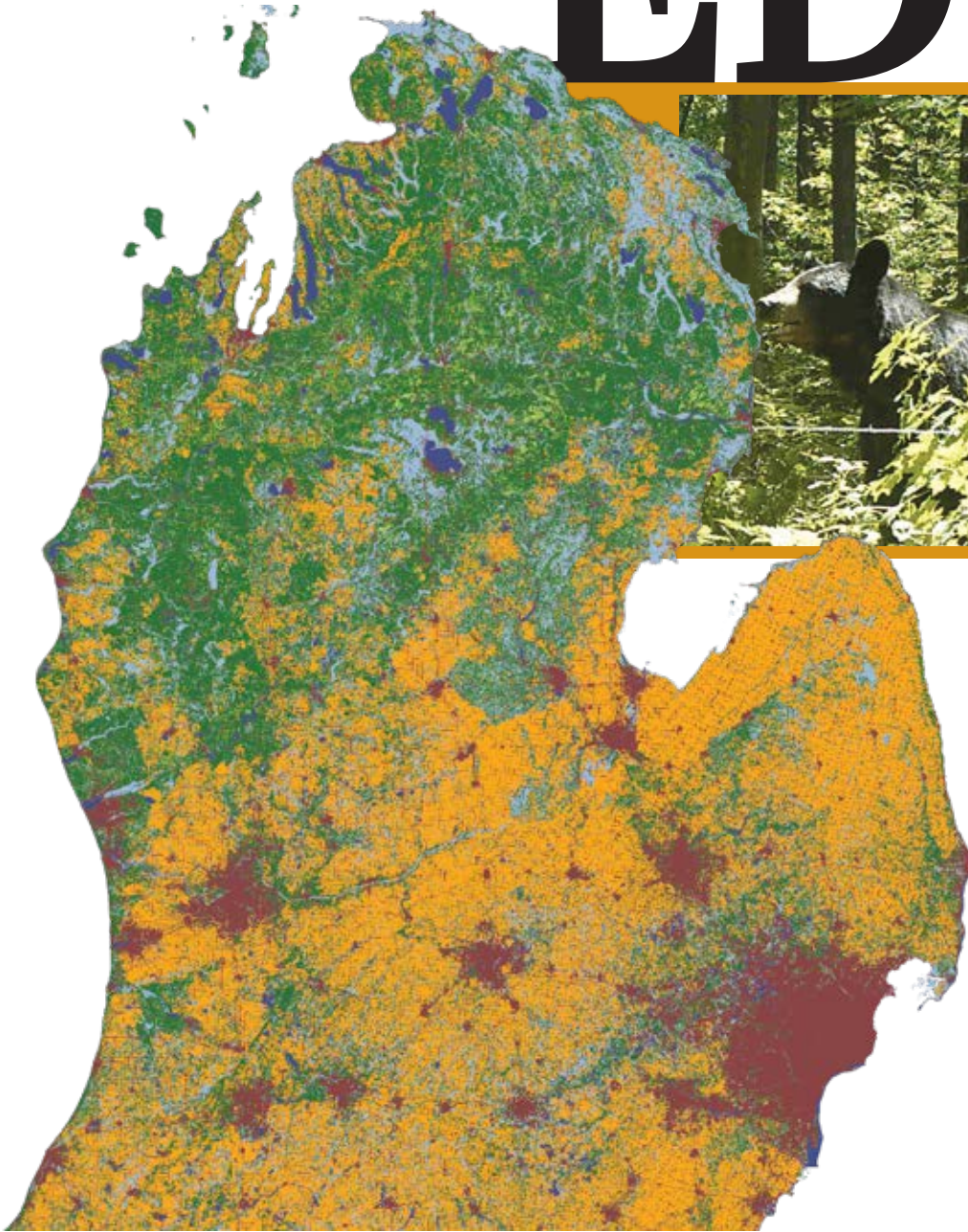


# BEARS ON AN EDGE



Imagine a 300-pound male bear at the edge of a hardwood forest that borders a crop field bursting with ripe corn. Does he take a detour to avoid venturing into this exposed area, or does he walk in and enjoy the abundance of food? Would it matter if this was the only crop field in the area or adjacent to five other fields? Or if there were many bears in the area? Or if there were people nearby? What if this bear was a sow with two cubs in tow?

- |            |                |           |             |
|------------|----------------|-----------|-------------|
| Open Water | Rock/Sand/Clay | Shrub     | Agriculture |
| Developed  | Forest         | Grassland | Wetland     |

JENNIFER SMITH  
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MICHIGAN STATE UNIVERSITY  
Photos Courtesy of Author

*By recognizing that animals, like humans, can make decisions dependent upon the context in which they are happening, we can account for the true complexity in patterns of resource use and bolster management efforts to effectively balance the needs of humans and wildlife.*



Like bears and other wildlife, humans make hundreds of decisions every day. Some of these decisions are small and relatively inconsequential—what to eat for breakfast, for example, while others are bigger with larger implications and consequences—like whether to accept a new job offer. Regardless of the magnitude of the decision, our choice is usually dependent on the context of our life at that point in time and space. Perhaps the weather influenced our decision to eat a cold or hot breakfast, while factors such as relationships, financial stability, and location might influence our decision to accept or reject a job offer. The concept that human decisions are context-dependent may not be surprising or new, but wildlife biologists have recently

questioned if animals are also capable of such behavior. Historically, lack of data and analytical capacity prevented us from describing and quantifying these contextual influences on the behavioral decisions of wildlife. Consequently, our ability to predict how wildlife respond to new landscapes and circumstances was limited.

At the Boone and Crockett Quantitative Wildlife Center at Michigan State University, we target conservation questions that are well-suited to advanced quantitative methods and to provide answers for existing management issues. Recently, our research coupled practical needs about shifting distributions of bear populations with innovative analytical approaches and demonstrated that it's not just

humans whose decisions are context-dependent. The choices black bears make about using resources (food, shelter, water, etc.) are also dependent on the context in which they occur—a reality which will become increasingly relevant as the physical landscapes, distributions of human and wildlife populations, and environmental conditions defining the context continue to change.

#### CHANGING EXPECTATIONS

The Lower Peninsula of Michigan is perhaps best known for miles of Great Lakes shorelines and its iconic mitten-shape. A lesser known, but consequential, characteristic is the sharp latitudinal division of land cover; the northern half of the Lower Peninsula is dominated by forests,

while the southern half is almost entirely urban and agricultural land. Historically, black bears in the Lower Peninsula of Michigan have lived in the northern half, where the forests provide abundant cover and food. So, you can imagine the surprise wildlife managers and residents felt when bears started showing up in neighborhoods hundreds of miles south of their typical northern range.

Since 2005, black bears have been spotted in the southern Lower Peninsula, and the sightings have raised pressing questions for wildlife biologists. Will black bears adapt to the southern Peninsula with its vastly different habitat and bear and human populations? How will bears impact agricultural lands in a region with a strong agricultural economy?

## GETTING OUR BEARINGS

Reports of black bears raiding crops and traveling through agricultural fields are found across the country. While not necessarily common, such behavior is concerning because these incidents can be dangerous and damaging for humans and their livelihoods. Generally, we expect black bears to avoid agricultural fields; such areas are woefully lacking in trees, which bears climb when threatened. On the other hand, during summer and fall many agricultural fields are full of ripening crops, and black bears feed ravenously at these times of year in preparation for the upcoming winter. To untangle this apparent paradox and to better understand how bears perceive this risk-reward situation, we need to take a closer look at how bears respond

to and utilize the environment around them.

Understanding which resources animals need for survival is a fundamental part of managing wildlife. Biologists who search for patterns in how, when, and why animals use different aspects of their habitat are studying their resource selection behavior. Fundamentally, resource selection studies try to answer a simple question: which resources do animals use and which do they avoid? When we understand these patterns, we can prioritize conservation of critical resources in the range of a species, identify resources important to multiple species, and anticipate conflicts between humans and wildlife who are invested in the same resource. Typically, findings from resource selection

studies reveal how a species responds (through use or avoidance) to a resource on average and the strength of this average response. However, when the landscapes animals occupy include fragmented habitats, multiple land uses, and uneven distribution of humans and wildlife, patterns of resource use become more complicated. Animals may respond differently to the same resource within these complex landscapes; in these cases, the average response doesn't adequately describe behavior towards a resource. Instead, we need to understand how the context around an animal in a complex landscape influences its response to a resource.

## HIGH-RISK, HIGH-REWARD

The evolving bear management situation in the Lower Peninsula of Michigan heightened the need to dig deeper into the question of how black bears respond to agricultural lands. Most existing resource selection studies of black bears and agriculture confirmed a general expectation: statistically speaking, black bears avoid agricultural land. Yet, we know that sometimes bears decide that exploiting an agricultural field is worth it. After all, these fields are a tempting high-risk, high-reward opportunity for bears, and the animal must be willing to trade higher safety for increased calories. Because of this inherent tradeoff, we suspected the choice a bear makes could be significantly nudged one way or the other by the specific context of the decision. The question was, under what conditions did black bears choose to exploit an agricultural field, and are those conditions predictable?

In response to sightings of black bears in the southern Lower Peninsula of Michigan, biologists at the Michigan

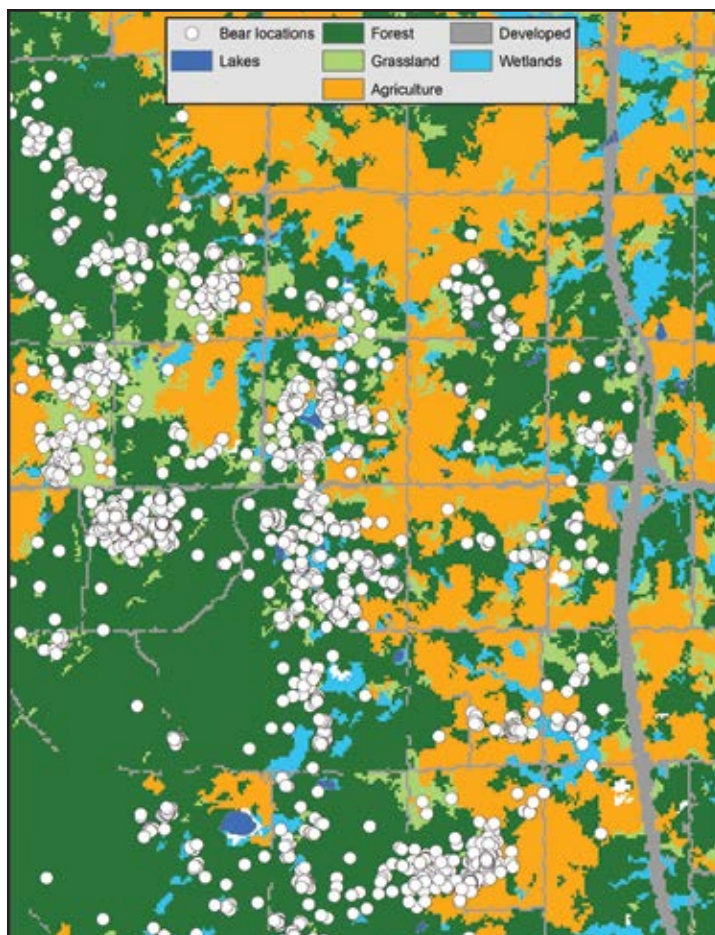
Department of Natural Resources and researchers from the Boone and Crockett Quantitative Wildlife Center trapped 15 bears on the southern edge of their typical northern range and outfitted them with GPS collars. Each bear's collar collected the location of the bear every 30-45 minutes. Some collars fell off, and some collared bears were harvested, but typically each collar collected four to seven months of data during the non-hibernation period. We used the GPS data to compare characteristics of the environment around locations a bear used with those of locations they could have used but didn't. Initially, these data look like a meaningless shotgun blast of points scattered across a satellite image. But when funneled into ecological models, we can use these data to create a resource selection analysis and evaluate if black bears respond differently to agricultural lands depending on the context of the encounter.

## WHAT MATTERS TO A BEAR?

If a black bear decimates a field of corn, it's understandable for the surrounding community, and especially farmers, to become concerned. But our research suggests all agricultural fields are not equally tempting to a bear. Instead, certain characteristics nudge the risk-reward balance of a bear using a field one way or the other. We discovered that the sex of a bear, the proximity of a field to human developments, and the number of other black bears (population density) and amount of agricultural land in the surrounding area all influenced the decision a bear made to either avoid or use a patch of agriculture.

The density of the local bear population influenced how likely either male or female bears were to use an

An example of GPS locations of a collared bear in the study.



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agricultural field, but the two sexes responded to this part of the context differently. In fact, their responses were complete opposites. Male bears decided in favor of using the field only when there were very few bears in the local population; females were more likely to go into a field if there were many bears nearby. Two realities of everyday life for black bears help explain this pattern.

First, animals compete with one another for resources. When animal populations are dense, there is often more competition to gain the food, water, and shelter an individual requires or prefers. Second, in the spring and summer, many female bears have cubs (which was true for all females in our study) and it's well known that females with cubs behave more cautiously than solo males. After all, females have invested an enormous amount of energy into these cubs who are dependent on her for protection, while males have only themselves to defend. Consequently, a male bear is overall more likely to risk entering an agricultural field. When a male who is part of a relatively small population approaches a patch of agricultural land,

the risk may be especially low to venture into the field because the chances of meeting a larger, more dominant male are low. Comparatively, a mother bear who is part of a small population faces less competition, and therefore has more freedom to choose which resources to use. From her perspective, agricultural fields are risky for her and her cubs, so her first choice may be to avoid them. However, a mother bear in a dense population with higher competition for food may be forced to use a resource she considers less desirable—in this case, an exposed field associated with humans.

Although males and females responded differently to the context of population density, they seemed to agree an agricultural field situated near a lot of human activity was too risky to enter. Both males and females avoided fields that were close to human developments, but they were willing to use one that was at least a few kilometers away from the nearest road or building. Bears were also more likely to use a field if it was relatively small and isolated, rather than connected to other agricultural fields. This suggests that, from the

perspective of a black bear, increased human presence added additional risk to entering agricultural lands. After all, a human is less likely to spot a bear in a field that is situated far away from buildings and roads, and a bear can retreat from a small patch of agriculture more easily than from a huge field. Black bears are skittish by nature, and they are a popular game species in Michigan, so while it's not surprising that a harvested species would perceive human activity as threatening, we also know black bears can become thoroughly acclimated to living and foraging in human-dominated landscapes. For the moment, stronger human presence swings the risk-reward balance towards avoiding agricultural fields for bears in the Lower Peninsula, but their skill at adapting to the context around them cautions us that this may not be the end of the story.

### LESSONS LEARNED

There is no evidence that black bears in the southern Lower Peninsula of Michigan are establishing a permanent, breeding, population. But sightings of lone individuals have persisted. Today, wildlife conservation is challenged

and complicated by rapid changes in land use and distributions of human and wildlife populations. Applying advanced analytical tools can help us make sense of the variation in how wildlife respond to these changing landscapes. In Michigan, we discovered we can anticipate where conditions favor use of agricultural areas by bears; small fields that are over a kilometer away from the nearest human development are most likely to tempt a bear, and areas with low bear densities will be especially appealing to males while high density areas could push females with cubs into fields. By recognizing that animals, like humans, can make decisions dependent upon the context in which they are happening, we can account for the true complexity in patterns of resource use and bolster management efforts to effectively balance the needs of humans and wildlife. ■

**LEFT:** Boone and Crockett Fellow Jennifer Smith keeps black bear cubs warm during a den visit to download data stored on-board the mother's GPS collar. **RIGHT:** Jennifer is with a sedated adult male bear ready to be fitted with a GPS collar.

