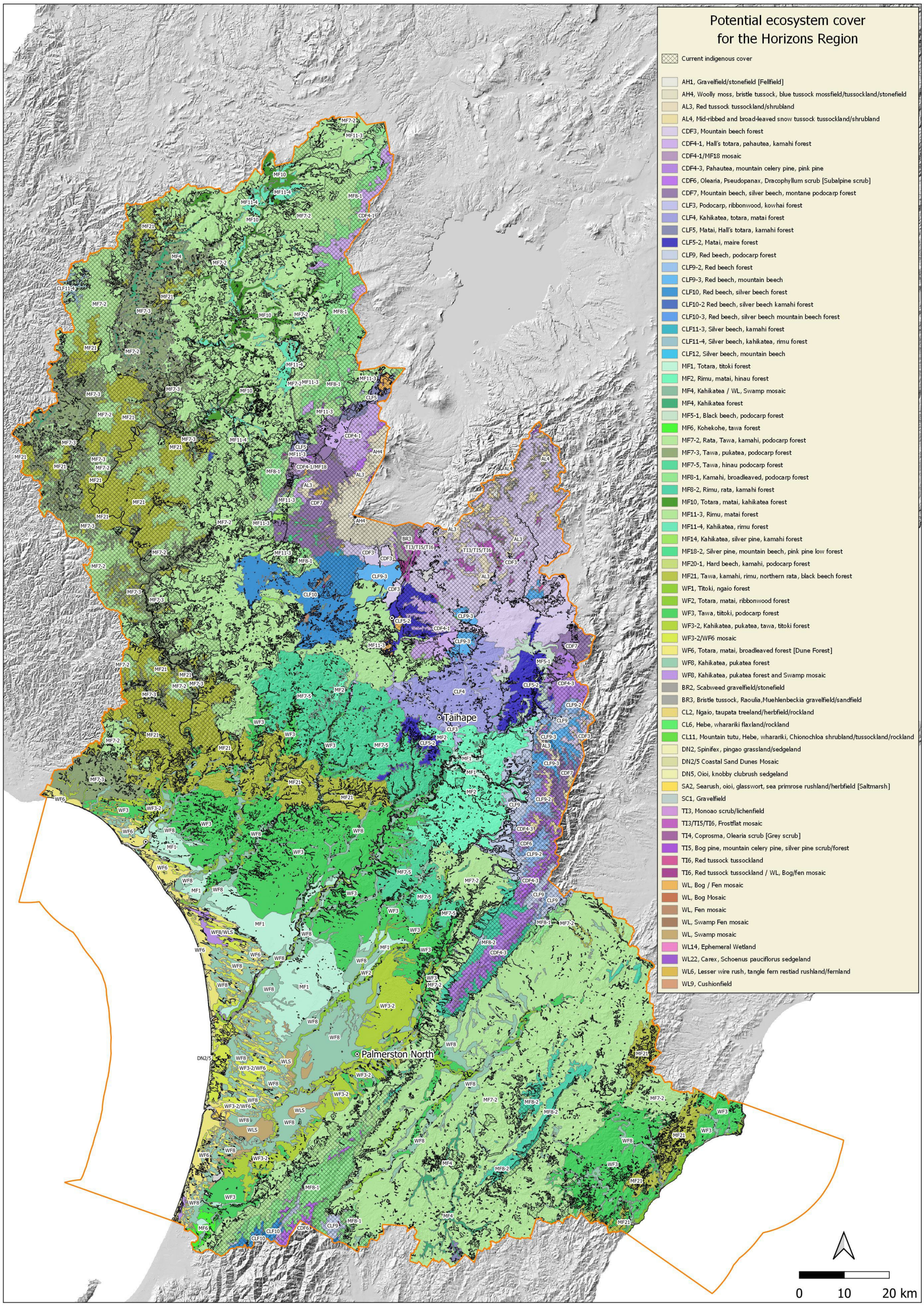
Supplementary Material



Appendix S1. Potential ecosystem cover for the Horizons Region, mapped using the ecosystem classification of Singers and Rogers (2014); the current (reduced) extent of indigenous-dominated cover is indicated by diagonally hatched polygons.

Appendix S2. Potential ecosystems for the Horizons Region.

Sixty-five ecosystems were mapped in the potential ecosystem cover layer for the Horizons Region as described in Singers & Lawrence (2018). The rationale and methods used to define these ecosystems are described in detail in Singers and Rogers (2014). The following brief ecosystem descriptions are taken from Singers and Rogers (2014), supplemented by additional information contained in Singers & Lawrence (2018). Note that as these descriptions refer to ecosystems potentially occurring throughout New Zealand, they include references to some species not occurring in the Horizons Region. Latin names for species identified by their common name are listed at the end of this Appendix.

a) Zonal ecosystems

High alpine —mean summer temperature < 5°C

AH1: Gravelfield/stonefield [Fellfield]. Gravelfield/stonefield with a sparse covering of sub-shrubs (Hebe spp.), *Celmisia* and other herbs, with extensive areas of rock pavement, boulderfield and bluffs, and limited areas of snow banks, cushionfield and herbfield.

AH4: Woolly moss, bristle tussock, blue tussock mossfield/tussockland/stonefield. Stonefield with a sparse covering of woolly moss, bristle tussock, blue tussock, species of *Gaultheria* and *Parahebe*, and kopoti, and locally mountain tōtara and *Dracophyllum recurvum*.

Low alpine —mean summer temperature 5–10°C

AL3: Red tussock tussockland/shrubland. Tall tussock grassland, shrubland of abundant *Chionochloa rubra*, and species of *Hebe* and *Dracophyllum*. Locally includes *C. pallens* on the main axial ranges of the Kaimanawa Mountains and northern Ruahine Range.

AL4: Mid-ribbed and broad-leaved snow tussock tussockland/shrubland. Tall tussock grassland, shrubland of abundant *Chionochloa pallens* subsp. *pallens*, and species of *Hebe* and *Dracophyllum*, with areas of talus, boulderfield and bluffs. Locally includes *C. rubra* in

the Kaimanawa Mountains and Ruahine Range, and *C. flavescens* subsp. *flavescens* in the Tararua Range.

Cold climate forests and scrub —mean summer temperature 10–12.5°C

CDF3: Mountain beech forest. Forest of abundant mountain beech, with small-leaved *Coprosma* spp., weeping matipo, mountain celery pine, snow tōtara, broadleaf, three-finger and putaputawētā, and locally Hall's tōtara. Locally also includes scattered silver and red beech in humid locations.

CDF4-1: Hall's tōtara, pāhautea, kāmahi forest. Podocarp, broadleaved forest with abundant Hall's tōtara, kāmahi and broadleaf, and locally mountain celery pine, pāhautea, tawheowheo and miro, as well as maire species and pōkākā at lower altitudes.

CDF4-3: Pahautea, mountain celery pine, pink pine. Podocarp, broadleaved forest with abundant pāhautea, mountain celery pine and pink pine, and locally Hall's tōtara, broadleaf, silver pine and bog pine.

CDF6: *Olearia*, *Pseudopanax*, *Dracophyllum* scrub [Subalpine scrub]. Short forest, scrub of wide range of local variants, with a range of species of *Olearia*, *Brachyglottis*, *Pseudopanax*, *Dracophyllum*, *Hebe*, *Coprosma*, *Hoheria*, montane podocarp trees, mānuka and whaririki. Locally includes monocultures, such as leatherwood scrub in southern Ruahine and northern Tararua Ranges.

CDF7: Mountain beech, silver beech, montane podocarp forest. Beech, podocarp and beech, podocarp, broadleaved forest of stunted mountain beech and/or silver beech, locally with Hall's tōtara, pāhautea, and pink, bog and silver pine at higher elevations and with yellow silver pine, silver pine, rimu, kahikatea, miro, pāhautea, Hall's tōtara and pōkākā at lower elevations.

Cool climate forests — mean summer temperature 12.5–15°C

CLF3: Podocarp, ribbonwood, kōwhai forest. Podocarp forest of abundant kahikatea, mataī and tōtara, with ribbonwood, narrow-leaved houhere, kōwhai and a wide variety of divaricating shrubs on free-draining soils.

CLF4: Kahikatea, tōtara, mataī forest. Podocarp forest with emergent kahikatea, mataī and tōtara, and occasional maire species, kōwhai and ribbonwood.

CLF5: Mataī, Hall's tōtara, kāmahi forest. Podocarp forest of abundant mataī, with occasional or local kahikatea, Hall’s tōtara, miro, tōtara, maire species, kāmahi and pōkākā, and locally (on the coldest, frost-prone sites) pāhautea, mountain celery pine and silver pine.

CLF5-2: Mataī, maire forest. Abundant mataī and occasional kahikatea, tōtara, Hall’s tōtara and hybrids with frequent maire (white and black), and occasional rimu. Other common understory species likely include broadleaf, tarata and lancewood.

CLF9: Red beech, podocarp forest. Beech, podocarp, broadleaved forest with abundant red beech.

CLF9-2: Red beech forest. Beech, podocarp, broadleaved forest of abundant red beech locally with silver beech, kāmahi and southern rātā, and occasional rimu, kahikatea, mataī and tōtara.

CLF9-3: Red beech, mountain beech. Abundant red beech and mountain beech and locally Hall's tōtara, black beech and occasional broadleaf.

CLF10: Red beech, silver beech forest. Beech forest and beech, podocarp, broadleaved forest of abundant red and silver beech, and locally with podocarp and broadleaved species with occasional black beech and mountain beech, Hall’s tōtara, pāhautea, kāmahi and hard beech, as well as rimu, miro and mataī at lower altitudes.

CLF10-2: Red beech, silver beech, kāmahi forest. Comparatively diverse dominated by red and silver beech, but with kāmahi, tawa, rewarewa, Hall’s tōtara and miro. Occurs only in the Rotokahu SR and Taheke Conservation Area in the Matemateaonga Ecological District.

CLF10-3: Red beech, silver beech, mountain beech forest. Forest of abundant red and silver beech with occasional black beech and mountain beech.

CLF11-3: Silver beech, kāmahi forest. Forest of abundant silver beech with rimu and kāmahi, and occasional Hall's tōtara and miro; locally with kahikatea on alluvial terraces.

CLF11-4: Silver beech, kahikatea, rimu forest. A mosaic of kahikatea, rimu, silver beech, tawa, kāmahi and tāwheowheo occurring on shallow sloping hillslopes with allophanic soils and depressions with gley soils on the Waitaanga Plateau.

CLF12: Silver beech, mountain beech forest. Forest of abundant silver and mountain beech, locally with kāmahi, Hall's tōtara, mountain celery pine, red beech, three-finger, kōtukutuku, broadleaf and small-leaved divaricating shrubs.

Mild climate forests — mean summer temperature 15–17.5°C

MF1: Tōtara, tītoki forest. Podocarp, broadleaved forest of abundant emergent tōtara, occasional mataī, kahikatea and rewarewa, with tītoki and māhoe abundant in the subcanopy, and locally maire species, ribbonwood, kōwhai and tarata. Pukatea, tawa and rimu are locally present but generally restricted to gullies.

MF2: Rimu, mataī, hīnau forest. Podocarp, broadleaved forest of emergent rimu and mataī, and occasional miro and tōtara, with abundant hīnau, and locally kahikatea, rewarewa, black maire, white maire and tītoki. Subcanopy species include abundant māhoe, porokaiwhiri, kaikōmako, five-finger, tarata and red māpou.

MF4: Kahikatea forest. Podocarp forest of abundant kahikatea locally with mataī and a sparse subcanopy of ribbonwood and houhere species, and locally kōwhai, pōkākā, māhoe and tarata on alluvial flood plains. Ribbonwood and houhere are locally absent, while pōkākā can often be more abundant. Divaricating shrubs are a common lower understorey element.

MF5-1: Black beech, podocarp forest. Beech forest and beech, broadleaved forest with occasional podocarp and broadleaved trees, including mataī and tōtara, and locally tītoki, hīnau, black maire, kōwhai, rewarewa, hard beech and red beech with kahikatea, kāmahi and northern rātā in sub-humid to humid areas.

MF6: Kohekohe, tawa forest. Podocarp, broadleaved forest of abundant kohekohe and frequent tawa, with occasional tītoki, māhoe, porokaiwhiri and nīkau, and scattered emergent rimu, pukatea and northern rātā.

MF7-2: Rātā, tawa, kāmahi, podocarp forest. Podocarp, broadleaved forest of emergent rimu, miro, kahikatea, mataī, tōtara and northern rātā, and abundant tawa, kāmahi, hīnau, rewarewa and pukatea.

MF7-3: Tawa, pukatea, podocarp forest. Podocarp, broadleaved forest of scattered emergent rimu, kahikatea and northern rātā, abundant tawa, pukatea and māhoe, and locally kāmahi, miro, hīnau and tāwheowheo.

MF7-5: Tawa, hīnau, podocarp forest. Podocarp, broadleaved forest of tawa, black maire, rewarewa, hīnau and emergent kahikatea and rimu. Kāmahi and northern rātā are restricted to moist locations, such as south facing gullies.

MF8-1: Kāmahi, broadleaved, podocarp forest. Podocarp, broadleaved forest of abundant kāmahi with rimu, mataī, miro and tōtara, occasional hīnau, rewarewa, maire species and kahikatea, and locally Hall's tōtara and pāhautea at higher altitudes.

MF8-2: Rimu, rata, kāmahi forest. Podocarp, broadleaved forest of abundant kāmahi with abundant rimu and northern rātā, and occasional miro, hīnau, rewarewa, maire species and Hall's tōtara at higher altitude.

MF10: Tōtara, mataī, kahikatea forest. Podocarp forest on free-draining volcanic pumice soils of abundant tōtara, mataī and kahikatea, and occasional miro and rimu, with a sparse subcanopy of broadleaved trees.

MF11-3: Rimu, mataī forest. Podocarp forest dominated by rimu and mataī occurring in mild to cool and sub-humid to humid locations from the Hauhungaroa Range to Ohakune and from Hihitahi to Owhakura.

MF11-4: Kahikatea, rimu forest. Abundant emergent large kahikatea and rimu over an infrequent canopy of miro, maire and locally mataī and locally kāmahi. The sub-canopy is typically infrequent, restricted to canopy gaps and is dominated by māhoe, kōtukutuku, horopito and wheki-ponga.

MF14: Kahikatea, silver pine, kāmahi forest. Podocarp forest with abundant kahikatea, and occasional rimu, silver pine and kāmahi. Locally includes southern rātā (South Island), pāhautea and pōkākā.

MF18-2: Silver pine, mountain beech, pink pine low forest. Low stature podocarp forest of abundant yellow silver pine, locally with mānuka, pink pine, silver pine, pāhautea and rimu, as well as mountain beech

MF20-1: Hard beech, kāmahi, podocarp forest. Beech forest and beech, podocarp, broadleaved forest of abundant hard beech with occasional rimu, miro, Hall's tōtara, tāwari, northern rātā, tānekaha, toatoa, tāwheowheo, kāmahi and rewarewa.

MF21: Tawa, kāmahi, rimu, northern rātā, black beech forest. Podocarp, broadleaved, beech forest with abundant tawa and kāmahi, and occasional rimu, northern rātā, kahikatea, hīnau, maire species and rewarewa, with pukatea on warmer sites, and black and/or hard beech locally abundant on ridges.

Warm climate forests — mean summer temperature 17.5–22.5°C

WF1: Tītoki, ngaio forest. Broadleaved forest of tītoki, ngaio, māhoe, five-finger, red māpou, kaikōmako, kōwhai, akeake and akiraho, locally occasional mataī, tōtara and kahikatea, and locally nīkau, tawa and rewarewa in northern and central part of range.

WF2: Tōtara, mataī, ribbonwood forest. Podocarp forest of abundant tōtara and mataī, with occasional kahikatea, ribbonwood and kōwhai, and a wide range of divaricating shrubs. Locally includes occasional tawa, tītoki and maire species in northern and more humid part of range and in inland examples, with occasional riparian black beech and red beech. Early successional derivatives on younger alluvial sites include kānuka, kōwhai, cabbage tree treeland and forest.

WF3: Tawa, tītoki, podocarp forest. Podocarp, broadleaved forest with emergent kahikatea, tōtara and mataī, abundant tawa and tītoki, and occasional rewarewa and hīnau. Locally includes northern rātā, pukatea, rimu and nīkau in warm and humid microclimates, and kohekohe in the northeast of the range.

WF3-2: Kahikatea, pukatea, tawa, tītoki forest. Podocarp broadleaved forest with occasional to frequent emergent kahikatea, occasional pukatea and rimu over a canopy of abundant tawa and tītoki. Māhoe and nikau are locally abundant in the sub canopy.

WF6: Tōtara, mataī, broadleaved forest [Dune Forest]. Podocarp, broadleaved forest of mosaics of kānuka, red māpou, korokia and akeake on very recent soils, grading into ngaio, tītoki, kōwhai, tōtara, mataī, rewarewa, maire species, māhoe, lancewood and kaikōmako. Locally includes kohekohe on older dune soils in Horowhenua District.

WF8: Kahikatea, pukatea forest. Podocarp, broadleaved forest of abundant kahikatea, with occasional to abundant pukatea, kiekie and supplejack, and locally rimu, tawa and swamp maire, particularly on organic and gley soils with a high water table.

Temperature inversion basins

TI3: Monoao scrub/lichenfield. Scrub of abundant monoao and lichens, and occasional silver tussock and *Pimelea prostrata*. Locally with ecotone margins of mountain celery pine, bog pine and mānuka. Likely to have included mountain celery pine and bog pine in the least

disturbed older successional examples, though these are now rare. Early successional derivatives include short tussock grasslands of species of *Poa*, *Festuca*, *Deyeuxia* and *Rytidosperma*, with inter-tussock prostrate herbfield species.

TI4: *Coprosma*, *Olearia* scrub [Grey scrub]. Scrub of two different variants: 1. on free-draining stony soils, with species including *Carmichaelia*, *Coprosma*, *Olearia*, *Hebe*, *Corokia cotoneaster*, mānuka, matagouri, and species of the lianes *Muehlenbeckia*, *Rubus* and *Clematis*; and 2. on poor-draining silty soils, with species such as *Coprosma* (*C. propinqua*, *C. pedicillata*), *Pittosporum obcordatum* and *Olearia* (*O. polita*, *O. virgata*). Early alluvial successions are dominated by short tussock grasslands (species of *Poa*, *Festuca*, *Deyeuxia* and *Rytidosperma*).

TI5: Bog pine, mountain celery pine, silver pine scrub/forest. Scrub and short forest with several local variants, including mountain celery pine and bog pine, locally with silver pine, pink pine, yellow silver pine, pāhautea and Westland tōtara, and often with divaricating shrubs and *Dracophyllum* spp.

TI6: Red tussock tussockland. Tall tussock grassland of abundant red tussock with inter-tussock herbfield/short tussockland and prostrate shrub species. Early alluvial successions are dominated by short tussockland of *Poa*, *Festuca*, *Deyeuxia* and *Rytidosperma* species. Typically includes an embedded, complex mosaic of bog and fen wetlands on organic soils.

b) Azonal ecosystems

Frequent geomorphic disturbance

BR2: Scabweed gravelfield/stonefield. Stonefield, gravelfield with a mosaic of prostrate herbfield of scabweed and willowherb species, including *Raoulia tenuicaulis*, *R. hookeri* and *Epilobium microphyllum* on bare gravels grading into short tussock grassland at higher altitude, and/or *Austroderia* spp. tall tussock grasslands, with species of *Hebe*, *Coprosma*,

Carmichaelia and *Coriaria*, and mānuka scrub on recent alluvial flood plains. Locally may also include *Olearia avicenniifolia*, especially at higher altitudes in Westland.

BR3: Bristle tussock, *Raoulia*, *Muehlenbeckia* gravelfield/sandfield. Gravelfield, sandfield with a mosaic of prostrate herbfield of species of *Raoulia* and *Pimelea*, and *Muehlenbeckia axillaris*, with localised patches of bristle and blue tussock, and mountain oat grass, and with scattered snow tōtara, *Gaultheria* spp. and *Olearia nummulariifolia*. Locally includes volcanic dunes.

CL2: Ngaio, taupata treeland/herbfield/rockland. Coastal rockland and colluvial slopes, locally with mosaics of treeland of taupata, kawakawa and harakeke and/or whaariki flaxland, and halophytic herbs (e.g. ice plant, sea primrose). Locally includes areas of short forest, scrub, with tītoki, puka, wharangi, ngaio and akeake.

CL6: Hebe, whaariki flaxland/rockland. Rockland and colluvial slopes with several local variants over a wide latitudinal/altitudinal gradient, with mosaics of short-statured herbs, grasses, short forest and scrub. Dominants include whaariki, *Poa anceps*, species of *Hebe*, *Gaultheria*, *Pimelea*, *Olearia*, *Sophora*, *Carmichaelia*, *Leucopogon*, *Cyathodes* and *Dracophyllum*, and tutu, and locally ngaio, kānuka, *Chionochloa flavicans*, *Astelia solandri*, *Dianella nigra* and *Collospermum hastatum*. Locally, subalpine species include *Hebe colensoi* and *Pimelea* spp. on inland sites, and local endemics on weakly weathered calcareous parent materials. Locally includes *Machaerina sinclarii*, kiokio, and rheophytic herbs, sedges, grasses and bryophytes associated with seepages, streams and rivers.

CL11: Mountain tutu, *Hebe*, whaariki, *Chionochloa* shrubland/tussockland/rockland. Rockland and colluvial slopes, with mosaics of grasses, herbs, ferns and shrubs. Dominants may include species of *Chionochloa*, *Poa*, *Rytidosperma*, *Elymus*, *Asplenium* and *Blechnum*, with whaariki, *Schoenus pauciflorus*, *Gingidia montana*, and species of *Celmisia*, *Helichrysum*, *Parahebe*, *Ourisia* and *Ranunculus*, and scrub of species of *Hebe*, *Melicytus*,

Coprosma, *Coriaria*, *Olearia*, *Hoheria*, *Brachyglottis*, *Dracophyllum* and *Pseudopanax*, kōtukutuku, wineberry and broadleaf. Locally includes endemic species on weakly weathered calcareous parent materials.

SC1: Gravelfield. Mobile gravelfield of predominantly shattered greywacke, argillite, igneous substrates and calcareous substrates on slopes of between 35° and 40° that locally include 26 species of specialised scree plants and associates, commonly including *Stellaria roughii*, *Epilobium pycnostachyum*, *Lignocarpa carnosula* and *Hebe epacridea*.

DN2: Spinifex, pīngao grassland/sedgeland. Sedgeland, grassland of abundant spinifex and pīngao, with occasional shore bindweed, sand coprosma, tauhinu and sand daphne, grading into rear semi-stable dunes with open, scattered dune scrub of bracken, *Muehlenbeckia complexa*, toetoe, harakeke and cabbage trees. Locally includes matagouri, mānuka, kānuka, tutu and *Olearia solandri*.

DN5: Oioi, knobby clubrush sedgeland. Sedgeland, herbfield of several local variants with both dry and ephemerally wet communities of a range of successional stages. Dominant species include *Carex pumila*, species of *Gunnera*, *Selliera*, *Isolepis*, *Epilobium*, *Ranunculus*, *Leptinella*, *Lobelia*, *Colobanthus*, *Geranium* and *Hydrocotyle*, and locally *Lilaeopsis novae-zelandiae*, *Myriophyllum votschii*, *Triglochin striata*, *Limosella lineata* and other turf-forming species. Older stages develop into oioi, knobby clubrush, toetoe and harakeke, and locally *Cyperus ustulatus*, *Lepidosperma australe*, silver tussock and *Raoulia* spp. Locally includes *Coprosma propinqua* and mānuka in older successions.

High water table

WL6: Lesser wire rush, tangle fern restiad rushland/fernland. Restiad rushland of abundant wire rush and tangle fern, with occasional sedges, including *Machaerina tenax* and square sedge, often with sphagnum and tussock grasses. May include pools and gradations to shrub

bogs (especially small podocarp trees), mānuka, *Dracophyllum* spp. and mountain tauhinu or red tussock fens.

WL9: Cushionfield. Cushionfield with species of *Oreobolus*, *Donatia*, *Gaimardia*, *Centrolepis*, Carpha *alpina* and *Phyllachne*, and often *Androstoma empetrifolia*, *Pentachondra pumila* and *Lepidothamnus laxifolius*. Locally includes scattered treeland, with mānuka, pink pine, mountain beech and yellow silver pine.

WL10: Oioi restiad- rushland/ reedland. Restiad rushland with abundant oioi, locally with large *Machaerina*, *Bolboschoenus* spp., kuta and lake clubrush, and often with occasional raupō and scattered harakeke grading into wetland scrub on margins.

WL11: *Machaerina* sedgeland. Sedgeland, rushland with a high water table dominated by species of *Machaerina*, square sedge, *Eleocharis* and *Juncus*, often with scattered harakeke and *Carex* spp. Locally includes oioi, tangle fern and *Gahnia* spp., which can be locally dominant. Lagg margins often grade into mānuka scrub fens.

WL12: Manuka, tanglefern scrub/fernland. Scrub with abundant mānuka and occasional species of *Olearia*, *Coprosma* and *Dracophyllum*, and species of *Machaerina*, square sedge, *Carex* and *Juncus*. Locally abundant tangle fern, *Schoenus pauciflorus*, sphagnum, stunted harakeke, and species of *Astelia* and *Gahnia*. Locally also includes bog pine, silver pine and pink pine.

WL13: Sphagnum mossfield. Mossfield of abundant sphagnum, often with a sparse canopy of stunted scrub/low treeland of mānuka, locally silver beech, bog pine and *Dracophyllum* spp., with abundant cover of sphagnum, and a sparse component of sedges, rushes and herbs (e.g. *Drosera binata*). =

WL14: Ephemeral Wetland. Herbfield and/or low sedgeland dominated by a wide range of predominantly montane, short-statured herbs, grasses and sedges. Dominants may *include*

species of *Leptinella*, *Lobelia*, *Hydrocotyle*, *Euchiton*, *Epilobium*, *Plantago*, Ranunculus, *Myriophyllum*, *Elatine*, *Glossostigma*, *Isolepis*, *Eleocharis*, *Carex* and *Deschampsia*.

WL18: Flaxland. Flaxland of abundant harakeke, often with toetoe, species of *Carex* (e.g. pūkio) and *Machaerina*, and kiokio, occasional wetland scrub, treeland of cabbage tree, spp. and mānuka, and locally weeping matipo and twiggy tree daisy. Areas with high water tables may be dominated by pūkio. May grade or succeed into wetland carr, with abundant emergent cabbage trees.

WL19: Raupo reedland. Reedland of abundant raupō, locally with species of *Bolboschoenus*, *Schoenoplectus* and *Machaerina articulata*, pūkio, harakeke, and swamp millet. A margin of scrub of Coprosma species and cabbage tree, and locally twiggy tree daisy and mānuka, with scattered kahikatea in unmodified areas. Often occurs on lake margins or includes small ponds with shallow water/pools with floating/rafted aquatics such as water milfoils, buttercups, willowherbs, species of *Potamogeton*, *Isolepis*, *Azolla* and *Lemna*, and spiked sedges (e.g. kuta).

WL20: *Coprosma Olearia* scrub. Scrub of species of *Coprosma* and locally twiggy tree daisy (which can be locally dominant), with a mosaic of a wide variety of *Carex* spp. and locally kiokio. May also locally include scattered harakeke, raupō, toetoe and cabbage trees.

WL22: *Carex*, *Schoenus pauciflorus* sedgeland. Sedgeland with mosaics of a wide variety of species of *Carex*, including *C. secta*, *C. virgata*, *C. diandra*, *C. coriacea*, *C. sinclairii* and *C. gauchichaudiana*, and *Schoenus pauciflorus*, with locally small pools and lakes often with a fringe of raupō. Schoenus becomes more abundant at higher altitudes, while occasional harakeke may be present at lower altitudes. Intact examples have margins of wetland scrub.

WL: Bog Mosaic. Mosaics of infertile wetlands including mostly WL6, with small areas of WL10 and WL11.

WL: Fen mosaic. Mosaics of wetlands of intermediate fertility including WL10, WL11, WL12 and WL13.

WL: Swamp mosaic. Mosaics of high fertility wetlands including WL18, WL19 and WL20.

Saline environments

SA2: Searush, oioi, glasswort, sea primrose rushland/herbfield [Saltmarsh]. Rushland, herbfield of sea grass, glasswort and sea primrose, locally with shell barrier and/or gravel beach ridges, grading into sea rush and oioi. Locally *Machaerina juncea* and *Schoenoplectus* spp. also occur, with areas of coastal herbfield (e.g. shore celery, half-star, bachelor's button, arrow grass) grading into a fringe of coastal scrub of salt marsh ribbonwood, *Olearia solandri*, *Coprosma propinqua* and small-leaved pōhuehue.

Scientific names for species referred to by their common names in the ecosystem descriptions, following Nicol (1997), with updated names from Manaaki Whenua Landcare Research (2023).

Common name	**Scientific name**
Akeake	*Dodonaea viscosa*
Akiraho	*Olearia paniculata*
arrow grass	*Triglochin striata*
bachelor's button	*Cotula coronopifolia*
beech (forest or species)	*Fuscospora* spp. and *Lophozonia menziesii*
black beech	*Fuscospora solandri*
black maire	*Nestegis cunninghamii*
blue tussock	*Poa colensoi*
bog pine	*Halocarpus bidwillii*

bracken	*Pteridium esculentum*
bristle tussock	*Rytidosperma setifolium*
broadleaf	*Griselinia littoralis*
buttercup	*Ranunculus* spp.
cabbage tree	*Cordyline australis*
five-finger	*Pseudopanax arboreus*
flax	*Phormium spp.*
glasswort	*Sarcocornia quinqueflora*
half-star	*Selliera radicans*
Hall's tōtara	*Podocarpus laetus*
harakeke, flax	*Phormium tenax*
hard beech	*Fuscospora truncata*
hīnau	*Elaeocarpus dentatus*
horopito	*Pseudowintera colorata*
houhere	*Hoheria* spp.
ice plant	*Disphyma australe* subsp. *australe*
kahikatea	*Dacrycarpus dacrydioides*
kaikōmako	*Pennantia corymbosa*
kāmahi	*Pterophylla racemosa*
kānuka	*Kunzea* spp.
kawakawa	*Piper excelsum*
kiekie	*Freycinetia banksii*
kiokio	*Blechnum* spp.
knobby clubrush	*Ficinia nodosa*
kohekohe	*Didymocheton spectabilis*

kopoti	*Anisotome aromatica*
korokia	*Corokia cotoneaster*
kōtukutuku	*Fuchsia excorticata*
kōwhai	*Sophora* spp.
kuta	*Eleocharis sphacelata*
lake clubrush	*Schoenoplectus tabernaemontani*
lancewood	*Pseudopanax crassifolius*
leatherwood	*Olearia colensoi*
lesser wire rush	*Empodisma minus*
māhoe	*Melicytus ramiflorus*
maire	*Nestegis* spp.
mānuka	*Leptospermum* spp.
matagouri	*Discaria toumatou*
mataī	*Prumnopitys taxifolia*
miro	*Prumnopitys ferruginea*
monoao	*Dracophyllum subulatum*
mountain beech	*Fuscospora cliffortioides*
mountain celery pine	*Phyllocladus alpinus*
mountain oat grass	*Deyeuxia avenoides*
mountain tauhinu	*Ozothamnus vauvilliersii*
mountain tōtara	*Podocarpus laetus*
mountain tutu	*Coriaria plumosa*
narrow-leaved houhere	*Hoheria angustifolia*
narrow-leaved maire	*Nestegis montana*
ngaio	*Myoporum laetum*

nīkau	*Rhopalostylis sapida*
northern rātā	*Metrosideros robusta*
oioi	*Apodasmia similis*
pāhautea	*Libocedrus bidwillii*
pīngao	*Ficinia spiralis*
pink pine	*Halocarpus biformis*
pōkākā	*Elaeocarpus hookerianus*
porokaiwhiri	*Hedycarya arborea*
puka	*Meryta sinclarii*
pukatea	*Laurelia novae-zelandiae*
pūkio	*Carex secta, C. virgata*
putaputawētā	*Carpodetus serratus*
raupō	*Typha orientalis*
red beech	*Fuscospora fusca*
red māpou	*Myrsine australis*
red tussock	*Chionochloa rubra*
rewarewa	*Knightia excelsa*
ribbonwood	*Plagianthus regius*
rimu	*Dacrydium cupressinum*
salt marsh ribbonwood	*Plagianthus divaricatus*
sand daphne	*Pimelea villosa*
scabweed	*Raoulia* spp.
seagrass	*Zostera muelleri* subsp. *novozelandica*
sea primrose	*Samolus repens*
sea rush	*Juncus krausii* var. *australiensis*

shore bindweed	*Calystegia soldanella*
shore celery	*Apium prostratum*
silver beech	*Lophozonia menziesii*
silver pine	*Manoao colensoi*
silver tussock	*Poa cita*
snow tōtara	*Podocarpus nivalis*
southern rātā	*Metrosideros umbellata*
sphagnum	*Sphagnum cristatum*
square sedge	*Lepidosperma australe*
supplejack	*Ripogonum scandens*
swamp maire	*Syzygium maire*
swamp millet	*Isachne globosa*
tānekaha	*Phyllocladus trichomanoides*
tangle fern	*Gleichenia dicarpa*
tarata	*Pittosporum eugenioides*
taupata	*Coprosma repens*
tawa	*Beilschmiedia tawa*
tāwari	*Ixerba brexioides*
tāwheowheo	*Quintinia serrata*
three-finger	*Raukaua simplex*
tītoki	*Alectryon excelsus*
toatoa	*Phyllocladus glaucus*
toetoe	*Austroderia* spp.
tōtara	*Podocarpus totara*
tutu	*Coriaria* spp.

twiggy tree daisy	*Olearia virgata*
water milfoil	*Myriophyllum* spp.
weeping matipo	*Myrsine divaricata*
wharangi	*Melicope ternata*
whararikí	*Phormium cookianum*
wheki-ponga	*Dicksonia fibrosa*
white maire	*Nestegis lanceolata*
willowherb	*Epilobium* spp.
wineberry	*Aristotelia serrata*
woolly moss	*Racomitrium lanuginosum*
yellow silver pine	*Lepidothamnus intermedius*

Appendix S3. Land Cover Database classes used in the analysis.

The following classes from LCDB4.1 were used in the development of layers to describe the current distributions of terrestrial ecosystems for the Horizons Region. Class descriptions are taken from Dymond et al. (2017). Broad groupings applied in our analysis are indicated for each class by bracketed text)

Class	**Description**
Alpine grass/ herbfield (primary)	Typically sparse communities above the actual or theoretical treeline dominated by herbaceous cushion, mat, turf, and rosette plants and lichens. Grasses are a minor component or infrequent, whereas stones, boulders, and bare rock are usually conspicuous.
Sand and Gravel (bare ground)	Bare surfaces dominated by unconsolidated materials of texture generally finer than coarse gravel (60 mm). Typically mapped along sandy seashores and the margins of lagoons and estuaries,

	lakes and rivers; and some areas subject to surficial erosion, soil toxicity and extreme exposure.
Landslide (bare ground)	Bare surfaces arising from mass-movement erosion generally in mountain-lands and steep hill-country
Gravel and Rock (bare ground)	Bare surfaces dominated by unconsolidated or consolidated materials of texture generally coarser than coarse gravel (60 mm). Typically mapped along rocky seashores and rivers, sub-alpine and alpine areas, scree slopes and erosion pavements.
Low Producing Grassland (non-forest)	Sward grassland and indigenous short tussock grassland of poor pastoral quality reflecting low soil fertility and extensive grazing management or non-agricultural use. Browntop, sweet vernal, *Danthonia*, fescue, and Yorkshire fog dominate, with indigenous short tussocks (hard tussock, blue tussock, and silver tussock) common in the eastern South Island and locally elsewhere.
Tall tussock grassland (primary above treeline and non-forest below treeline)	Indigenous snow tussocks in mainly alpine mountain-lands and red tussock in the central North Island and locally in poorly drained valley floors, terraces, and basins of both islands.
Depleted grassland (non-forest)	Areas, mainly former short tussock grassland in the drier eastern South Island high country, degraded by over-grazing, fire, rabbits, and weed invasion, among which *Hieracium* species are conspicuous. Short tussocks usually occur, as do exotic grasses, but bare ground is more prominent.
Herbaceous Freshwater Vegetation	Herbaceous wetland communities occurring in freshwater habitats where the water table is above or just below the substrate surface

(wetland)	for most of the year. The class includes rush, sedge, restiad, and sphagnum communities and other wetland species, but not flax or willows, which are mapped as flaxland and deciduous hardwoods respectively.
Herbaceous Saline Vegetation (coastal)	Herbaceous wetland communities occurring in saline habitats subject to tidal inundation or saltwater intrusion. Commonly includes club rush, wire rush and glasswort, but not mangrove which is mapped separately.
Flaxland (wetland)	Areas dominated by New Zealand flax usually swamp flax (harakeke) in damp sites but occasionally mountain flax (whararikí) on cliffs and mountain slopes.
Fernland (secondary)	Bracken fern, umbrella fern or ring fern, commonly on sites with low fertility and a history of burning. Mānuka, gorse, and/or other shrubs are often a component of these communities and will succeed fernland if left undisturbed.
Mānuka and/or Kānuka (secondary)	Scrub dominated by mānuka and/or kānuka, typically as a successional community in a reversion toward forest. Mānuka has a wider ecological tolerance and distribution than kānuka, with the latter somewhat concentrated in the north with particular prominence on the volcanic soils of the central volcanic plateau.
Broadleaved Indigenous Hardwoods (secondary)	Lowland scrub communities dominated by indigenous mixed broadleaved shrubs such as wineberry, māhoe, five-finger, *Pittosporum* spp., fuchsia, tutu, tītoki, and tree ferns. This class is usually indicative of advanced succession toward indigenous forest.

Subalpine shrubland (primary)	Highland scrub dominated by indigenous low-growing shrubs including species of *Hebe*, *Dracophyllum*, *Olearia*, and *Cassinia*. Predominantly occurring above the actual or theoretical treeline, this class is also recorded where temperature inversions have created cooler micro-climates at lower elevations, e.g. the 'frost flats' of the central North Island.
Matagouri or Grey Scrub (low-stature)	Scrub and shrubland comprising small-leaved, often divaricating shrubs such as matagouri, *Coprosma* spp., *Muehlenbeckia* spp., *Casinnia* spp. and *Parsonsia* spp. which, from a distance, often have a grey appearance.
Indigenous Forest (primary)	Tall forest dominated by indigenous conifer, broadleaved and beech species.

Appendix S4. Input data for the prioritisation analyses.

Prioritisation input data

The main inputs to the Zonation spatial prioritisation analyses were generated from a polygon-based spatial layer generated by intersecting the potential ecosystems layer developed by Singers & Lawrence (2018) and the current land cover (LCDB4.1; https://lris.scinfo.org.nz/layer/423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/), with the latter restricted to cover classes dominated by indigenous species as described in the main paper and identified in Appendix S3. The intersected layer was extensively edited to reconcile incompatible combinations of potential ecosystem and current land cover that resulted largely from the contrasting spatial scales at which these two layers were compiled. For example, at the upper altitudinal limit of cold climate forests many small polygons (slivers) delineated areas whose potential cover was mapped as tussock grassland

but had a current cover mapped as forest, or vice versa; these were allocated to the same ecosystem as that assigned to the adjacent forest or tussock grassland. Seventy-five new data fields were added to the edited intersection layer, one for each of the 65 primary ecosystem classes mapped in the potential ecosystem layer, and one for each of the ten secondary, general wetland, and bare ground cover classes from the LCDB4.1 layer (as listed in the lower section of Appendix S8). Values were assigned to these fields as follows:

(1) For all polygons indicated as supporting a primary LCDB4.1 cover class (Appendix S3), the ecosystem field matching the identified potential ecosystem was given a value of 100; values for all other fields were set to zero; where a polygon was mapped as containing a mosaic of two primary ecosystems, e.g., a complex mosaic of kahikatea-pukatea forest (WF8) and fertile swamp wetland (WLS), values of 50 were allocated to the two corresponding ecosystem fields;

(2) For all potential forest polygons identified as now supporting a secondary LCDB4.1 cover class, the field corresponding to its LCDB4.1 secondary cover class was given a value of 95 and the corresponding potential ecosystem field was given a value of 5. Use of two values in this way allowed once forested areas now supporting secondary cover to be differentiated in the prioritisation analyses according to the potential ecosystem cover likely to develop there in the absence of further disturbance;

(3) For polygons mapped in both the potential ecosystems and LCDB4.1 layers as supporting wetland, the corresponding potential ecosystems field was assigned a value of 100. Where the LCDB4.1 coverage indicated a general wetland type (‘Herbaceous Freshwater Vegetation’, ‘Herbaceous Saline Vegetation’), but the potential ecosystems layer indicated a non-wetland ecosystem (e.g., WF, MF, etc.), the corresponding LCDB4.1 general wetland field was given a value of 100. This latter approach was required because the LCDB4.1 mapping contains

many small wetland polygons identified from satellite imagery that are smaller than the minimum area discriminated in the potential ecosystems layer;
(4) For polygons mapped as having a potential cover of forest but now mapped as bare ground, a value of 5 was assigned to the corresponding potential ecosystem field, and a value of 95 was assigned to the corresponding bare ground field. This allowed areas now classified as bare ground to be differentiated according to their potential ecosystem cover;
(5) For polygons containing a non-forest ecosystem in the potential ecosystem layer (e.g., BR, CL, TI, etc.) a value of 100 was assigned to the corresponding ecosystem field.

The intersected layer was then used to create a set of gridded or raster data layers (30m by 30m cells) covering all areas still supporting indigenous cover, with one layer for each of the 65 terrestrial ecosystems from the potential ecosystem layer, and one for each of the ten general wetland, secondary and bare ground classes from the LCDB4.1 layer.

Note that integer values in the range 0–100 were used to populate these layers to allow the layers to be saved as integer grids, substantially reducing both storage requirements and read time when commencing a prioritisation analysis. Once read into Zonation, values are standardized by transforming them into a 0–1 range, allowing different biodiversity features to be compared on the same relative scale. By contrast, the relative contribution of the different features (layers) to the calculation of priority is controlled by weights specified for each layer as described both in the main text and in Appendix S5.

Estimating ecological integrity

In the absence of field-based estimates of ecological integrity, a numerical layer describing spatial variation in the estimated integrity across the Horizons Region was constructed using a

scoring based approach taking account of the impacts of four biodiversity pressures, i.e., fragmentation, risks of weed invasion, logging (in forest ecosystems), and introduced browsers. Estimates of the impacts of each pressure (or their components) were based on expert assessment of their likely effects on terrestrial ecosystems. While the values assigned to these estimates may appear to have a questionable level of precision, values were set so that once the individual penalties (e.g., for individual browsers) were combined, the aggregated values for the various components (e.g., the combined effect of browsers) were constrained to the same maximum value. It should also be noted that while this approach can be criticised as being arbitrary, its contribution to the ranking outcomes is to provide broad estimates of the relative integrity of different sites supporting the same ecosystem, so that sites with high integrity are generally ranked more highly than those of low integrity, all other things being equal.

Estimates of the condition or integrity of ecosystems were constructed in two stages. In the first stage, estimates were constructed of the likely intrinsic condition of surviving indigenous-dominated sites, i.e., in the absence of recent management interventions. These estimates were constructed by combining separate estimates of the effects of fragmentation, risks of weed invasion, logging (in forest ecosystems), and introduced browsers. In the second stage an estimate of the overall current condition was created by combining these estimates of intrinsic condition with estimates of the likely gains made through recent conservation management actions, particularly those aimed at controlling populations of vertebrate browsers and predators.

Fragmentation – the effects of fragmentation on terrestrial ecosystems are diverse (e.g., Young & Mitchell 1994; Burns et al. 2011), and include loss of the microclimate typical of

extensive natural communities, increased access for predators and domestic stock, increased vulnerability to invasion by introduced weeds, and greater susceptibility to the effects of adjacent land uses including impacts such as hydrological alteration and drift of fertiliser and/or sprays. These effects were estimated by creating from the LCDB4.1 coverage, a 30 m resolution, gridded data layer that mapped the distribution of all surviving, indigenous-dominated ecosystem patches, regardless of their composition; these (14,737) habitat patches varied in size from 0.01 ha to nearly 315,691 ha, with a mean of 51.4 ha.

This layer was then used to calculate a continuously varying description of habitat fragmentation in which the value for each cell indicated the weighted average amount of indigenous cover in a surrounding circle with a radius of 2 km; weights were specified using a (Gaussian) filter so that immediately adjacent cells were given a relative weight of 1, those at a distance of 500 m were given a relative weight of 0.75, those at a distance of 1 km a weight of 0.3, those at a distance of 1.5 km a weight of 0.07, and those at a distance of 2 km a weight of 0.01. The highest values in the resulting layer (one) were allocated to cells that are completely surrounded by indigenous cover to a distance of 2 km. Values progressively decreased as the amount of surrounding cover decreased, declining to a value of around 0.5 on the long, straight edges of very large blocks of indigenous cover, and approaching zero as patches of indigenous cover decreased in size, became more convoluted in shape, and/or more geographically isolated from their neighbours. Overall, this gridded layer had a mean value of 0.79, and a range from 0.004 to 1.0.

Weeds – the threats of weed invasion to indigenous ecosystems are influenced not only by fragmentation but also by variation in human population densities, with pressures from weed invasion generally increasing in close proximity to human settlements (e.g., Timmins &

Williams 1991). To estimate this effect, human population data, captured during New Zealand's 2013 national census (http://www.stats.govt.nz/Census/2013-census.aspx), was converted into spatial population density estimates (people per ha) for each of the Region's 3104 census sample units (mesh blocks). Because of their highly skewed distribution (mean = 9.9, range = 0 to 462), these density estimates were subject to a fifth root transformation ($x^{0.2}$) and converted into a gridded or raster data layer. This layer was then processed with a filter that for each grid cell, calculated the highest values (90th percentile) occurring within a circular neighbourhood with a radius of 250 m, allowing the effects of local high population densities to be spread out into the surrounding landscape.

Logging – this primarily results in loss of key structural elements of forests, occurring both through clearance of forests to enable land uses, and through selective removal of some species, particularly emergent podocarps that were valued because of their generally larger size and greater timber value than broadleaved tree species. These impacts were assessed from broad scale mapping of indigenous forest composition (FSMS6; https://koordinates.com/layer/300-nz-fsms6-north-island/) produced by the former New Zealand Forest Service that differentiates between unlogged and partially logged forests. Partially logged forests mapped in the Horizons Region are mostly former podocarp-tawa forests from which the podocarps have been preferentially removed leaving a canopy now dominated by tawa (type 'N'), former podocarp-tawa-beech forests now dominated by tawa and beeches (type 'O') forest, and more heavily cutover former podocarp forests mapped as general hardwoods (type 'P'). Given the relatively coarse spatial scale of this mapping (1:250,000), it captures logging impacts only in larger blocks of forest (> c. 25 ha), these occurring mostly in the north of the Horizons Region; many smaller forest remnants are likely to have also been modified by logging, but describing these impacts was beyond the scope of

this project. Sites identified in the FSMS6 layer as having been logged but still supporting (modified) forest cover were allocated a score of 0.5, while all other sites were allocated a score of 1.0.

Browsers and predators – while all of the introduced predators occurring in Horizons Region, along with possums, are likely to occur throughout the Region, several introduced browsers, i.e. red deer, sika deer, fallow deer, sambhar deer, goats and pigs are more patchily distributed. This was accounted for using maps compiled in 2007 and stored on the Department of Conservation's spatial data server (e.g. http://geoportal.doc.govt.nz/ArcGIS/rest/services/GeoportalServices/DOC_BDIPEST_FeralGoat_2007/ MapServer); these were subsequently updated by Horizons Regional Council staff to reflect contemporary changes in their distributions. Given the complex overlaps between the four different deer species, and their broadly similar impacts, distribution data for them were combined into a single layer in which it is assumed that one or more deer species can potentially be found throughout the Region. For each browser, sites within its known range were allocated a score of 0.841, and sites outside the known range were allocated a value of one. The four layers (possums, deer, goats and pigs) were then cross multiplied, sites with only one browser present receiving a score of 0.841, those with two browsers a score of 0.707, those with three browsers a score of 0.595, and those with four browsers a score of 0.5.

These estimates of habitat fragmentation effects, mean human population density, browser impacts and logging impacts were then combined to estimate the intrinsic condition, i.e., the condition or ecological integrity expected in the absence of active biodiversity management. The first two components were standardised to convert them into a common scale where values of 0.2 indicate impacts resulting in severely degraded ecological conditions in the

absence of management intervention, and a value of 1 indicates a complete absence of impact. Estimates of habitat fragmentation effects were simply rescaled into a range from 0.2–1, while the transformed and smoothed population-based estimates of weed invasion risk were inverted and rescaled into a range from 0.2–1, i.e., so that low values correspond to high population densities and vice versa. The layers describing browser and logging impacts were used directly in the forms described above, i.e., with values ranging from 0.5 ('logged' or 'all four browsers present') to 1.0 (unlogged or 'no browsers present').

These four pressure layers were then combined to estimate the intrinsic condition calculated as:

$$\textit{Intrinsic condition} = EI_{\text{fragmentation}} * EI_{\text{weed}} * EI_{\text{logging}} * EI_{\text{browser}} \quad (1)$$

where $EI_{\text{fragmentation}}$ is the estimated ecological impact of fragmentation, EI_{weed} is the estimated impact of human mediated weed invasion, EI_{logging} is the estimated impact of logging, and EI_{browser} is the estimated impact of introduced browsers. Multiplying these estimates together rather than averaging them recognises that the effects of different biodiversity pressures generally interact with each other, with lowest condition occurring when a site is affected by all four pressures. For example, weed impacts can be expected to be most intense in sites that are not only close to human settlement, but also suffer from fragmentation, logging modification and browsing. Lowest values for the intrinsic condition estimates (c. 0.025) occurred in very small, logged forest patches (< 1 ha) with no core habitat and close to high human population densities; at the other extreme, values exceeded 0.7 on the southern and western slopes of Ruapehu and in the upper Rangitikei catchment, locations that have

extensive areas of unmodified indigenous cover, few if any permanent human residents, and lack populations of goats.

Estimates of **recent management gain** were constructed using unpublished data supplied by Regional Council staff that identified locations receiving control of browsers and/or predators by public agencies over the last five years; additional sites managed by community groups were identified from the Predator Free New Zealand website (https://predatorfreenz.org/get-started/find-a-group/). For each site, information describing management actions were used to estimate the approximate intensity of control using a scoring approach in which values ranged between zero and one. Sites receiving no management were allocated scores of zero; managed sites received scores that reflected the degree to which control of both browsers and predators has been sustained over the last five years. The final management gain layer had values of zero where no recent control has been applied, through to a maximum value of 0.95 in Bushy Park, an intensively managed sanctuary northwest of Whanganui; above average values occur at Mount Bruce, in the upper Turitea catchment and its surrounds on the northern end of the Tararua Range, in the Manawatu gorge, in the middle reaches of the Akitio River, in the lower Otamateanui Stream (upper Rangitikei), in forests east of Rangitaua and west of Mangaeturoa, and at three forested sites east and south of Pureora village.

The **overall biodiversity condition** was then calculated by averaging the separate estimates of intrinsic condition and recent management gain**,** i.e.

$$\textit{Overall condition} = (\textit{intrinsic condition} + \textit{management gain}) / 2 \quad (2)$$

Final values in the gridded condition layer varied between 0.033 (small isolated fragments with strong human and/or browser impacts, and receiving minimal management intervention) through to a maximum of 0.76 (larger indigenous patches receiving intensive management).

Mask files for hierarchical rankings

To allow assessment of the adequacy of ecosystem representation provided by DOC-administered land versus land of other tenures, the public conservation areas spatial data layer was used to create a binary mask grid differentiating between land currently administered by the Department of Conservation (1's) and all other land (0's). An inverted version of this layer (non-DOC land = 0, all other land = 1) was used in the eight intermediate prioritisations, with negative weights of increasing magnitude used to progressively penalise the allocation of high priorities to non-DOC land.

Appendix S5. Command and setup files for the prioritisation analyses.

Technical considerations

All prioritisations were performed using Zonation 5 V1.0, which is available for download from https://zonationteam.github.io/Zonation5/. All prioritisations used the default marginal loss rule (CAZ2) as described in the Zonation manual (Moilanen et al. 2022). In brief, the marginal loss rule specifies how the aggregate biodiversity loss caused by removing conservation action in any grid cell is calculated. This takes into account both occurrences of individual biodiversity features within each cell and how much of each of those biodiversity features still occurs in the remaining landscape.

Five other important settings were applied during the analysis process, as follows:

(1) All ten prioritisations used differential weights for the ecosystem layers so that those ecosystems subject to greater loss since human settlement were assigned higher priorities than those less reduced in extent, all other things being equal. Ecosystems reduced in extent by less than 50% were given a weight of one, those whose extent has been reduced by 50–75% were given a weight of two, and those whose cover was reduced by 75% or more were given a weight of three. Secondary ecosystems were given a weight of 0.1, reflecting their generally much lower contribution to ecosystem representation relative to primary ecosystems.

(2) All ten prioritisations used a condition layer to encourage the allocation of higher priorities to sites with higher ecological integrity than sites of low integrity, all other things being equal; the integrity layer was constructed by combining landscape scale estimates of major biodiversity pressures and recent management interventions as described in Appendix S4.

(3) All ten prioritisations used connectivity settings to encourage the allocation of higher priorities to grid cells occurring in parts of the landscape in which different ecosystems are located in close proximity to each other. These connectivity effects are applied most strongly to closely related ecosystems occurring adjacent to each other, declining to zero at a distance of one km. Individual interaction effects for all pairwise combinations of ecosystems are specified in a connectivity matrix described in the attached .txt file. Cell values within these distances in each input layer were increased to reflect the presence of other ecosystems, with the degree of increase varied to reflect the expected degree of interaction between different ecosystems (see Lehtomäki et al. 2009, Leathwick 2019 for details), e.g., higher levels of interaction are likely between different forest ecosystems than between forest and coastal ecosystems.

(4) The DOC-constrained prioritisation used an analysis mask that differentiated DOC-administered land (value = 1) from all other land (value = 0). This was used to constrain the

allocation of priorities so that all DOC-administered land had higher priority than all other land.

(5) The eight intermediate rankings used an additional negatively weighted input layer that differentiated between DOC-administered land (value = 0) and all other land (value = 1), i.e., the inverse of the mask used in the DOC-constrained prioritisation. This allowed the allocation of priorities to non-DOC land to be penalised, with the degree of penalty controlled by the magnitude of the negative weight. Eight such prioritisations were performed using weights of -2, -5, -10, -20, -40, -80, -160 and -320 respectively.

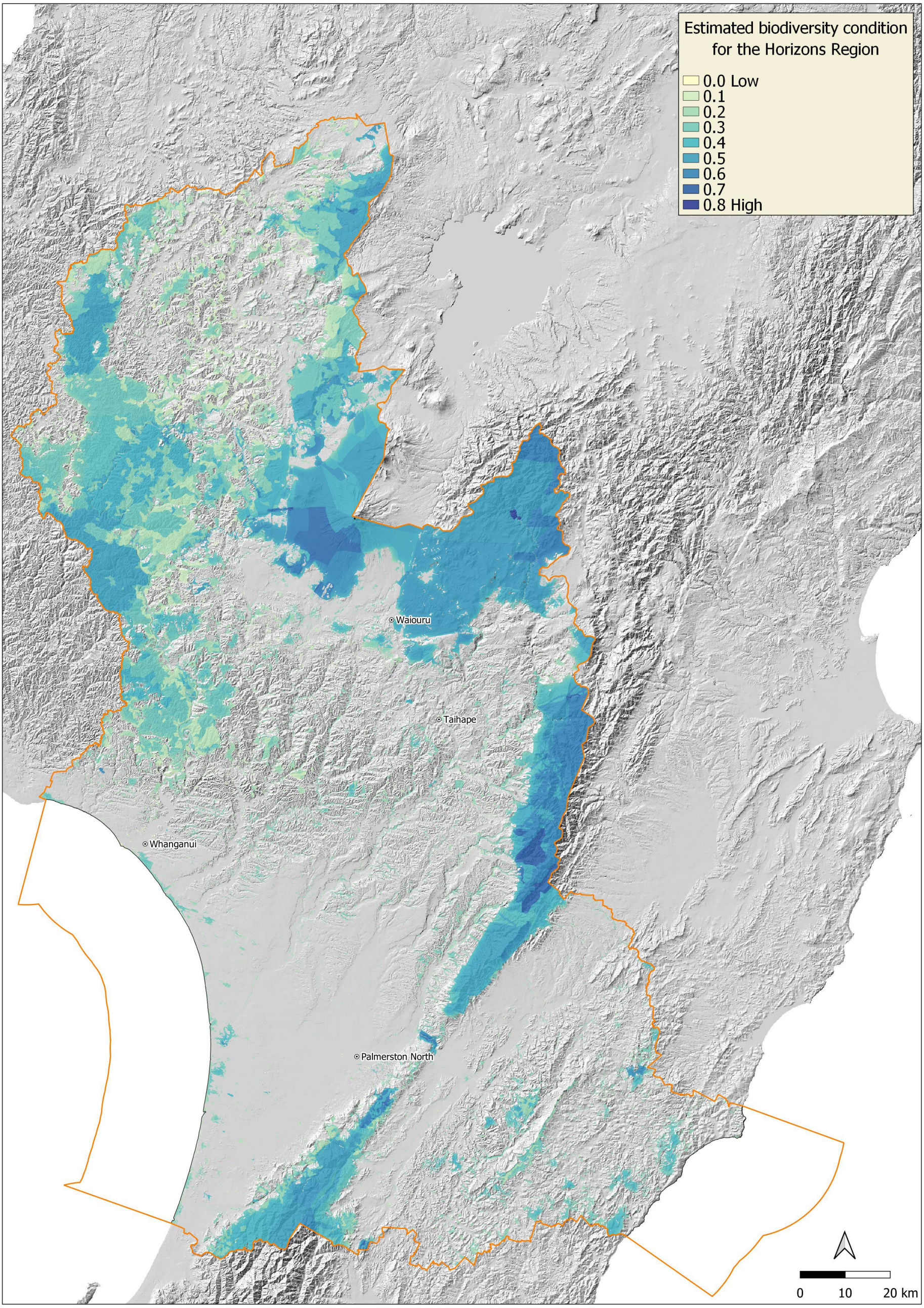
Analysis setup files

All ranking analyses were run using a command file ('RunZonation.cmd'), as described in the Zonation manual. The example command file listed in the attached .txt file contains command lines for four prioritisations that can be all run sequentially by removing the 'rem' text at the start of each line. Alternatively, individual analyses can be run by activating just the relevant lines in the command file.

Some analysis options are controlled using flags contained in the command lines contained in the command file (see the attached .txt file) while others are specified within a parameter file (Horizons_Z5_settings.Z5). The gridded files describing the distributions of the input biodiversity features (ecosystems in this case) are listed in a text file ('Horizons_features.txt'). Use of the condition layer requires the use of a text file that identifies the gridded condition layer to use ('ConditionLayers.txt'), and similarly, the use of landscape connectivity requires a text file ('HorizonsConnectivityMatrices.txt') that identifies the connectivity matrix to be loaded and applied to the input files. Details for each of these are described in the attached .txt

file; more comprehensive descriptions of how to set up an analysis can be found in the Zonation manual.

Appendix S6. Data file for the prioritisation analyses. Command and setup files for running the prioritisation analyses are available for download in a separate text file.



Appendix S7. Estimated condition of surviving indigenous-dominated terrestrial ecosystems for the Horizons Region.

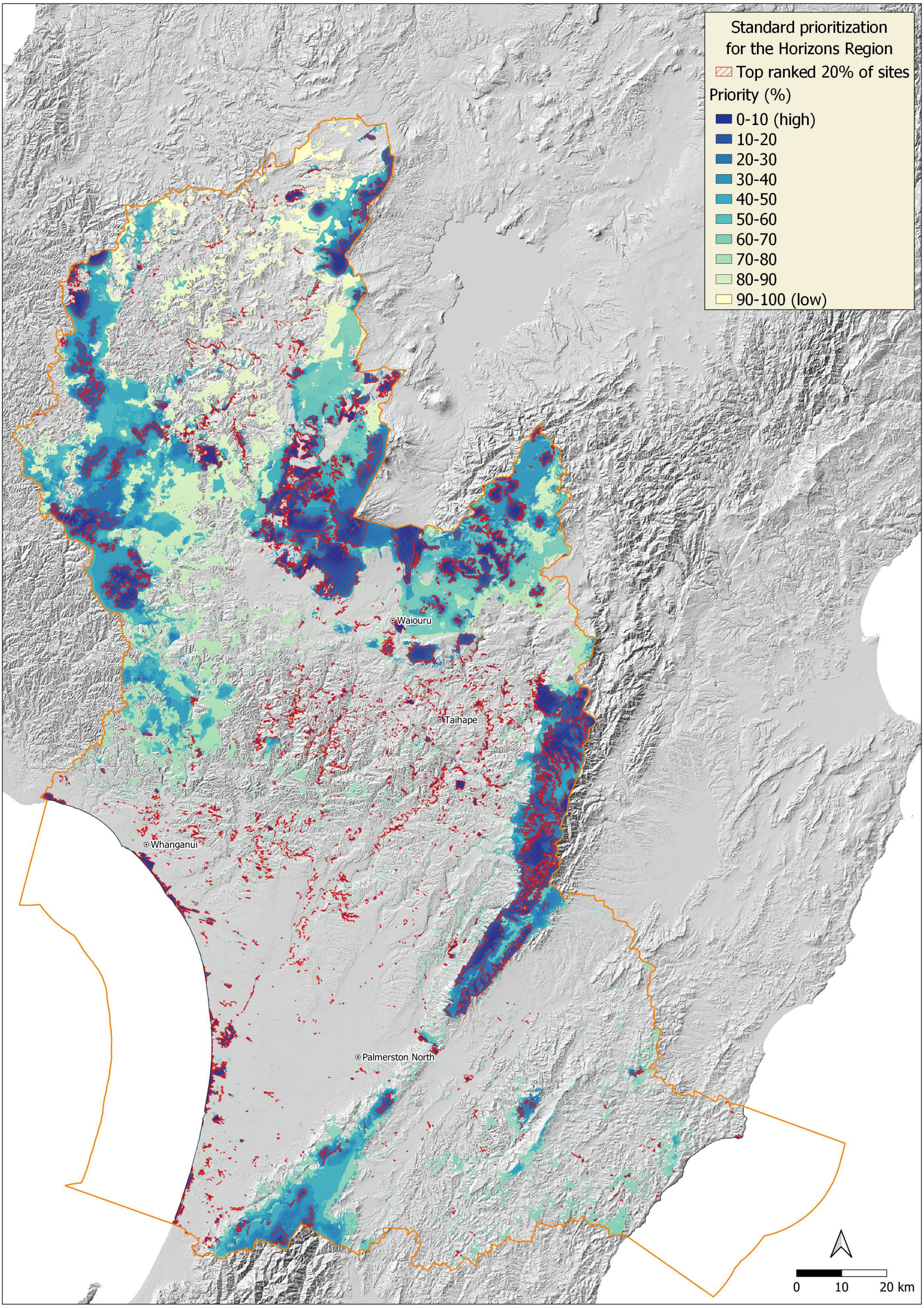
Appendix S8. Potential and current geographic extents of terrestrial ecosystems of the Horizons Region and their representation in various subsets of the indigenous-dominated landscape selected using spatial prioritisation. Estimated historic and current extent of primary ecosystem cover for the Horizons Region, along with the representation of individual ecosystems in various subsets of the landscape; the extent of non-primary cover classes from the LCDB4.1 coverage is shown separately in the lower part of the table. Percentage values are calculated in relation to the current extent of each ecosystem. Landscape subsets were chosen from spatial prioritizations as follows: '**Standard**' – the top-ranked 20% of surviving indigenous-dominated cover selected from an unconstrained prioritization; '**DOC-con.**' – the top-ranked 20% of surviving indigenous-dominated cover selected using the DOC-constrained prioritization in which sites administered by the Department of Conservation were constrained to have the highest ranks; '**All-DOC**' – the 51.3% of surviving indigenous-dominated cover currently administered by the Department of Conservation; '**Interm.**' – an intermediate prioritization in which the assignment of high priorities to non-DOC land was discouraged using a land tenure layer with a weight of -80. The extent of LCDB cover classes is shown separately in the lower part of the table. Percentage values are calculated in relation to the current extent of each ecosystem. Latin names for species identified by their common name are listed at the end of Appendix S2.

Ecosystems of Singers & Rogers (2014)	**Historic**	**Current**	**'Standard' top 20%**		**'DOC-con.' top 20%**		**'All DOC' 51.3%**		**'Interm.' top 20%**	
	extent (ha)	**extent (ha)**	**extent (ha)**	**%**	**extent (ha)**	**%**	**extent (ha)**	**%**	**extent (ha)**	**%**
AH1: Gravelfield/stonefield [Fellfield]	778	775	775	99.9	578	74.5	578	74.5	755	97.4
AH4: Woolly moss, bristle tussock, blue tussock mossfield/tussockland/stonefield	12 373	12 377	5249	42.4	7893	63.8	10 285	83.1	6290	50.8
AL3: Red tussock tussockland/shrubland	12 188	11 874	5848	49.3	5668	47.7	5735	48.3	5508	46.4
AL4: Mid-ribbed and broad-leaved snow tussock tussockland/shrubland	9959	11 253	3200	28.4	5 247	46.6	8563	76.1	3381	30.1
CDF3: Mountain beech forest	97 580	25 681	3243	12.6	4671	18.2	12 866	50.1	3618	14.1
CDF4-1: Hall's tōtara, pāhautea, kāmahi forest	28 977	12 238	8220	67.2	9203	75.2	10 733	87.7	8392	68.6
CDF4-3: Pāhautea, mountain celery pine, pink pine	21 653	13 018	5395	41.4	8475	65.1	11 014	84.6	6665	51.2
CDF6: *Olearia*, *Pseudopanax*, *Dracophyllum* scrub [Subalpine scrub]	11 186	8747	5309	60.7	6888	78.7	8459	96.7	5934	67.8
CDF7: Mountain beech, silver beech, montane podocarp forest	28 215	19 590	4496	23.0	6114	31.2	18 591	94.9	5082	25.9
CLF3: Podocarp, ribbonwood, kōwhai forest	3339	176	172	97.6	13.7	7.8	14.3	8.1	172	97.6
CLF4: Kahikatea, tōtara, mataī forest	32 480	1390	1351	97.2	98.9	7.1	102	7.3	1260	90.6
CLF5: Mataī, Hall's tōtara, kāmahi forest	6640	1487	1435	96.5	1255	84.4	1276	85.8	1428	96.0
CLF5-2: Mataī, maire forest	22 722	1614	1257	77.9	227	14.0	226	14.0	1067	66.1
CLF9: Red beech, podocarp forest	26 668	13 827	4458	32.2	6425	46.5	10 467	75.7	4940	35.7

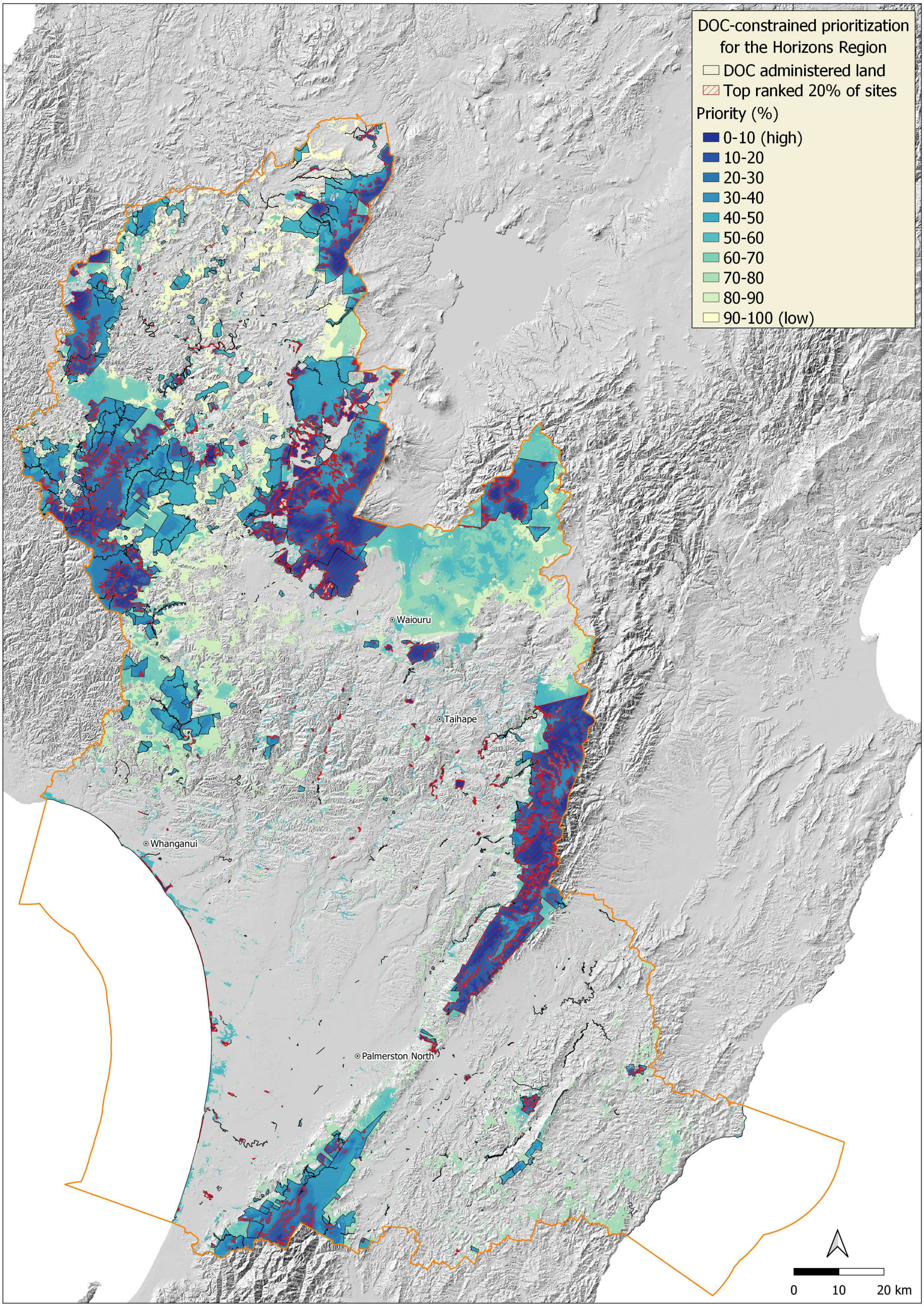
CLF9-2: Red beech forest	8525	7893	4946	62.7	6366	80.7	7396	93.7	5495	69.6
CLF9-3: Red beech, mountain beech	14 147	7031	6095	86.7	5179	73.7	5203	74.0	5222	74.3
CLF10: Red beech, silver beech forest	33 828	11 554	6744	58.4	8014	69.4	9751	84.4	7363	63.7
CLF10-2: Red beech, silver beech, kāmahi forest	199	198	198	100.0	196	99.2	197	99.2	198.1	100.0
CLF10-3: Red beech, silver beech, mountain beech forest	98.3	94.1	94	100.0	-	-	-	-	94.1	100.0
CLF11-3: Silver beech, kāmahi forest	15.1	15.0	15	100.0	15.0	100.0	15.0	100.0	15.0	100.0
CLF11-4: Silver beech, kahikatea, rimu forest	2048	890	879	98.7	532	59.8	532	59.8	866	97.3
CLF12: Silver beech, mountain beech forest	293	287	287	99.9	280	97.6	280	97.6	287	99.9
MF1: Tōtara, tītoki forest	53 597	536	507	94.6	40.0	7.5	40.2	7.5	495	92.3
MF2: Rimu, mataī, hīnau forest	43 121	1465	1357	92.6	669	45.7	683	46.6	1239	84.6
MF4: Kahikatea forest	14 307	430	413	96.0	90.2	21.0	90.4	21.0	389	90.4
MF5-1: Black beech, podocarp forest	5369	737	712	96.6	87.4	11.9	87.7	11.9	685	93.0
MF6: Kohekohe, tawa forest	2492	49.7	48	96.2	-	-	0.2	0.4	47.8	96.2
MF7-2:Rātā, tawa, kāmahi, podocarp forest	700 019	145 347	7224	5.0	10 436	7.2	83 865	57.7	7587	5.2
MF7-3: Tawa, pukatea, podocarp forest	99 946	29 286	10 300	35.2	10 616	36.3	15 902	54.3	9436	32.2
MF7-5: Tawa, hīnau, podocarp forest	84 234	2052	1812	88.3	154	7.5	154	7.5	1650	80.4
MF8-1: Kāmahi, broadleaved, podocarp forest	65 705	39 295	1658	4.2	2786	7.1	34 304	87.3	1760	4.5
MF8-2: Rimu, rātā, kāmahi forest	26 096	10 512	7588	72.2	7788	74.1	8693	82.7	7455	70.9
MF10: Tōtara, mataī, kahikatea forest	18 158	1090	988	90.7	205	18.9	209	19.2	874	80.2
MF11-3: Rimu, mataī forest	57 724	11 950	8058	67.4	8144	68.2	9094	76.1	7692	64.4
MF11-4: Kahikatea, rimu forest	14 184	1133	1008	89.0	192	16.9	194	17.1	865	76.4
MF14: Kahikatea, silver pine, kāmahi forest	1941	220	211	95.9	121	54.9	123	56.1	210	95.6
MF18-2: Silver pine, mountain beech, pink pine low forest	2109	1118	1066	95.4	1070	95.7	1093	97.8	1069	95.6
MF20-1: Hard beech, kāmahi, podocarp forest	169	168	168	100.0	168	100.0	168	100.0	168	100.0
MF21: Tawa, kāmahi, rimu, northern rātā, black beech forest	184 973	83 419	8425	10.1	17 343	20.8	50 552	60.6	12 104	14.5

WF1: Tītoki, ngaio forest	1854	5.4	3	63.9	-	-	-	-	3.3	60.9
WF2: Tōtara, mataī, ribbonwood forest	19 651	287	261	90.8	56.1	19.5	56.1	19.5	256	88.9
WF3: Tawa, tītoki, podocarp forest	200 797	5569	4001	71.9	286	5.1	295	5.3	2696	48.4
WF3-2: Kahikatea, pukatea, tawa, tītoki forest	55 424	486	435	89.6	35.5	7.3	35.5	7.3	417	85.7
WF6: Tōtara, mataī, broadleaved forest [Dune Forest]	40 842	232	176	75.8	9.0	3.9	9.7	4.2	141	60.7
WF8: Kahikatea, pukatea forest	113 335	1 051	922	87.8	103	9.8	109	10.4	849	80.8
BR2: Scabweed gravelfield/stonefield	1092	251	251	100.0	36.6	14.6	36.6	14.6	249	99.2
BR3: Bristle tussock, *Raoulia*, *Muehlenbeckia* gravelfield/sandfield	2947	2888	2669	92.4	45.9	1.6	46.2	1.6	2156	74.7
CL2: Ngaio, taupata treeland/herbfield/rockland	257	30.8	31	99.1	-	-	-	-	30.6	99.1
CL6: *Hebe*, whahariki flaxland/rockland	732	356	356	100.0	43.7	12.3	43.8	12.3	356	100.0
CL11: Mountain tutu, *Hebe*, whahariki, *Chionochloa* shrubland/tussockland/rockland	101	98	98	100.0	-	-	-	-	97.8	99.6
SC1: Gravelfield	36.6	34.3	34	100.0	34.3	100.0	34.3	100.0	34.3	100.0
TI3: Monoao scrub/lichenfield	2000	1761	1643	93.3	10.4	0.6	17.6	1.0	1165	66.2
TI4: *Coprosma*, *Olearia* scrub [Grey scrub]	30.9	0.6	1	100.0	0.6	100.0	0.6	100.0	0.6	100.0
TI5: Bog pine, mountain celery pine, silver pine scrub/forest	2891	2410	2076	86.1	386	16.0	386	16.0	1591	66.0
TI6: Red tussock tussockland	2476	2166	1934	89.3	41.6	1.9	54.1	2.5	1272	58.8
WL6: Lesser wire rush, tangle fern restiad rushland/fernland	925	871	863	99.1	807	92.7	807	92.7	821	94.2
WL9: Cushionfield	14.4	14.2	14	100.0	14.2	100.0	14.2	100.0	14.2	100.0
WL14: Ephemeral Wetland	10.9	5.2	5	100.0	2.8	53.5	2.8	53.4	5.2	100.0
WL22: *Carex*, *Schoenus pauciflorus* sedgeland	1.1	1.0	1	100.0	-	-	-	-	1.0	100.0
WL: Bog Mosaic	1568	1873	1507	80.4	713	38.1	717	38.3	1238	66.1
WL: Fen mosaic	2867	2797	2166	77.5	1178	42.1	1208	43.2	1887	67.5
WL: Swamp mosaic	1500	1117	1089	97.5	114	10.2	114	10.2	978	87.6

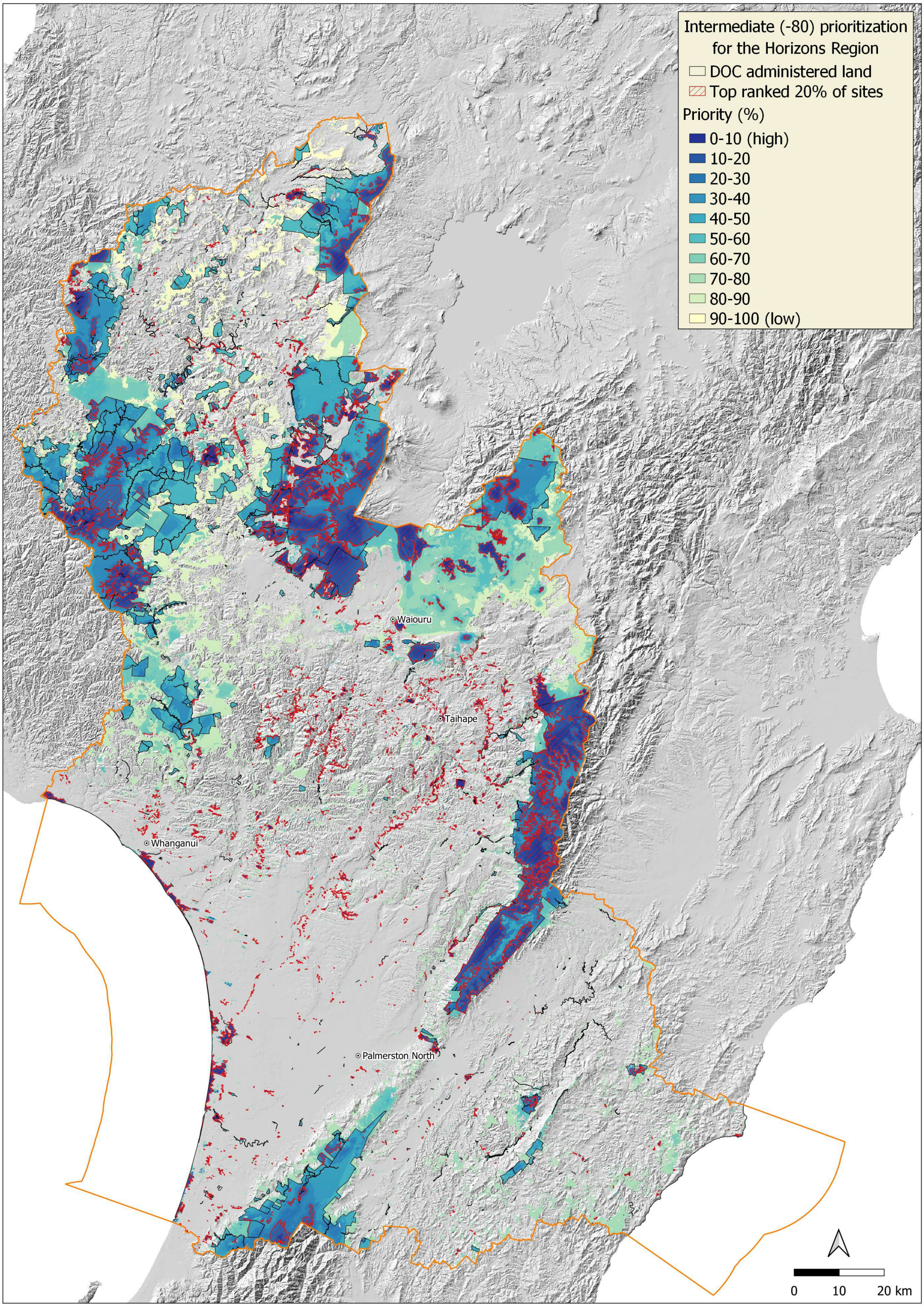
SA2: Searush, oioi, glasswort, sea primrose rushland/herbfield [Saltmarsh]	885	308	308	100.0	30.4	9.9	30.5	9.9	308	100.0
DN2: *Spinifex*, pīngao grassland/sedgeland	2101	1579	1188	75.2	383	24.2	384	24.3	957	60.6
DN5: Oioi, knobby clubrush sedgeland	87	372	357	96.1	56.6	15.2	56.5	15.2	331	89.0
Subtotal	**2 214 061**	**517 380**	**143 597**	**27.8**	**147 634**	**28.5**	**331 995**	**64.2**	**145 613**	**28.1**
Land cover classes from LCDB4.1 (after Cieraad et al. 2015)										
Freshwater wetlands		2828	1725	61.0	823	29.1	911	32.2	1409	49.8
Saline wetlands		41.9	41.9	100.0	1.5	3.7	1.5	3.7	41.9	100.0
Fernland		858	337	39.3	173	20.2	189	22.0	220	25.6
Grey Scrub		889	573	64.5	395	44.5	395	44.5	397	44.7
Mānuka and/or Kānuka		105 896	762	0.7	371	0.4	19 379	18.3	360	0.3
Broadleaved Hardwoods		70 276	647	0.9	801	1.1	22 488	32.0	597	0.9
Tussock Grassland		33 595	407	1.2	504	1.5	4771	14.2	323	1.0
Subalpine Scrub		16 535	356	2.2	493	3.0	7325	44.3	351	2.1
Low Producing Grassland		3982	2702	67.9	45.8	1.2	47.8	1.2	1986	49.9
Gravel/Rock		5252	539	10.3	442	8.4	1240	23.6	407	7.7
Subtotal		**240 152**	**8090**	**3.4**	**4050**	**1.7**	**56 746**	**23.6**	**6089**	**2.5**
Overall total		**757 533**	**151 687**	**20.0**	**151 684**	**20.0**	**388 741**	**51.3**	**151 703**	**20.0**



Appendix S9. Results from the standard prioritisation of surviving indigenous ecosystems of the Horizons Region.



Appendix S10. Results from the DOC-constrained prioritisation of surviving indigenous ecosystems of the Horizons Region.



Appendix S11. Results from the intermediate (−80) prioritisation of surviving indigenous ecosystems of the Horizons Region.

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