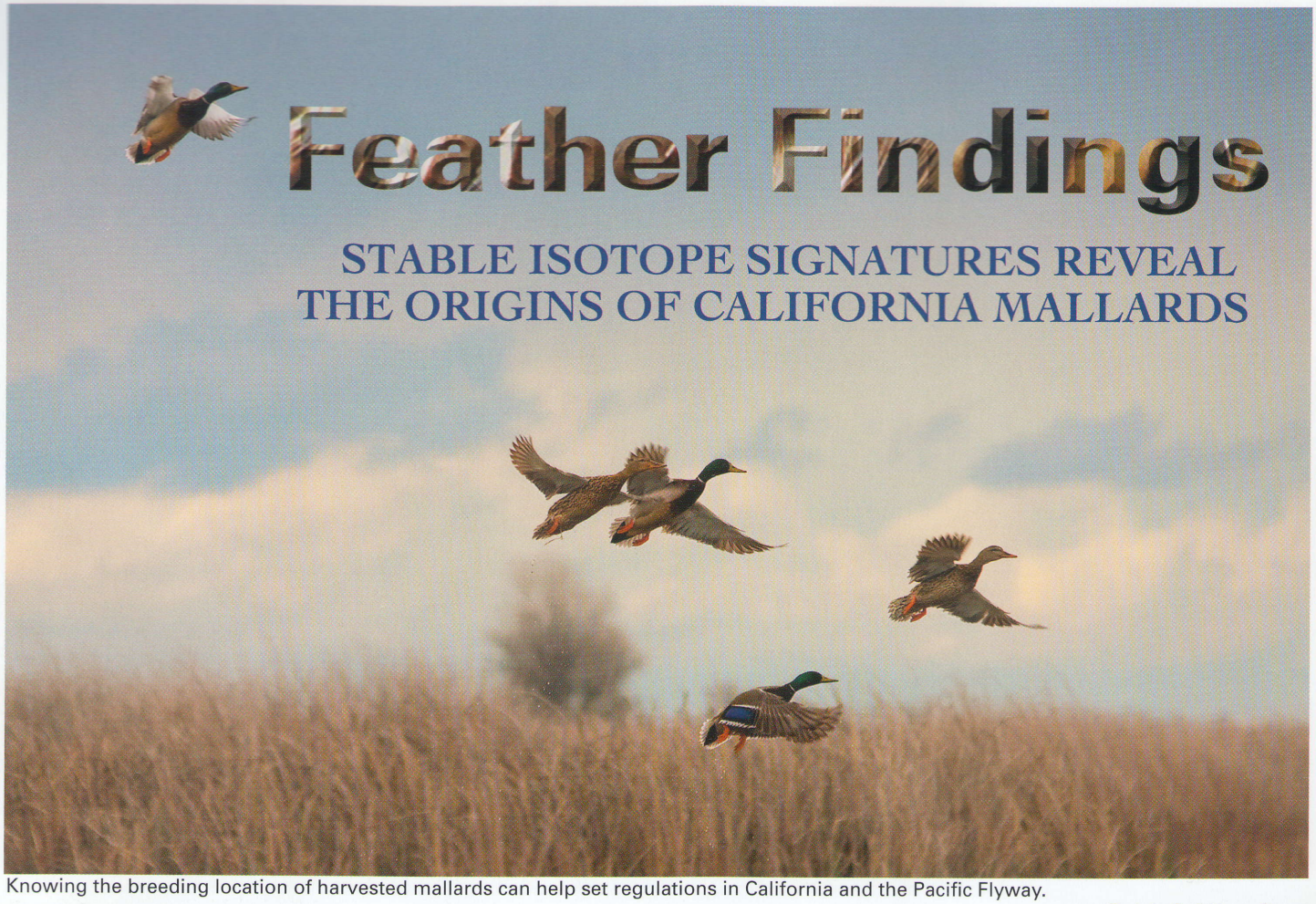

Feather Findings

STABLE ISOTOPE SIGNATURES REVEAL THE ORIGINS OF CALIFORNIA MALLARDS

Knowing the breeding location of harvested mallards can help set regulations in California and the Pacific Flyway.

Photo by David Loren Borges

by Josh Ackerman, Collin Eagles-Smith, Garth Herring, and Mark Herzog

Hunters annually harvest about 300,000 mallards in California, the third most of any US state. Mallards make up nearly one-quarter of the total duck harvest in California, making mallards an important duck for hunters' bags. Band returns during the 1960s and early 1970s indicated about 58 percent of mallards harvested in California originated from California and southern Oregon breeding grounds. However, the contribution of locally-raised mallards to hunter harvest is thought to have increased since that time. During the duck hunting season, locally grown mallards may make up a larger proportion of harvest early in the season and then decline as more and more northern migrants travel south to California throughout winter. This has implications for waterfowl management, including setting harvest regulations in the Pacific Flyway.

Together with our partners at the US Fish and Wildlife Service, California Department of Fish and Game, Conaway Ranch, University of California Davis, and California Waterfowl, we are analyzing chemical signatures in the flight feathers of hunter-harvested mallards to estimate the relative contribution of local (California and southern Oregon) and migrant (Canada and Alaska) mallards to hunter harvest. We also are investigating whether the proportion of harvested mallards originating from California declines over the course of the hunting season.

The chemical signatures derive from stable isotopes of hydrogen, nitrogen, carbon, and sulfur, which occur naturally in the environment. By identifying these signatures we can map the breeding and rearing locations of mallards harvested in California's Central Valley. This approach is a powerful technique for interpreting the geographical origins of birds, because the relative proportions of each isotope in the environment differ among regions in fairly predictable ways. Quite simply, ducks are what they eat. They assimilate the same chemical patterns into their body as those found in the ecosystem. By determining the isotope signature within duck tissues,

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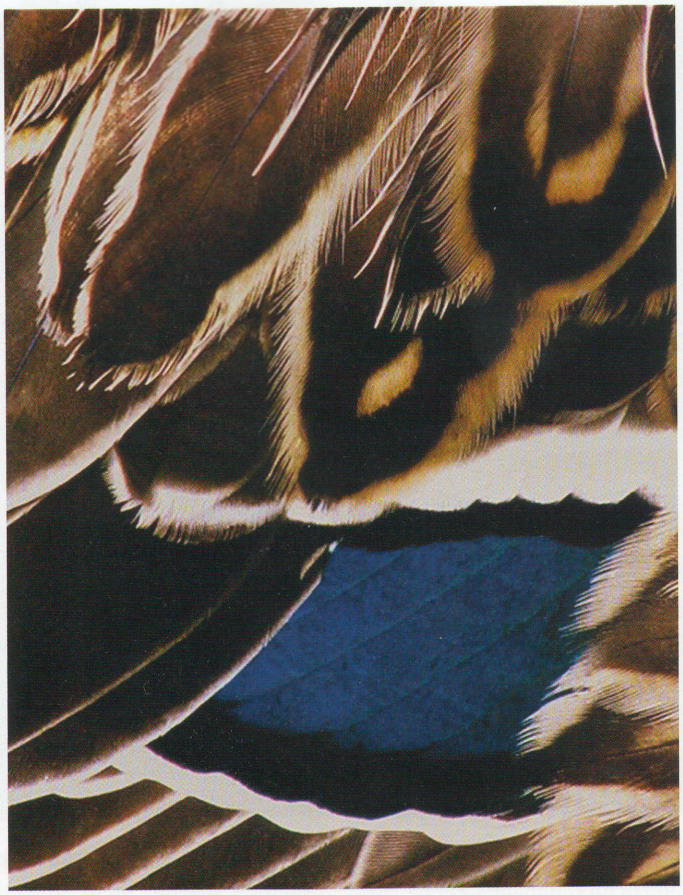
we can get a general estimate of where that duck has been.

For this research, we are using the stable isotope values found in flight feathers, because they denote a discrete time window representative of breeding and molting in spring and summer. Flight feathers of mallard ducklings are grown on the breeding grounds before they are capable of flight, and flight feathers of adults are completely molted near breeding regions immediately following the nesting season. Additionally, once feathers are grown, the isotopic patterns within them do not change. Those feathers will reflect the chemical signature of the geographic region in which they were grown. Therefore, stable isotope signatures in flight feathers give us clues to where adults molted and ducklings were raised. From these data, we can then determine whether a mallard harvested in California was a year-round resident or whether it migrated from more northern breeding grounds.



The amounts of hydrogen, nitrogen, carbon, and sulfur found in flight feathers can tell biologists about the location of a mallard's breeding grounds. Photo by Jeanne Wallen

The recent advent of stable isotope technology in ecological research has brought about powerful new tools to use as forensic recorders of dietary sources in migratory animals and can often be related to landscape use. Physical and biogeochemical processes drive many geographical and habitat-based isotope patterns in elements such as hydrogen, carbon, nitrogen, and sulfur, and these differences are then reflected in the isotope ratios of animal tissues.

Hydrogen isotopes are particularly useful in migratory bird studies, because global weather patterns result in predictable changes in hydrogen isotope ratios along latitudinal gradients. Water contains both light and heavy hydrogen isotopes, which differ only in whether or not a neutron is present in the hydrogen atom. Globally, the greatest amount of water is evaporated near the equator, making clouds and forming weather systems. "Heavy water" (containing the heavy hydrogen isotopes, called deuterium) falls more readily as rain near the equator and is less prevalent as you move towards the polar regions. The "lighter water" stays longer in the atmosphere and comprises a greater portion of the rain as you move toward the polar regions. Thus, the general ratio of heavy to light hydrogen isotopes is higher at the equator and declines toward the poles. These water molecules are then incorporated into the ecosystem through normal biological processes, and are eventually passed on to ducks through their diet allowing us to learn about their feeding locations.

Although we have just initiated this study, our preliminary data indicates that over 60 percent of mallards harvested in California originate from breeding grounds in California and southern Oregon. Interestingly, the proportion of local to migrant mallards harvested varied among sites that were not very far apart (75 miles), with hunters at the Sacramento National Wildlife Refuge harvesting a larger proportion of migrating mallards than did hunters at Conaway Ranch in the Yolo Bypass. We also found that hunters were slightly more likely to harvest local mallards earlier in the duck hunting season.

These preliminary results suggest that local mallards are a substantial portion of hunters' bags, similar to the historic analyses of hunter harvest using band returns. More detailed studies will be needed to refine these patterns more fully. The combined results support the notion that habitat improvements to wetland and upland breeding habitats within California and southern Oregon can make an important contribution to the abundance of mallards during the hunting season.

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