The Conservation Planning Specialist Group: Using data to foresee and respond to species conservation crises

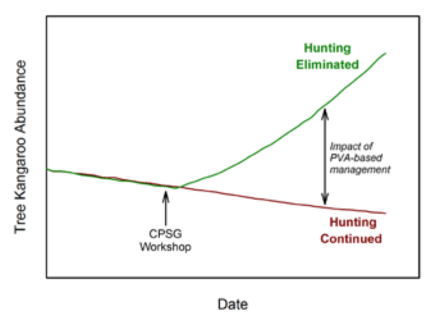
Assessing the human condition and its consequences for wildlife persistence

In its most applied form, population viability analysis (PVA) has emerged as one of the most effective processes for providing scientific rigor to species conservation planning efforts. The prospective simulation modeling tools used in PVA can help clarify, evaluate and prioritize human-mediated threats to wildlife populations and habitats, define and evaluate alternative management options in relation to their effectiveness in promoting demographic stability within declining populations, and develop operational strategies for long-term species conservation that are explicitly based on assessments of relative risk. As such, PVA is playing an increasingly central role in the formulation of long-term recovery plans for threatened and endangered species worldwide.

However, our ability to incorporate more complex interactions involving social science data and processes into these quantitative risk assessments is more limited. Nearly all existing PVA models make simplified assumptions about the impacts of human activities on the dynamics of wildlife populations and the ultimate driving forces that affect the proximate threats. If PVA is to evolve into an ever more useful tool, the analytical models we use must be able to more effectively integrate a variety of data types from diverse scientific disciplines. In this way, a more focused picture of the complex nature of human-wildlife interaction will emerge.

Tree kangaroos are native to West Papua, Papua New Guinea and northern Australia. The ten species comprising this group occupy some of the world's last remaining undisturbed rain forest habitat. Perhaps the most endangered species is Scott's tree kangaroo, known locally in northwestern Papua New Guinea as the tenkile. There are likely less than 250 tenkile remaining in the rain forests on the slopes of the Toricelli Mountains. While loss and degradation of their habitat is always a concern, perhaps the most acute threat to the species' future persistence is unsustainable hunting by local human communities. In particular, local hunters have a strong preference for removing adult females because of their relative ease of capture and the larger biomass obtained per unit hunting effort, given the frequent presence of a young offspring (joey) still nursing from its mother. Therefore, it was critical to assess the magnitude of the hunting threat for this species and its impact on the likelihood of persistence.

We were able to construct simplified predictive models for the tenkile and other related tree kangaroo species, and attempted to incorporate the female-biased hunting threat into our risk assessments. Our general models proved to be successful in illustrating conceptually the consequences of removing adult females from the population, and prompted local community leaders to consider modifying their hunting practices to help conserve this unique biological resource. Unfortunately, however, we were missing key pieces of information that would have



greatly improved the accuracy and utility of our model projections – improvements that could have further protected the tenkile from future extinction.

Firstly, while we were able to interview local hunters to derive basic estimates of the total number of tenkile females removed annually from the wild, we were unable to determine what proportion of the total population that offtake represented. Because we lacked credible estimates of the total population size for the species in the wild, we could not deduce the proportional impact of the hunting threat. This proportional expression of the hunting threat is a critical parameter used in our prospective risk assessments. We recognize that data such as these may not always be available; on the other hand, if they are available we may not always know the proper channels to access the data for our conservation planning. Developing a more effective mechanism for scouring the global biodiversity data universe would be an indispensable component of our quantitative risk assessment efforts.

Secondly, and perhaps more importantly, we lacked important information on the projected future characteristics of the human communities near the tenkile's wild habitat. These characteristics would no doubt shape our understanding of how hunting might change in nature and intensity as the local human population changes in response to a host of biological and social variables. What is the predicted number of humans expected to occupy this region over the next 50 years? What is the expected community age and gender structure, which would help us predict the number of active hunters among these communities? What is their predicted level of economic development, which might impact their future propensity for hunting tenkile? And what are the current and future behavioral drivers that motivate individual hunters to act the way they do? All of these questions elicit critical pieces of information that are used in a PVA context to project the intensity of hunting as a future threat to tenkile populations. Yet we had very little available expertise in the fields of human population demography, anthropology and sociology to draw upon for answers to these questions. As a result, we could not provide meaningful perspectives on the future for tenkile conservation in the face of an evolving human-dominated landscape. Gaining access to these types of data – likely available across a range of sources in the business, human health and sociological sectors – would revolutionize our ability to effectively plan for effective species conservation in a rapidly-changing world.

Our goal as the Conservation Planning Specialist Group is to help the global species conservation community create effective plans to save the world's endangered species. By uniting different disciplines and the information upon which they are built, we can advance the science and practice of species conservation to a new level of sophistication and effectiveness.

Forecasting the impacts of climate change on ice-dependent arctic fauna

The reduced access to prey by polar bears that feed from ice floes in the Canadian arctic has been well publicized and is causing appropriate alarm as one indicator of the impacts that are expected from global warming. Unfortunately, however, that is just the tip of the iceberg [sorry, I couldn't resist the analogy] regarding the changes that will be coming to the arctic fauna. Working with the Norwegian Polar Institute, we have been using "meta-models" that link population projections of polar bears, ringed seals, and bearded seals in the Barents Sea via the impacts that each species has on the other and the ways that those interactions will be affected by reduced springtime ice cover.

Ringed seals and bearded seals are currently abundant, and are essential prey species for polar bears and other top predators. Polar bears emerging with cubs from winter dens in the spring require abundant prey near shore in order to nurse their growing cubs and replenish the fat reserves of the mothers. Ringed seal pups in lairs (snow-covered dens) on the land-fast ice provide that essential resource, while bearded seals provide an additional primary prey throughout the year. In recent years, ice cover on the fjords around the archipelagoes of the Barents Sea has not been adequate to provide a platform for ringed seals to raise pups. Pups are therefore abandoned by their mothers and immediately eaten by bears, foxes, and other predators and scavengers.

Through the novel use of linked models of the population dynamics of the three species, we were able to project that the consequences of the reduced ice will be played out over a period of decades: initially, bears can easily prey on the abandoned seal pups; subsequently, the seal population will crash due to a lack of surviving pups to replace adults that age; eventually, the polar bears will lack the springtime prey needed to raise cubs; finally, both the ringed seal and bear populations will collapse. Several lessons emerged from our analyses, none of which would have been predicted from the single-species models typically employed by wildlife agencies and conservation scientists. The arctic species facing the greatest impact of climate change might well be the ringed seal – a species that is currently abundant and therefore not the focus of close monitoring and concern, but a species that is a key link in many arctic food chains. Furthermore, the consequences of the changing arctic climate might not be readily apparent until several decades after the processes have already been set in motion. Finally, to detect the disruptions to the ecological communities more quickly will require monitoring of seal pup and bear cub survival, rather than the standard censuses of the adult populations.

We were able to forecast impending changes in the arctic community through the use of our new modeling tools that enable analysis of effects that cascade through species interactions. However, a major constraint on our ability to predict the time course and the spatial patterns of the changes is the very limited data on the local and seasonal changes to ice cover around the archipelagoes. Consequently, currently we can provide only coarse guidance to management authorities regarding, for example, what areas of the arctic to protect (from impacts of increased shipping, mineral exploration, and tourism) as refugia for ice dependent fauna.

The essential climate data that are needed to make predictions (e.g., ice and snow cover of fjords in April) will not come from the global or even regional climate models that have been developed, but rather from assembled local knowledge – from accounts of fishermen and hunters, ecotourists, and others in the local communities. Intensive scientific monitoring of local weather conditions could fill the need, but the data must already exist within local reports, social media, and other local sources, if only it could be accessed efficiently. Traditional scientific data collection across the Arctic to detect where important changes are occurring would require a massive monitoring program, whereas people engaged in various activities are increasingly dispersed throughout the Arctic and therefore could provide a more extensive monitoring system than anything that the agencies could implement. Presently, the wildlife conservation and management communities do not have the expertise or resources to access the data that are available. That needs to change.

Seeing emergent diseases before it is too late

Over the past few decades a previously unknown fungal disease (chytridiomycosis) rapidly spread through ecosystems in every continent (except Antarctica), decimating frog populations and causing the extinction of almost certainly 100s of species. Although we don't often think about the role that amphibians serve in ecosystems, in many regions they are major components of the food chains – connecting the invertebrate microfauna to the larger vertebrates.

The decimation of frog populations due to the human-mediated spread of chytrid was detected only when individual field biologists traded stories and a few of them realized that the collapses of populations that they studied were not just local phenomena but instead part of a global disaster. The recognition of what was happening occurred just in time for the conservation community to mount a response of research, monitoring, and rescue that has prevented the ultimate loss of 100s of species. [Zurich Zoo has been among the leaders with the "Amphibian Ark" initiative – taking action to protect frog species through breeding programs, support of field efforts, and communicating the issues to the public.] Unfortunately, however, recognition of the crisis was too late for many other species.

If the chytrid epidemic had been recognized just a few years later (as would have been likely if a few scientists had not been comparing notes), the devastation would have been worse. Time was needed to develop tests for the fungus, determine treatments, develop husbandry and breeding methods for rescued populations, and establish field monitoring. Conversely, if the patterns had been recognized even a few years sooner, protocols to stop the spread of the fungus into additional regions could have been put in place, as is now being done to prevent the spread of a related and potentially equally devastating salamander chytrid disease.

Chytrid fungal disease in frogs is not a unique outcome of global commerce, and it certainly will not be the last time that a disease is spread to ecological communities that are not adapted to withstand it – with devastating impacts ecologically and often also on human health and economies. Other cases that we are currently facing include the white-nose syndrome that has decimated many bat species in North America, West Nile disease and avian influenza affecting bird populations, tuberculosis and other diseases transmitted between wild and domestic ungulates, ebola in great apes, distemper in many carnivores, … and who knows what other epidemics that are already underway but not yet recognized.

We know that these pandemics have happened, are happening, and will happen. We shouldn't be relying on surveillance by luck to try to see trends in time to take necessary actions. A data aggregation system that constantly monitored scientific publications, agency reports, news reports, and other sources of information for trends in wildlife population numbers, areas of occurrence, and unusual amounts or causes of mortality would reveal prospective disasters far more quickly and reliably than the fortuitous recognition (or not!) by a few scientists who were paying attention to broad patterns. The same surveillance would help reveal also the arrival of invasive species, something that presently is usually noted too late for effective action.

The Conservation Planning Specialist Group and its partners have developed and employed powerful analytical models for projecting consequences of environmental change and human activities on wildlife, and also processes for using such analyses within stakeholder deliberations to develop effective conservation action plans. However, successful application of these proven methodologies must be underpinned by data. Given the magnitude of the problems, and our abilities to respond, it is not sufficient to keep relying on just the knowledge of the "people in the room". We need to effectively and efficiently access the world's data.