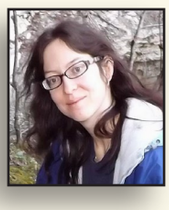
Where in the World Are Pallas's Fish Eagles?

The World's First Comprehensive Study of *Haliaeetus leucoryphus* Seasonal Movements and Habitat Ecology with GSM/GPS Technology



Marla Steele is a Ph.D. student majoring in Biology at the University of Arkansas. She is currently working with the National University of Mongolia, the Mongolian Ornithological Society, and the Bombay Natural History Society to research the habitat and movement ecology of Pallas's Fish Eagles.

A journey of over 2000 miles, for human and eagle alike, started with a single home range map covered in question marks, an irresistible challenge to a graduate student starting her Ph.D. program at the University of Arkansas. The species in question, Pallas's Fish Eagle (*Haliaeetus leucoryphus*), has an extensive historical range of over 1,000,000 km^2, and virtually no information concerning its seasonal movements or non-breeding habitat ecology is known. Extensive literature review into the species' ecology revealed conflicting records and observations that described a large fishing eagle that could be observed in fairly high densities along all major freshwater sources within its expansive range with a cryptic life history prior to the 1900s. Historical records provide vague observations of breeding individuals within the Indian subcontinent that disappear with the coming of monsoon rains, while others argue that the eagles remain sedentary within the area year-round. In the northern extent of the range, around Mongolia and Kazakhstan, the records agree that the birds disappear by September/October and re-appear around May. Despite contradicting records and a significant lack of knowledge on Pallas's Fish Eagle life history overall, there is one somber truth that appears to be supported by all countries within the past fifty years: Pallas's Fish Eagles are disappearing.

Photo by Marla Steele

Chinggis with the transmitter.

Conservation efforts are hampered by a lack of knowledge in the birds' seasonal movements and habitat ecology. In order to provide an effective conservation strategy, habitat ecology and global connectivity must be understood, and communication across political borders must be maintained. In an effort to provide baseline information and address this gap in knowledge, I approached the Mongolian Ornithological Society, National University of Mongolia, and Bombay Natural History Society with a proposal to team up and fit Pallas's Fish Eagles with 70g solar-powered, GSM/GPS transmitters in their respective countries. Together, we began the world's first study of Pallas's Fish Eagle migration and habitat ecology with GSM/GPS technology.

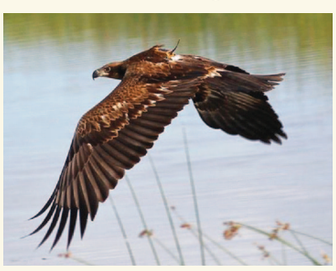


Photo by L. Jargal

Pallas's Fish Eagle.

The incorporation of GSM technology could be likened to art. Historical records, observations, and field journals create a basic black and white sketch describing the bird. Observation-based field studies, including radio telemetry, population surveys, and community-wide interaction studies, provide a rich color-palette that allows for a significantly improved comprehension of a species' general ecology as a whole. Yet, the use of GSM transmitters takes research a step further; it shifts a two-dimensional image to a three-dimensional sculpture with detailed data, allowing one to physically perceive shape, size, color, and even texture. GSM/GPS transmitters have an incredible potential to collect detailed fine-scale observations with GPS coordinates at a measure that would have been impossible two decades ago. A single transmitter has the capability to collect over 22,000 coordinates, not including errors and outliers, in a single month. With such an extensive dataset and the assistance of global climate and topographic data, the project has the potential to not only identify Pallas's Fish Eagle habitat and seasonal movements, but also model flight timing and strategies on a three-dimensional level, in accordance to large- and fine-scale climate and topographic factors. In the face of global climate change and the potential onset of an El Niño event for 2015, the results could prove invaluable to conservation efforts.

However, the reward of such a detailed, groundbreaking study is not without its fair share of risks and uncertainties. The first challenge that any biologist must face when fitting an animal with a transmitter is the initial capture of the study animal. Pallas's Fish Eagles can be extremely difficult to observe. Furthermore, there has never been a previously described attempt to capture and tag the species; my colleagues and I were forced to embark on a long process of trial-and-errors. Trapping efforts began in Mongolia in 2012; that first summer, we walked away without capturing a single Pallas's Fish Eagle. The following year, we caught our first juvenile Pallas's Fish Eagle on July 4, 2013 by a single toe with padded leg traps. He was christened as "Chinggis" in honor of Mongolia's revered hero, Chinggis Khan. The grins of the team were blinding, and eyes were suspiciously moist. Chinggis was promptly fitted with his 70g GSM/GPS transmitter and released back to the Mongolian steppe. We watched him fly away with a combination of elation and trepidation in anticipation of the second risk.

The second danger of GSM/GPS technology is the strict dependence of GSM cell towers for data transfer. It is important to note that cell reception is extremely limited in regions of the world where human populations are small or landscape is rugged and desolate. In the event that cell reception is unavailable, the GSM/GPS transmitter serves as a data logger. However, the tagged animal must eventually move into cell reception or the transmitter is useless, except in the event of an unlikely recapture. Mongolia has a considerably small human population and a significant portion remain tied to their nomadic roots. As such, cell reception is extremely limited in rural areas. Upon Chinggis's release, our team watched the result of two years worth of fundraising and months of exhaustive fieldwork fly away with no guarantee of results. Yet, luck remained on our side; the next day, we made a special trip to the local soum center, the area's only internet source within a day's drive, to see if Chinggis had checked in.

Data began streaming immediately, and the results were beautiful. While transmission times were occasionally sporadic depending on the area, the collected GPS coordinates clearly illustrated Chinggis's daily movements with a precision of every 1-3 minutes during the day. With the fine-scale data, I was able to begin calculating habitat utilization probability densities and locate clear examples of thermal-soaring behavior (see figure, page 7). These results are barely the tip of the iceberg in terms of what can be discovered in the coming years. After several months of traveling along Mongolia's river systems, the moment of truth arrived. One day, Chinggis left his current foraging territory, ironically beside the Chinggis Khan International Airport, and flew south, never looking back. From there, a

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