Canine Assistants for Conservationists

ALTHOUGH SOME FORENSIC USES OF SCENT-following dogs may be questionable, as Brisbin, Austad, and Jacobson point out in their letter "Canine detectives: the nose knows—or does it?" (10 Nov., p. 1093), the scent discrimination abilities of canines are still impressive. Controlled behavioral tests indicate that dogs can distinguish the odors from different species of animals, male and female dogs, and even different individuals within a species (*1*). These abilities are proving invaluable in conservation programs for endangered and difficult-to-distinguish species (*2*), particularly when combined with molecular techniques for the analysis of DNA extracted from the sloughed intestinal cells contained in feces (*3*).

Conservationists might have a new way to identify the calling cards of endangered species such as this San Joaquin kit fox.

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We have obtained molecular genetic confirmation of the ability of trained scenting dogs to distinguish among the scats (feces) of sympatric canid species. We trained dogs (*4*) to detect scats of the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) and ignore those of coyotes (*Canis latrans*). One German shepherd recovered 435 presumed kit fox scats along 140 kilometers of transects in the Carrizo Plain Natural Area, California, in 16 days. We were able to isolate DNA from 329 of the scats. Mitochondrial DNA tests developed in the National Zoological Park's Molecular Genetics Laboratory (*5*) revealed that all 329 scats were indeed from kit foxes. Thus, the dog was 100% accurate in identifying kit fox scats in the presence of coyote, skunk (*Mephitis mephitis*), and badger (*Taxidea taxus*) scats along the transects. Species identification based on mitochondrial DNA (*5*) costs about $40 per sample. Hence, use of scent-detection dogs to distinguish scats from species of interest could provide a cost-effective alternative to laboratory methods in some conservation applications.

Fecal DNA analysis is potentially a powerful method for identifying species, population size, sex ratio, home range, paternity, and kinship (*6*). However, finding enough samples for this approach is difficult and time-consuming in many habitats, such as dense vegetation. Along transects through vegetation, our trained dog found about four times as many kit fox scats as an experienced person searching for scats visually. Thus, trained scent dogs can greatly increase the utility of DNA techniques in conservation and might be the only way to obtain information on the presence or absence of some endangered species around the world.

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References and Notes
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2. Dogs have been used successfully to find feces of grizzly bears (*Ursus arctos horribilis*) (S. Wasser, personal communication), black bears (*Ursus americanus*) (S. Wasser, personal communication; P. Paquet, personal communication), wolves (*Canis lupus*), and coyotes (P. Paquet, personal communication).
3. M. H. Kohn and R. K. Wayne, *Trends Ecol. Evol.* **12**, 223 (1997).
4. Our training methods were similar to those used when training dogs to detect narcotics.
5. E. Paxinos *et al.*, *Mol. Ecol.* **6**, 483 (1997).
6. M. H. Kohn *et al.*, *Proc. R. Soc. Lond. Ser. B.* **266**, 1429 (1999); H. B. Ernest *et al.*, *Mol. Ecol.* **9**, 433 (2000).

Present and Future Control of Malaria

CONFLICT WITHIN A SCIENTIFIC DISCIPLINE HAS the elements of a Dr. Jekyll–Mr. Hyde persona. On the positive side, it results from different interpretations of data gathered at the forefront of a fast-breaking field. Conflict in this light lends an air of excitement and stimulates new experiments that will resolve the contentious issues. On the negative side, conflict arises from clashes of rigid ideals, political agendas, control over research prioritization, and the competition for limited resources. Conflict from this perspective has a stifling effect on research progress as one group or another exerts its control.

After reading the Policy Forums in the 24 November issue by C. F. Curtis ("The case for deemphasizing genomics in malaria control," p. 1508) and S. L. Hoffman ["Research (genomics) is crucial to attacking malaria," p. 1509] about the merits of genomics research in the fight to control malaria, I was left wondering what kind of debate I was witnessing and if the people who suffer from this disease don't deserve better from all of us working in the area. The urgency of committing resources to solutions that work today cannot be denied. The life of a child is worth more than a research grant. At the same time, one of the lessons of drug-resistant pathogens and insecticide-resistant vectors is that we must set the groundwork for solutions that are 5, 10, and even 20 years down the line. Not thinking of future approaches is as irresponsible as ignoring immediate needs. Let us provide today insecticide-impregnated bed nets and the best available therapeutic and prophylactic drugs, but also invest in genomics research that can lead to vaccines and better vector control.

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WHETHER GENOMICS IS IMPORTANT FOR malaria control is the topic of Curtis's and Hoffman's Policy Forums, but this type of debate is not new. Similar discussions often take place when new discoveries, revolutionary technologies, or paradigm shifts oc-