12 GRANITE GRAVEL FIELDS & SAND PLAINS, NEW ZEALAND

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CLASSIFICATION

National: Granite gravel fields and granite sand plains are indistinguishable from each other; both are classified as Naturally Uncommon Ecosystems in New Zealand (Williams et al. 2007; Richardson et al. 2012).
International: No international example of this ecosystem type is yet known
IUCN Habitats Classification Scheme (Version 3.0): 4. Grassland / 4.4 Temperate

ECOSYSTEM DESCRIPTION

Distribution

Granite is widespread bedrock in western South Island, New Zealand, forming the dominant bedrock in two alpine regions; Fiordland and North-West Nelson (Rattenbury et a. 1998, Turnbull et al. 2010). These two regions, once contiguous, share a common origin as part of the Fiordland Terrane, formed during the Cretaceous, 120 million years ago (Coates 2002, Reay 2003). Lateral movement of the Pacific and Australian plates along New Zealand's Alpine Fault during the last 25 million years has separated granites within this Terrane. Typical granite landforms throughout this belt are tors, screes and boulders. Nationally, only a few examples are known of extensive dunes or plains of fine sands and small-grained gravels in high alpine situations, with the most significant areas being located on the Lookout Range in NW Nelson, and Mt Titiroa in eastern Fiordland (Figure 1). Worldwide, there are no other known examples of this ecosystem type, suggesting that it may be an ecosystem that is endemic to New Zealand.

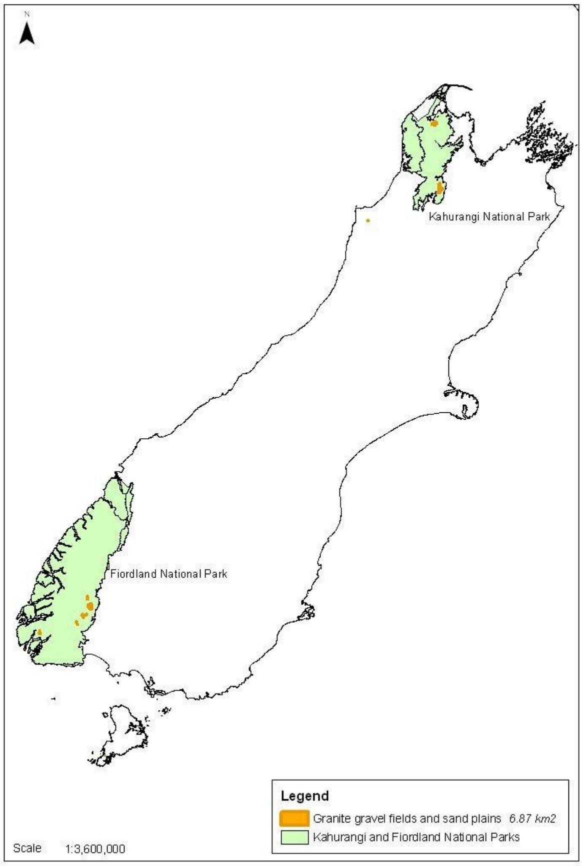

Figure S12. 1. Map of the South Island of New Zealand showing the current known occurrences of the granite gravel field and sand plain ecosystem.

Abiotic environment

Granite gravel fields and sand plains are characterized by extensive dunes or plains of fine sands and small-grained gravels (Figure 2) (Richardson et al. 2012). They occur on very exposed sites above treeline (1100-1600 m, mean annual temperate 3.4°C-4.7°C), where erosion-prone granite bedrock is close to the surface. Sites typically comprise approximately 80% bare ground and bedrock (Richardson et al. 2012, Figure 2). Due to their chemistry and structure, these granites crumble and rot to form angular gravels and ultimately sands. Relative to other alpine granite ranges in New Zealand, rainfall is relatively low (2100-2400 mm) and the terrain is flatter (mean slope of 12°, range 1°-32°), and this may encourage the production of low dunes. While many features of these ecosystems are shared with other alpine granite surfaces, such as low soil nutrients high light and extreme weathering, others such as the mobile substrate and excessive drainage, are unique.

The NW Nelson granites were formed at a shallower depth and have experienced substantially less physical and chemical weathering relative to the granites in Fiordland (Reay 2003). Soils are very poorly developed, well-drained and excessively nutrient-poor, with low nutrient concentrations. For example, mean total phosphorus (P) was 69.5 mg kg^{-1} and 55.7 mg kg^{-1}, and total nitrogen (N) was 0.04%and 0.03%, at the Lookout Range and Mt Titiroa, respectively. The proportion of total P as inorganic P was higher on Mt Titiroa (53%) than on the Lookout Range (33%; Table S1), reflecting steeper topography, erosion and input of mineral P.

Characteristic native biota

Vegetation is sparse and species poor. For example, a sample of 90 plots (each 100 m^2) from the Nelson and Fiordland locations identified a total of only 86 vascular plant species (Richardson et al. 2012). The native biota is characterised by low shrubs (e.g., Dracophyllum pronum), grasses (e.g., Poa colensoi), cushion plants (e.g., Chionohebe pulvinaris) and small herbs (e.g., Anisotome imbricata var. prostrata and Notothlaspi australe) (Richardson et al. 2012). Vegetation height rarely exceeds 30 cm, with many plants being prostrate and woven among the granite particles, forming small mounds or islands (Figure 2). Few native invertebrates or animals are known to be strongly associated with this characteristic vegetation. However, the wider mosaic of granite gravel fields and sand plains, screefield, alpine tussock grassland and herbfield support a range of invertebrate species including the rare carabid beetle, Mecodema integratum, the range-restricted giant scree weta Deinacrida connectens, and the Mt Titiroa sand and gravel fields support a recently described moth Hierodoris extensilis, known only from there and nearby Mt Burns (Hoare et al. 2012).

Key processes and interactions

The weathering and erosion of the granite bedrock is the key abiotic process governing the production of mobile, highly drained and nutrient poor substrate. It is thought that the relatively gentle topography, relatively low rainfall and high wind exposure promotes the formation of extensive dune systems. The vegetation is adapted to cope with low soil nutrients and highly mobile substrate. Facilitation may be important for plant establishment, with the establishment of pioneer vegetation (e.g. Dracophyllum pronum or Chionohebe pulvinaris) creating locally stabilised "islands" in which other species may become established. Coupled with on-going erosion processes, these processes create the open mosaic of mounded vegetation clumps that is characteristic of this ecosystem (Figure 2). The loose gravels may provide burrowing sites for insects, but this has not been explicitly studied.

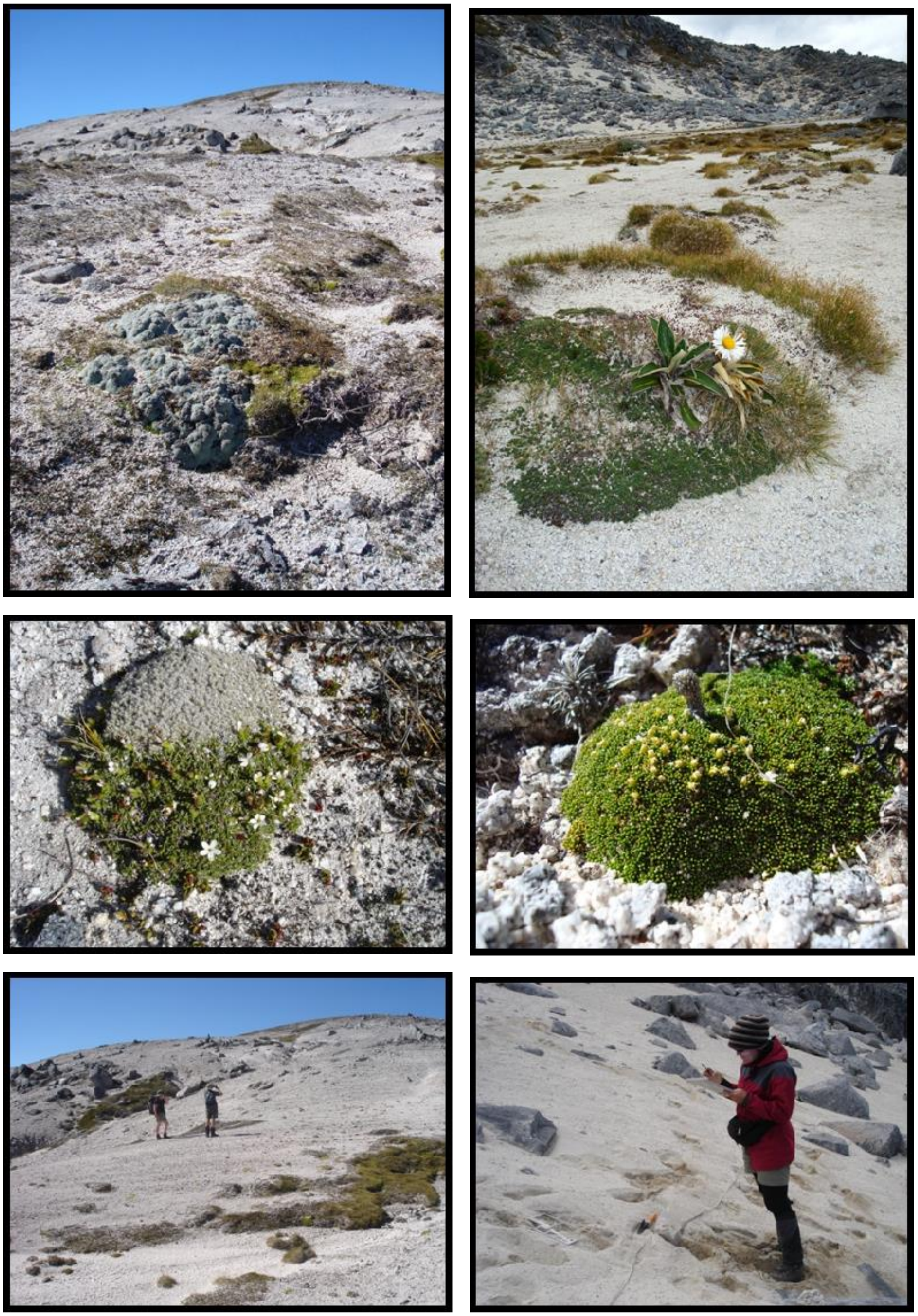

Figure S12. 2. Examples of the granite gravel fields and sand plains ecosystem from the Lookout Range, NW Nelson (left) and Mt Titiroa, Fiordland (right) showing landforms and characteristic plant associations (photos provided by Sarah Richardson & Susan Wiser).

Threatening processes

We know of very few, if any, processes that significantly threaten the characteristic biota of the granite gravel fields and sand plains ecosystem. This ecosystem is located entirely within conservation estates (99.8% is contained within Kahurangi and Fiordland National Parks), and due to its geographic isolation it receives little anthropogenic pressure. Invasive species are uncommon (e.g. only one of the 86 plant species found in 180 plots was exotic). Exotic mammals are likely to be transient and live predominantly in the surrounding mosaic of grassland, shrubland and forest. Mammalian predation may threaten the invertebrate fauna and climate change may pose an increasing threat in the future, but these are not thought to be significant threats to the maintenance of this ecosystems characteristic biota within the next 20 years.

Because of the lack of threatening processes and the apparent stability of the biotic and abiotic components of this ecosystem over the assessment time frames, we do not define thresholds of collapse.

ASSESSMENT

Summary

Criterion	A	B	C	D	E	overall
subcriterion 1	LC	LC	LC	LC	DD	LC
subcriterion 2	LC	LC	LC	DD		
subcriterion 3	LC	LC	LC	LC		

Criterion A

Current decline: Current spatial extent of granite gravel fields and sand plains is estimated as 687 ha (Figure 1). All examples of this ecosystem type are located in legally protected conservation land, with 99.8% located within two National Parks; Fiordland, gazetted in 1952 and Kahurangi, gazetted it 1996 (Figure 1). There is no evidence to suggest declines in the extent of granite gravel fields and sand plains over the last 50 years. The status under criterion A1 is therefore Least Concern.

Future decline: All areas of this ecosystem are located within legally protected conservation land. Although mining is permitted on conservation land in some locations, there are no known minerals of economic value beneath this ecosystem. There is no reason to expect future declines in extent over the next 50 years. The status under criterion A2 is therefore Least Concern.

Historical decline: The isolated alpine environment of granite gravel fields and sand plains has insulated them from anthropogenic land clearance and burning. There is no evidence of decline in extent since 1750, so it is therefore listed as Least Concern under criterion A3

Criterion B

Extent of occurrence: Extent of occurrence is 61,727 km^2, making this ecosystem Least Concern under criterion B1.

Area of occupancy: The number of 10 km × 10km grid squares occupied by granite gravel fields and sand plains is 15, with 7 containing >1% of the ecosystem type. This initially places the ecosystem within the threshold to be Endangered. However, there are no observed or inferred continuing declines in spatial extent, abiotic environmental or biotic interactions, no observed or inferred threatening processes, and the ecosystem exists at more than five locations. Granite gravel fields and sand plains are therefore listed as Least Concern under criterion B2.

Locations: Granite gravel fields and sand plains occur at nine distinct locations (Figure 1). There are no major threatening processes operating at these locations that are capable of causing collapse or making the ecosystem critically endangered within a short time period. This ecosystem is therefore listed as Least Concern under criterion B3.

Criterion C

Current decline: A recent survey of the granite gravel fields and sand plains characterised the abiotic environment in which these ecosystems occur (Richardson et al. 2012). There is no evidence to suggest that this environment has changed over the past 50 years and the surrounding mosaic includes extensive areas of virgin old-growth forest. Granite gravel fields and sand plains are therefore Least Concern under criterion C1.

Future decline: Although internationally the temperature increase due to climate change is expected to be stronger in the alpine zone, geology, fertility, exposure and substrate mobility, rather than temperature, are the main abiotic factors affecting the characteristic biota in this ecosystem. These features are expected to remain stable over into the future. Granite gravel fields and sand plains are therefore listed as Least Concern under criterion C2.

Historical decline: New Zealand's alpine ecosystems have a high degree of natural climate variability, and the long term trend has been relatively stable since 1750 (Duncan et al. 2010). As there is no evidence to suggest that there have been any major long-term changes to the ecosystems abiotic environment and its ability to sustain its characteristic biota, it is listed as Least Concern under criterion C3.

Criterion D

Current decline: Invasive plants are largely absent from these ecosystems, due primarily to their geographic isolation and harsh environment (Richardson et al. 2012). Invasive mammals are likely to be affecting insect and bird abundance across the entire extent, however, these species are not key components of the ecosystem identity, appear not to play critical roles in ecosystem function, and changes in their abundance are unlikely to be symptoms of future ecosystem collapse. Granite gravel fields and sand plains are therefore listed as Least Concern under criterion D1.

Future decline: Although there are no reasons to expect future decline in the biotic interactions that sustain the native biota, other than apparently minor disruptions caused by invasive mammals, the basis for projection is highly uncertain. Granite gravel fields and sand plains are therefore listed as Data Deficient under criterion D2.

Historical decline: There is no evidence to suggest historical decline in biotic processes and interactions that sustain the characteristic biota of this ecosystem. Although there are likely to have been a number of now-extinct bird species present in these ecosystems (Worthy and Holdaway 2002), they are unlikely to have played critical roles in the maintenance of this ecosystem. Granite gravel fields and sand plains are listed as Least Concern under criterion D2.

Criterion E

No quantitative modelling of risk of collapse has been undertaken. Granite gravel fields and sand plains is therefore Data Deficient under criterion E.

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