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On-line

### Assessing Wild Bornean Orangutan (*Pongo pygmaeus wurmbii*) Populations with Drone Imagery

MADELINE M. EORI<sup>1,4</sup>, ELIZABETH BARROW<sup>2</sup>, VICTORIA GEHRKE<sup>2</sup>, TERRI BREEDEN<sup>2</sup>,  
ERIN E. KANE<sup>1</sup>, TRI WAHYU SUSANTO<sup>2,3</sup> and CHERYL D. KNOTT<sup>1,2,4</sup>

<sup>1</sup>Department of Anthropology, Boston University,

<sup>2</sup>Gunung Palung Orangutan Conservation Program, Indonesia,

<sup>3</sup>Department of Biology, National University, Indonesia,

<sup>4</sup>Department of Biology, Boston University

Wild orangutan populations are estimated to have declined by well over 50% in the last 60 years. Thus, a rapid, reliable survey method that can be used across orangutan habitat types is needed to track orangutan population density. Individual, adult orangutans build a new nest each night so orangutan populations have historically been evaluated through systematic, ground-based, nest surveys. However, orangutan nest surveys are costly, time-consuming, require some degradation of the forest, and are restricted to areas that are accessible by ground teams. In 2016-2017, we pilot-tested the use of drones to survey orangutan populations in Gunung Palung National Park, Borneo, Indonesia, determining that nests can be spotted and counted from the imagery collected. In 2018-2019, drone imagery for 50 transects was obtained and analyzed to calculate population density. Nests in the images were classified into nest degradation categories to match ground methods. On average, fewer nests were found using drone imagery analysis than ground surveys. We calculated habitat specific conversion factors for drone nest surveys, based on our ground-truthing, to estimate orangutan population densities. We compare the density values using these two methods and demonstrate the validity of using drones as an effective technique for estimating orangutan population size. Data were compared to completed phenological surveys and showed close correspondence between nest density and fruit availability. The drone imagery will allow for more rapid assessment of new or more intensive human impacts on the land, providing further insight into what conservation efforts are needed to protect orangutan populations.

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