

an amphibian species' resistance to disease," Todd said, "and conservationists can use this information in service of captive breeding or other efforts that seek to maintain healthy amphibian populations globally."

Raptor research takes flight

Raptors are birds of prey such as hawks and falcons that provide a number of important environmental benefits. Some raptors—barn owls, for instance—keep rodent populations in check. Raptors can indicate the presence of environmental contaminants. Many years ago, scientists established a connection between DDT and the decline of bald eagles, peregrines, and ospreys. Since that pesticide was banned in 1972, these species have recovered.

"Raptors signal a healthy ecosystem" said Josh Hull, an adjunct professor in the Department of Animal Science. "They are also a good indicator of species diversity."

Hull studies raptors with a team of graduate students and colleagues at UC Davis. They are using genetic tools to understand more about individuals in a population, the relationships among different populations, and the prey species that are important to survival. With the advent of next-generation sequencing technology, more powerful computers, and good old-fashioned field work, Hull's team is gaining new insight into these magnificent birds to assist wildlife managers in conservation efforts.

For instance, Yosemite National Park has a genetically distinct population of great gray owls—a "charismatic" species that is a high priority for park managers. "They're an isolated population that appears to have been on its own for many thousands of years," Hull said. "They appear to be very rare, but we don't have a good sense of how this population is doing."

One of Hull's students, Joe Medley, devoted his graduate work to collecting molted feathers from known nesting areas in the park's high country. From those samples, DNA has been extracted and genetic markers called microsatellites were used to identify individual owls and get a better sense of population status.

The sharp-shinned hawk is the smallest hawk in North America. Working with Golden Gate Raptor Observatory (GGRO) scientists, graduate student Ryan Bourbour has collected DNA samples with a swab from the birds' beaks to learn what these hawks are eating while migrating.

"People are always asking, 'What do hawks eat?'" Hull said. "Beyond that, from a conservation perspective, this is going to help us understand what these birds need."

Work is now underway to sequence DNA that will identify prey species of the sharp-shinned hawks.

Cooper's hawks are a fairly common yet understudied species. Hull's group is interested in finding out which populations are being monitored by GGRO. Graduate student Breanna Martinico is analyzing Cooper's hawk DNA from the Marin Headlands and from other locations around the country.

"Are we monitoring a local population of California birds or are we monitoring a population migrating from someplace else?" Hull asks. "That's important because if we see a decline, where should we look for the problem? We've seen this in red-tailed hawks with two distinct populations that fly through the Marin Headlands—one from California and one from the northern Intermountain West."

The Harlan's hawk is categorized as a subspecies of red-tailed hawk, but some people believe it is a separate species. "There's a lot of debate about this because there's a lot of variation in the birds' plumage," Hull said. "Each individual looks different from the next to a much greater extent than any other raptor species that we work with."

Genetic analyses by graduate student Megan Mayo have shown, however, that the Harlan's hawk and red-tailed hawk are the same species. "We're confident that they're not a different species and we're confident that they are interbreeding, so that leaves some other ecological factor that is causing this variation to persist," Hull said. ●

JOSH HULL/UC Davis



Ecology Graduate Group Ph.D. student Megan Mayo has been studying population variation in tundra-breeding, rough-legged hawks, which migrate as far as California in the winter. Scientists are concerned with how rough-legged hawks (pictured with Mayo) will respond to global warming. Knowledge of this species' population structure can help determine areas of importance for conservation management.