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Evaluation of thermal infrared imaging from uninhabited aerial vehicles for arboreal wildlife surveillance

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An important component of wildlife management and conservation is monitoring the health and population size of wildlife species. Monitoring the population size of an animal group can inform researchers of habitat use, potential changes in habitat and the resulting behavioral adaptation, individual health, and the effectiveness of conservation efforts. Arboreal primates are difficult to monitor as their habitat is often poorly accessible and most primate species have some degree of camouflage, making them hard to observe in and below the tree canopy. Surveys conducted using uninhabited aerial vehicles (UAVs) equipped with thermal infrared (TIR) cameras can help overcome these limitations by flying above the canopy and using the contrast between the warm body temperature of the monkeys and the cooler background vegetation, reducing issues with impassable terrain and animal camouflage. We evaluated the technical and procedural elements associated with conducting UAV-TIR surveys in an arboreal and terrestrial macaque species. Primary imaging missions and analyses were conducted over a monkey park housing approximately 160 semi-free-ranging Japanese macaques (*Macaca fuscata*). We demonstrate that Repeat Station Imaging (RSI) procedures using co-registered TIR image pairs facilitate the use of image differencing to detect targets that were moving during rapid sequence imaging passes. We also show that 3D point clouds may be directly generated from highly overlapping UAV-TIR image sets using Structure from Motion (SfM) image processing techniques. A point cloud showing area-wide elevation values was generated from TIR imagery, but it lacked sufficient point density to reliably determine the 3D locations of monkeys.