Volunteer 'eyes on the skies' track peregrine falcon recovery in California

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In recovery from the deadly legacy of DDT, American peregrine falcons (*Falco peregrines anatum*) faced new uncertainty in 1992, when biologists proposed to stop rearing young birds in captivity and placing them in wild nests. Tim Wootton and Doug Bell published models that year in ESA's journal *Ecological Applications*, projecting population trends for the falcon in California, with and without direct human intervention in the falcons' reproductive lives. They concluded that the birds would continue to recover without captive rearing, though the population growth rate might slow. Fledgling introductions had bolstered wild falcon numbers and genetic diversity, but survival would ultimately depend on cleaning up lingering DDT contamination to create healthy conditions for wild birds, they argued.

This month, they return to their 1992 predictions to see how the American peregrine falcons have fared over the last two decades, with a new report featured on the cover of the September 2014 issue of *Ecological Applications*. Though falcon numbers are lower than hoped for, data from volunteer survey programs, calibrated with more intensive surveys by wildlife biologists, confirmed a recovery trajectory well within the trends Wootton and Bell predicted.

"The challenge was to come up with data," said Wootton. "Once a species falls off the endangered species list, there is not a lot of funding to track how management, or lack of management, is doing," he said. "There was limited data that was appropriate being collected on the falcon, so we turned to a couple of well-known bird censuses that cover

wide geographic areas."

The follow-on study provided insights in the use of volunteer-generated data as well as an important test of population viability analysis, a tool increasingly used to evaluate alternative management plans and identify conservation priorities for endangered species, including sea turtles, grizzlies, and desert tortoises. It supported the importance of considering the health and behavior of geographic groups of a threatened species within a larger population. The 1992 paper identified falcon population "sinks" in parts of Southern California where chemical contamination lingered and the birds could not maintain numbers without migrants from healthier areas. Unfortunately, the falcon's recovery has continued to lag in these areas.

Once widespread across North America, the world's fastest bird had disappeared from the east by mid-century and was near extinction on the continent by 1975, when a survey found only 159 breeding pairs of American peregrine falcons. Chicks often did not survive to hatch in thin shells made fragile by a metabolite of the famously persistent insecticide DDT, which, along with its metabolites and breakdown products, accumulates in fatty tissues and can haunt soils for decades. DDT came into use during World War II to prevent the spread of serious insect-borne disease. Its use expanded widely and indiscriminately over North America in the next three decades.

Testimonials from scientists, like Rachel Carson's *Silent Spring*, eventually brought attention to the environmental hazards of organochloride insecticides. Canada banned agricultural use of DDT in 1970, and the US followed in 1972. The peregrine was listed as endangered in 1970 under the original Endangered Species Conservation Act of 1969. Peregrine numbers steadily improved in 1980s, and the US Fish and Wildlife Service removed the falcon from endangered species protection in 1999.

"Amateur falconers developed methods to captive rear and release falcons because they were personally concerned about the birds," said Wootton. "A group at UC Santa Cruz adopted and adapted the techniques that people had used in falconry for centuries and a fleet of volunteers helped monitor nests."

Without parents to guide and protect them, released fledglings often ran afoul of owls and other dangers, but the captive breeding programs succeeded in boosting falcon numbers. How healthy released birds were, and what would happen when the flow of introduced young stopped, was unknown.

"Our 1992 models suggested they would be okay," said Wootton.

To fill the large information gaps between the end of intensive falcon monitoring in 1992 and sporadic later surveys, Bell and Wootton drew on data collected by the Audubon Society's long-running Christmas Bird Count and by the Breeding Bird Survey, administered cooperatively by the US Geological Survey's Patuxent Wildlife Research Center and the Canadian Wildlife Service. They expected that the more formally structured Breeding Bird Survey would be most consistent with systematic census data collected by the Santa Cruz Predatory Bird Research Group during its captive rearing program (1975-1992) and in a 2006 follow-up census, and with 2003 data from the US Fish and Wildlife Service. The authors were a little surprised to discover that data from the Christmas Bird Count served better in this particular study.

The Audubon Society has organized a yearly Christmas Bird Count since 1900, urging volunteers to count bird sightings over 24 hours in locations of their choice in mid-December to early January. Some participants have recorded feathered visitors to their backyard feeders while others hiked into local parks and wilderness preserves. The society has an interest is in getting people to participate and enjoy birding as well as

gather data, and encourages first-time observers as well as scientists and life-long birders to join the count. To make year-to-year data more comparable, local groups return yearly to count birds in established spots, and often make efforts to assure that experienced birders accompany novices. Groups report results as birds sighted per hour per group.

The Breeding Bird Survey has recruited birding enthusiasts who can identify all breeding bird species in their geographic area by sight and sound since 1966. Throughout the summer breeding season, dedicated volunteers record observations during explicitly defined 3-min observation sessions at 50 roadside stops along 40 kilometer routes. Wootton suspects that the greater number of 'eyes on the skies' in the Christmas Bird Count was key to obtaining a reliable sampling of the rare peregrines, overcoming variables of motivation, experience, location, and time. Predators like peregrine falcons are rare compared to other birds, even when populations are healthy. Mustering many observers lowers the likelihood of undercounting rare birds.

Peregrine falcons that breed in California often do not migrate, which reduces the discordance of recording observations in different seasons. It is possible that for more common birds, or different ecological questions, the Breeding Bird Survey would perform better. Wootton noted that a reliable calibration data set was essential, though he has high confidence in the volunteer data.

"I'm very positive about volunteer datasets. I think that comes from my background as a participant in other volunteer data collection programs going into university. I had a sense that people taking part in the programs knew what they were doing. That's especially true in the birding world. Many non-scientists are very good at observing and identifying birds," said Wootton.

The Breeding Bird Survey, the Christmas Bird Count, and other citizen science programs like eBird are supported by strong communities of knowledgeable, competitive amateurs who provide learning resources to novices and create a culture of high expectations. Wootton speculated that these traits help produce high-quality data that can be integrated into research programs. Their success suggests to him ways in which the amiably competitive and obsessive nature of scuba diving, for example, might be harnessed to monitor coral reef health, and produce sorely needed natural history data.

Population viability analyses are often used for planning conservation management, but management changes are rarely used to evaluate whether models are actually useful. Bell and Wooton would like to see predictions tested across wider situations to provide a rigorous test of model. But rigorous testing depends on long-term data collection. Ecologists are awakening to the potential of citizen naturalists armed with smartphones, databases, and social media tools to join them in that long term effort for conservation and discovery.

More information: J. Timothy Wootton and Douglas A. Bell (2014). Assessing predictions of population viability analysis: Peregrine Falcon populations in California. *Ecological Applications* 24:1251-1257. dx.doi.org/10.1890/13-1323.1

J. Timothy Wootton and Douglas A. Bell (1992). A Metapopulation Model of the Peregrine Falcon in California: Viability and Management Strategies. *Ecological Applications* 2:307-321. dx.doi.org/10.2307/1941864

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