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Abstract: Increasing numbers of long-term studies have shown that natural marks can be used to identify individuals using a photographic file index. Photographic identification is a powerful non-intrusive method for obtaining information on behavior, population size and live-history parameters in wild populations.

Computer-aided Photograph Matching: An Example from Serengeti Cheetahs

*by Marcella Kelly**

Increasing numbers of long-term studies have shown that natural marks can be used to identify individuals using a photographic file index. Photographic identification is a powerful method for obtaining information on behavior, population size and life-history parameters in wild populations.

This method is non-intrusive and hence is particularly advantageous in studies of threatened and endangered species. Yet handling large quantities of photographs is time consuming and prone to error. Computer-aided matching can speed up the process of individual identification from photographs. I used a three-dimensional (3-D) computer matching system on Serengeti cheetahs and tested its accuracy. This matching system was developed by Hiby and Lovell (1990, 2001) for marine mammals originally. This method enabled me to determine demographic parameters for the cheetah population which were useful in constructing a population viability analysis (Kelly and Durant 2000).

Cheetahs of the Serengeti Plains were photographed beginning in 1969. From 1969-1991 most photographs were not distinguished in the field, creating a backlog of 10,000 photographs of unidentified individuals. I entered these photographs into the computer and digitized the backbone, belly line, shoulder, and hip joint for each animal. A 3-D model of the cheetah's body is projected onto the photographic image allowing the computer to line up its 3-D model with the two-dimensional photographic image. This technique allows the user to enter photographs regardless of orientation of the animal to the camera. The model can be rotated and rolled to line up with the image. Subregions of a cheetah's coat patterns are extracted and compared to others. Cheetahs with high correlations between dark and light patterns score high similarity coefficients and hence are a match.

I found the program to be extremely accurate. At similarity coefficients of 0.500 the computer was nearly 100% accurate in predicting a match. The number of missed matches by the computer was only 6.5% when using a similarity threshold of 0.450. However, missed matches can be further reduced by including more than one photo of each animal. I also found that poor quality photographs and those at skewed angles to the camera produced lower similarity coefficients, resulting in more missed matches. However, it is still useful to use such photographs as they often match to high quality photographs.

Entering each photograph takes 1-3 minutes and comparing two photographs takes 2-4 seconds. Hence, tens of thousands of comparisons can be run overnight. It only takes an hour or two to train an operator to use the program. No reliance on observer memory is required, making this method robust to user inexperience. This method provides an accurate and fast way to deal with large quantities of photographs of individuals and it can be modified for other species with complex yet variable coat patterns.

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* Marcella Kelly
Department of Wildlife
Fish and Conservation Biology
University of California
One Shields Avenue
Davis, CA 95616, USA

Email: <mjkelly@ucdavis.edu>