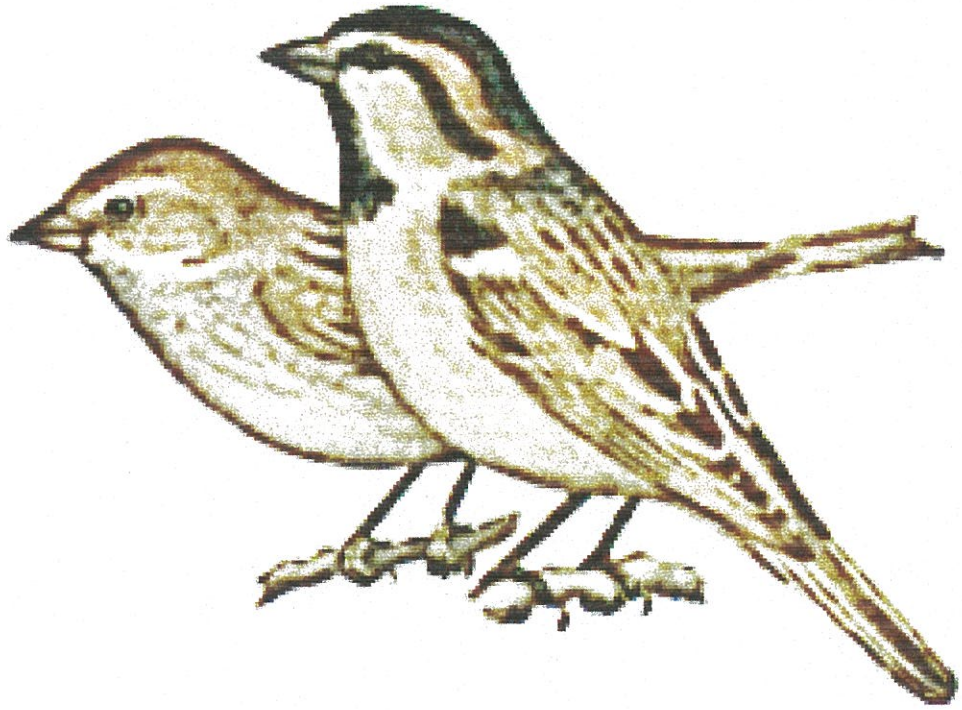
Gobi Sparrow Research Project



Commencing April 2000

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I. Introduction

The majority of detailed scientific studies are carried out in Western countries where financial backing is available to support institutions, provide materials, state-of-the-art technology, and highly trained staff. The species studied are either those which are found in the temperate habitats where the Universities themselves are, or those which can be reared conveniently in the laboratory.

Extensive studies of 'model organisms' have their advantages, especially if detailed life-history questions are to be addressed. However, investigating life-histories and ecology of more diverse species in lesser studied-habitats also holds its advantages. New behaviours or strategies may be observed, and we can determine how widespread certain traits are in relation to other species in the same genus. We can gain information on species distribution, and interactions with other organisms in the environment. In an applied sense, this leads to a better understanding of dynamic ecosystem processes. Local involvement in a project and foreign investment encourages local interest in environmental matters. From a purely moral/aesthetic view, learning about nature is of great value and something which interests most humans.

The unique situation of many lesser studied organisms also makes them attractive subjects for scientific study. They may hold answers to certain scientific questions because of key biological features of their own physiology or the environment which they inhabit. The Gobi Sparrow Research Project investigates the breeding biology of the saxaul sparrow, *Passer ammodendri*, because it is resident in a particularly remote and arid environment, allowing us to address questions about breeding decisions of birds where resources are particularly limited and chick-rearing constrained to a short time when conditions are favourable.

Overleaf: Political map showing position of Mongolia (formerly known as Outer Mongolia) in Central Asia. Until 1991 Mongolia was a Soviet satellite and access to foreigners was restricted. The country, 3 times the size of France, has a population of only 2.5 million. This area supports a variety of habitats from siberian-type forest, high mountains, tundra, extensive grasslands, lake systems, desert and desert steppe.

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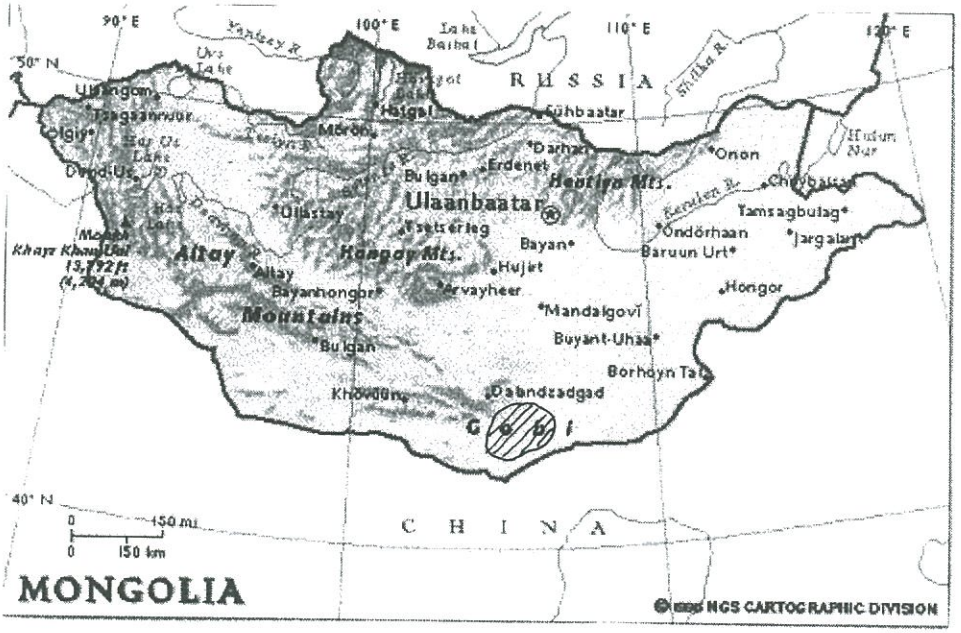
The Gobi Desert

The Gobi desert forms 22% of the land area of Mongolia and stretches into northern china. A rocky desert with sandy plains and craggy mountains, the prevailing climatic conditions are extreme. Summer temperatures range between -15°C at night to +42°C during the day. Snow may persist until April and high winds and violent dust storms are frequent in spring and summer. Despite this, saxaul plants (*Haloxylon ammodendron*) cover areas of the Gobi, sometimes in such great numbers they are known are 'Saxaul forests'. Saxaul sparrows build their nests in holes within these scrubby bushes.

As well as being under particularly severe environmental stresses, saxaul forests are under increasing human pressure. Saxaul forests growth rates and the area covered by forest has declined rapidly in the last 25 years. The ecosystem is fragile but one which, in areas, is still relatively undisturbed.



Study area in Gobi Desert, Mongolia

II. Scientific investigation of Breeding Constraints in Desert Species:

Environmental predictability and sex allocation in Saxaul Sparrows, *Passer ammodendri*

Theory and Concept

Where male and female offspring give different are of different value to parents in different environments, parents may benefit by producing daughters under certain conditions and sons under others. This may be for a number of reasons: because one sex is more costly to produce in some situations, or may disperse earlier than the other sex so reducing competition for food with the parents, or one sex may help parents provision future young. New evidence is accumulating that avian species do indeed invest differentially in the two sexes (e.g. Heinsohn *et.al.* 1997, Kilner 1998, Nishiumi 1998), and some studies present remarkable evidence of female bird's adaptive control over egg sex ratio (e.g. Komdeur *et.al.*1997, Daan *et.al.* 1996, Ellegren *et.al.* 1996). Unlike in mammals, in birds females are the heterogametic sex (have two different sex chromosomes). They therefore have the potential to 'decide' which sex of offspring they produce by laying an egg with either a 'W' (female) or 'Z' (male) chromosome, in response to their breeding situation

One factor which causes selection for skewing the sex ratio in animals is the availability and predictability of food to females for offspring provisioning. For example, female parasitoid wasps tend to lay female eggs on large hosts and males on small hosts (see Charnov, 1982). In contrast, many avian species produce young in environments with varying food availability, and have long incubation and rearing periods. Consequently, an accurate prediction of resource availability during the time of parental care may be more difficult (Oddie, 1998). Importantly, this could explain why sex ratio skews amongst birds are not as extreme as those recorded for invertebrate taxa.

Some birds which inhabit more consistent environments and breed within a very restricted time window may, however, be better placed to predict food abundance during chick rearing. In arid ecosystems breeding birds are particularly responsive to rainfall patterns and control breeding decisions accordingly. They represent good candidates for avian species which can produce strong sex ratio skews. A given amount of rainfall, leading to immediate foliage growth and consequent increase in insect abundance, is an obvious environmental cue available for females to estimate future food supply while developing and laying eggs. The saxaul sparrow, *Passer ammodendri,* is resident in the western Gobi desert and breeds in stands of saxaul (*Arthyophytum*) and sand acacias (*Ammodendron*) around oases. It is ideal for investigating sex allocation in relation to resource availability because of its breeding situation and because it is quite unique amongst desert species in that it nests in holes rather than building open or woven nests. Data can be collected easily from such species by providing nest-boxes for breeding individuals.

Female breeding sparrows respond to environmental cues in areas of saxaul scattered in an inhospitable habitat. The largest skew in avian sex ratio yet recorded has been demonstrated in a species where sex ratio of clutches varied between islands with different insect abundances on territories (Komdeur *et.al.* 1997).

Food quality and quantity have been found to have significant effects on clutch sex ratios in the zebra finch, an Australian passerine living in similar desert conditions (Kilner, 1998, Bradbury and Blakey, 1998). Both of these studies were conducted on captive populations; studies of free-living zebra finches are difficult (see Zann, 1996). Saxaul sparrows, however, being obligate hole-nesters, present an ideal system to work on using nest-boxes to facilitate data collection.

III. Aims

1. To set up nest-box areas in saxaul shrubs around 5 oases in the Southern Gobi desert, Mongolia. There are many oases in this area within reasonable distance of each other.
2. To test whether sex ratio varies between oases, and in relation to rainfall and insect abundances. I expect birds in oases with high rainfall and insect abundance to bias brood sex ratios towards the sex most affected by food limitation. The identity of this sex can be determined within one breeding season by comparing mortality rates between males and females. In a second year it will be possible to determine by comparing effects of fledgling weight on recruitment.
3. To test whether parental feeding effort varies between pairs with different brood sex ratios.

IV. Research Plan

In April 2000 establish nest-box areas will be established in saxaul stands at oases in Gurvansiakhan National Park, Monoglia. Boxes will be monitored to record nest-building behaviour, timing of breeding, clutch sizes, parental and chick biometrics, and small blood samples (5-10µl) will be collected from both young and adults. Parental feeding observations will be recorded during repeated one hour focal watches of nests. Saxaul densities will be mapped and insect abundances measured (see Komdeur *et.al.* 1997). Field work will be completed in July.

Blood samples will be used to identify offspring sex using a PCR based technique (Griffiths *et.al.* 1998). This technique detects different lengths of DNA in the bird's chromosomes. Males with only one type of chromosome have one piece of DNA of one size only, but females with 2 different sex chromosomes have 2 ifferent sized pieces on DNA. Clutch, brood and fledging sex ratio will be determined. Molecular work will be conducted at the University of Glasgow during August. Statistical analysis and writing up will be completed by 31 December 2000.

Tests for differences in mean sex ratio between oases will be performed using analysis of variance; whether sex ratio variation is associated with food conditions will be tested using powerful directional heterogeneity tests (e.g. Rice and Gaines, 1994).

V. Future work

Field work in 2000 is intended as a pilot study to establish nest-box areas which can be continued to be studies in subsequent years. I am particularly interested in making comparisons of sex ratio between years in relation to rainfall and food abundance. Data generated in 2000 would provide material for a fellowship application.

Having collected basic data I can carry out studies to establish cause and effect relationships between environmental/genetic variables and sex allocation. Supplementary feeding experiments could investigate effects on primary sex ratio when food constraints are relaxed. I will analyse sex ratio adjustment in relation to other variables, such as paternal and maternal conditions/characters, timing of breeding etc. Saxaul sparrows are sexually dichromatic with a number of potentially sexually selected characters (eye-stripes, black bib) and are sexually dimorphic (Summer-Smith, 1988).

Considering the restricted breeding of this species to defined areas, frequencies of each sex (for future mating opportunities) may be important in sex allocation decisions (Fisher, 1930). Dispersal of individuals between oases will be important to investigate, and yield interesting genetic data in its own right. Dispersal data may also be important in determining mixing between populations around oases. Monitoring populations and sexes of individuals provides data which can be used in future management and conservation decisions.

Much incidental data will be collected which will provide a basic record of the flora and fauna present in this area. Dried plant specimens will be donated to the collections at the Mongolian Academy of Sciences and the Royal Botanical Gardens, Edinburgh. Similarly, insect specimens will be donated to the Mongolian Academy of Sciences and the Natural History Museum, London. Altogether, the collection of these data will allow an understanding of the biodiversity and ecological balance in this previously undescribed area. This is invaluable for future management decisions, especially as more of the country becomes under scrutiny for potential resources exploitation following recent financial pressures after the disintegration of the former USSR.

VI. Participants

Name:	Kate Oddie
Correspondence:	Institute of Cell, Animal and Population Biology, University of Edinburgh, West Main's Rd, Edinburgh, EH9 3JT, UK
Role:	Scientific Research Coordinator
Nationality:	British
Education:	PhD (Dec 1996 – Mar 2000) Edinburgh University: Sex allocation and sex-specific nesting performance in three hole-nesting passerines. BSc. (Honours) Zoology, First Class, Bristol University
Experience:	Four years field experience with nest-box breeding passerines, including trapping/netting adults and taking blood samples from more than 5,000 birds (adults and chicks). Previous and current research focuses on sex-specific differences in performance of offspring and sex ratio variation, particularly with respect to maternal condition, and differential parental investment in the sexes. Familiar with molecular analyses involved, having sexed over 2,000 individuals already using this technique.

Name:	Bold Ayurzanyn
Correspondence:	Mongolian Academy of Sciences, Institute of Biology, Ulaanbaatar 51, Mongolia
Role:	Collaborator from Mongolian Academy of Sciences
Nationality:	Mongolian
Education:	PhD. Mongolian State University (1957)
Experience:	From 1957-1961 lecturer at MSU. Has participated in expeditions in central and south west Mongolia, and conducted work in all parts of Mongolia. In 1961 established the Ornithological sector at the Institute of Biology, Mongolian Academy of Sciences and continues this work. Member of State Commission of Endangered Species. Has published 5 books and over 120 scientific works.

Name:	To be decided
Correspondence:	Mongolian State University, Ulaan Baatar.
Role:	Collection of insect specimens to record diversity and abundance of insect species at field sites.
Experience:	Student currently studying Biology at the Mongolian State University who will collect field data as undergraduate field project.

Name:	To be decided
Correspondence:	Mongolian State University, Ulaan Baatar.
Role:	Collection of avian field data – egg counts, blood sampling and trapping/netting of adult birds.
Experience:	Student currently studying Biology at the Mongolian State University who will collect field data as undergraduate field project.

These two students will be chosen through a lecturer at the State University in 2000.

Name:	Christophe Herrmann
Correspondence:	Institute of Cell, Animal and Population Biology, University of Edinburgh, West Main's Rd, Edinburgh, EH9 3JT, UK
Role:	Logistics
Nationality:	French
Experience:	Planning and organisation of 1 year solo trip over Africa by motorbike, including desert crossings. Professional qualifications in carpentry and civil engineering. Basic mechanic skills.

VII. Budget

50 nest-boxes/ 30 breeding pairs at 5 sites.

	Quantity	Cost	Net cost
Field Equipment			
Nest-box materials (wood, nails)	250	2.00	500.00
Power drill, accessories, hammer, saw	1	140.00	140.00
Mist-nets – 4x18ft, 1x30ft, 1x42ft	6	various	150.00
Balance –10g, 50g	4	30.00	120.00
Callipers	2	31.25	62.50
Ringing pliers	2	6.00	12.00
Wing rule	2	5.50	11.00
Split colour rings and aluminium rings	600	1.50	200.00
Photographic films and development	10 x 36 slidefilm	10.00	100.00
Stove	1	60.00	60.00
Tent	2	300.00	600.00
First aid kit	1	250.00	250.00
Field Guides and books	various	250.00	250.00
Geographical Positioning System	1	125.00	125.00
Consumables (blood sampling and stationary)			400.00
Miscellaneous (wire, tools etc)			200.00
Lab Expenses			
Determining sex from blood samples			
At £1.50 per bird (150 broods, av. Brood size =6)	900	1.50	1350.00
Travel and Transport			
Visa	2	50.00	100.00
Rtn. Air ticket Ulaan Bataar	2	700.00	1400.00
Extra baggage allowance	50kg	5.00/kg	250.00
Accommodation/food in Ulaan Bataar	20 days	10.00/day	200.00
Vehicle hire for transport to Gurvansaikhan with driver		130.00	130.00
Transport within park 50km/day	3 months	300.00/month	900.00
Insurance	2	200.00	200.00
Mongolian Counterparts	2	250	500.00
Living expenses (inc. permits) in Mongolia and U.K.			2920.00
Working in Park	1500 togrog/day	200.00	200.00
GRAND TOTAL			**11330.50**

Grants received:

Association for the Study of Animal Behaviour		4822.00
French Development Grant		700.00
Linnean Society Percy Sladen Memorial Trust		600.00
Total:	**£**	**6122.00**

Grants requested:

Wilson Ornothological Society		up to 400.00
British Ornithologists Union		up to 1000.00
Total:	**£**	**1400.00**

Possible total: **7522.00**

VIII. References

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IX. Acknowledgements

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