High Biodiversity in Association with the Common Baobab Tree

Lyndsay Hellekson
The University of Arizona
School of Natural Resources
Biological Sciences East
Tucson AZ 85721

At first glance the common baobab tree does not seem that unusual. Upon further inspection one tree in Namibia proved that they can in fact be quite unique. In five days time, 248 cavities were discovered in the tree, 4 gecko species turned out to be permanent residents, and 24 different bird species used the tree. The cavities housed 4 bird nests, 4 gecko nests (2 with egg shells), and a carnivore den, wasp nests, termite tracks, and countless spider webs. The study was too short in duration to make any sweeping conclusions, but it hints at the possibility that baobabs may be linked to high animal biodiversity.

Introduction and Background

The baobab tree is part of the Bombacaceae family which comprises 30 different genera of tree species. Four of these are classified as succulents including the genus of the baobabs, *Adansonia* (Baum 2004). The baobabs are regarded as the largest succulent plants in the world by most botanists. The genus comprises only 8 species, 6 of which are found only on the island of Madagascar. There is one species each on the continents of Africa and Australia. Long distance dispersal via the ocean may explain the presence of this unique tree in Australia and Africa (Baum 1998).

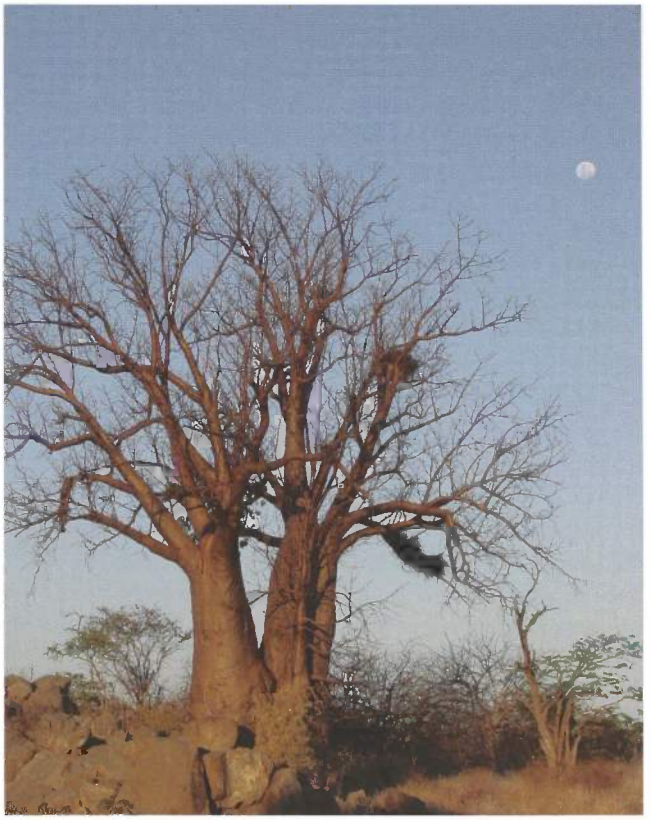
The species of baobab monitored during this study is found in 32 African countries. There are an abundance of different names for the so-called 'common baobab' (*Adansonia digitata*). In English it is known as the Monkey Bread Tree, Tree of Life, Upside Down Tree, Sour-Gourd Tree, Lemonade Tree, and Dead Rat Tree. In other languages it is Kremetartboom (Afrikans); Isimuku, UmShimulu, IsiMuhu (Zulu); Ximuwu (Tsonga); Mowana (Tswana); Muvhuyu (Venda), just to name a few, but no matter what it was called, the trees were and are an important source of food, drink, and medicine to indigenous people. The hollow trunks of the trees can store water, the pithy bark can be used to make ropes and baskets, and the vitamin C rich pulp of the fruits can be used to make a lemonade-like drink and numerous traditional medicines. Lastly, the roasted seeds make a coffee-like blend that has been sold and used in trade for thousands of years (Pakenham 2005).

Annually the trees produce enormous, carrion-scented flowers that last only a single day and are pollinated by fruit bats (Pakenham 2005). Once the fruits form they are important food sources for many animal species. Rosy-Faced Lovebirds (*Agapornis roseicollis*), Ruppell's Parrots (*Poicephalus rueppellii*), Vervet Monkeys (*Chlorocebus pygerythrus*), and Yellow Baboons (*Papio cynocephalus*), are just a few of the many animals known to eat baobab fruits.

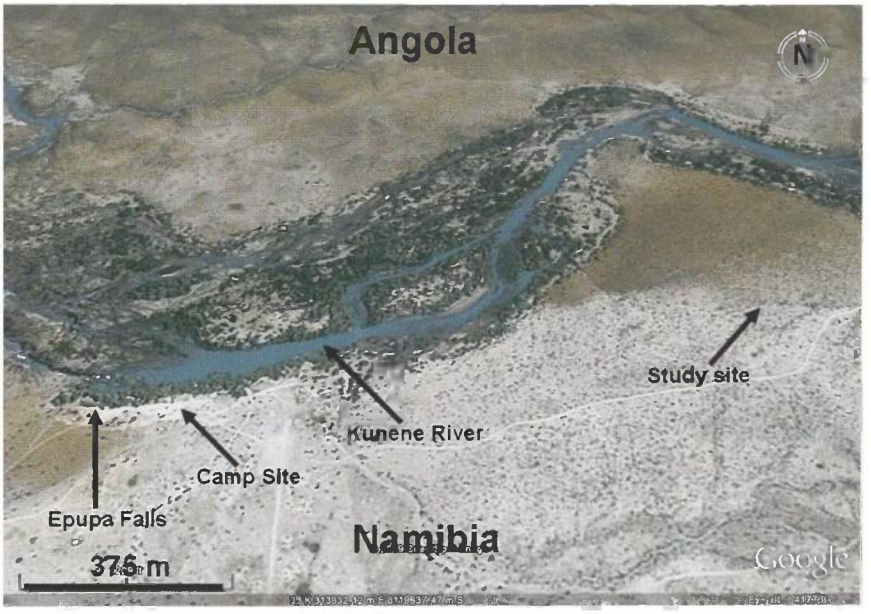
Site Description

The study area was near the campground at Epupa Falls, Namibia. More specifically, it was 1 km south of the Kunene River's banks on the border of Namibia and Angola, in a dry ravine (map p. 4). The aspect of the study site was northeast with an azimuth of 75 degrees, the slope was relatively gentle at 17 degrees and the GPS coordinates in map datum Nad83 are Zone 33 South, 314678 Easting 8119576 Northing. The baobab itself was relatively small in comparison to those located closer to the river. Its circumference was 47 feet and the height was approximately 21 feet. However, four of the branches were over 3 feet in diameter, adding a great deal of surface area to the tree.

The surrounding area's vegetation type is classified as arid savannah woodland. Savannas are most commonly defined as tropical seasonal ecosystems with a continuous herbaceous cover and a discontinuous cover of trees (Belsky 1990). The arid savannah areas in Namibia are further broken into 3 more specific vegetation type classifications: bushveld, lowveld, and thornveld. The study site falls within the thornveld.



Adansonia digitata (LH)



Most of the thornveld woodland in Namibia is dominated by Mopane trees (*Colophospermum mopane*), although at least 5 other deciduous tree species were identified in this study area (Table 1). Rat's tail grass *(Sporobolus pyramidalis)* and lovegrass (*Eragrostis curvula)* were the 2 dominant grasses in the area, which is generally considered to be a sign of overgrazing (Scholes and Archer 1997). There was an obvious presence of both goats and cattle in the vicinity. The Himba people living there depend on these animals for their livelihoods.

Materials and Methods

The fieldwork for this study was conducted from the 19th to the 23rd of June, 2008; primarily between 0700-1100 in the morning and 1730-2000 in the evening. The total man-hours involved was approximately 40, spread between 4 individuals, often with 2 people working at the same time. The fieldwork consisted of 5 basic parts: 1) Cavity Inventory, 2) Leaf Litter Plots, 3) Bird Inventory, 4) Reptile Inventory, and 5) Small Mammal Trapping.

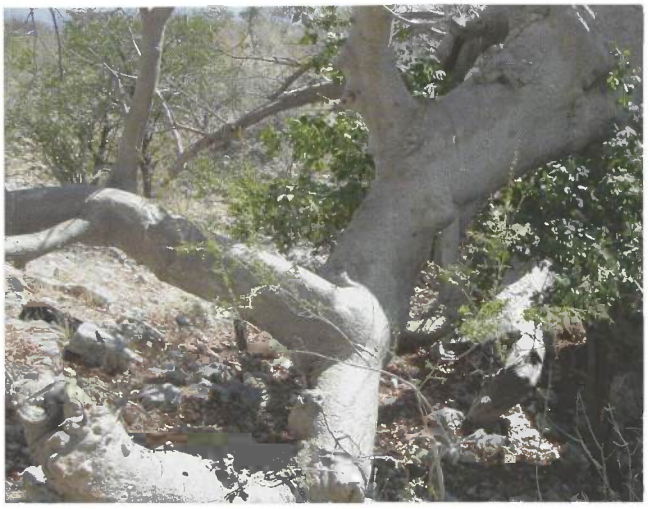
Cavity Inventory

The entire surface of the tree was meticulously searched for cavities. The minimum cavity depth was 2 cm and the maximum cavity depth was 30 cm. Anything deeper than 30 cm was simply marked >30. The diameter was also recorded and always corresponded with the maximum distance across the opening. Cavities were labeled as either a slit or round opening. Lastly, observers noted whether the cavity was occupied or not; and if possible which animal or insect species was using it.

Cavities in the Baobab (LH)

Leaf Litter Plots

During the leaf litter plots, every particle of litter was removed to see the ground below and to gather the organic material and weigh it. Due to time constraints only 2 plots were inventoried. One plot was on the ground directly below the tree's canopy and one was within the largest cavity of the tree. The plot on the ground was 1.0 m^2, while the plot in the tree was broken into 2 patches, one was basically a triangular half of a 50x25 cm^2 and the other a 15x30 cm^2 for a total surface area of 1.075 m^2. Any insects, eggs, seeds, etc. that were seen were also recorded.



Plot 1. Ground below branch (LH)

Plot 2. Cavity in tree (LH)

Bird Inventory

The bird inventory required few materials: 10x42 binoculars and a guidebook for Southern African Birds were used. The observers were positioned roughly 10 meters from the tree. Sightings were recorded only when the bird or birds landed in the tree. Birds that flew through the area were noted, but not counted. When a group landed in the tree, the number of sightings attributed was equal to the group size. Other than two male Cinnamon Breasted Rock Buntings, it was impossible to tell individual birds apart. Consequently the number of sightings per species, not the number of individuals of each species was recorded. Lastly, the dominant activity or behavior of the birds as well as the amount of time spent in the tree was recorded.

Reptile Inventory

The reptile inventory was purely observational and was not conducted in any systematic or consistent manner from day to day. Generally, the tree was searched in mid to late morning after the avian inventory was completed and then searched again both at dusk prior to setting small mammal traps, as well as a second search completed within an hour after dark. Binoculars and photo documentation were used to aid in the identification of the gecko and skink species seen.

Small Mammal Trapping

Sherman live traps were baited with fresh peanut butter and placed strategically around the study site. Three traps were set around the perimeter of the tree in places rodents would likely pass through and 2 traps were placed inside the largest cavity in the tree. Small mammal trapping was conducted for 3 consecutive nights and then discontinued due to both a lack of success in capturing anything and the presence of ants in the traps. As a result, this section will not appear in the results or discussion portions of this paper.

Results and Discussion

Cavity Inventory

The photos depict a few of the 248 cavities detected in the baobab tree. In total, sixty-three percent of the cavities were occupied by an insect or animal species. Some of the cavities had signs of use from up to 5 different organisms, but the vast majority had only 1-2. Spider webs were the main sign of life and were found in forty percent of the cavities (n=99).

Eight mud nests were noted. Two of these were avian and each one was very different in size indicating different bird species had nested inside the cavities. The other 4 could be used by geckos or another unknown animal species. There were also 2 stick nests, one was a very tiny cup, approximately 6-8 cm diameter and one was quite large >30 cm, but both seemed to be avian nests as well.

Two gecko nests with eggs were located and 15 other cavities showed occupation, either through the presence of a gecko or indirectly through presence of feces. Turner's thick-toed geckos were recorded for 5 of the cavities, although during the actual inventory only 3 were seen. The other 2 geckos had been detected during the reptile inventory or by incidental observation. One Boulton's gecko was also seen exiting a cavity during this inventory. Lastly, an un-identifiable snake shed was found inside one of the trees cavities.

Leaf Litter

In plot 1 completed on the ground below the tree, ground cover was split between 65 percent leaf litter and 35 percent rock cover. Rocks varied in size from 2 mm to 20 cm. There was only trace bare soil and live vegetation. The few blades of grass were *Eragrostis* sp. (lovegrass). The total mass of the leaf litter was 200 grams, roughly 1.6 times as much as the leaf litter within plot 2 inside the large cavity. Beneath the leaf litter, there were 8 mopane tree seeds, 2 sets of unknown insect wings, 2 live cockroaches, 2 spider exoskeletons, 2 spiders, 2 live beetles, and 3 ants.

In plot 2 done inside the cavity, the rock particles ranged in size from 4 to 15 cm. There were no tiny pieces of gravel like in plot 1. There was significantly more soil in this plot. The cavity was broken into 2 subplots. In subplot 1 it was split relatively evenly between soil and rock (50 percent / 50 percent), while in the smaller subplot 2 (more exposed) there was 100 percent leaf litter cover over the soil. The soil was mostly made up of rotting chunks of wood and varied in depth from 2-6 cm. The total mass of the leaf litter removed from both subplots was 125 grams. Only 12 spider webs were seen versus 35 in plot 1, likely due to significantly less leaf litter present. There were 7 insect and 3 spider exoskeletons, 2 live caterpillars, 1 wasp nest, 1 scorpion claw, 4 wings from unknown insects, 10 unknown tree seeds, 7 baobab tree seeds, 3 un-hatched and 4 hatched gecko eggs. One of the main differences between the plots is the much greater gecko use of the leaf litter within the cavity. This is perhaps also due to soil not rock below the leaf litter. In addition, there seemed to be more insects using the leaf litter on the ground.

Avian Inventory

During four mornings of observation, 22 avian species were seen using the tree and three others flew through without landing. These are listed in Table 2 page 9. The table lists all of the species that landed in the tree as well as several that were seen flying overhead.

There were 722 minutes of observation during the study, for an average of 181 minutes per day. There were 77 sightings in the tree, although the number of individual birds that used the tree is probably much less, since there were many repeat visits by some individuals. CBRB and RFL are the two species with the most sightings, followed by the Black-Chested Prinias. The prinias were only seen once, but they were traveling and feeding as a flock. The lovebirds usually just stopped very briefly (always less than 5 minutes) and called, while the CBRBs sang for up to an hour at a time from the very top of the baobab's branches. The researchers believe that there were only 2 individual CBRB's that continually used the tree. They are likely overrepresented in terms of species abundance, but in terms of time spent in the tree, this species far surpassed all others. The two CBRBs together account for 91 minutes of the observation time or 12 percent.

The two most common behaviors for all bird species were calling and looking around; however, two southern Yellow-billed hornbills and two Ruppell's parrots were seen early in the morning roosting in the tree. There was also an unknown passerine species that came in at dusk on 2 of the 4 nights to roost in bushes next to the tree. No animals were observed feeding in the tree, likely due to the fact that all but 2 of the fruits had been eaten already and the tree had already dropped its leaves for the dry season (winter).

Yellow-billed hornbill (LH)

Reptile Inventory

Three gecko species were seen on the tree or inside the cavities of the baobab during the study: 1) Barnard's day gecko (*Rhoptropus barnardi*), 2) Turner's thick-toed gecko (*Pachydactylus turneri*), and 3) Boulton's day gecko (*Rhoptropus boultoni boultoni*). The day before the official study began, all 3 of the gecko species, numbering 15-20 individuals, mostly Boulton's day geckos were seen during a brief visual examination as the class hiked past. The presence of the geckos was the primary reason this particular study was chosen.

The total observation time for reptiles was 318 minutes and there were 32 total gecko detections. Like the avian observations, the true number of individuals may be lower. However, the geckos did not move large distances and each used only a very small portion of the tree's surface area, so the observers avoided double-counting when possible. The Boulton's account for fifty percent (n=16), the Barnard's for thirty-four percent (n=11), and the Turner's thick-toed (TTT gecko) for sixteen percent (n=5) of total detections.

The nocturnal TTT geckos predictably occupied the same cavities the majority of the time. The TTT geckos were never observed outside of the cavities at the study site. Perhaps if the surveys had been done later in the night, instead of twenty minutes after dusk, the results would have been different. On several occasions a cavity that had been occupied in the daytime would be empty at night, but it is impossible to say whether the geckos moved to another cavity, moved deeper into the same cavity, or were outside feeding. Several cavities were > 30 cm deep and there was ample opportunity to avoid detection.

Turner's thick-toed gecko in baobab cavity (T. Edwards)

Boulton's day gecko (T. Edwards)

Although not seen in the tree, an Ovambo Tree Skink (*Mabuya binotata)* and a Spotted Sandveld Lizard (*Nucras intertexta*) were seen moving through the leaf litter. In addition, Bradfield's day geckos (*Lygodactylus bradfieldii*), Common Ground Agamas (*Agama aculeata aculeata*), and Namibian Rock Agamas (*Agama planiceps*) were seen within 500 meters of the study area. The first two were found along the banks of the river, but one Rock Agama was seen in very close proximity to the site in similar habitat. These results show a wide diversity of reptiles considering the time frame. A summer survey would likely yield even more species.

Conclusions

Although the duration of this study was extremely short and the time of year was not ideal, the baobab tree clearly hosts a vast array of insect and animal species. Its' cavities provide important nesting habitat for several bird and gecko species. Additionally, when the fruits are fresh it is also an important food source for mammals species, an area that was left untouched in this particular study. A follow-up study during the summer would be ideal.

References

Baum, D. A., DeWitt-Smith, S., & Oldham, R. A. (2004). "Unique Flowering Plant Families of the Tropics." American Journal of Botany 91(11): 1863-1871.

Baum D. A., Small R. L., & J.F. Wendel (1998). "Biogeography and Floral Evolution of Baobabs (Adansonia, Bombacaceae) as Inferred From Multiple Data Sets." Systematic Biology, Vol. 47, No. 2: 181-207.

Curtis, B. & C. Mannheimer (2005) The Tree Atlas of Namibia. National Botanical Research Institute Publishing, Windhoek: 674 pages.

Pakenham, R. (2005). The Remarkable Baobab. W.W. Norton Publishing, New York: 144 pages.

Belsky, J. (1990). "Savanna Ecology and Management: Australian Perspectives and Intercontinental Comparisons." Journal of Biogeography, Vol. 17, No. 4/5: 483-489.

Soares, Claire. "The tree of life (and its super fruit)," The Independent. 17 July 2008. Online: http://www.independent.co.uk/news/world africa/the tree of life-and-its-super-fruit-869737.html

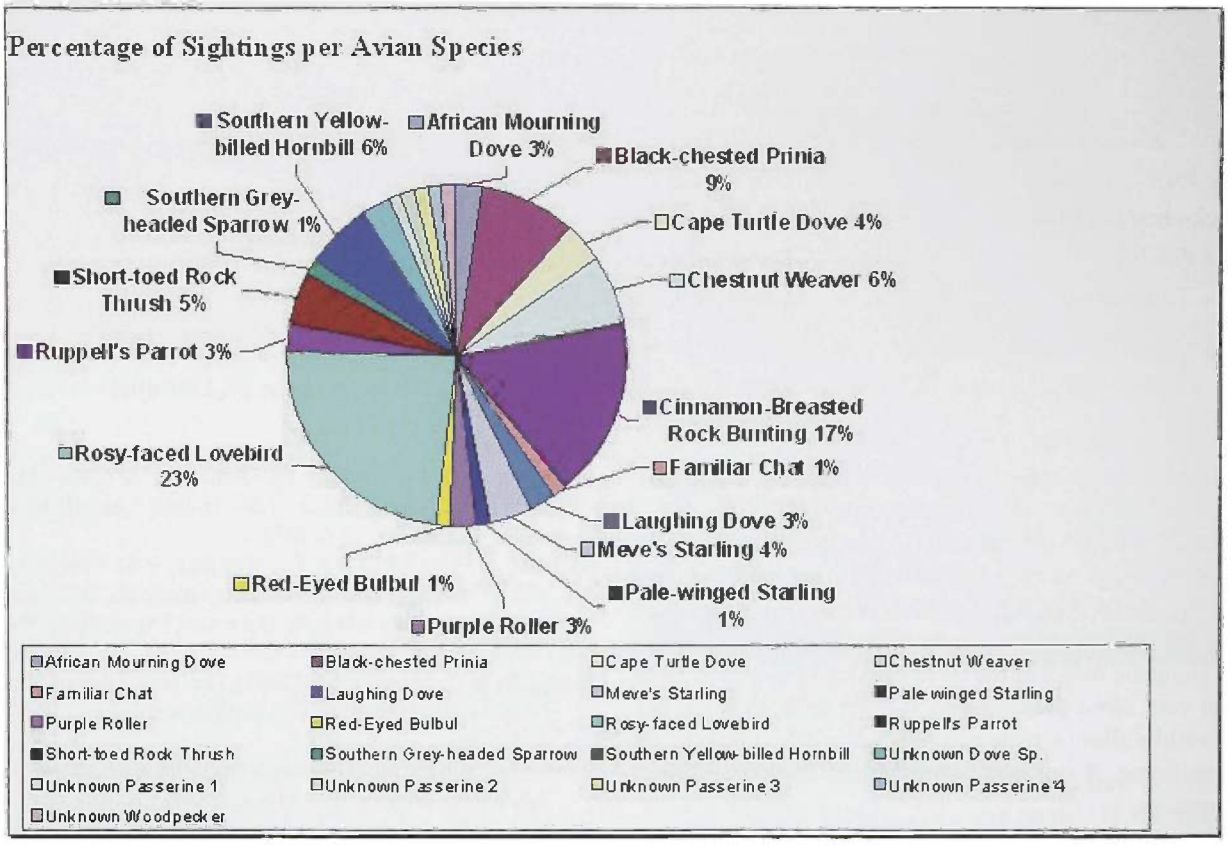
Scholes R.J. and Archer S.R. (1997). "Tree-grass interactions in savannas." Annual Review in Systematic Ecology. Vol. 28, 517-544.

Wilson, R. T. (1988). "Vital statistics of the baobab (*Adansonia digitata*)." African Journal of Ecology, 26 (3): 197-206.

Table 1. Tree species growing near the baobab

Common Name	Scientific Name
White-stem Corkwood	*Commiphora tenuipetiolata*
Feather-leaved Corkwood	*Commiphora kraeuseliana*
Poison Bottle Tree	*Adenium boehmianum*
Flame-thorn Acacia	*Acacia ataxacantha*
Camel-thorn Acacia	*Acacia erioloba*
Mopane Tree	*Colophospermum mopane*

Figure 1. Proportion of sightings that can be attributed to each avian species.



Epupa Falls, Namibia (T. Edwards)

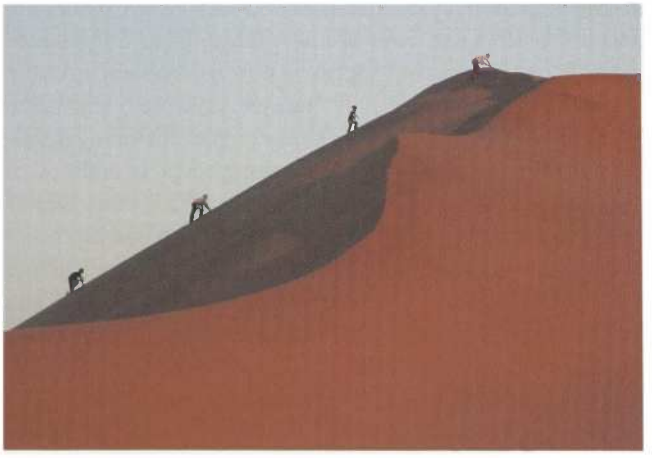
Table 2. Avian species that landed in the tree as well as several that were seen flying overhead.

Common Name	Scientific Name or Description	# Sightings
African Mourning Dove	*Streptopelia decipiens*	2
Bearded Woodpecker	*Dendopicus namaquas* – Not a positive ID	1
Black-chested Prinia	*Prinia flavicans*	7
Blue Waxbill	*Uraeginthus angolensis* – 1 observed flying, did not land	0
Cape Turtle Dove	*Streptopelia capicola*	3
Chestnut Weaver	*Ploceus rubiginosus*	5
Cinnamon-Breasted Rock Bunting	*Emberiza tahapisi*	13
Familiar Chat	*Cercomela familiaris*	1
Laughing Dove	*Streptopelia senegalensis*	2
Meve's Starling	*Lamprotornis mevesii*	3
Pale-winged Starling	*Onychognathus nabouroup*	1
Purple Roller	*Coracius naevis*	2
Red-Eyed Bulbul	*Pictnonotus nigricans*	1
Rosy-faced Lovebird	*Agapornis roseicollis*	18
Rock Kestrels	*Falco rupicolis*- 2observed flying, did not land	0
Ruppell's Parrot	*Poicephalus rueppellii*	2
Short-toed Rock Thrush	*Manticola brevipes*	4
S. Grey-headed Sparrow	*Passer diffusus*	1
S. Yellow-billed Hornbill	*Tockus leucomelas*	5
Unknown Dove Sp.	Seen at dusk,very poor visual	2
Unknown Passerine 1	Landed very briefly, could not identify	1
Unknown Passerine 2	Landed very briefly, could not identify	1
Unknown Passerine 3	Landed very briefly, could not identify	1
Unknown Passerine 4	Landed very briefly, could not identify	1
Yellow-billed Oxpecker	*Buphagus africanus* – observed flying overhead	0

Study Abroad in Namibia

Lyndsey Hellekson participated in the University of Arizona Study Abroad program in Namibia in the summer of 2008. This program is ongoing and open to students with an interest in international nature conservation, wildlife ecology, arid lands ecology or related fields. Dr. Hans-Werner Herrmann heads up this program in which participants visit the true coastal Namib desert and a cline of arid and semiarid habitats which extend from the west coast to the east inland. Students also travel to waterfalls along the Kunene River.

Namibia has one of the best developed infrastructures for tourism in Africa and has a large number of campgrounds and good roads. A stable political situation and long established nature conservation programs allow visitors to fully experience African ecosystems, as well as the local people and their cultures. For further information go to www.studyabroad.arizona.edu



Gobabeb Research Station, Namibia