Customer Story

San Diego Zoo

Challenge

In the fight against extinction, conservation scientists must assess hundreds of complex ecological and behavioral variables to gain essential insight into habitat attrition and population dynamics.

It's survival analysis – literally

San Diego Zoo scientists bring ecosystems back into balance to stave off extinctions

Animal populations big and small, across the globe, fight for survival against changing ecosystems – new environments to which they are not naturally adapted. One team at the world-renowned San Diego Zoo is studying the effects of habitat loss in its own backyard. These scientists hope they can save at-risk animals both locally and in other parts of the world by better understanding the complicated dynamics of ecosystems in flux.

Extinction and decline are complicated processes that cannot be attributed to any singular factor. But by building an understanding of the many variables which together affect ecosystem balance, scientists stand a chance at helping to save at-risk species. The San Diego Zoo is at the front line of this fight. By uniting its expertise in animal care with cutting-edge conservation science, the zoo's researchers lead the global effort to end extinction.

An adaptive management approach to conservation aims at sustainable outcomes

Scientists of the San Diego Zoo's Applied Animal Ecology Division conduct important behavioral and ecological research to advance the institution's conservation mission. The division espouses an adaptive management approach – which means gathering information about the entire ecosystem over time in order to understand how endangered and threatened species are affected by factors like habitat degradation, predation or competition.

In the case of San Diego County, California, scientists have noted significant habitat loss and fragmentation over the past few years due to human activity. Such changes have led to the diminution of native grasslands and a proliferation of aggressive invasive species.

Habitat loss in this region does not mean all native populations are thrown into peril; however, the reduction of one population can have a ripple effect that affects the survival of other species. The California ground squirrel population, for example, has diminished markedly across the county as a result of habitat attrition. While the squirrel itself is not at risk locally, the western burrowing owl – for which the breeding population is indeed at risk of extirpation from San Diego County – relies on ground squirrels to provide burrows for nesting. When habitat loss pushes squirrels out, the western burrowing owl is at risk.

While a simple short-term solution to this problem might be to construct artificial burrows in which owls could nest, J.P. Montagne, Research Coordinator with the division, sees this option as unsustainable. The ultimate goal of conservation work, he says, is to help reestablish healthy, self-sustaining ecosystems that require little future intervention from humans.

The theory goes that if you can bring back the squirrels, you'll also bring back the burrowing owl population. In reality, however, it's much more complicated than that. Squirrel populations' success is dependent on a wide array of environmental and behavioral factors that go far beyond a macro-view of habitat loss. The San Diego Zoo seeks to understand

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>
> J.P. Montagne, Applied Animal Ecology Division of the San Diego Zoo

those factors that facilitate the natural system's population dynamics. And that means experimentation and ultimately, data analysis.

Strategic decisions grounded in data science

Over the course of three years, Montagne has translocated over 700 squirrels in order to study variables affecting squirrels' ability to thrive as well as the effects translocated populations have on the habitat itself.

Prior to each move, Montagne performed a series of behavioral assays with the squirrels, a subset of which were radio-collared so that he could monitor them for three months following their release. To complicate matters further, the team was forced to discontinue a handful of its relocation sites, supplementing the data by introducing new geographies with unique abiotic and biotic characteristics. With a laundry list of temporal, ecological, geographic and what Montagne calls "animal personality" variables, the resulting data set was a statistical challenge.

"It was a complex data set – we did translocations a few years in a row and had multiple plots at each site. And all these variables were really hard to wrap my head around," he says, "but JMP helped me figure it out."

Montagne runs multiple survival regression analyses on the number of days the squirrels survived as well as to evaluate movement parameters in the wake of a translocation. "Without JMP," he says, "I don't know that I could have mastered this kind of complex survival analysis as quickly and easily as I did. Its visualization and graphing features really make it easier for us as biologists to answer our research questions.

"Had I not had JMP, I would have had to learn R. I've used R in the past and it's also a great tool, but there's a huge learning curve – having to master scripting, for one. Most of us here at the institute are not statisticians. We're ecologists, biologists, reproductive physiologists. And we use statistics as a tool to help us answer the questions posed by our research."

Montagne says JMP® cuts through the noise in his data to point at important relationships between variables. For example, analysis showed that the clay content of the soil was among the most important predictive abiotic factors of survival.

Data-driven conservation interventions help reestablish at-risk populations

But how does identifying predictive factors (and understanding their interrelationships) actually translate into promoting squirrel repopulation? Montagne relies on the findings of his analysis to inform the strategic management decisions he and his team must make. By understanding the impact of predictive factors like soil quality, they'll be able to translocate squirrels to sites in San Diego County where they'll have the best chance at survival. And with it, they hope to see the western burrowing owl begin to come back.

JMP has helped make sense of the complex data that drives this kind of conservation management decision making, Montagne says – even for scientists who, like his team, are less familiar with statistics. "Not only did I use JMP to run my analyses, you could say that I also used JMP to learn statistics," Montagne laughs.

JMP saves researchers a lot of time, he says – and the need to adapt research questions to what would otherwise be limited data sets. As a result, scientists now have more time to spend in the field playing an active role in the zoo's conservation efforts.

This intervention, like so many conservation strategies, isn't foolproof of course. But many reintroduction projects – take, for example, the high-profile Yellowstone wolf reintroduction efforts of the late 1990s and 2000s – have had tremendous success in recent years. And much of this success can be attributed to a turn toward systematic, scientifically informed management decision making.

Solution

Use JMP to run multiple survival analyses and build statistical models that help researchers to identify the best adaptive management strategy for at-risk species.

Results

Several formerly declining species are now making a comeback in San Diego County.

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