

# REDISCOVERY OF THE WOOLLY FLYING SQUIRREL (*EUPETAURUS CINEREUS*)

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The woolly flying squirrel (*Eupetaurus cinereus*) is a rare, unusual, and poorly-known sciurid. Most information concerning this species comes from a few study skins collected over a century ago. In 1994, a live specimen was captured in northern Pakistan, and new physical and behavioral information gathered. Remains of other specimens were found, and anecdotal information was gathered from local people concerning natural history of the squirrel.

**Key words:** *Eupetaurus cinereus*, Pakistan, Sciuridae, woolly flying squirrel

The woolly flying squirrel (*Eupetaurus cinereus*) is one of the least known mammals in the world. It originally was described by Thomas (1888) from two skins and a skull. Locations for these and other specimens collected in the late 1800s were mostly from the Gilgit and Hunza districts at the confluence of the Himalayan, Karakoram, and Hindu Kush mountain ranges in or near what is now northern Pakistan. Little information about this animal has been gathered since then, and most of what is published has been inferred from analyzing these skins (Blanford, 1891; Chakraborty and Agrawal, 1977; Ellerman, 1963; McKenna, 1962; Roberts, 1977). Although Thomas (1888) stated that one of his skins probably was from Tibet, and Agrawal and Chakraborty (1970) noted the purchase of a skin from northern Sikkim, no reliable documentation of the woolly flying squirrel currently exist in areas east of northern Pakistan.

The woolly flying squirrel is a large squirrel, with a length of head and body of 500-600 mm and extremely dense, thick fur. Its tooth structure is hypsodont, which differentiates it from other members of the Sciuridae (McKenna, 1962; Nowak, 1991). Thomas (1888) described the skull as having a long, trumpet-shaped muzzle. He also stated that relative to other flying squirrels

*Eupetaurus* had more marked supraorbital notches, longer anterior palatine foramina, and a shorter bony palate. The tail differs from other species of flying squirrels in Pakistan (*Petaurista petaurista* and *Hylopetes fimbriatus*), as it is cylindrical, not flattened, and without a black tip. The location of pads on the feet differ, with the soles more heavily furred (Roberts, 1977). Because of the bluntness of the claws on early specimens, Thomas (1888) speculated that the animal lives among rocks rather than in trees.

The only information that concerns a live individual is brief and anecdotal (Lorimer, 1924). No records of the woolly flying squirrel have been obtained by scientists working in the area since 1924. Additionally, recent work in northern Pakistan (D. Blumstein, G. Rasool, T. Roberts, G. Schaller, C. Woods, pers. comm.) has provided no evidence of its existence. As a result, it is not listed in references on endangered or threatened species (Greenbridge, 1993; Inskipp and Barzo, 1987; Lidicker, 1989; Thornback and Jenkins, 1982; United States Fish and Wildlife Service, in litt.).

## STUDY AREA AND METHODS

During June-July of 1992 and 1994, I visited most of the locations where specimens originally had been collected. These include the Shishpar (36°50'N, 74°55'E), Naltar (36°07'N, 74°14'E),

Kargah (35°56'N, 74°13'E), Sai (35°45'N, 74°30'E), and Astor (35°22'N, 74°52'E) valleys. The region containing these sites is characterized as high, cold desert dominated by *Artemisia* and *Juniperus* above 2,000 m, with a few valleys having forests of *Pinus* and *Picea* at higher altitudes. The centrally located town of Gilgit (35°55'N, 74°20'E), at 1,500 m, has a yearly mean temperature of 17.2°C ( $\bar{X}$  summer = 28°C;  $\bar{X}$  winter = 6°C). Precipitation, ca. 127 mm annually, occurs mostly between March and June, with August receiving what little monsoon-effect rains reach into the mountains ( $\bar{X}$  = 13 mm—Willmott et. al., 1981). Extensive efforts were made to gather information about the animal from local inhabitants at each site visited (ca. 200 interviews), and, when warranted, efforts were made to capture individuals using Tomahawk 207 livetraps (>200 trapnights).

## RESULTS

On 8 July 1994, a female *E. cinereus* was captured by two local men in the Sai Valley. The capture site was located between Hurkus and Gashu Gah (35°45'N, 74°27'E). The squirrel was captured in a cave at 3,200 m, ca. 800 m above the valley floor on the south side of the Sai River. The cave was ca. 10 m up an isolated, northwest-facing, vertical cliff wall. The wall was ca. 20 m high by 100 m long and situated at the top of a long slope. The slope varied from 30 to 60 degrees. The area was well vegetated, with long grasses below the cliff face and scattered *Pinus wallichiana* growing nearby. Continuing downslope to the river at 2,400 m were scattered *Juniperus macro-poda*. The cave entrance was ca. 2.0 by 2.5 m, and the depth of the cave was ca. 3.5 m.

The squirrel appeared fully mature and the following measurements were taken: length of tail, 545 mm; length of hind foot, 90 mm; weight, 2.5 kg. In a crouch, the head and body measured 355 mm in length and 255 mm in height at the middle of the back. The eyes appeared large. Four teats were visible. The dorsal fur was long (50–70 mm) and of two types; a thick woolly underfur, 30–40 mm in length, and longer guard hairs. The underfur was pale gray

with buff tips, and guard hairs were charcoal gray to black with buff tips, resulting in an overall palely grizzled-gray color. The ventral side was a paler gray in color. Hairs on the head and ears were shorter. All feet were covered in black hairs above and below. A small black patch of hair occurred on the muzzle and chin. The tail was long, cylindrical, and the same color as the back. The tail tapered toward the end and had a cream-white tip ca. 40 mm long. All claws on the fore and hind feet were sharp.

The animal was kept overnight in a live-trap. She remained inactive until 1945 h, when she began to groom herself. At 2200 h, the animal began to move around and slowly investigate her surroundings. Bouts of activity continued until 0400 h when she curled up and went to sleep. Her sleeping posture was in a sitting position with her head on her chest and her tail curled to the right under the chin and up onto the shoulder. At all times, the animal appeared slow-moving and calm. Her only defensive reaction was a sudden slap with front paws when the cage was touched. When disturbed while sleeping, her only movement was to open her eyes and observe the disturbance. The only vocalizations were four soft grunts and a quiet “chirr” sound upon initial transfer from the capture bag into the cage.

Upon release at the base of the cliff wall, the squirrel returned to the cave along a series of ledge switchbacks. Her movements appeared slow with the animal stopping and looking back a number of times.

Body parts of woolly flying squirrel also were discovered in the Sai Valley. The parts were all found within 100 m of a roost of an eagle owl (*Bubo bubo*). The site was at 2,500 m elevation on the south side of the Sai River between Hurkus and Gashu Gah. It was near the Chahochi camp site and 2–3 km west of the capture site of the woolly flying squirrel. The parts were fresh and included: associated right humerus, radius, ulna, and hand; associated two innominate bones, partial vertebral column, right and

left femora, right and left tibiae, and right foot; two femora and one right tibia; sections of caudal vertebrae from two individuals.

#### DISCUSSION

The capture of a woolly flying squirrel and discovery of body parts demonstrate that this species is not extinct. Discussions with local people suggest that its present range extends from Astor in the southwest through the Chilas region to the Tangir Valley in the southeast. It occurs on both sides of the Indus River, and through Naltar in the north, an area of ca. 500 km<sup>2</sup>. The range may include parts of Hunza in the north and Chitral in the east. This range encompasses the arid montane region of Pakistan excluding areas heavily influenced by the summer monsoons.

A number of physical features recorded from the captured individual were new or differed from previously described specimens. While the captured individual had a length of tail of 545 mm and a tail collected from the roost of the eagle owl measured 540 mm, lengths of tails previously recorded were 370, 380, and 480 mm (Nowak, 1991; Roberts, 1977). The claws on the captured specimen and on the forefoot and hind foot of the body parts collected near the owl roost were sharp, contrary to all previously published descriptions from collected skins. The captured specimen had a white tip to the tail, although the distal portions of the tails collected from the roost of the eagle owl did not have white tips. White tail-tips are not mentioned in most other descriptions, although Thomas (1888) describes one specimen from Astor as having a white tail-tuft. Weight and number of teats have not been reported previously.

My observations suggest that the woolly flying squirrel is nocturnal. Local people state that it is solitary and active all year. They describe it as often or always residing in caves on vertical cliff walls during the day, not among boulders as previously suggested. These caves consistently are located

at 2,400–3,800 m elevation. This corresponds with the elevation where scattered conifers (*Juniperus macropoda*, *Pinus wallichiana*, *P. girardiana*, and *Picea smithiana*) are found, at least in Sai and Astor. Local people state that the squirrel climbs into these trees to feed. Small piles of droppings of the woolly flying squirrel were found around the base of pines near the site of capture, further suggesting that the squirrel feeds in these trees. The discovery of remains of squirrels at the roost of the eagle owl suggests that the owl is a frequent predator of woolly flying squirrels. Given the long, sharp claws on the front feet, the slapping motion exhibited by the captive individual may well be an effective defense against smaller predators.

While the woolly flying squirrel apparently was never abundant, local people in Sai and Astor state that it was much more common 10–15 years ago, and that its range in these areas has become more restricted. The reason for this change, if it is occurring, is unknown. While the eagle owl may be an important predator, local people insist that the owl is rare in the areas in question. The woolly flying squirrel is not hunted for food or its fur by local people in the southern valleys. Instead, it is held in some regard, for a material (called *salagit* in Urdu), thought by some to be its urine, which is collected from caves and sold in medicinal potions. There are many collectors of this material in Sai, Astor, and Chilas, and these people state that when visiting caves they occasionally see the squirrel, which is known as *charge* in the local Shina language.

Pakistan, although only slightly larger than Texas, has the seventh-largest population of humans of any country in the world (World Bank, 1994). The recent increase in human population in northern Pakistan has led to an increase in domestic goats and sheep. In each valley, hundreds or thousands of animals are grazed during summer within the elevational range of the woolly flying squirrel. They have a visibly negative effect

on the growth of grasses and other herbaceous vegetation and on the regeneration of woody vegetation. Pakistan also has the third-highest rate of deforestation in the world (World Bank, 1994). Extensive illegal deforestation is occurring in northern Pakistan wherever pine, spruce, or juniper stands exist. During a visit to the Sai Valley in July 1994, ca. 1,000 mature conifers were seen cut and piled in one location. If the woolly flying squirrel depends on these plants for food or temporary shelter, grazing and deforestation may have important effects on its populations.

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