Designing for the Unknown:

the transformative potential of mine clearance on the Falkland Islands

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Project Overview

On April 2nd, 1982, the Argentine Navy invaded the Falkland Islands, a sovereign territory of the United Kingdom. The ensuing conflict, known as the Falklands War, lasted for 72 days, killing hundreds and leaving behind approximately 25,000 landmines, landmines which the UK has begun to remove.

Examples abound where military reservations have sustained high amounts of biodiversity and supported endangered species, "no man's lands" such as the Korean DMZ emphasizing the plasticity of ecologies and their resilience. However, what makes the Falklands' minefields unique is that the only organisms found here capable of detonating the mines are humans and domesticated animals. Nearly all of the land on the Falklands is used for pasture, suggesting that besides nature reserves, these minefields may be the only potential refugia free from grazing pressures on the main islands. This project seeks to establish the composition of the minefield ecosystems and determine if they foster greater amounts of biodiversity than non-mined lands, in the process addressing questions of endemism, population dynamics in island ecosystems and the evolution of hybridization and its implications for speciation.

Project Information

In December 2006, *National Geographic* ranked the top 111 islands in the world. Their metric was complex, but based primarily upon all of the things for which that magazine is known: pristine natural environments and cultural authenticity (or their idea of it). The Falkland Islands were ranked 9th, with the magazine calling it "wild" and "bleak" but pointing out that "Leftover landmines from the 1982 conflict inhibit hiking" (Tourtellot 2006, 3). Were these landmines never to exist, it is probable that the islands would have been ranked even higher. With 30,000 visitors in 2009, tourism is already a significant source of revenue for the islands and it would seem that landmine clearance can only help that industry's growth (No author, 2010). Couple this with growing speculation over fossil fuel resources in the nearby sea and a $40 million per year industry in selling fishing licenses, and a changing pattern of land use needs emerge. A question arises: Could the demining process be used as a catalyst to reorient land use towards more ecologically and economically productive uses? And: On the Falkland Islands how might those ends be defined?

The Falkland Islands are a compelling case study for natural selection and endemism on oceanic islands because they exist somewhere between the classifications of paleo- and neo- endemism. I will make the argument that the Falkland Islands once exhibited paleoendemism, but these species were replaced by what I will call proto-neoendemics. The geological record suggests that the Falkland Islands were once part of southern Africa, yet none of the flora or fauna found on the islands indicates a genetic relationship to any organisms currently or previously found in Africa. Rather:

"the Falklands biota is so strongly Patagonian that derivation of that biota is best seen as resulting from dispersal, much of it probably recent. This dispersal biota appears to have replaced, and perhaps displaced, the South African biota present on the islands as they detached from South Africa and drifted across the south Atlantic Ocean" (McDowall 2005, 49).

Whenever this replacement or displacement occurred, it was not long enough ago that these new Patagonian species had enough time to develop into species in their own right. While evolution on most oceanic islands follows the adaptive radiation model, species on the Falkland Islands are strongly linked to the pattern of anagenetic speciation. Anagenetic evolution is a process altogether different from adaptive radiation – in it a single introduction evolves without diverging into different species and, as such, slowly builds up genetic variation through time, with all of this genetic variation remains within the single species. Stuessy et al.'s 2006 paper on anagenetic speciation found that there were 14 endemic species on the Falkland Islands and that 71% of all species here followed the anagenetic model. Compare this to data, for instance, from Hawaii, where there are 828 endemic species and a 7% anagenetic

speciation rate. “[D}uring anagenetic speciation, initial founder populations proliferate, and then accumulate genetic variation slowly through time by mutation and recombination in a relatively uniform environment, with drift and/or selection yielding genetic and morphological divergence sufficient for the recognition of new species” (Stuessy et al. 2006, 1259). As a result, even though these islands are 300 miles away from South America and have no history of human settlement prior to their discovery in 1592, there are virtually no endemic species on the islands. For instance, no endemic monocots are found here, and out of 93 dicots found on the islands, none of their genera are endemic to the islands (McDowall 2005). Similarly, a study of the island’s flora by Broughton and McAdam (2002, 279) found that “The Islands are home to a relatively poor native flora, comprising 171 species of vascular plants, 13 of which are endemic”. Those species which are endemic exhibit very little genetic variation to their continental counterparts. The flora then, to a certain extent, is better adapted to anthropogenic landscape changes than might otherwise be expected for an island with such a high degree of isolation. Indeed, McDowall (2005) notes that this very remoteness has hindered scientific study of the islands’ ecosystems.

With low levels of endemism we find that there have been no documented extinctions of plant species on the Falkland Islands, a reality which contrasts sharply to places such as Hawaii, where high levels of endemism coupled with massive landscape change have utterly devastated the island’s unique flora and fauna. However, I will argue that this does not mean that the Falkland Islands’ flora has remained unaffected by human contact – this is an illusion created by the biological species concept. When one begins to look at the Falkland Islands’ flora, it becomes evident that “Many species are at the eastern and southern limits of their range[s] in the Falkland Islands’” (McDowall 2005, 53). So although most “rare” species on the Falkland Islands occur abundantly in continental South America, “they develop under locally adapted populations (ecotypes), which may be genetically or physiologically distinct from populations elsewhere” (Broughton and McAdam 2002, 285) especially given that the Falkland Islands constitute a geographic extreme location for many of its species. It would appear that human disturbance on these islands does not represent a potential for species extinction, so much as it represents the possibility for the erasure of locally adapted genotypes through hybridization with members of the same species or closely related continental species. At the same time, the erasure of these local genomes has the potential to be a process with net creativity – hybridization could lead to novel gene combinations that could, over time, increase species fitness or lead to the creation of distinct species or subspecies. Levin et al. (1996, 14) note: “many insular plant genera have weak interspecific crossing barriers with both their insular and continental counterparts”. Couple this with the fact that human disturbance creates the conditions necessary for such hybridization to occur and one sees how this is likely to occur on the Falkland Islands.

Major disturbance to the Falkland Islands has, in the past occurred via agriculture, primarily through the grazing pressures brought on by intensive sheep farming. Not only were European forage species introduced to facilitate the growth and effectiveness of pasture land, but native grasses were removed or harvested as winter feed for sheep, cattle and horses. Yet, while detrimental, these grazing pressures remained relatively consistent since their introduction in the 1860s and refugia of significant size remained for indigenous species. However, “since the early 1980’s agricultural practice, and the economic infrastructure of the Falkland Islands, has been undergoing rapid change. The flora is now under ever increasing pressure from agricultural diversification and intensification, including widespread pasture improvement programmes, and to a lesser extent from the current road-building programme.” (Broughton and McAdam 2002, 285).

Conventional logic in conservation circles dictates that invasive and exotic species proliferate at the expense of indigenous/endemic species. While some studies have shown that this does occur, it is essential to recognize that this dynamic is not a given, nor does it even predominate. Plant “invasions” generally occur concomitantly with habitat destruction and widespread human interference to previously undisturbed sites. Those instances where an exotic species is introduced to a pristine ecosystem and wreaks utter havoc are extraordinarily rare. As such, it becomes difficult to disentangle the degree to which introduced plants become detrimental to ecosystem biodiversity in the sense that their introduction is accompanied by the devastation of these environments anyways. Caujape-Castells et al. (2010, 116) provide an extended commentary on this:

“Nowadays, alien plants are an important component of many habitats on most oceanic islands. However, the extent to which alien plant invasions have brought about the decline and extinction of native plants on islands is still debated. The assumption that invasive plants cause extinctions has been countered by observations that native and alien plant species richness on different oceanic islands are positively rather than negatively correlated, and negative impacts of alien plants on native plants had rarely (until recently) been rigorously demonstrated.”

It becomes evident that a situation is developing on the Falkland Islands that has repercussions beyond the scope of concerns of any single party. There are currently no land use plans in place that suggest how demined lands will be dealt with, yet it is important to recognize that these lands will now be usable for the two most significant land degrading forces on the islands: humans and agriculture. One might question then the logic of Kew Botanic Gardens’ recent proposal to “restore” and monitor landscapes after the demining process is complete, especially given that the composition of minefield ecosystems remains unknown. Even if ecological restoration were a productive endpoint for the demined areas, the vast scale of the demined lands makes comprehensive restoration an impossible endpoint. The amount of resources and time needed to accomplish this is simply not possible, especially in a peripheral site where demining activities are met with ambivalence by the local populace.

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