JMP® CUSTOMER STORY

University of Arizona

Scientists are taking a new look at how statistics can help extract previously untapped insight from observational fieldwork, guiding conservation management decisions toward more effective long-term strategies.

CHALLENGE

When urban development encroaches on natural wildlife habitats, it is often the animals who lose out. While for prairie dogs that has historically meant extermination, conservationists are now focusing their efforts on relocating them. But to move a prairie dog colony – and ensure that relocated colonies thrive in the long term – requires understanding the complexities of the prairie dog social unit.

SOLUTIONS

Data from a combination of observational fieldwork and laboratory studies helps scientists create a detailed map of social structures within a prairie dog colony. To help make sense of the data, behavioral ecologists like Jennifer Verdolin, PhD, use JMP®, a statistical discovery software that simplifies repeated measures analysis, facilitates exploratory analysis and streamlines the mapping of complex social interactions.

RESULTS

The results of Verdolin's statistical models challenge conventional wisdom about prairie dog behavior, opening the door for new conservation strategies that could significantly improve long-term survival.

Statistical approaches to understanding prairie dog behavior is key to improved conservation outcomes

The encroachment of humans on previously untrammeled lands can set off a cascade of species and habitat loss with widespread implications for ecosystem health. In the native grasslands of North America, prairie dogs (of the genus *Cynomys*) too often come into conflict with humans – and lose. Throughout history, these small, burrowing ground squirrels have been exterminated, with just 5% of their historical peak population size remaining.

New threats such as climate change, plague and urban sprawl have further reduced prairie dog numbers such that two species are listed as threatened and endangered, respectively, and the remaining species warrant protection but have no designated status. The continued loss of prairie dogs from an ecosystem has implications stretching up and down the food chain. Prairie dogs play a key role in their environment: They turn over the earth, enhancing nutrient cycling; their burrows provide shelter for many species including snakes and burrowing owls; and they themselves are a critical food source for raptors and the nearly extinct black-footed ferret. Losing prairie dogs entirely may mean losing other important species as well; they are what conservationists call a keystone species.

An evidence-based approach to conservation management

While conservation practices as a whole have grown more successful over time, prairie dog relocation efforts beginning in the mid to late 20th century have had mixed success; even in recent times, these efforts have ended in comparatively high prairie dog mortality rates.

For many years, conservation management decisions were made according to experienced biologists and land managers' expert intuition. And conventional wisdom held that prairie dogs affected by urban development should be relocated at the colony level, in part because with traditional behavioral observations, there is often insufficient time to undertake social unit-level relocations.

Today, ecologists are increasingly challenging conventional conservation practices by seeking to make the field more evidence-based. New data collected in the field is changing scientists' perceptions not only of animal social behavior but also of the complicated dynamics of the whole ecosystem. And in some cases, what they're learning comes as a surprise.

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Assistant Professor of Practice
University of Arizona

Statistical rigor within reach

Jennifer Verdolin, PhD, is an Assistant Professor of Practice at the University of Arizona, where she studies the behavior of prairie dogs and their social group. By embracing statistics as a key research practice, she has shed light on behaviors that contradict long-standing beliefs about prairie dog social dynamics. For example, while convention previously held that prairie dogs lived in male-dominated social groups – and that females mated only with those males – Verdolin has shown through her analysis of both field observation and genetic data that the mating opportunities are secondary to the social life of prairie dogs.

A careful statistical analysis of genetic data revealed that the number of offspring a resident male sired was either the same or sometimes *less* than those sired by a male outside of the social group. This observation led her to conclude that the purpose of social was cooperative territory defense by both males and females in the group. When it came to reproduction, it was clear that female prairie dogs often mate outside of their immediate social groups.

In mapping a more complete picture of prairie dog social behavior, Verdolin aims to help redirect and refine conservation strategies to drive at higher survival rates. As scientists' understanding of the critical interconnectedness of coteries grows, she says, conservation managers get closer to identifying the specific relocation metrics and parameters that optimize animals' chance of survival.

Underlying Verdolin's breakthrough findings are data from countless hours of observational fieldwork, recording behavioral and vocalization patterns of individuals and collecting samples for DNA testing in the lab. Genetic sampling alone creates vast quantities of data for each coterie, and managing unique identifiers across a colony of more than a thousand individuals is no small challenge.

After counting and collecting data by hand – and running analyses through Excel – during her graduate research, Verdolin made a new discovery: JMP® statistical software. As a researcher whose methods involved basic analysis, yet whose core expertise in biology meant she had little prior training in statistics, JMP had an obvious appeal. Using JMP allowed for more complex and nuanced analyses in her PhD research, leading to the many exciting discoveries she made.

Astrid Cabello Photography

"It's hard to make errors in JMP," she says. "The interface helps you set up and run tests, and the data visualization makes it easy to see the results right away." Plus, she adds, prompts within the software help guide users to set up and run experiments and provide a menu of standard options and recommendations for dealing with messy data.

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JMP® helps remove human error by making analysis of big data sets manageable

Repeatability is a key principle in any field of scientific research, and biology is no exception. Performing analyses in the same way, with exactly the same parameters every time, is key to arriving at conclusions that hold up under scrutiny. Verdolin says that in addition to the interactive, visual appeal of data analysis in JMP, the software systematizes modeling methods so as to reduce human error. "With JMP, I can reanalyze the data really quickly in either exactly the same way, or in a different way to see what else it is trying to tell me," she adds.

Using JMP to create t-tests, chi-squares, linear models, stepwise regressions, repeated measures or principal component analysis, Verdolin also says the software helps keep track of what she's done, particularly in the data exploration phase of research. "Data visualization in JMP helps find errors or outliers and identify things you might not have considered," she says.

In JMP 16, a new Enhanced Log feature is tailormade for recording keystrokes, allowing users to focus on playing around with their data, without losing track of what they've just done. Furthermore, the latest version of the Enhanced Log can even generate scripts so that with just one click, users can run any process again. This means taking a lot of the human error out of repeated measures and principal component analysis. Being able to precisely repeat a method makes comparing data sets more reliable, more trustworthy and importantly, much faster.

JMP® takes the fear factor out of statistics

Verdolin explains that as the field becomes more data-driven, it is critical that the next generation of scientists embrace statistical methods. In her classes at the University of Arizona, she plans to introduce students to JMP to help take the fear factor out of statistics, telling them to have a clear research question – and to never be afraid to use data to explore it. JMP, she says, really sets students free to explore the story that their data is telling.

Once students learn that statistics isn't so daunting when you have the right tools, they can get excited about new discoveries. Right now, a wildlife biologist may only spend 15-20% of their day on statistics, but good data analysis is an essential part of doing good scientific work – work that can lead to understanding that, like Verdolin's own results, challenges conventional wisdom and advance scientific knowledge.

In wildlife biology, like most sciences, challenging the status quo is most successful when you have the data to support your conclusions. And JMP helps non-statisticians work in a more evidence-based way. "Who'd have thought that prairie dog females are so free-wheeling!" Verdolin laughs. "The ease of JMP analysis helped me show it."