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A Wilson's Warbler pauses on one of its last days before departing for the wintering grounds in western Mexico. See article, p. 44. *Photo by © Mia McPherson.*

Catch, Release, Catch Again

Is bird banding still valuable in the 21st century?

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On a brisk July morning in Yosemite National Park, Lauren Helton walks up to a mist net near Hodgdon Meadow to find she has caught a Wilson's Warbler. With deft fingers, Helton quickly untangles the tiny bird, pops it into a soft cotton bag, and walks back to the bird banding station where the science will happen.

Helton, and now the warbler, are taking part in a 30-year-old bird banding program called MAPS, which stands for Monitoring Avian Productivity and Survivorship. The program is coordinated by The Institute for Bird Populations (IBP), but MAPS is really a collaboration of bird banders across North America, collecting critical data on birds and contributing the data to IBP for archiving in a central database available to scientists. The MAPS database contains over 2.5 million bird capture records covering almost every state in the U. S. and every Canadian province.

The MAPS program was started by IBP's founder David DeSante in 1989, but scientists have been banding birds since at least the 1890s. Why are we still using this antique technique in 2020? We now have sophisticated technology like miniaturized GPS transmitters and smart phones with eBird. What can a bird in the hand and a small metal band tell us that these other things can't? Quite a bit, it turns out.

For instance, after banding the bird, one of the first things Helton does is carefully examine the bird's skull. To Helton's trained eye, the skull provides important clues about the bird's age. Though it sounds grim, "skulling" is a non-invasive process. Small songbirds have conveniently thin, translucent skin. By holding the head feathers aside, Helton can see right through the skin to the crown of the skull.

Birds' skulls are delicate, especially when they are young. Initially the skull consists of a single thin layer of bone, which is translucent just like the skin. But as the bird ages a second layer forms, connected to the first with a series of struts. The additional layer and struts give the mature skull a less translucent and "stippled" appearance. Skull maturation occurs at different times in different species.

For Wilson's Warblers and most other wood-warblers, the second layer of the skull is completed in the autumn after hatching. Helton's examination shows this Wilson's Warbler's skull is only partially covered by a second layer, so, although the bird superficially appears to be an adult female, it hatched just a month or two ago.

If we observed this Wilson's Warbler through binoculars, we might assume it's an adult female, but it isn't. Helton will record its age as "hatch-year," which means it hatched within the past few months, it is not reproductively mature, and it won't breed until at least next spring.

Why is distinguishing a "hatch-year" bird from an "after-hatch-year" bird so important to population biologists? It helps them determine what stages in a bird's life cycle are driving changes in the population, by allowing them to estimate a key demographic parameter: *productivity*. Productivity is the rate at which young are produced and is estimated by comparing the number of hatch-year birds caught throughout the summer to the number of adult, or after hatch-year, birds caught.

Putting an old-fashioned band on a bird also permits estimates of the other two key demographic parameters: *survival* and *recruitment*. Most songbirds breed in the same area from year to year (especially if they are successful there), so the proportion of banded birds that are recaptured the following year is a good gauge of survival.

With some fancy math and information about population trends, you can then estimate recruitment. Recruitment in this case is the rate that breeding individuals are added to the population, either by surviving to breeding age or by emigrating from another population. Recruitment is critical because a given population might be very productive, hatching lots of chicks, but if too few of those chicks survive to make chicks of their own (low recruitment), the population will decline.

Sadly, populations of Wilson's Warblers are declining. In its 2014 climate report, the National Audubon Society categorized the species as being at risk due to climate change. In a recent study published in the scientific journal *Ecology and Evolution*, IBP researcher Jim Saracco, along with U. S. Geological Survey biologist Madeleine Rubenstein, used age data from Wilson's Warblers captured at MAPS stations to help understand productivity and recruitment. Based on 16 years of MAPS data from coastal California, the Sierra Nevada, and the Pacific Northwest, the researchers found that productivity and recruitment had a bigger effect on population growth than adult survival.

They also found that climate variability affected warblers' productivity and survival. Productivity was increased by warmer spring temperatures, possibly because warmer springs mean more insects to feed nestlings. Drought in portions of Mexico, where the Wilson's Warbler populations breeding in the Sierra Nevada and coastal California spend the winter, reduced adult survival in those populations.

Climate change is a broad term encompassing changes in temperature, precipitation, and other factors that vary from region to region. Studies like Saracco and Rubenstein's identify specific aspects of climate change that affect species like the Wilson's Warbler, and help target conservation efforts toward key points in the species' life cycle. But this study would not be possible without old-fashioned bird

The adult male **Wilson's Warbler** is easy to recognize to species, but what about all the aspects of warbler biology that go beyond field identification? The MAPS program (Monitoring Avian Productivity and Survivorship) emphasizes the importance of studying birds' age, molt, reproductive status, and more. The eventual goal is to develop a comprehensive view of avian population dynamics in North America. *Box Elder County, Utah; Sept. 23, 2018. Photo by © Mia McPherson.*

banding and the careful age determinations made by MAPS banders like Helton.

Back to the warbler in hand, Helton turns her attention to its feathers. MAPS banders collect detailed information on feather condition and molt. Helton blows on the bird's body, ruffling the plumage to look for "pin feathers" or newly emerged feathers still partially covered in their sheaths. She gently extends the bird's wings, examining the flight feathers for wear to determine if they've been recently replaced. Helton also examines the wing coverts and the tail.

Why focus on feathers? First, they provide another set of clues about a bird's age. Even in species without distinctive juvenile plumages, a bird's first set of adult feathers typically has subtle but diagnostic differences from its second set. Also, molt is an energetically demanding and essential process in a bird's life. Understanding the timing and the process of molt can yield insights into what bird populations need to thrive.

The bird banding process provides the only opportunity to assess molt in songbirds. In some larger species, such as shorebirds or gulls, a good photo may be all you need to examine a bird's feathers, but for most species this strategy is often impractical. With smaller birds that inhabit dense vegetation, like the Wilson's Warbler, a bird in the hand provides by far the best look at individual feathers.

And feathers are worth a closer look. In 2018, IBP scientists analyzed data from 936 MAPS banding stations to learn where different species molt. Most migratory landbirds in North America had long been thought to molt on the breeding grounds just before they migrate to their winter habitats. But a few species were known to undergo a *molt migration*, moving to discrete *molting grounds* where they replace their feathers before migrating to their wintering grounds.

The Institute for Bird Populations applies both traditional and emerging methods to the study of avian population health.

The scientists wondered if molt migration might be more widespread than previously known. So, they calculated the probability of catching molting birds at the same MAPS station where that individual was also known to breed. They found evidence that many species, including several previously thought to molt on their breeding grounds, are actually *molt migrants*.

Although the breeding grounds may have plenty of food early in the summer, food availability may decline towards the end of the season—especially in the arid Interior West, where molt migration is especially prevalent. Molt migrants are on the move to take advantage of habitats where food is more abundant late in the summer so they have the necessary energy to replace their feathers. In Colorado and elsewhere in the Western Interior, molt migrants may be on the move as early as late June, around the time of the solstice!

The discovery that molt migration is more common than previously thought has significant conservation implications. To conserve birds, we must protect the habitat they need

Is this "just a female" **Wilson's Warbler?** If so, is it a hatch-year or after-hatch-year female? Could it be a hatch-year male? Digital photography and other technologies have improved our ability to resolve such questions, but bird banding gives us access to avian morphology and physiology that other methods cannot. *Box Elder County, Utah; Sept. 2, 2018. Photo by © Mia McPherson.*