CONSERVATION

Droppings Give the Lowdown On Stress in the Spotted Owl

Sitting in the woods and waiting for an owl to poop might seem like an unrewarding research assignment. But such field work has enabled researchers to show, for the first time, that disturbing a wild bird's habitat by logging can measurably increase the animal's stress. This preliminary finding—fiercely challenged by at least one biologist—has raised new doubts about the adequacy of governmental efforts to protect the northern spotted owl, a threatened species that lives in old-growth forests in the northwestern United States.

The work, reported in this month's issue of *Conservation Biology* by animal physiologist Samuel Wasser of the University of Washington, Seattle, and wildlife biologists Kenneth Bevis, Gina King, and Eric Hanson of the state's Yakama Indian Nation, demonstrates a potentially valuable new technique for monitoring stress in beleaguered wildlife. While biologists can monitor an animal's stress by measuring stress hormones in blood, capturing a wild creature and drawing its blood can itself trigger a powerful stress response, biasing a study's results. "The question is how does one measure stress in a wild animal without inducing it," says Steven Monfort, a researcher with the National Zoological Park's Conservation and Research Center in Front Royal, Virginia.

Wasser and his colleagues had a solution: Scoop up the owl's feces, which also contain stress hormones. Like a time capsule, the fecal sample holds hormonal evidence of a bird's stress before a researcher's arrival might have triggered a reaction. Wasser and others pioneered the fecal-sampling technique in the mid-1980s to monitor stress and reproductive hormones in wild animals such as baboons, but it has never been used with an endangered bird. The technique "offers a very promising way to measure the physiological effects of habitat disturbance," says Rocky Gutierrez, a biologist at Humboldt State University in Arcata, California.

Gutierrez and other biologists believe that high stress levels in a wild animal can signal trouble. Stress hormones—released in response to disturbances such as loud noises or threats from predators—often cause dramatic physiological changes, such as a faster heart beat, which can help an animal survive a crisis. But repeated triggering of the stress response can be harmful, at least in the laboratory. Experimental animals pushed into a state of chronic stress produce fewer young, are less resistant to disease, and die prematurely.

In recent years, some biologists have wondered whether such chronic stress is contributing to the decline of some endangered species, such as the spotted owl. Researchers estimate that owl populations are shrinking by 4% per year, despite federal efforts to protect the bird's habitat, including regulations that limit logging in 28-hectare circles around active nests.

High-stress environment. Owls farther from major logging roads or recent clear-cuts showed lower levels of stress hormones (blue).

To test this theory, Wasser and his colleagues measured levels of the stress hormone corticosterone in fecal samples collected from 16 pairs of spotted owls nesting on the Yakama Indian Reservation in Washington and from about 150 other owls scattered across the Pacific Northwest. They found that male owls living within 0.41 kilometers of a major logging road or a patch of forest that had been clear-cut within the last 10 years had corticosterone levels almost two times higher than those of owls living more than 3 kilometers away. They also found that males living near clear-cut areas had significantly higher corticosterone levels than those of owls living near areas that had been selectively logged with methods that leave some trees standing. While female owls did not exhibit the same stress pattern, the researchers did find that hormone levels in all females, even those not nesting, rose during the 45-day period in which young owls get ready to leave the nest.

Wasser says the results—which he emphasizes are preliminary—raise some questions about the efficacy of federal regulations designed to protect the owl. "The fecal-hormone measure allows you to get a handle on three very important questions," he says. "First, are we protecting a big enough area around owl nests? If the data hold up, that suggests the circles are too small. Second, does the logging technique make a difference to the owl? The answer appears to be yes. Third, when should you restrict timber harvest during the reproductive season? It appears to be that 45-day period when the young are popping their heads out the nest." Currently, Wasser notes, logging near nests is often restricted for a longer period.

Wasser believes the technique could help biologists monitor how owls and other endangered species are faring under the federal government's Habitat Conservation Plans (HCPs). The 50- to 100-year-long agreements set aside prime habitat for a region's endangered species, while opening other areas to logging and other types of development. By monitoring fecal hormones, Wasser believes land managers could gain an "early warning" that a conservation plan needs tinkering. He notes, however, that a controversial new federal policy of "no surprises" (*Science*, 13 June, p. 1636), which bars the government from making major changes to an HCP once it's been hammered out, could limit the usefulness of such monitoring.

One prominent spotted owl biologist fiercely challenges the new study. "It is an interesting idea, but I don't trust the results," says Eric Forsman of the U.S. Forest Service's Forest Science Laboratory in Corvallis, Oregon. He says the study's sample size is too small for the researchers to conclude that factors other than logging or roads (such as prey availability) aren't responsible for the measured stress differences. More important, he says, so far "there is no evidence that this stress translates into a significant effect on reproduction or survival."

Wasser, however, believes that future owl studies will confirm the link between chronic stress and impaired reproduction seen in laboratory studies. And one senior federal wildlife manager dismisses the criticism. "You always have dueling biologists," says David Frederick, Washington state supervisor for the U.S. Fish and Wildlife Service in Olympia, which helped fund Wasser's study. "There are extraordinarily few data out there on disturbance, and now we have a tool that will help us address that issue."

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