TURNING ECOLOGICAL DATA INTO DECISIONS

Proteus

YOUR ECOLOGICAL STATISTICAL EXPERTS

What Is There?

You've been asked to assess biodiversity but knowing what's there, and being confident in the results, isn't always straightforward. "Not found" doesn't mean "not present." Poor design, low detectability, or limited methods can all lead to missed species.

Sometimes you're focused on a specific target species. Other times, it's broader patterns such as species richness or community structure. Each requires a different approach.

We help you match the method to the question. For single-species questions, we use tailored designs and models (like occupancy models) to reduce, and account for false absences. For broader biodiversity assessments, we draw on tools like multi-species occupancy models, species accumulation curves, PERMANOVA, and diversity indices.

We can help you:

- Design field surveys that reduce the risk of false absence
- Use models that account for detection probability and effort
- Apply biodiversity metrics and community analyses across taxa
- Clearly communicate the likelihood of presence or absence
- Defend your results with transparency around assumptions

Case Study: Braided River Invertebrate Monitoring

The Problem: A monitoring programme needed to assess invertebrate biodiversity across two braided river systems, but low detectability and variable survey effort risked underestimating what species were truly present.

Our Solution: We applied a multi-season, multi-species occupancy model to estimate the occupancy of recognisable taxonomic units (RTUs) over a four year period. Spatial (trap line) and temporal (month/year) covariates were included in the occupancy component, while detection probability was held constant. From the model's posterior distributions, we generated community matrices to calculate Shannon diversity, Simpson diversity, and species richness. We also assessed how increasing sampling effort (number of traps and lines) affected detection and occupancy, helping to evaluate trade-offs between effort and confidence.

The Outcome: The model predicted higher species richness and diversity at one site compared to the other. It also quantified the sampling effort needed, such as the number of traps or lines, to achieve specific detection thresholds, particularly for rare species. We recommended increasing survey effort at the lower effort site to improve detection and occupancy estimates and create a more balanced study design.

Where is it and why?

Knowing a species is present is only part of the picture. You may need to understand where it occurs, how its distribution varies across space, and what's driving those patterns.

But spatial data can be messy. Surveys may miss areas of suitable habitat, and habitat data may be incomplete or uneven. Detecting a species in one location doesn't mean it's absent from other parts of the site (especially if survey coverage is incomplete).

We help unravel this complexity using spatial models that link occurrence data with habitat, environmental, and survey covariates revealing the likely distribution of species and the ecological factors that shape it.

We can help you:

- Model species distributions using environmental and spatial data
- Predict where species are likely to occur under different scenarios
- Identify habitat features associated with presence
- Account for survey coverage and detection biases
- Communicate spatial uncertainty clearly to support decisions

Case Study: Threatened Bird Reintroduction (Site Selection)

The Problem: A reintroduction programme needed to identify suitable habitat for a threatened native bird. Past releases had failed, likely due to predation and habitat mismatch. Without current field data or fine scale habitat maps, there was a risk of selecting suboptimal sites, wasting resources and endangering translocated birds.

Our Solution: We adapted an existing resource selection model based on GPS tracked individuals from a previous release site and applied it to a broader reintroduction area. Using a grid based approach, we extracted environmental variables, including vegetation type, distance to water, altitude, slope, and land cover from national datasets. We used generalised linear models to estimate the relative probability of use for each location and mapped predicted habitat suitability at a 100 m resolution across the entire region.

The Outcome: The model predicted higher habitat suitability in areas closer to water, farther from tracks, at lower altitudes, and with gentler slopes. Bird presence was positively associated with shrub and bracken vegetation. Predicted suitable habitat was concentrated in specific parts of the landscape. We recommended that site selection be guided by ground truthing and local knowledge particularly regarding predator control, which was not included in the model but remains critical to the success of any reintroduction effort.

How many are there?

You've counted something, birds, bats, bugs, but raw counts are just the starting point. What you need is a reliable estimate of how many individuals are out there, how that number is changing, and how confident we can be in the results.

But abundance estimates are never exact. They depend on survey effort, detection probability, and variation in environmental conditions, all of which introduce uncertainty.

We help you move from raw counts to statistically grounded estimates, using models that account for detection, effort, and variability. And just as importantly, we summarise results with confidence intervals and clearly explain what the models assume so findings can be interpreted and applied with a realistic understanding of their limits.

We can help you:

- Choose an appropriate method for abundance or density estimation
- Design your study and establish appropriate field protocols
- Account for detection probability and effort in your analysis
- Quantify the uncertainty around your estimates
- Compare results across years, sites, or scenarios
- Communicate findings in a way that supports confident decision making

Case Study: Kangaroo Density Estimates in National Parks

The Problem: A monitoring programme aimed to track kangaroo populations across multiple national parks to support long-term management. However, variation in habitat, survey effort and method, and detectability between parks and years meant that raw counts alone could not reliably indicate population trends or support confident comparisons.

Our Solution: We used line transect distance sampling to estimate kangaroo densities across several national parks allowing us to account for variation in detectability by species and area within each survey year. We generated total kangaroo density estimates per km^2 with confidence intervals and also modelled population trends over a ten year period to evaluate long term changes.

The Outcome: Over the ten year period, kangaroo densities increased in two of the national parks, while the third showed a decline. We recommended improvements to the line transect survey design to enhance efficiency and increase statistical power in future monitoring.

How do I find it?

You've got a question to answer, but if your survey can't reliably detect the species you're looking for, you won't get the data you need. Whether you're targeting rare birds, elusive mammals, or cryptic invertebrates, detection is never guaranteed and some methods work better at detection than others.

We help you navigate those trade-offs. From pilot studies and detection trials to power analysis and simulation, we use quantitative tools to test how well your survey design is likely to perform, before you even set foot in the field.

We can help you:

- Identify the key detection challenges for your species or system
- Select methods that maximise detection while staying within budget and field constraints
- Use pilot data or simulations to test survey performance
- Quantify the trade-offs between effort, coverage, and confidence
- Build a defensible design backed by evidence, not guesswork

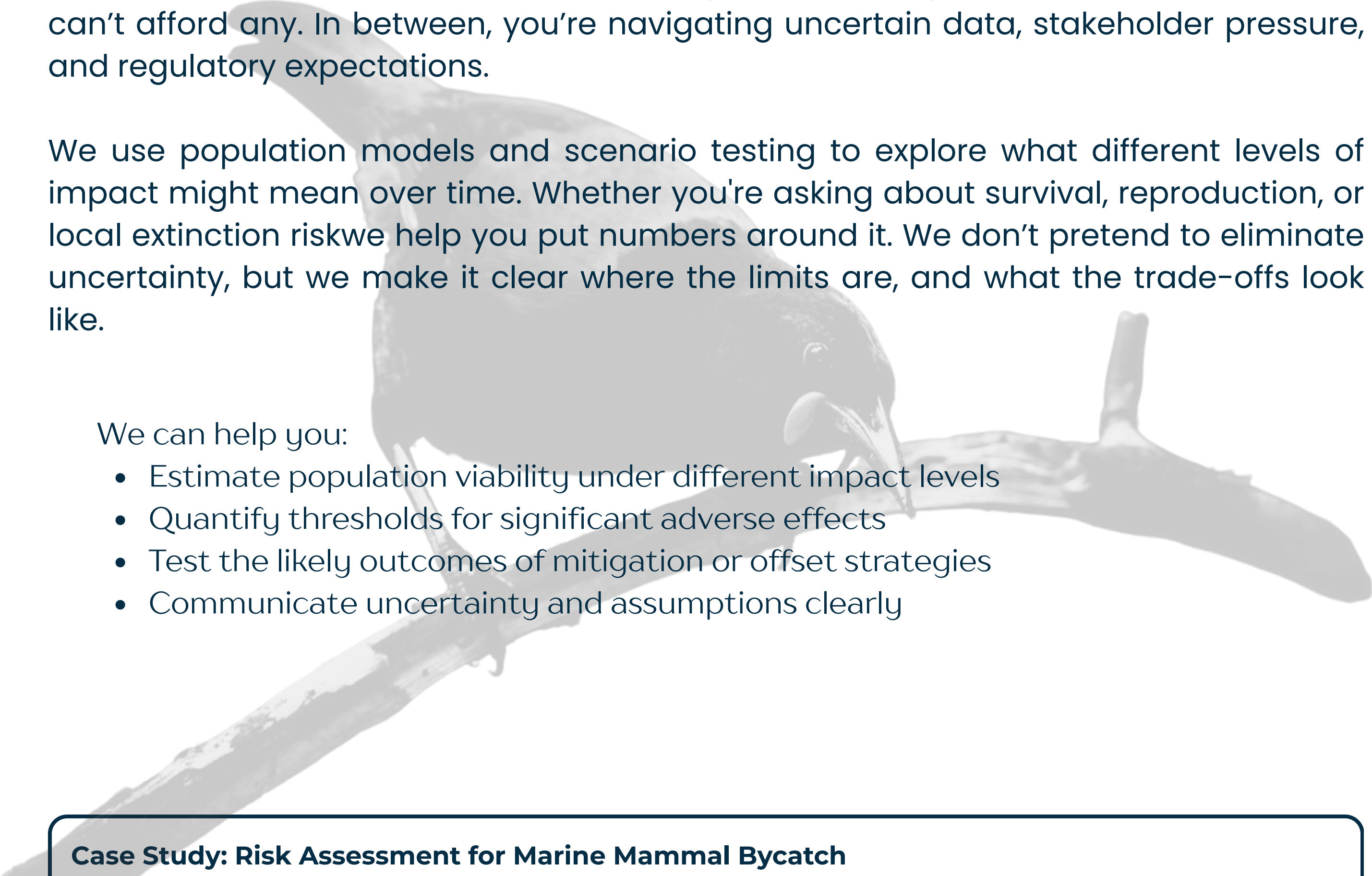
Case Study: Aerial Survey Design for Hector's Dolphin Distribution

The Problem: A spatial monitoring programme aimed to estimate the abundance and distribution of Hector's dolphins along the East Coast of the South Island. However, previous assumptions about where dolphins occurred were uncertain, and existing protected areas didn't always align with observed distributions. To improve conservation and management planning, a survey was needed that could reliably detect dolphins across a large and variable coastal region.

Our Solution: We conducted systematic aerial line-transect surveys covering inshore and offshore zones, using distance sampling to estimate detection probability. We fitted density surface models (DSMs) that combined survey data with environmental covariates including depth, distance from shore, and geographic region to predict dolphin occurrence. The analysis produced spatial predictions of density at a 5 × 5 km resolution.

The Outcome: The survey revealed areas of high dolphin density both within and outside existing protected areas, providing a more accurate and spatially complete picture of the population. The modelling approach allowed us to identify where survey effort was most effective and where future monitoring or protection might be prioritised.

How many can we lose?



Every project comes with some ecological cost. The real question is: how much is too much? It’s not always easy to tell. Some species can cope with small losses. Others can’t afford any. In between, you’re navigating uncertain data, stakeholder pressure, and regulatory expectations.

We use population models and scenario testing to explore what different levels of impact might mean over time. Whether you're asking about survival, reproduction, or local extinction riskwe help you put numbers around it. We don’t pretend to eliminate uncertainty, but we make it clear where the limits are, and what the trade-offs look like.

We can help you:

- Estimate population viability under different impact levels
- Quantify thresholds for significant adverse effects
- Test the likely outcomes of mitigation or offset strategies
- Communicate uncertainty and assumptions clearly

Case Study: Risk Assessment for Marine Mammal Bycatch

The Problem: Marine mammals like Hector’s, Māui, and common dolphins face ongoing pressure from fisheries bycatch. But understanding how much bycatch is too much isn’t straightforward. Small populations, sparse data, and variable mortality rates make it difficult to know where the tipping point is and whether current impacts are sustainable.

Our Solution: We applied a spatially explicit risk assessment framework to estimate the potential population level effects of bycatch across multiple marine mammal species. For each species, we calculated Potential Biological Removal (PBR) a science-based threshold that defines how many individuals could be lost each year without compromising population viability. We used demographic data, where available, to model population growth rates and compare estimated bycatch levels against sustainable limits.

The Outcome: The results showed that some species, like Māui and Hector’s dolphins, are likely being impacted beyond sustainable levels while others, like common dolphins, had greater tolerance under current conditions. The analysis provided a clearer picture of where bycatch risk is highest, where uncertainty is greatest, and where mitigation is most urgently needed. It gave managers an evidence based way to prioritise protection efforts and communicate the risks and trade-offs with greater confidence.

Better statistics, Better understanding, Better environment

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