Monitoring mountain lion using footprints: A robust new technique

Zoe Jewell, Vet. M.B, and Sky Alibhai, PhD, visiting research scientists, Nicholas School of the Environment, Duke University, and the JMP Division, SAS Institute, Cary, North Carolina.
Jonah W. Evans, Mammalogist, Texas Parks and Wildlife Dept., Alpine, Texas.

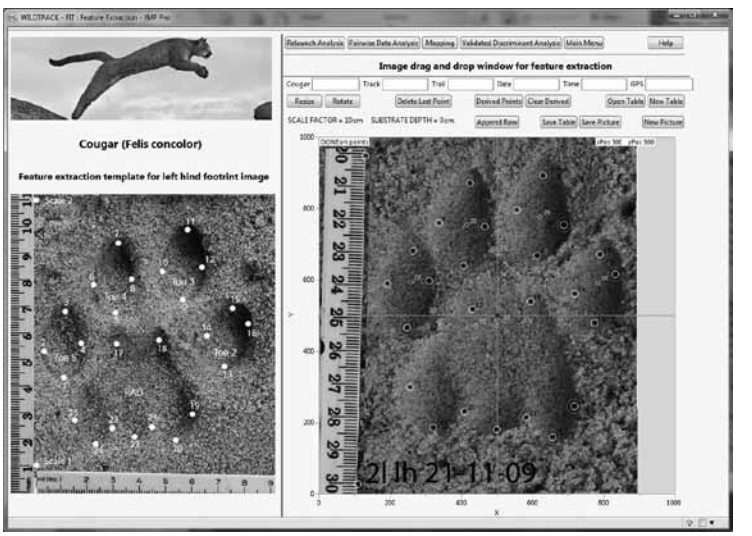
In the USA the largest and most wide-ranging felid is the puma (*Puma concolor*). Pumas are extending their range eastward across the US. However, Holbrook et al. (2012) found that puma populations in South Texas have declined more than 50% from historic levels. Jonah Evans, a CyberTracker certified Track & Sign Specialist and State Mammalogist for the Texas Parks and Wildlife Department (TPWD), has been researching how to evaluate the current levels of unregulated hunting and trapping and their effects on puma populations. Zoe Jewell and Sky Alibhai, founders of WildTrack (www.wildtrack.org) and visiting research scientists at Duke University and the SAS Institute (www.sas.com), North Carolina, have developed a non-invasive and cost-effective approach to monitoring endangered species, the Footprint Identification Technique (FIT). Their work with black rhino in Zimbabwe and Namibia (Alibhai, Jewell & Law, 2008) demonstrated negative fertility effects (Alibhai, Jewell & Towindo 2001) and collaring problems (Alibhai and Jewell 2001) following repeated immobilization, and drove their search for a better method of monitoring (Alibhai Jewell & Law 2008). They raised concerns about the quality of research data resulting from techniques that effect the physiology or behavior of the target species (Jewell 2013).

FIT was developed with the help of expert local trackers in Africa, and has so far been adapted for use with 10 endangered species. It is able to distinguish at the species, individual, sex and age-class levels from digital images of footprints alone. Jewell, Alibhai and Evans are now collaborating on a project to develop FIT for use in monitoring puma populations. They have collected 535 footprints from 35 captive (16 males:19 females) animals of known sex and identity to form the initial track library. A video showing the collection of prints is available at http://youtu.be/OKlNKneBhDc. Accuracies of >90% have been obtained in classifying by individual and sex.

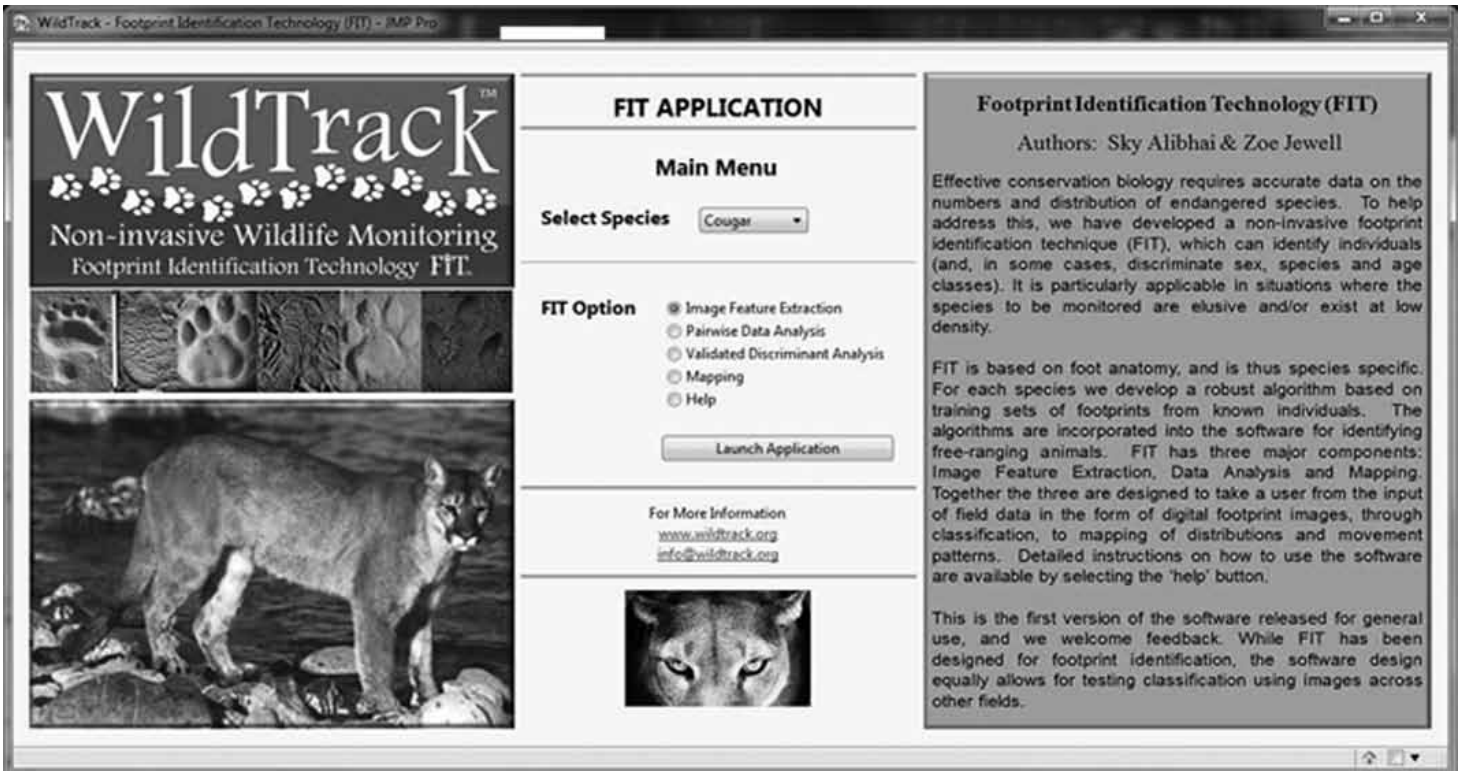
The FIT data capture and manipulation process is as follows. First, a series of digital images are captured along a trail using a standardized photographic protocol (http://wildtrack.org/citizen-science/photographing-footprints/). A metric ruler is placed on the horizontal and left axes of the footprint and an information slip recording GPS, date, photographer and track number is placed near the ruler. The image is opened by a user-interface, in a customised FIT add-in in JMP software (www.jmp.com; SAS Institute). Feature extraction opens another window to allow the placing of landmark points at specific anatomical landmark points on the image. A JMP script then extracts >120 measurements of areas, lengths and angles from the footprint. The variables that provide best classification are extracted using stepwise selection, and trails then compared using a customized model based on a cross-validated pairwise discriminant analysis, with Ward's clustering technique. This outputs individual identification through a cluster dendrogram. Sex, age-class and species discrimination are provided by discriminant analysis alone.

The apparent benefits of FIT are its low cost and accuracy when compared with other methods. Since data are relatively easy to collect, it is particularly amenable to efforts by trackers, citizen scientists and opportunistic ramblers. While rocky, mountainous terrain and limited access to private property may prove to be difficult obstacles to overcome, the researchers are optimistic that the FIT method will become a valuable tool for monitoring pumas in the near future. Field validation of the captive-derived algorithm for free-ranging puma is now underway. Jewell, Alibhai and Evans invite anyone with access to free-ranging pumas to join this effort by contributing footprints for the field validation trial. Please contact info@wildtrack.org for more information.

Meanwhile, we remain humbled by the tracking skills which evolved with our ancestors thousands of years ago, and which inspired the development of the footprint identification technique.



The FIT feature extraction interface, showing template image (left) and test image (right) with landmark points in place prior to feature extraction.



MANAGEMENT NOTES

Research to Regulation: Cougar Social Behavior as a Guide for Management

Wildlife Society Bulletin; DOI: 10.1002/wsb. 299

Richard A. Beausoleil,[1] Washington Department of Fish and Wildlife, 3515 State Highway 97A, Wenatchee, WA 98801, USA
Gary M. Koehler, Washington Department of Fish and Wildlife, 2218 Stephanie Brooke, Wenatchee, WA 98801, USA
BenjaminT. Maletzke, Washington Department of Fish and Wildlife, P.O. Box 522, Pullman, WA 99163, USA
Brian N. Kertson, Washington Department of Fish and Wildlife, 1775 12th Ave NW, Suite 201, Issaquah, WA 98027, USA
Robert B. Wielgus, Large Carnivore Conservation Lab, Washington State University, Pullman, WA 99163, USA

ABSTRACT. Cougar (*Puma concolor*) populations are a challenge to estimate because of low densities and the difficulty marking and monitoring individuals. As a result, their management is often based on imperfect data. Current strategies rely on a source–sink concept, which tends to result in spatially clumped harvest within management zones that are typically approximately 10,000 km^2. Agencies often implement quotas within these zones and designate management objectives to reduce or maintain cougar populations. We propose an approach for cougar management founded on their behavior and social organization, designed to maintain an older age structure that should promote population stability. To achieve these objectives, hunter harvest would be administered within zones approximately 1,000 km^2 in size to distribute harvest more evenly across the landscape. We also propose replacing the term "quota" with "harvest threshold" because quotas often connote a harvest target or goal rather than a threshold not to exceed. In Washington, USA, where the source–sink concept is implemented, research shows that high harvest rates may not accomplish the intended population reduction objectives due to immigration, resulting in an altered population age structure and social organization. We recommend a harvest strategy based on a population growth rate of 14% and a resident adult density of 1.7 cougars/100 km^2 that represent probable average values for western populations of cougars. Our proposal offers managers an opportunity to preserve behavioral and demographic attributes of cougar populations, provide recreational harvest, and accomplish a variety of management objectives. We believe this science-based approach to cougar management is easy to implement, incurs few if any added costs, satisfies agency and stakeholder interests, assures professional credibility, and may be applied throughout their range in western North America.