WHAT'S DRIVING Pheasant Declines?

New research that identifies key problems can help drive practices that will help California's pheasant population.

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Many hunters still recall the best days of pheasant hunting in California: You and your dog are walking through grassy uplands and along winding levees, surrounded by valley oaks and cottonwoods, the Sutter Buttes standing tall in the distance. Suddenly, 20 pheasants flush in front of you and within seconds, you have limited for the day.

Pheasants were introduced in California in the late 19th Century, and they were most successful in areas producing cereal grain crops with adjacent fencerows, headlands, wetlands, riparian areas or other natural features. Pheasant hunting became an economically significant pastime, with harvest reaching more than a half-million birds per year in the 1960s.

But scenarios like the one above are becoming extremely rare as pheasant populations have experienced widespread declines in most parts of the state.

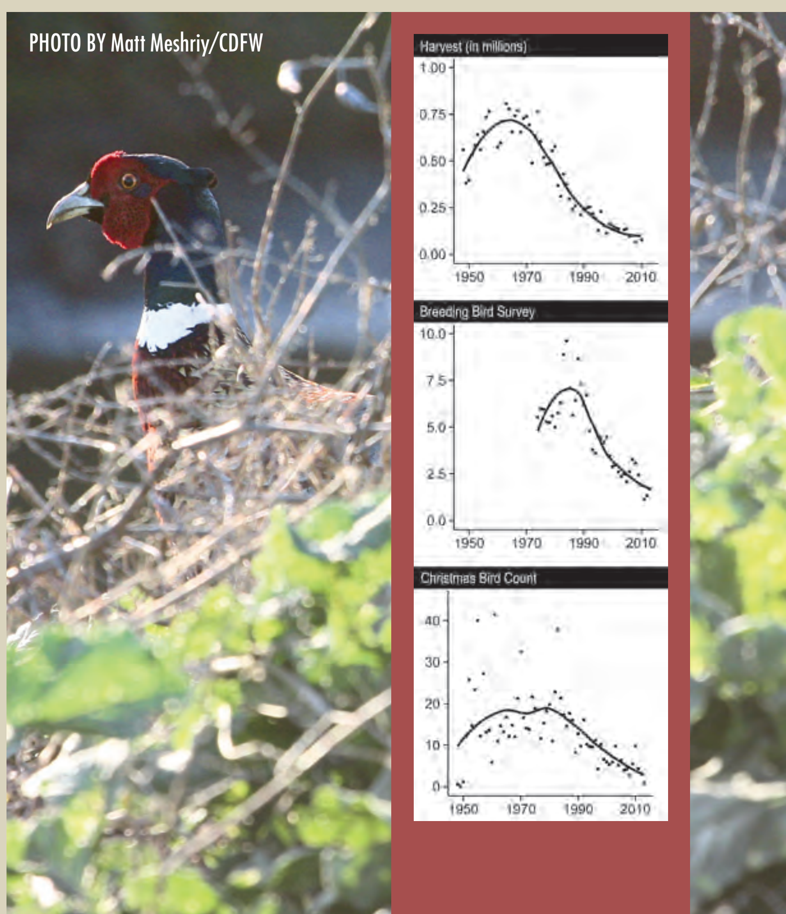
Most pheasant hunters have theories for the decline, and whether they believe farming practices, predators or other land management practices are to blame, they would all be partially right.

Agricultural regions across North America have recently experienced rapid declines in bird diversity and abundance, attributed to three factors: agricultural intensification, increased pesticide use and greater susceptibility to predation from habitat change. The ring-necked pheasant is no exception. But to truly understand why pheasants are declining in areas where they once thrived, empirical evidence is needed.

Through collaboration with Pheasants Forever and the California Department of Fish and Wildlife, and with funding from the state's Upland Game Bird Stamp Account, U.S. Geological Survey scientists have begun investigating changes in patterns of pheasant abundance across California.

For the initial phase, scientists are combining three measures – Breeding Bird Survey, Christmas Bird Count and Annual Game Take Survey data – into an index that relates pheasant population trends to variations in the amount of crop land, types of crops, amount of pesticides used, minimum temperatures, precipitation and avian predators and competitors.

In addition to investigating statewide effects, USGS scientists are also collecting information in the field regarding several distinct pheasant populations in the San Joaquin and Sacramento valleys and the Klamath Basin to help inform local management efforts. Understanding what's contributing to recent population declines is the first step to helping managers maintain healthy populations.



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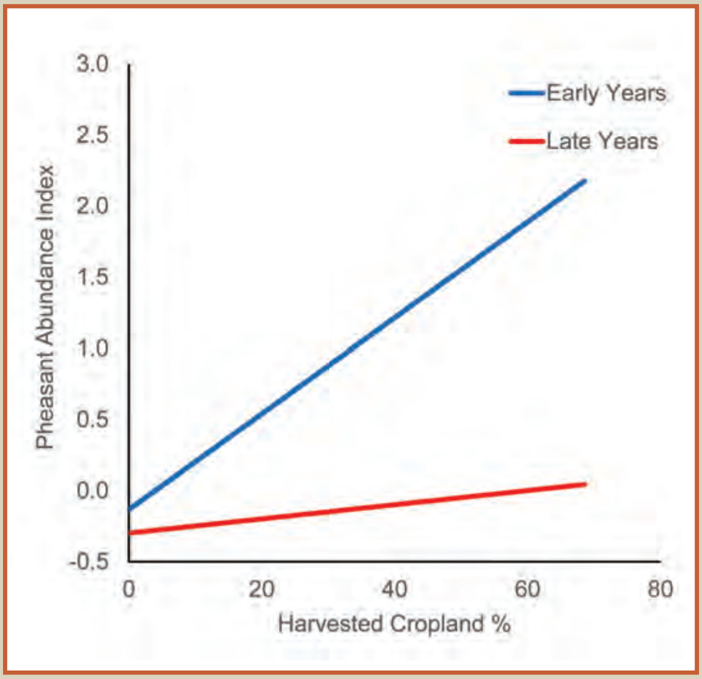
Preliminary findings mirror hunters' experiences: Pheasant populations have declined substantially over the past 25 years.



CROPS MATTER

Preliminary findings suggest widespread changes in land use, predator abundance and environmental conditions have had compounding impacts on pheasant populations, with the greatest impact coming from changes in harvested cropland over the past few decades. But the impact has varied: In earlier years, harvested cropland positively influenced pheasant abundance. However, that effect diminished through time.

This complex interaction can be explained by industrialization and intensification of farm practices, and the loss of unharvested cropland areas such as lands that were historically set aside and enrolled in the U.S. Department of Agriculture's Conservation Reserve Program and Set Aside Program.

The San Joaquin and Sacramento valleys have steadily converted from small diversified farms to large monoculture operations, so agricultural habitats probably no longer hold the same value to pheasants. In the past, when small diverse farms were standard, pheasants likely used a mosaic of farmed and natural habitats that met their needs, moving between different crop types as fields matured and were harvested. For example, small grains such as wheat and barley provided cover during the nesting and brood-rearing seasons, and have been shown to increase breeding success. Likewise, sugar beets provide high structural habitat quality and cover during the nesting and wintering seasons due to their long growing season.

Preliminary analysis indicated barley, winter wheat and sugar beets were associated with pheasant abundance.

Two of these crops – barley and sugar beets – have all but disappeared in California and have been replaced with more profitable monoculture operations that don't appear to help pheasant reproduction.

Increased industrialization of farming also increased mechanization, which reduced stubble height after harvest and left large acreages of bare ground during winter months, diminishing pheasant habitat.

Preliminary analysis suggests rice may not have benefited pheasant populations as much as other crops, especially in the Sacramento Valley, where conversion of barley fields to rice contributed much of the pheasant habitat loss. Rice increased 63 percent in California between 1953 and 2011. Rice is flooded during most of the growing season and provides little to no cover while hens are nesting or rearing broods. And while in the past many harvested rice fields once provided pheasants with winter cover and foraging habitat, increased post-harvest flooding for straw decomposition since the 1980s, when burning was sharply limited, seem to have greatly reduced that value.

Likewise, across the Central Valley, conversion of grain and row crops to nut orchards is also driving habitat loss. Acres of nut trees in the Central Valley more than tripled since 1980. Because orchards typically lack vegetative ground cover and

Relative Importance	Modeled Effects	Association
1	Harvested and unharvested cropland	Time Dependent
2	Pesticide application	Negative
3	Increased temperature	Negative
4	Increased precipitation	Positive
5	Corvid abundance	Negative
6	Turkey abundance	Negative
7	Raptor abundance	Negative

trees provide perches and nest sites for avian predators, as little as 15 percent tree cover can severely limit pheasant populations.

The concentration of agriculture in the San Joaquin and Sacramento valleys also resulted in a loss of unharvested cropland and set-aside lands, which are associated with pheasant abundance across much of their range in North America. Set-aside lands in California decreased 86 percent between 1987 and 2012. Since 1949, cropland used as pasture has fallen 71 percent and fallowed cropland has dropped 67 percent.

The reduction of unharvested lands fragmented the already shrinking farmland habitat available to pheasants and other farmland bird populations in California. And the value of remaining patches of fallow fields and cropland used as pasture is also influenced by the surrounding harvested cropland. Although some local-scale habitats such as state-managed wildlife areas appear to offer good pheasant habitat, they are often surrounded by large, low-diversity farms. Hence, these areas may function as population sinks for pheasant and other farmland birds – islands of populations that can't sustain themselves.

PESTICIDES ALSO A FACTOR

Initial results also revealed that pesticides applied to crops or sprayed to control mosquitoes reduce the value of agricultural areas to pheasants. Pesticides can have lethal and sub-lethal effects on pheasants. For example, organophosphates affect the functioning of nervous systems of insects and other organisms, whereas systemic insecticides such as neonicotinoids are absorbed by plants, making them toxic to species that forage on them.

Pheasant chicks depend on both plants and insects for food, making them especially vulnerable to the toxic effects of pesticides. Pesticides may indirectly affect pheasant brood survival, as pesticide application can lead to widespread insect mortality, limiting food resources for pheasant broods. When food is limited, pheasant hens with broods move longer distances to forage, which likely decreases chick survival. The increased cost of foraging may also result in smaller clutch sizes, starvation, slower growth and reduced over-winter survival.

Additionally, fields are disked shortly after being harvested and herbicides are applied to field edges, fence rows and other vegetated corridors. Loss of diversity in crops and wetland and riparian systems, coupled with increased pesticide application near

Ravens are efficient nest predators, and their populations have been growing in California. PHOTO BY TATIANA GETTELMAN/USGS)

agricultural areas used by pheasant, decreases the land's ability to sustain wild pheasant populations. This appears to have led to declines in pheasant numbers in prime hunting areas.

OTHER BIRDS AND CLIMATE

Preliminary study findings also link avian predators and competitors to pheasant declines. Although observations of competition between wild turkey and pheasant have been anecdotal at best, the rise of turkey in certain regions has coincided with the decline of pheasant in those regions and warrants investigation. Crows and ravens have also increased substantially in California. They are efficient nest predators and could be harming pheasant population growth here as they do greater sage-grouse in many regions of the West.

Predation of adult pheasants by raptors could also be significant in regions of northern California. Reductions in suitable cover crops make pheasants more susceptible to predation, compounding the negative influence of raptors and ravens in intensively farmed areas.

Climate effects such as temperature and precipitation were shown to vary regionally. Rising temperature during the breeding, brood-rearing and wintering seasons negatively influenced pheasant abundance throughout much of California. The amount of precipitation during brood rearing was particularly important in the Central Valley. Water sources are known to be an important component of pheasant habitat, reducing the negative effects of drought conditions and providing shrubby vegetation for winter, nesting and escape cover, as well as an abundance of invertebrates. Increased temperatures and low precipitation reduce the amount of water available through evaporation and decrease insect availability for chicks and juveniles.

In addition to understanding how landscape-level factors drive pheasant populations in California, it is important to know how these large-scale factors influence local pheasant populations. To gain a better understanding of factors that influence pheasants at local scales, scientists are now collecting field data on several pheasant populations and investigating specific population vital rates such as nest, brood and adult survival. These data will help managers at state wildlife areas and private hunting clubs learn how agricultural practices, predator composition and habitat availability are influencing populations, and help guide pheasant management practices.

Relative Importance	Modeled Effects	Association
1	Barley	Positive
2	Sugar beets	Positive
3	Nut trees	Negative
4	Winter wheat	Positive
5	Sorghum	Positive
6	Vegetable seed	Positive
7	Rice	Negative
8	Cotton	Positive
9	Grapes	Negative
10	Hay	Not significant
11	Corn	Not significant
12	Wheat	Not significant
13	Oats	Not significant
14	Fruit trees	Not significant

IT'S NOT HOPELESS

California's landscape was once ideal for a thriving pheasant population, ushering in an era of pheasant hunters whose dedication helped fuel habitat protection. However, biological simplification of agricultural areas and the loss of wildlife-friendly non-farmed habitats has become commonplace. These preliminary findings suggest management strategies that increase available year-round cover and minimize impacts on insect food resources may be the best bet to reversing this negative trend.

For example, increased set-aside of lands that are intensively farmed provides additional cover and refuge during months in which harvested cropland is bare or flooded and may prevent these areas from becoming population sinks.

Increasing height and acreage of stubble left after harvesting crops or leaving unharvested edges would likely increase cover and foraging opportunities within harvested fields.

And using chemicals that target specific pest species or encouraging organic farming practices would likely reduce impacts on food resources, thereby reducing effects of pesticides on farmland bird communities.

Reducing human-made structures such as power lines that benefit raven and raptor populations may reduce potential predation on eggs and birds.

Informing land-management practices with science such as this can help give the next generation of hunters the experience of wonder when spending those fall mornings outdoors enjoying the natural world with others who share that same passion.

CROPLAND CHANGES IN CALIFORNIA

Agricultural uses better for pheasants

- **BARLEY:** Down 99 percent between 1954 and 2013, from 2.1 million acres to 20,000.
- **SUGAR BEET:** Down 93 percent from 1975 to 2012, from 300,000 acres to 20,000.
- **UNHARVESTED CROPLAND (SET-ASIDE LAND):** Down 86 percent between 1987 and 2012, from 700,000 acres to 100,000.
- **PASTURE:** Down 71 percent since 1949, from 3.5 million acres to 1 million.
- **FALLOWED CROPLAND:** Down 67 percent since 1949, from 1.5 million acres to 500,000.

Agricultural uses worse for pheasants

- **RICE:** Up 63 percent between 1953 and 2011, from 350,000 acres to 570,000 acres.
- **NUT TREES:** Up 220 percent between 1980 and 2012, from 300,000 acres to 980,000.