known chicks (Table 1). There were no significant correlations between hatching success and distance from sea (r = -0.540, $P = 0.070$), service road (r = 0.132, $P = 0.682$), nor neighboring nests (r = -0.160, $P = 0.618$).

The diurnality indices indicated a slight bias of most observed behaviors as occurring more diurnally, except for incubation and chicks resting (Table 2). There was a statistically significant difference in the incubation routine between day and night ($Z = 3.05$, $P = 0.0022$), and the diurnality index indicated a greater incidence of incubation at night (Table 2). The birds incubated more during the night compared to during the mid-day periods, and both parents were involved in incubation, although it was not possible to differentiate between sexes as there is no sexual dimorphism in Saunders's Tern. Nocturnally-biased behaviors were also associated with lower average temperatures compared to most other behaviors (Table 3).

During the mid-day period, when the birds were not incubating nests, they appeared to fly over the nests, and photographs revealed the slight movement of the eggs presumably due to the wind created by such low flights. During mid-day periods, parents either alternated foraging or both left the nest unattended to forage. In two cases, the eggs went > 20 h without incubation just one to three days before hatching. Parenting was conducted by both parents who, on the first three days during the peak forage time (mid-day), returned to the nest with a fish within 10 to 15 minutes. Once a

Table 2. Diurnality Index of different activities of Saunders's Terns (*Sternula saundersi*) at Sir Bani Yas Island, UAE, April-June 2017 and 2018. Negative values indicate behaviors occurring more often or longer at night and positive values indicate those that are diurnal.

Behavior	Diurnality Index
Disturbance	0.41
Feeding by parents	0.79
Parental care	0.91
Incubation	-0.12
Flying over nest	0.42
Feeding by chicks	0.82
Brooding	0.88
Latent learning w/parents	0.93
Latent learning wo/parents	0.68
Resting in absence of parents	-0.52

Table 3. Ambient temperatures in relation to different activities of Saunders's Terns (*Sternula saundersi*) at Sir Bani Yas Island, UAE, April-June 2017 and 2018.

	Temperature (°C)		
Behavior	Average	Min.	Max.
Incubation	33.7 ± 0.6	29.8	38.9
Feeding (parents)	35.9 ± 0.9	30.1	38.9
Parental care	35.8 ± 0.7	30.1	38.9
Flying over nest	35.7 ± 1.3	29.8	38.9
Feeding by chicks	37.5 ± 0.9	33.8	39.9
Brooding	36.7 ± 0.7	33.4	39.9
Latent learning w/parents	30.8 ± 0.6	29.8	34.5
Latent learning wo/parents	33.8 ± 0.7	30.1	35.6
Resting in absence of parents	31.7 ± 0.7	28.8	36.9

parent came to a chick with a fish, the other parent flew away to hunt and bring food to the growing chicks.

Out of twelve nests we monitored, three nests failed completely. The data from the camera traps revealed that one nest failed due to predation by feral cats, while two nests failed due to anthropological factors (movement of vehicles and vehicle noise). At the nests that failed due to anthropological factors, the mean disturbance (by vehicles passing by) of failed nests was substantially higher (52 ± 2 times per day) in comparison to the successful nests (5.6 ± 0.2 times per day).

Discussion

Saunders's Tern preferred coastal areas with scarce vegetation for nest sites. Similarly, the closely related Little Tern (*Sternula albifrons*) and Least Tern (*Sternula antillarum*) prefer open, sandy beaches and islands as their breeding sites (Oro *et al.* 2004; Thompson *et al.* 1997). According to a study on the biology of Little Tern, 63% of nesting colonies were on beaches (Oro *et al.* 2004). The nest of Saunders's Tern is a depression in the ground, similar to the Little Tern and Least Tern (Oro *et al.* 2004; Thompson *et al.* 1997). In the current study, Saunders's Terns were found in loose colonies, similar to Little Tern and Least Tern that form colonies up to 30 pairs (Massey 1977; Oro *et al.* 2004). However, not all birds in the colonies breed (Fraser 2017). In the current study, the pairs involved in breeding were almost half of the colony, while the remainder were nonbreeders.

Our mean clutch size for Saunders's Tern was lower compared to the mean clutch size of 2-3 eggs in Least Tern and Little Tern (Thompson *et al.* 1997; Fraser 2017; Pakanen *et al.* 2014). There are no previously reported egg measurements for Saunders's Tern to compare with our results. Egg size may indicate the health of the breeding pair, quality of habitat and abundance of food, and may also affect the hatching success (Oro *et al.* 2004). In Little Tern and Least Tern, second and third attempts to breed after prior nest failure (replacement nests) in the same breeding season have been reported, however, clutch size was usually reduced to 1-2 eggs (Fraser 2017). Pakanen (2014) reported 54% replacement nests in Little Tern. It may be hypothesized that replacement nests can be an attempt to increase breeding success of the colony. However, no hatchlings were recorded by Pakanen (2014) out of replacement nests.

Both Saunders's Tern parents were observed incubating eggs, similar to Little Tern and Least Tern (AlRashidi and Shobrak 2005; Thompson *et al.* 1997). In our study, the duration of the incubation period was similar to the reported incubation period of 17-22 days in Little Tern (Fraser 2017). During the incubation phase, parents take on the costs of the survival of their eggs and maintain an optimal temperature for chick growth. These costs include loss of foraging time and risk of exposure to predators. Moreover, they must combat harsh weather

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conditions to protect the growing embryos in the eggs. The optimal temperature for many bird species during incubation is 36-40.5°C. Timing of the breeding season is thus a critical factor to the breeding success and is an adaptation to avoid extreme climatic conditions of the year (AlRashidi and Shobrak 2015). The recorded temperatures during the breeding season on Sir Bani Yas Island were between 28.8-39.9°C. However, the temperature may rise to near 50°C later during the year.

The diurnality index in our study suggests that the Saunders's Tern incubated more during the night compared to the day times, possibly to cope with lower temperatures during the night. AlRashidi and Shobrak (2015) reported Saunders's Tern incubated more when the ambient temperatures were near or below 25 °C (as temperature below 25 °C can be lethal for the embryo) and incubated less when temperatures were high. Moreover, they observed less incubation during morning and evening, which could be associated with peak foraging times for the parents or increased activity of predators. Saunders's Tern are pugnacious and defend their nest from predators. Similar behavior is also reported for Least Tern (Thompson *et al.* 1997). Parents were observed flying aggressively over the nest in our study and by AlRashidi and Shobrak (2005), an adaptive behavior to deter predators.

If Saunders's Terns anticipate high predation risk or extreme daytime temperatures are intolerable, they may abandon their eggs during incubation (Amat and Masero 2004). Similar behavior is reported in Little Tern, abandoning their eggs if there is disturbance or heavy rain (Pakanen 2014). Predation is one of the major threats to the breeding success of terns. In our study, nest predation by cats was one of the contributing factors to nest failure. Similarly, predators such as gulls, dogs, and ravens have been reported to affect breeding success of Little Tern and Least Tern (Thompson *et al.* 1997; Swickard 1972). Pakanen (2014) reported 60% of nest failure in Little Tern was due to predation. In our study, chicks moved around in the breeding site, usually staying close to rocks or plants for cover. The same behavior is reported in the chicks of other tern species (Oro *et al.* 2004; Thompson *et al.* 1997), which demonstrate escape behavior in response to any threat, covering dozens of meters and seeking immediate cover. Chick mortality is reported due to abandonment by the parents, starvation, and exposure to extreme weather conditions in Least Tern (Swickard 1972). The mean fledgling survival rate was higher in our study compared to the mean fledging rate of 45% in Little Tern (Fraser 2017). Swickard (1972) reported 56-74% mortality rate from hatchling to fledgling for Least Tern.

Our results provide details on the nesting biology of Saunders's Tern, adding valuable knowledge about a poorly studied species and revealing similarities with its congeners as would be expected. The deployment of a higher number of camera traps in future years around breeding sites could provide more insight into the nesting biology and identify threats to the species. Therefore, we recommend further studies to extensively cover these limitations and to provide deeper insight into the breeding success of this species.

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Appendix III: Determining population trend and breeding biology of Common Kestrel (*Falco tinnunculus*) at Sir Bani Yas Island of Emirates.

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DETERMINING POPULATION TREND AND BREEDING BIOLOGY OF COMMON KESTREL (*FALCO TINNUNCULUS*) AT SIR BANI YAS ISLAND OF EMIRATES

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ABSTRACT

Successful breeding is associated with propagation and well-being of the species and requires a healthy and intact ecosystem. However, to analyse these effects, the knowledge of the natural behaviours and variations in the breeding biology of the birds is essential. Common kestrel (*Falco tinnunculus*) is widely distributed in Asia, Africa and Europe. The current study was designed to evaluate the population trends and breeding success of common kestrel in Sir Bani Yas Island from 2014-2018, and to provide an insight to the survival of this species in a restored habitat. Population of common kestrel was monitored through line transect method by categorising it into three habitat types *viz*. Mountains, Forests, and Pastures/open area. In each habitat category, two transects of 2,000 meters length and 200 meters width on each side were laid. The population data from three habitat types showed statistically significant difference in preference of habitat types (H-Value = 27.43, DF = 2, P-Value = 0.0000011). The birds showed preference of open/pasture habitats in non-breeding season and mountains during breeding season. The courtship and nesting started during early April and the eggs were laid during late April. The average clutch size was 3.75 ± 0.31 eggs per clutch. The average incubation period was 29.13 ± 0.52 days resulting in average hatchlings of 3.50 ± 0.53 chicks. The eggs were incubated 74.02 ± 1.69 % and were unattended for 24.54 ± 1.64 % of the total incubation period. The finding of this study can be used as future reference to study the breeding success of the species and provide cues for further improvement of the ecosystem conditions by improving the habitat condition on the Island based ecosystems.

Key words: Afforestation, Apex predators, Breeding Behaviour, Common Kestrel, Ecological health

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INTRODUCTION

Aves are one of the principal classes of vertebrates, surrogated as ecological health indicators. They assist in the assessment of changes in the ecosystem, ecological health, and effects and risks to the ecological set up by climate change and anthropogenic activities (O'Connell *et al.,* 2007). Birds of prey can endorse increased biodiversity by both facilitation of resources and making them available to species that could not otherwise avail them, and by trophic cascades, i.e. by affecting the trophic levels (Sergio *et al.,* 2008). Top predators are used as conservation tools and are very effective to determine ecological health (Ronka *et al.,* 2011).

Successful breeding is regarded as an indicator of a healthy and intact ecosystem; any changes in breeding success can immediately provide cues for degrading ecological health that can be a result of environmental changes or anthropogenic catastrophes (Ronka *et al.,* 2011). However, to analyse these effects and aim the interpretations towards the conservation and management interventions, the knowledge of the natural behaviours and variations in the breeding biology of the birds is essential (Ronka *et al.,* 2011).

The reproductive success is influenced by many factors such as photoperiod, availability of food during the breeding season, climate conditions, geographic variation of the breeding areas, presence or absence of predators, as well as the extent of human disturbance. All these factors may affect the onset of the courtship, egg laying, clutch size and fledging success in a given ecological set up (Bustamante and Rodriguez, 2003; Carrillo and Gonzalez-Davila, 2010; Vasko *et al.,* 2011).

Common kestrel (*Falco tinnunculus*) belongs to family Falconidae and is listed as Least Concern (LC) in Red List of Threatened Species by IUCN (BirdLife-International, 2016). In the United Arab Emirates (UAE) it is winter visitor and passage migrant with some resident populations (Aspinall *et al.,* 2011). Common kestrel prefers mountainous and rocky areas but is also found in deserts, forests, farmlands, towns and gardens (Anushiravani and Roshan, 2017a; Aspinall *et al.,* 2011).

The breeding pairs usually select cliff, tree cavities, crags, poles, artificial nesting boxes or sometimes building structures; they are also known to usurp nests from other species (Anushiravani and Roshan, 2017a; Hustler, 1983). The reported start of the courtship and nest selection is late March, and egg laying starts between late April and early May with an average clutch size of 3-6 eggs (Massemin *et al.,* 2002; Valkama *et al.,* 2002). The incubation in common kestrel is reported to be between 27-31 days; and the average fledging period is 27-39 days (Valkama *et al.,* 2002; Anushiravani and Roshan, 2017a).

Sir Bani Yas Island was developed as a wildlife reserve for the conservation of endangered species. The island was transformed from barren, arid land to suitable habitat for more than 160 migratory and resident bird species by the plantation of more than two million trees (Mehmood *et al.,* 2014). The abundance of prey species started attracting many raptors including eagles, falcons, harriers, osprey and kestrel. As discussed earlier, to assess the ecological health by surrogating birds of prey, it is imperative to note their behaviours, population trends and breeding pattern over the period to be able to infer the signals of a requirement of conservation intervention. There is no reported study on the breeding of common kestrel in UAE and in Sir Bani Yas Island. The current study was designed to evaluate the population trends and breeding success of common kestrel in Sir Bani Yas Island and to provide an insight to the survival of this species in a restored habitat and to serve as a guideline for further studies and management interventions regarding the conservation of these apex predators.

MATERIALS AND METHODS

Study Area: Sir Bani Yas Island is regarded as the largest natural island in the Emirate of Abu Dhabi, UAE (Figure 1). It is 180 km south-west of Abu Dhabi city and 8 km offshore with a total area of 87km² (Kabeer *et al*., 2020).The island is declared as a protected area for conservation of endangered and indeginous fauna and flora (Mehmood *et al.,* 2014). The detailed description of the study area is presented in Table 1.

Data Collection: Population and breeding success of common kestrel was studied from January 2014 till December 2018. Population of common kestrel was monitored through line transect method monthly (Sutherland *et al.,* 2004). The island was categorised into three habitat types viz. Mountains, Forests, and Pastures/open land. In each habitat category, two transects were laid; each transect was 2,000 meters long and 200 meters wide on each side (L = 2,000 m; W = 400 m) (Anwar *et al.,* 2015). Each transect was visited once a month. Two transects were at least 1,000 meters apart from each other. A pair of binoculars (Steiner Skyhawk 10x42) and a camera (Nikon DSLR 3200 with 400 mm lens) was used to identify and record the birds (Anwar *et al.* 2015). The species identification was verified through field guide "Birds of the United Arab Emirates - A guide to common and important species (Aspinall *et al.,* 2011).

The birds were observed to identify their nesting sites. Once located, the nests were identified and their locations were recorded (AlRashidi and Shobrak, 2015). To monitor breeding activities, each nest was monitored early morning (7 to 8 am), afternoon (12-1 pm) and late evening (4:30 to 5:30 pm) for one hour each (three hours per day). The observation time and activities were limited to avoid disturbance and undue stress to the nesting birds. The team was properly camouflaged while monitoring the nests with binoculars. Each monitoring was done by a team of two observers. During 2017 and 2018, multiple teams were used to collect breeding data due to additional nests. The incubation and fledging periods were recorded. Moreover, clutch size, number of hatchlings, and number of fledglings were also recorded for each nest. Other parameters such as the times where parents were feeding the chicks, and chicks with and without parents were also recorded (Antonov *et al.,* 2007; Poirazidis *et al.,* 2009).

Statistical Analysis: The population and habitat selection parameters were subjected to Kruskal-Wallis H Test using Minitab® 18 statistical software. Hatching success percentage was calculated by dividing number of hatchlings with the clutch size; the fledging success percentage was calculated by dividing number of fledglings with the number of hatchlings. Additionally, the survival rate percentage was calculated by dividing the number of successful fledglings with the clutch size (Antonov *et al.,* 2007).

RESULTS

The population (mean ± SE) was 8.17 ± 0.60, 9.75 ± 0.55, 10.50 ± 0.56, 12.42 ± 0.84, and 16.67 ± 1.50 individuals during 2014, 2015, 2016, 2017, and 2018 respectively. Kruskal-Wallis Test confirmed a statistically significant difference (H-Value = 22.07, DF = 4, *P*-Value = 0.00019) in the populations over the course of five years i.e. from 2014 – 2018 (Figure 2). The higher population density was from April to September (Figure 3).

The population data from three habitat types showed statistically significant difference (Kruskal-Wallis Test) in preference of habitat types (H-Value = 27.43, DF = 2, *P*-Value = 0.0000011) (Figure 4). The mean population during each year in different habitat categories is presented in table 2. The birds showed clear preference of open/pasture habitats, especially for feeding. They used to select a vantage point such as a tree top or a pole and search for prey from it. In breeding season, they chose mountains.

During the study period total eight nests were monitored. Common kestrel on Sir Bani Yas Island preferred small crevices or cavities on vertical cliffs of the mountains (87.5 %) about 12-15 feet above ground or on the top of high tower (12.5 %) more than 100 meters high. The average height of the nest was 31.81 cm with an average width of 25.70 cm. The birds also preferred same nesting sites used during previous breeding season. Common kestrel started courtship and nesting during early April and the egg laying started during late April. The average clutch size was 3.75 ± 0.31 eggs with a range of 2-5 eggs per clutch. The average incubation period was 29.13 ± 0.52 days (range = 27-31 days); resulting in average hatchlings of 3.50 ± 0.53 chicks. The hatching and fledging success are given in table 3. All the hatchlings successfully fledged the nest. Only one nest failed and yielded no hatchlings. The mean fledging period was 35.63 ± 5.16 days (range = 37 – 45 days).

The eggs were incubated 74.02 ± 1.69 percent of the total incubation period. The incubation was mostly by female, where male would incubate during her absence only and for shorter durations. While they were unattended 24.54 ± 1.64 percent of the total incubation duration (Table 4). Parents spent 1.44 percent time feeding in the nests, where male would bring food for the female. During the total fledging period, 68.22 ± 0.46 percent time the parents attended the chicks; whereas, the chicks were unattended in the nests 28.09 ± 0.43 percent of the time and 3.69 ± 0.16 percent of the fledging period was spent by chicks on feeding (Figure 5). The hunting technique varied during breeding and non-breeding season, as common kestrel used flight-hunting as major hunting technique during breeding season, whereas, they used both flight and perch-hunting techniques during non-breeding season.

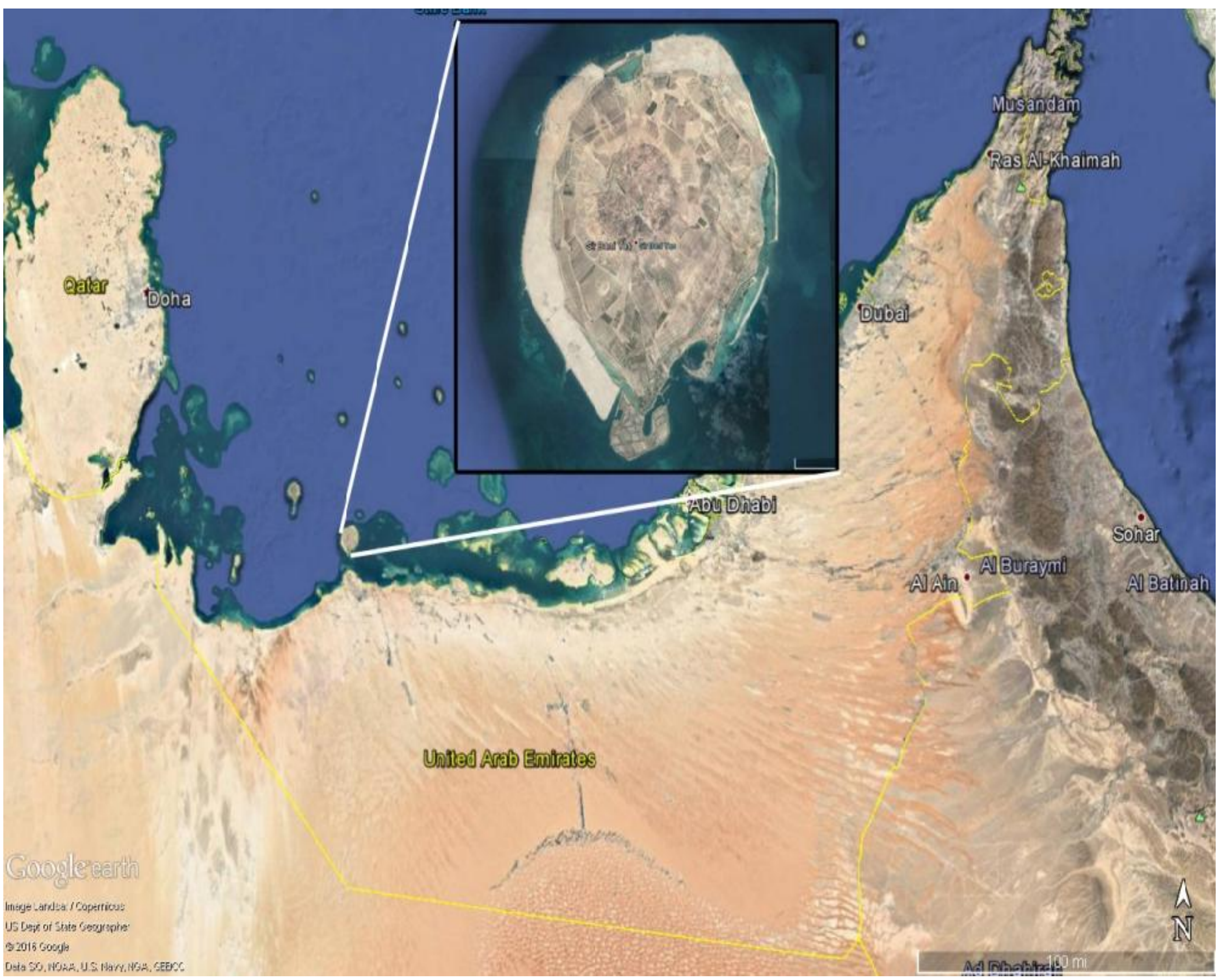

Fig. 1. Map of Sir Bani Yas Island, UAE, for breeding success study of Common kestrel (*Falco tinnunculus*)

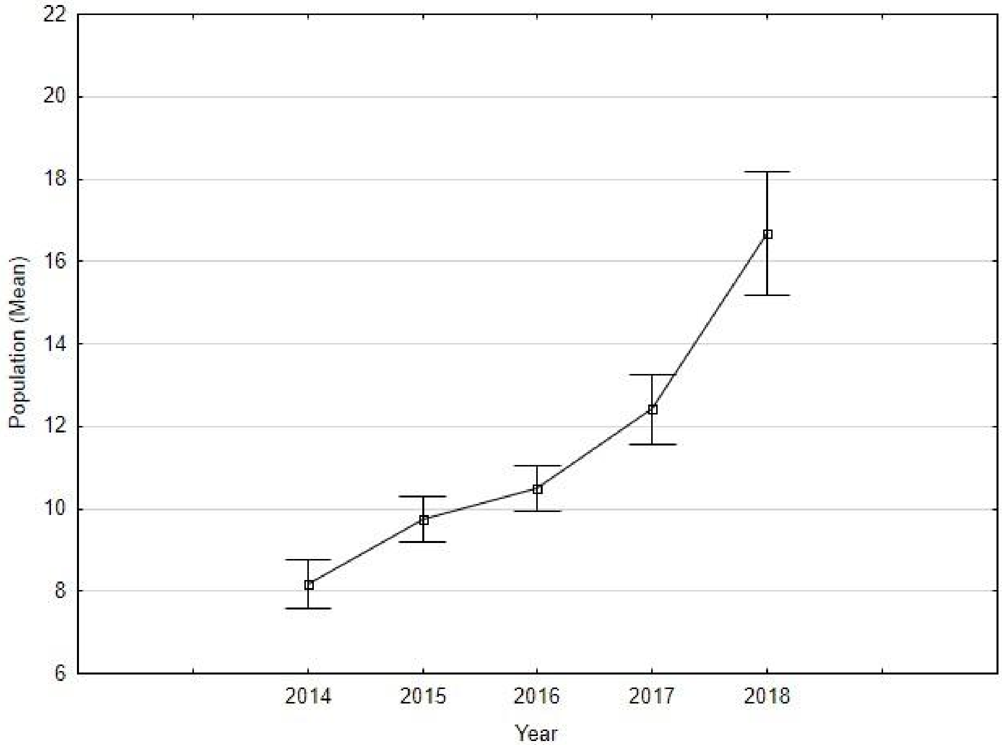

Fig. 2. Yearly population trend of Common kestrel (*Falco tinnunculus*) from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

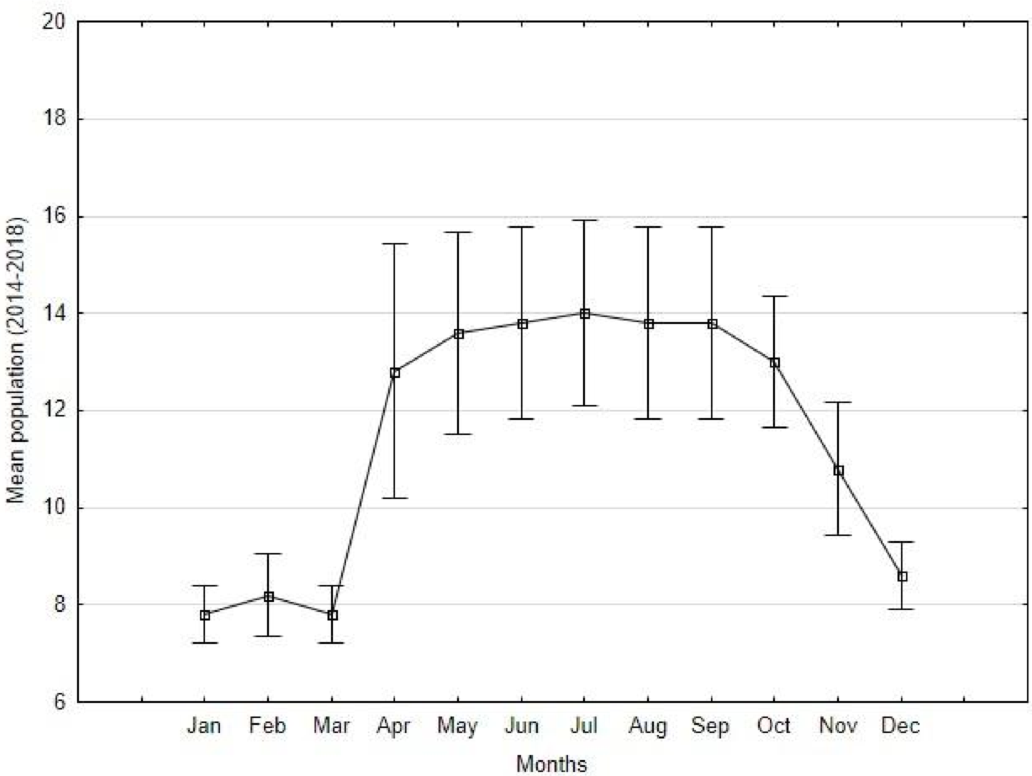

Fig. 3. Monthly population trend of Common kestrel (*Falco tinnunculus*) from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

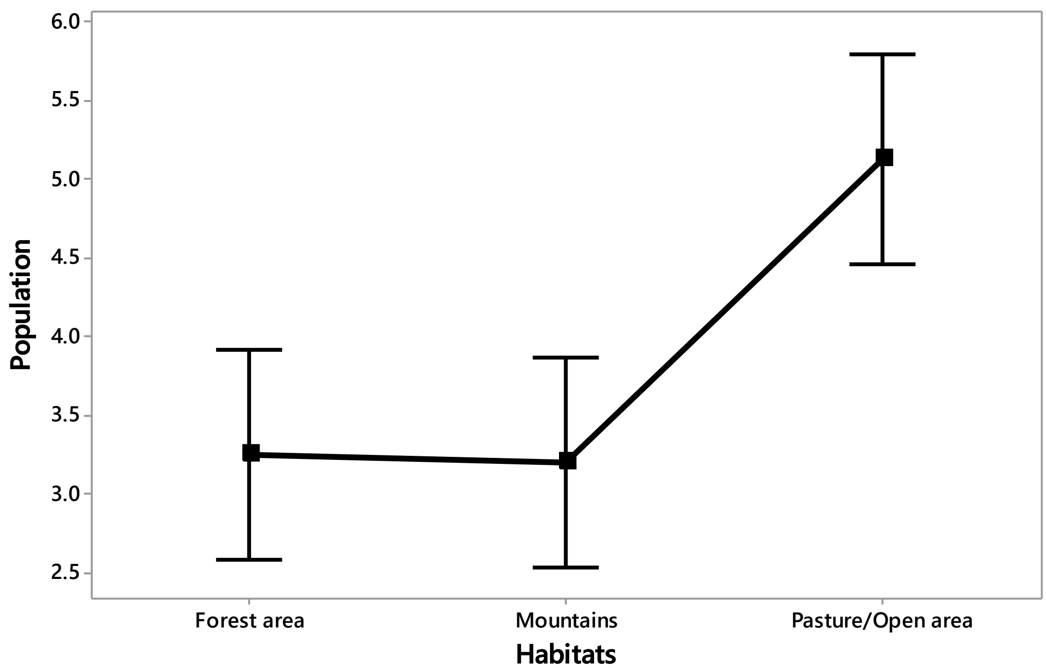

Fig. 4. Population trend of Common kestrel (*Falco tinnunculus*) in different habitat types from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

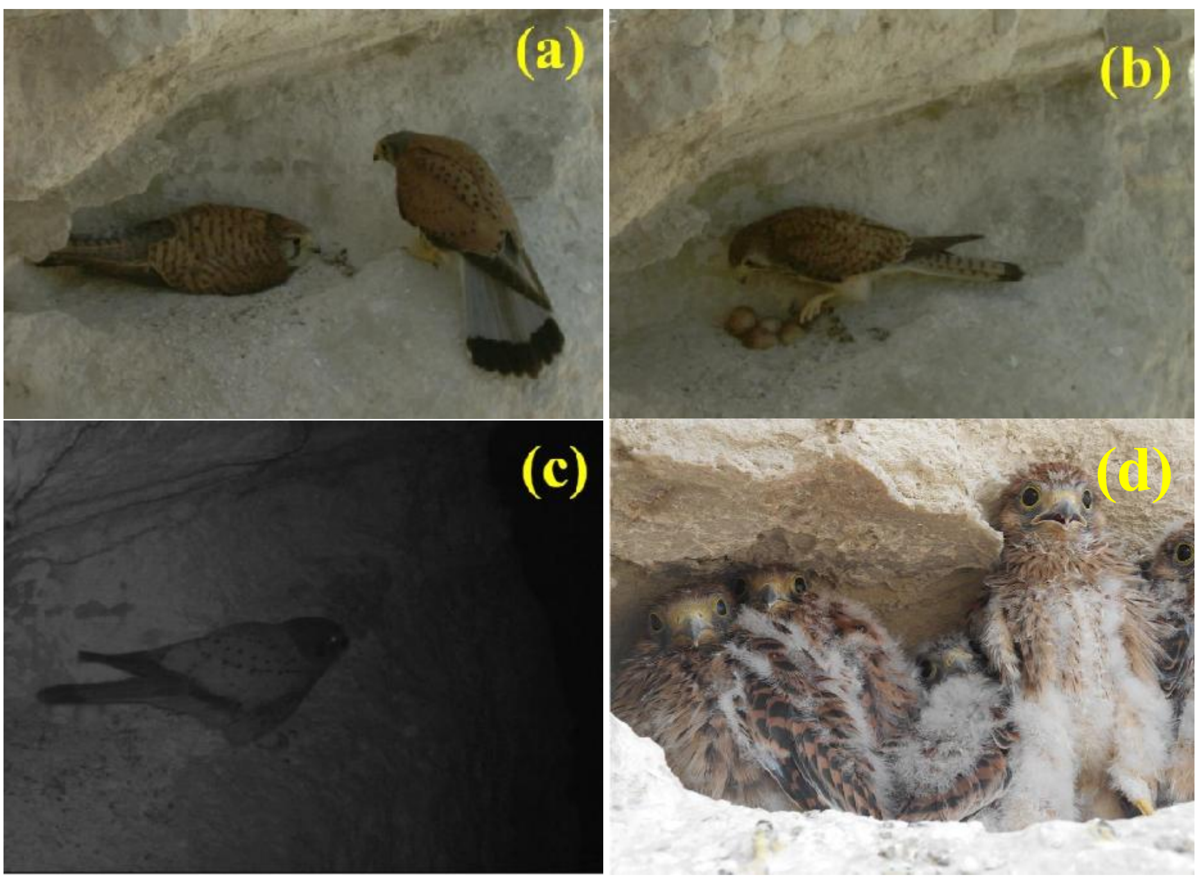

Fig. 5. Photographs of Common kestrel (*Falco tinnunculus*) at Sir Bani Yas Island, United Arab Emirates (a) presence of both parents at nest (b) female turning eggs during incubation (c) female during incubation at night (d) chicks in the nest waiting for parents to bring food

Table 1. Description of the area (Sir Bani Yas Island, UAE) for breeding success study of Common kestrel (*Falco tinnunculus*) (Mehmood *et al*. 2014).

S.	Parameters	Description
1	Total Area	*8,700 ha*
2	Area of Arabian Wildlife Park (AWP)	*4,100 ha*
3	Coordinates	*24°20' N; 52°36' E*
4	Avg. temp	*18.1-35.8 º C*
5	Annual rainfall/year	*54.97 – 119.04 mm*
6	Avg. humidity	*26.3% - 56.6%*
7	Total number of animals	*16,000*
8	Total trees planted	*> 2 million*
9	Total number of birds' species	*165*

Table 2. Mean population of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Year	Population Mean ± SE in Different Habitat Types		
	Mountains	Forest area	Pasture/Open area
2014	2.17 ± 0.51	2.58 ± 0.31	3.42 ± 0.53
2015	2.25 ± 0.60	3.08 ± 0.23	4.42 ± 0.42
2016	2.50 ± 0.63	3.08 ± 0.31	5.08 ± 0.56
2017	3.17 ± 0.81	3.33 ± 0.48	5.92 ± 0.79
2018	5.92 ± 1.46	4.17 ± 0.82	6.83 ± 1.11

Table 3. Breeding success of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Breeding Success Variables	Value
Number of Nests	**8**
Average Clutch size (Numbers)	**3.75 ± 0.31**
Average number of hatchlings	**3.50 ± 0.53**
Average number of fledglings	**3.50 ± 0.53**
Hatching Success (Percentage)	**87.50 ± 12.50**
Fledging success (Percentage)	**100.0 ± 0.00**
Total Nests Failed (Numbers)	**1**

Table 4. Incubation and Parenting routine of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Incubation and Parenting Variables	Value (Mean ± SE)
Total incubation period	**29.13 ± 0.52 Days**
Time for eggs incubation by parents during incubation period	**74.02 ± 1.69 %**
Feeding time by parents during incubation	**1.44 ± 0.13 %**
Time during incubation while eggs were unattended	**24.54 ± 1.64 %**
Total fledging period	**35.63 ± 5.16 Days**
Time Chicks were attended by parents during fledging period	**59.70 ± 8.54 %**
Time Chicks were unattended by parents during fledging period	**24.57 ± 3.53 %**
Time chicks were fed during fledging period	**3.23 ± 0.48 %**

DISCUSSION

The population trend, habitat preference and breeding success of the common kestrel were studied first time on Sir Bani Yas Island. Birds of prey can impact the bird diversity of an area by regulating the resources and controlling the prey populations (Sergio *et al.,* 2008).

The results of current study show a steadily establishing population of common kestrel on Sir Bani Yas Island. The increase in population suggests abundance of resources (such as shelter and prey) on the island and the success of the extensive afforestation efforts to create a suitable habitat for endangered, resident and migratory fauna on the island (O'Connell *et al.,* 2007). There was a surge in population from late April until September on the island. The population was higher during these months due to addition of hatchlings and later declined when the fledglings dispersed out of the island in October.

Common kestrel preferred habitats with pastures and open areas during non-breeding season and for predation. This could be attributed to the abundance of the prey and clear vantage to search their prey species. During breeding season, the birds preferred nesting in mountainous habitats. This preference can be due to the safety and privacy of the nests and chicks (Roberts, 1991). The preferred habitat of common kestrel coincides with our findings; as they are reported to exist in mountainous areas, forests, farmland and pastures (Anushiravani and Roshan 2017a; Aspinall *et al.,* 2011: Casagrande *et al*., 2008).

The gradually establishing population and successful breeding of common kestrel on Sir Bani Yas Island also indicates the good health of the ecosystem as successful breeding is directly proportional to the ecological health (Ronka *et al.,* 2011). The preference of nesting site was for small crevices and cavities in the mountainous areas. Other studies also suggest that common kestrels prefer cliffs as nesting sites but are also found to nest on artificial structures and even nest boxes (Shrubb, 1993). The average nest dimensions of common kestrel nests were higher than the dimensions in studies from (Anushiravani and Roshan, 2017) who reported the nest dimensions from 32 sites to be 19.7 x 21.9 cm. However, this could be dependent on the availability of the good nesting sites, as the pair was not observed to expand the nests or to alter them significantly from their original condition.

The average clutch size in the current study was within the described range of 3-6 eggs (Massemin *et al.,* 2002; Valkama *et al.,* 2002); but the mean clutch size was lower as compared to 5.03 ± 0.7 eggs in a study conducted in Iran (Anushiravani and Roshan, 2017a). Only one nest had a lower clutch size of two eggs and was the only nest that failed to produce any hatchlings. Due to failure of one nest the hatching success dropped to 87.50 ± 12.50 percent; as all other nests had 100% hatching rate. Due to abundant food supply and critical nesting site selection, the fledging success was cent per cent. The hatching rate (87.50 %) was higher in our study compared to 84.4% reported in Iran along with the fledging rate which was previously reported as 73.9% (Anushiravani and Roshan., 2017a).

The incubation period in the current study coincided with the previous studies ranging from 27 – 31 days; the average fledging period in the current study was similar to the previous studies on common kestrel (Anushiravani and Roshan, 2017a; Charter *et al.,* 2008; Valkama *et al.,* 2002).

The eggs were incubated 75% of the total incubation period and were left unattended 25% of the time during incubation period. Due to the choice of nesting site, there was no threat to the unattended eggs or chicks (unattended in the nest about 28% of total fledging period). All the nests were inaccessible to humans, predators or other animals. However, in the failed nest there were pugmarks of rock hyrax (*Procavia capensis*) near the nest. We could not establish a link of rock hyrax presence to the failure of the nest; due to absence of concrete evidence.

The male brought food for female 1.44% of the incubation time when female did not leave the nest for feeding; the male would bring food to the female. Mostly the prey species brought by the male were ocellated skink (*Chalcides ocellatus*), gecko species, gerbil species, parts of rock pigeon (*Columba livia*) and grey francolin (*Francolinus pondicerianus*). There were also many other prey items that could not be identified with binocular. Various studies have reported 49 prey items (Charter *et al.,* 2008) 172 prey items (Anushiravani and Roshan, 2017b) and 349 prey items (Gao *et al.,* 2009) for common kestrel during breeding season. Considering the abundance of prey species, safe nesting sites and successful breeding; it is indicative that the ecological health at Sir Bani Yas Island is in favour of biodiversity, especially propagation of raptors.

Successful breeding and healthy population is regarded as an indicator of a healthy and intact ecosystem; any decline in breeding success and population can immediately provide cues for degrading ecological health that can be a result of environmental changes or anthropogenic catastrophes. This could be attributed to the presence of the prey and clear vantage to search their prey species. Common kestrel started courtship and nesting during early April and the egg laying started during late April. Both parents take part in incubation and rearing of chicks. Male was more involved in hunting and feeding operations for the female and chicks.

Conclusion: The increase in population of Eurasian Kestrel during the study period suggests abundance of resources on the island and the success of the extensive afforestation efforts to create a suitable habitat. The bird prefers pastures and open areas during non-breeding season and for predation. The finding of this study could be used as future reference to study the breeding success of the species and provide cues for further improvement of the ecosystem conditions by improving the habitat condition at the Island. However, the observations on incubation and parental care can be further studied using camera traps to have concrete information on nest failure.

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Appendix IV: Breeding of the Osprey, (*Pandion haliaetus*) in natural and artificial nesting substrates in the United Arab Emirates (Aves: Accipitriformes).

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SHORT COMMUNICATION

Breeding of the Osprey, *Pandion haliaetus,* in natural and artificial nesting substrates in the United Arab Emirates (Aves: Accipitriformes)

Bilal Kabeer[a,b,*], Sadaf Bilal[a], Sadia Abid[a], Pavla Hejcmanová[a], Muhammad Arslan Asadi[b], Muhammad Jawad Jilani[b] and Abid Mehmood[a,b]

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The Osprey (*Pandion haliaetus*) has a cosmopolitan distribution and it is a not rare breeder in some coastal areas in the United Arab Emirates, Bahrain, and Oman in the Arabian Gulf region (Jennings, 2010; Khan, Javed, & Shah, 2008). The species is predominantly a ground nester in Arabia, but it also takes advantage of human-made constructions such as abandoned buildings or electricity pylons (Jennings, 2010). Artificial nesting platforms have been installed in the United Arab Emirates to aid reproduction and to overcome a lack of a sufficient number of suitable nesting sites. Nest platforms are known to have a positive effect on the breeding productivity of Ospreys and other raptors (Brown & Collopy, 2008; Hunt et al., 2013). The current study therefore compares the breeding success of a small population of Ospreys on the mainland and on the neighbouring island and evaluates the efficency of artificial nesting platforms which have been established to enhance breeding success.

The study was conducted at two locations in the western region of Abu Dhabi, United Arab Emirates. The first location was Sir Bani Yas Island that has a total area of 87 km² and was developed and defined as a protected wildlife reserve. Initially, the island consisted of barren arid land, and according to the master plan for its development, more than two million trees were planted to provide a suitable habitat for endangered fauna, especially for bird species on the island (Dhaheri et al., 2017). The second study site was 4600 ha forest, located 350 km from Abu Dhabi and is one of the protected areas near Al Sila city.

Every year from 2014 to 2019, both study areas were surveyed to locate nests. All active nests were marked using a handheld GPS unit (Garmin, etrex) and information such as nest height, diameter, material used in nest construction, altitude from sea level, distance from nearest human establishment, paved and unpaved roads was recorded using measuring tape (Ali, Mahmoud, & Elamin, 2015). Nest type was assigned either as natural nests if the nests were on any naturally occurring structure (i.e. rock, ground or tree) or artificial nesting platform if the nest was on a human-made platform (Khan et al., 2008).

A total of nine natural nests were observed in Al Sila, and three natural and five nests on platforms in Sir Bani Yas Island (Table 1). These platforms were constructed at

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Table 1. Nest types, hatching and breeding success of Osprey (*Pandion haliaetus*) on mainland and Sir Bani Yas Island in the United Arab Emirates.

Location	Nest Type	Nest ID	Year	No of Eggs	No of hatchlings	No of fledgelings	Hatching Success	Fledging success
Al Sila	Natural: mainland	ASN-1	2014	3	3	3	100.0	100.0
		ASN-2	2015	2	2	2	100.0	100.0
		ASN-3	2015	3	2	2	66.7	100.0
		ASN-4	2016	3	3	2	100.0	66.7
		ASN-5	2017	3	2	2	66.7	100.0
		ASN-6	2017	2	2	1	100.0	50.0
		ASN-7	2018	3	3	2	100.0	66.7
		ASN-8	2018	3	1	1	33.3	100.0
		ASN-9	2019	3	3	3	100.0	100.0
SBY	Natural: island	NNS-1	2014	3	2	0	66.7	0.0
		NNS-2	2015	0	0	0	0.0	0.0
		NNS-3	2016	0	0	0	0.0	0.0
	Platform: island	ANP-1	2017	3	2	2	66.7	100.0
		ANP-2	2018	2	2	1	100.0	50.0
		ANP-3	2018	3	2	2	66.7	100.0
		ANP-4	2019	3	3	2	100.0	66.7
		ANP-5	2019	2	2	2	100.0	100.0

the end of 2016 to provide more nesting sites to the birds on the island after unsuccessful breeding on natural nesting sites.

The stages of breeding such as incubation, hatching, and fledging success was recorded. The activity was observed through binoculars or a spotting scope. The observations were taken from a vantage point ranging from 50 to 150 metres depending upon the site characteristics and the response of the birds to the observer (Clancy, 2006). Information such as disturbance due to developmental activities and interspecies competition were also recorded. The nests were monitored daily, early morning and late evening for 30 minutes.

The hatching success was calculated by taking the percentage of hatchlings out of clutch size, and the fledging success was calculated by taking the percentage of fledgelings out of the total number of hatchlings. The data were analysed using the non parametric Man-Whitney U Test in Statistica 10 statistical software for data between locations, nest types, and years.

Nest construction starts earliest in early December. Out of 17 nests studied, the birds used the same nest 14 times. The same nests were used nine times at the two locations in Al Sila forest, and five times at the two platforms at Sir Bani Yas Island.

In 2014, only one breeding pair of Ospreys was recorded on Sir Bani Yas Island. They constructed a nest on a sand berm at the edge of the beach and laid three eggs. Only two eggs hatched with a hatching success of 66.7%. Both young died on the fourth day due to a robust cold gale, eventually leading to zero fledging success. In 2015 and 2016, the birds constructed nests but did not lay any eggs. In 2015, they constructed a nest on a telecommunication tower but abandoned it without laying eggs. Later, Egyptian Geese (*Alopochen aegyptiaca*) took over the nest.

The average clutch size in the natural nesting sites was 2.33±1.15 eggs per nest, while it was 2.60±0.55 for nests on platforms. The difference is statistically not significant (U=30.0; P=1.0) (Table 1). The mean incubation period was 35.0±2.16 days for all nests. The mean number of hatchlings was 1.92±1.08 in natural nesting sites and 2.20±0.45 hatchlings at nesting platforms. The difference was statistically not significant (U=28.0; P=0.87). The mean hatching success was 69.44±38.82 per cent in natural nests, and 86.67±18.26 per cent at nesting platforms. Neither were these differences was significant (U=24.0; P=0.56).

The mean fledging period of all nests was 53.0±4.58 days. The mean number of fledgelings in natural nests was 1.50±1.09 fledgelings compared to 1.80±0.45 fledgelings in the platform nests on the island (difference not significant; U=26.0; P=0.71). The mean fledging success was 65.28±42.91 per cent for natural nesting sites and 83.33±23.57 per cent for nesting platforms. The platform occupancy rate was 33% in 2017 and 67% in 2018 and 2019.

Multiple factors could have attributed to the failure of egg-laying, such as continuous disturbance from Egyptian Geese and the construction of a new cruise ship beach. Geese are reported to take over Osprey nests and artificial platforms in many areas (Henny, Collins, & Deibert, 1978). Moreover, in 2016, construction works were the cause of disturbance.

The present study shows that the provision of nesting platforms was successful in enhancing the reproduction rate of the Ospreys on the island. The nests on platforms were more successful in producing fledgelings compared to nests on natural substrates in disturbed habitats and with interspecific competition for nesting sites. The provision of platforms reduces competition for nesting sites and provides safety to adults and young.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

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Appendix V: Curriculum Vitae

BILAL KABEER

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Email: bilal@wildbiodiversity.org

Professional Summary

Experienced Assistant conservation manager providing services with demonstrated history of working in the animal conservation services industry. Skilled in sustainability, Wildlife, Data analysis, Biodiversity and science. Strong programme and project management. Professional with a master of philosophy (M.Phil.) focused in Wildlife Management.
Ph.D. Aspirant at CULS university Czech Republic.

Professional Skills

- **Operations Management**
- **Team and Resource Management**
- **Strategy and Policy Development**
- **Budget Management**
- **Procurement**
- **Asset Management**
- **Project Proposals**
- **Report and Presentation**
- **Internal & External collaboration**
- **Wildlife Management**
- **Forest / Botany Management**

Soft Skills

- **Negotiation and public dealing**
- **Proficient in English**
- **UAE Driving license**
- **Expert in Animal Welfare**
- **Proficient in MS Project**

Personal Information

Date of Birth: 15-03-1988
Gender: Male
Marital Status: Married
Nationality: Pakistani
Residence Address: Abu Dhabi

Professional Experience

(United Arab Emirates)

March 2015 –Current | **Barari Natural Resources, UAE**

Assistant Conservation Manager/Zoologist

- Contract Management:
- Planning, strategies, and protocols provided by management their implementation in the field and execution as per SOPs.
- Managing and coordinating the field operations of a globally important collection of desert fauna on Sir Bani Yas Island. Monitor the status and trends of wildlife populations.
- Manage endangered species populations, including conservation, protection, and rehabilitation
- Promoting Ecotourism and give innovative plans for improving the tourists, experience along with the supreme objective of animal welfare and wildlife conservation
- Record keeping, preparation of guidelines, protocols and working schedules for client
- Managing feeding of 16,000 animals at the island on a daily basis pellet feeding and grass, visit sites and manage clearance and good hygienic conditions for animals
- Facilitate field staff in segregating & sorting data as directed by the reporting structure staff
- To facilitate in reporting structure in different development activities for proper data storage, registers, stock list and keeping updated as needed
- To update by any new innovation for management of data on day to day wildlife management

Operations Managing:

- Animal Husbandry
- Animal Monitoring
- Carnivore Monitoring
- Bio-security
- Feeding and Watering
- Manpower Management
- Monitoring interspecies interaction
- Census
- Camp Management
- Animal Health
- Vehicles and logistics
- Physical capture of animals

Wildlife Services' Management

- Collaborate with other institutions for breeding loans and animal donations, research and trainings
- Promote eco-tourism on the island and improve visitors' experience
- Maintain healthy animal collection and ensuring all basic requirements of the animals are met
- Designing animal vaccination and herd management plans with the wildlife manager
- Identifying opportunities to reduce animal feed cost through plantation for fresh fodder and browse for the animals
- Management of wildlife biosecurity

Dec 2013 – March 2015 | **Barari Natural Resources, Abu Dhabi**

AVIFAUNA BIOLOGIST

- Monitor and recording of birds on a monthly basis.
- Migratory birds surveys.
- Management of the Aviary and Birds.
- Rearing of Ratite chicks. (Ostrich, Emu & Rhea).
- Record keeping of bird's

Nov 2010 – Nov 2013 | **PARC, Pakistan**

RESEARCH ASSISTANT

- Study on Biology Captive Breeding of Endangered Wild Animals In captivity at Poultry& Wildlife Research Section"
- "Genetic Improvement of Selected Indigenous Poultry Breeds"
- Worked on two research projects
- Aviary management, monitoring birds, supervision of staff
- Data Recording
- Developing Technical and financial reports
- Work with poultry management include backyard poultry rearing

Aug 2010 – Oct 2010 **Biodiversity Park, Attock Oil Refinery, Pakistan**

RESEARCH INTERNEE

- Management of Biodiversity Park.
- Monitor and record behavior of bird's species in Aviary.
- Maintenance of Botanical garden
- Management of staff and daily operations

EDUCATION

2015 – In Progress **Czech University of Life Sciences, Prague, Czech Republic**

- **Degree: Ph.D. 2015- in Progress(Animal Science and Food Processing)**
- **Research**: Bird communities at an offshore island of Abu Dhabi, Sir Bani Yas, UAE.
- **Courses**: Ecology, Animal Production, Ornithology, Biochemistry, Zoo-hygiene a presence, Livestock production in tropics and subtropics, Management of research and Dissertation Methodology.

2013-Completed **Pir Mehr Ali Shah, Arid Agriculture University, Pakistan**

- **Degree: M. Phil. (Master of Philosophy in Wildlife Management) 2013.**
- **Research**: Feed preference of Hog deer (*Axis porcinus*) under captivity
- **Courses:** Forest recreation and park management, Bio-statistical analysis, Protected areas and management, Endangered species and their management, Essentials of wildlife conservation-National perspectives, Forestry and environment, Wildlife study techniques –Management aspects, Wildlife food and foraging, Management aspects of wildlife behavior, Wildlife policies legislation and international conventions and Bio-statistical Analysis.

2010-Completed **Pir Mehr Ali Shah, Arid Agriculture University, Pakistan**

- **Degree: M.Sc. (Master of Science in Wildlife Management) 2010.**
- **Research**: Status of water birds at Kallar Kahar Lake Chakwal, Pakistan.
- **Courses:** Principal of wildlife management, Wildlife study techniques, Mammalogy, Elements of statistics and biometry, Ornithology, Conservation Biology, Experimental statistics, Terrestrial wildlife management, Wildlife wetland management, Wildlife population ecology, Wildlife damage management, and Herpetology

2007-Completed **Punjab University, Pakistan**

- **Degree: B.Sc. (Biological Sciences) 2007**
- **Institute:** Punjab University, Pakistan
- **Courses:** Zoology, Botany, and Chemistry

Training Objectives/Certifications

2017 **Insect Taxonomy & Field Sampling Skills**

- Insect Taxonomy & Field Sampling Skills from Oxford university

2015 **Field Survey Tecniques**

- Field survey techniques to study birds from Oxford university

2012 **Scientific Technological Workshop OIC**

- High altitude ecosystem and Climate change from Comstech Institute, Islamabad.

2010 **Animal Husbandry**

- Physical capture & restrain from Pakistan Agriculture Research Council

Publications

1. Abid Mehmood, Sadia Abid, Pavla Hejcmanová, Muhammad Arslan Asadi, **Bilal Kabeer**, Muhammad Jawad Jilani, Sadaf Bilal, Muhammad Waseem Ashraf. 2019. Comparison of physiological responses of Arabian striped hyaena (*Hyaena hyaena sultana*) to effective immobilisations with ketamine-medetomidine and ketamine-xylazine in (semi-) captive conditions. Peer J 7:e7326.

2. **Bilal Kabeer**, Maqsood Anwar, Muhammad Rais, Muhammad Jawad Jilani, Muhammad Arslan Asadi, Sadia Abid, Sadaf Bilal, Farrukh Saleem, Babar Hilal Ahmed, Agha Waqar Yunus, Saleem Zahid, Muzamil Anjum, Pavla Hejcmanova, Muhammad Kamal Sheikh and Abid Mehmood.2018. Study of Feed Preference of endangered Hog deer (*Axis Porcinus*) under captive conditions in Pakistan. Journal of International Journal of Conservation Science. Volume 9, Issue 2, April-June 2018:337-344.

3. Farrukh Saleem, Babar Hilal Ahmad, Saleem Zahid, and **Bilal Kabeer**. 2014. Comparative productive performance of indigenous naked neck and naked neck crossbred layer chickens. Journal of Agriculture Research. Res. Vol. 27 No.4, 2014.

4. Sadia Bilal, Muhammad Rais, Maqsood Anwar, Iftikhar Hussain, Madiha Sharif, **Bilal Kabeer**.2011.Habitat association of Little Grebe (*Tachybaptus ruficollis*) at Kallar Kahar Lake, Pakistan. Journal of King Saud University – Science. Volume 25, Issue 3, July 2013, Pages 267-270.

5. Noman Khalique, Muhammad Rais, Tariq Mehmood, Maqsood Anwar, Sakhawat Ali, Sadia Bilal, **Bilal Kabeer**. 2012. Study on Some Waterfowls of Mangla Dam, Azad Jammu, and Kashmir. Journal of population and fauna, Ukraine.Vol.21 No.44-49, 2012.

6. M. Rais, **B. Kabeer,** M. Anwar and T. Mehmood.2010. Effect of habitat degradation on breeding water birds at Kallar Kahar Lake District Chakwal. The Journal of Animal and Plant Sciences. 20(4), 2010, Page: 318-320.

7. **Bilal Kabeer**, Sadaf Bilal, Sadia Abid, Pavla Hejcmanová, Muhammad Arslan Asadi, Muhammad Jawad Jilani &Abid Mehmood.2020. Breeding of the Osprey, (*Pandion haliaetus*), in natural and artificial nesting substrates in the United Arab Emirates (Aves: Accipitriformes). Zoology in the Middle East. Volume 66, 2020 - Issue 2.

8. **Kabeer B**, Bilal S, Abid S, Hejcmanová P, Mehmood A, Asadi MA and Jilani MJ. Some aspects of breeding ecology and threats to Saunders's tern (*Sternula saundersi*) at an offshore island of United Arab Emirates. Water Birds. (Accepted).

9. **Kabeer B**, Bilal S, Abid S, Hejcmanová P, Asadi MA, Jilani MJ and Mehmood A. 2021.Determining population trend and breeding biology of Common Kestrel(*Falco tinnunculus*) at Sir Bani Yas Island of Emirates. Journal of Animal and Plant Sciences.Volume 31(2):2021:596-603.

Conferences, Exhibitions, and Seminar

- Participated in 1 day ACTIVE SUPPORT IN THE FOD WALK CAMPAIGN in Sir Bani Yas Airport by Abu Dhabi Airports. (2015).
- Letter of Appreciation to be Part of CONSERVATION INTRODUCTION OF ARABIAN TAHR ON SIR BANI YAS ISLAND by The Arabian Tahr steering Committee (2014).
- Certificate of participation on the occasion of Spring Festival FANCY BIRD & DOG SHOW (2013).
- Certificate of Appreciation by Pakistan wildlife foundation for contribution as YOUNG SCIENTIST to nature conservation in Pakistan. (2013).
- Certificate of Merit Laptop (Awarded with Laptop) on the basis of merit to excel professionally YOUTH INITIATIVE, GOVERNMENT OF PUNJAB. (2012).
- Participated in 3 days INTERNATIONAL ZOOLOGICAL CONGRES in GC University Lahore Pakistan (2012).
- Participated in 3 days INTERNATIONAL ZOOLOGICAL CONGRES in University of Azad Jammu & Kashmir, Muzaffarabad, Pakistan (2011).
- Certificate for 1-day participation in Energy Conservation Training Workshop/Seminar on Agriculture, Buildings, Transport, Industry & Power and Clean Development Mechanism, PC Hotel, Pakistan.

Computer Skills

- M.S Word
- M.S PowerPoint
- M.S Excel, M.S Access
- M.S FrontPage
- Adobe Photoshop
- In-Page (Urdu)
- E-mail/Internet

Reference

- Dr. Abid Mehmood, Manager Wildlife conservation Sir Bani Yas Island, Barari Forest Management, Abu Dhabi, UAE(abid@barari.ae +971506632023).

- Sabir Bin Muzaffar Department of Biology, College of Science, PO Box 15551, Al Ain United Arab Emirates University Phone: +971-3-7136549 Mobile: +97150-1121793 Website: http://faculty.uaeu.ac.ae/s_muzaffar

- Dr. Maqsood Anwar, Chairman, Department of Wildlife Management, PMAS-Arid Agriculture University, Pakistan (maqsoodanwar@uaar.edu.pk; +923345434784).

- Dr. S M H Andarabi, Principal Scientific Officer Pakistan Agriculture Research Centre, Islamabad, (andrabi123@yahoo.com)+92335167360).