RESTORATION OF DEGRADED COASTAL GRASSLANDS IN THE FALKLAND ISLANDS

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ABSTRACT
In the Falkland Islands the coastal grasslands are the most valuable for wool production and important habitats for wildlife. Tussac grass (*Parodiochloa flabellata* Lam.) and sandy areas which support an *Ammophilia - Elymus* association have been degraded by overgrazing, burning and invasion by alien flora and fauna. Traditional approaches to restoration, mainly by replanting, have had limited success. Research on more holistic and ecological methods of restoration is proposed.

KEYWORDS
Ammophilia arenaria, Falkland Islands, overgrazing, *Parodiochloa flabellata*, restoration, soil erosion, wildlife conservation

INTRODUCTION
On most of the Falkland Islands sheep are ranched to produce wool. The coastal grasslands are the most valuable native pastures yet they have been degraded (McAdam & Walton 1990, Wilson et al. 1993). Their value is linked to the abundant sea-going wildlife which inhabits them, particularly the millions of penguins. Fertilisers and supplements are not used extensively, thus the natural input of nutrients via animal excreta balances those exported in wool and other livestock products.

The overall aim is to restore and sustain the productive potential of the coastal grasslands. Improved management of the coastal grasslands, the wildlife and their marine food supply is needed for a sustainable rural economy. This is crucial now given developments in the livestock, tourism, fishing and oil industries. This paper outlines research on restoration of the coastal grasslands which is generally more holistic and ecological than conducted previously.

STATES
Assessing the state of the grasslands is an essential prerequisite to restoration. A reduced cover of plants, deleterious changes in species composition and soil erosion are most evident in the maritime tussock grassland, dominated by Tussac grass.

Before livestock ranching began in the early nineteenth century, Tussac was much more widespread along the coast than it is now. Where Tussac cover was removed the peat formed by its tall (-3m) tussocks was eroded leaving sub-soil or bedrock. Alien plants such as *Poa annua*, *Stellaria media* (Moore 1968) *Rumex acetosella* (L.) and *Holcus lanatus* (L.) invaded Tussac communities.

Sand and peat in exposed Tussac soils are readily transported in the windy and seasonally dry climate and where they accumulate the introduced *Ammophilia - Elymus* association often occurs (Moore 1968). Such areas require stabilisation to reduce damage to pasture and contamination of sheep fleeces.

Satellite imagery and aerial photographs could be used to quantify and monitor degraded areas and field surveys would provide corresponding 'ground truth' data. Maps could be produced and the soil, plant and animal resources listed using geographic information systems. This information would help advisers and land owners plan and prioritise restoration work.

CAUSES
Most of the causes of the degradation are 'man-made'. Tussac evolved without the influence of large ungulates and was easily damaged by unrestricted grazing (McAdam & Walton 1990). Fire was another main cause of its disappearance (Gennard & McAdam 1986), while alien plants, fungal rusts, insects, rats, cats, rabbits and foxes may have contributed to local degradations. In sandy areas trampling and rubbing by livestock hastened erosion of peat and sand (Wilson et al. 1993).

Removal of livestock from degraded Tussac has probably enhanced its recovery, however little is known about the periods required. Preliminary results from a soil and vegetation survey showed that only partial regeneration of moderately degraded Tussac areas occurred within twenty years since stock removal (Department of Agriculture, unpublished data). Restoration strategies should assess the effects of grazing by livestock and the impacts of wild geese, rabbits, hares and rats. Information is needed on the impact of fire on Tussac regeneration, peat hydrology and nutrient cycling. Disorders allegedly caused by stem-boring weevil larvae and fungal rusts may reduce Tussac vigour but they alone do not cause Tussac death (Fuller 1995). Information is needed on the effects of alien predators on wildlife and their habitats and the potential benefits arising from eradication of the aliens.

The effects of livestock removal on Marram grass (*Ammophilia arenaria* L.) establishment, dune colonisation and sand accumulation are also being researched. The relations between livestock activities and sand mobility and how this can be effectively reduced under extensive grazing requires study.

RESTORATION
As long as there is a stable and penetrable soil with adequate nutrients, water and plant propagules then restoration should be possible and self-sustaining. Deficiencies in these resources require correction and human intervention may be necessary to re-establish the processes that affect their availability.

Traditionally, restoration concentrated on planting tillers of Tussac grass for winter feed and shelter, and Marram or Lyme (*Elymus arenarius* L.) grasses to stabilise mobile sand dunes. For Tussac this method has been partially successful and only a few small island farms have restored areas large enough to contribute significantly to wool production or tourism. Marram has colonised most sandy areas while Lyme grass is less common.

Optimum planting sites, materials, treatments and timings for re-establishment of Tussac tillers have been determined (Fuller, J. unpublished data) while the fertility of Tussac soils is being surveyed. The types and levels of nutrients to sustain re-established Tussac, its root growth and associations with micro-organisms would be worthwhile studies. Monitoring natural recolonisation of degraded soils by Tussac seedlings may indicate surface substrates which could be artificially created to hasten the process.

For habitat restoration, more information is needed about whether the re-establishment of Tussac grass will attract wildlife. The proximity of a site to migratory routes and breeding grounds could affect the rates of recolonisation by fauna and the time necessary for the habitat to become self-sustaining.

The restoration of degraded sandy areas uses internationally known techniques for replanting Marram and Lyme grasses. Complementary local research across a range of coastal environments evaluates the use of seaweed mulch for sand stabilisation and soil conditioning which could enhance grass growth.

CONCLUSION

The recent land reforms in the islands have inspired a sense of stewardship among the new owner-occupiers and many are interested in restoring degraded coastal grasslands. However the relatively low agricultural output from the ranching system restricts the use of inputs such as fencing and fertilisers. Additionally, alternative good quality pasture for breeding flock replacements is either scarce or expensive, thus few land owners are able to remove livestock from the coastal grasslands for the long periods that may be needed for restoration. Consequently, landowners require assistance to restore and sustain the coastal grasslands for the benefit of all the Falkland Islanders and its internationally renowned wildlife.

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