Supplementary material

Appendix S1 | Model description and parameterization of FATE-HD for native vegetation in the Ecrins

Appendix S2 | Simulation workflow for invasion scenarios

Appendix S3 | Functional groups building of alien and ornamental species and FATE-HD parameterization

Appendix S4 | SDMs for alien and ornamental PFGs and evaluation

Appendix S5 | Results of simulations when yearly introductions were stopped after the first 300 years of initialization.

Appendix S6 | PFG level elevation dynamics

Appendix S7 | Temporal dynamics of spatial patterns of richness of aliens

Appendix S8 | Spatial patterns of richness of Ornamentals across scenarios

Appendix S1 | Model description and parameterization of FATE-HD for native vegetation

Model description

The hybrid simulation model FATE-HD was parameterized and validated for the native plant functional groups of the Ecrins National Park (ENP, Fig. S1) by Boulangeat et al. (2014), resulting in an accurate reconstruction of the current vegetation structure and distribution at 100 m resolution. Here we built on the same validated parameterization and initialization for the native vegetation and subsequently simulated alien species spread through an invasion module.

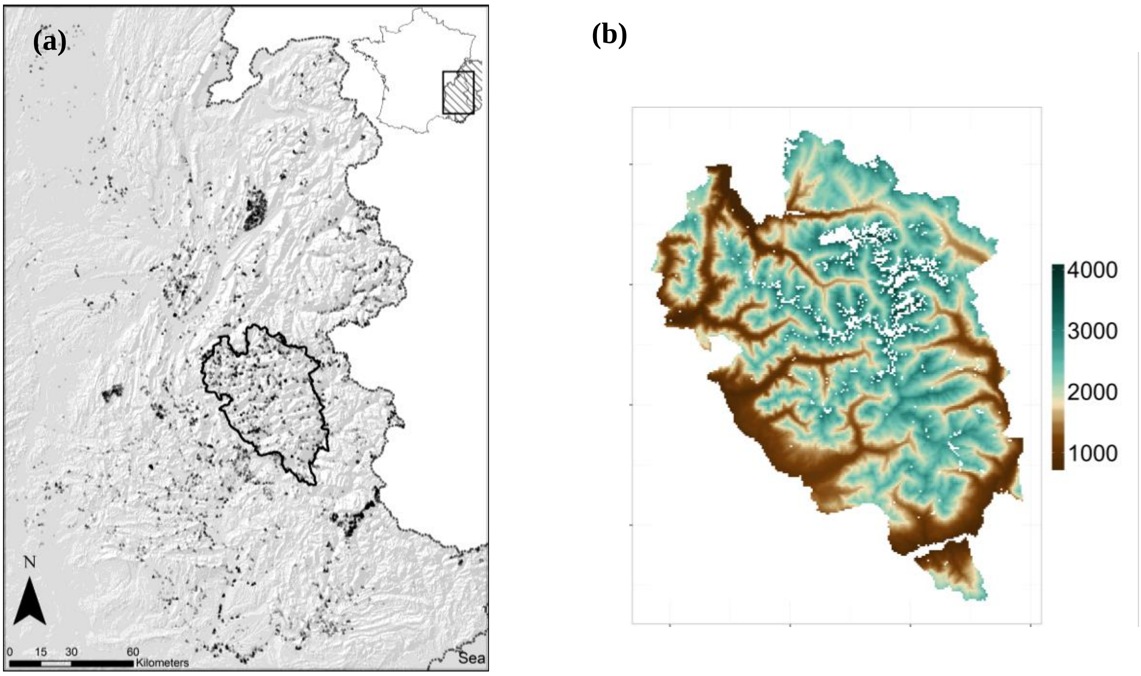


Figure S1. Study area. **(a)** The Ecrins National Park (ENP), delimited with a bold line, is located in the southeast of France in the French part of the Alpine Arc. Gray strips in the inlay indicate the Alpine Convention area. Community plots that have been surveyed in the region are represented by triangles. Adapted from Boulangeat et al. 2012. **(b)** Map of the elevation in the ENP.

In the *baseline initialization for the native vegetation* reconstruction we simulated 24 native plant functional groups (PFGs) identified by Boulangeat et al. (2012, 2014) for summarizing the functional characteristics and environmental preferences of the most dominant vascular plant species occurring in the park (Table S1). These are divided into 6 chamaephyte groups, 10 herbaceous groups and 8 phanerophyte groups, which compete for light based on their height and shade tolerance. Plant succession is modeled independently in each pixel, with individuals of each PFG merged into cohorts and assigned to a height stratum (here six strata: 0-0.7m; 0.7-1.5m; 1.5-4m; 4-10m; 10-20m; taller than 20m). For each stratum, the available light level (high, intermediate, low) is given according to the total abundance of all cohorts located in the strata above. Immature cohorts produce less shade per unit area than mature ones. According to the PFG's shade tolerance at different life stages (germinant, immature, mature), the light level determines if a cohort can survive, if recruitment occurs and the efficiency of germination. Population dynamics also depend on environmental suitability, which is determined through suitability maps produced through SDMs for each PFG (see below). Each year of the simulation, the continuous environmental suitability maps are converted to binary filters according to a threshold randomly drawn from a uniform law. The annual variability in environmental conditions thereby affects all PFGs in the same way, representing "good" and "bad" years for the vegetation. This environmental filter influences both recruitment and fecundity, which thus occur only in favorable pixels. Climate changes can be introduced by affecting environmental suitability (i.e. changing bioclimatic variables used to calculate it). For our simulations, SDMs for native PFGs were fit using the ensemble modeling platform *biomod2* (Thuiller et al. 2009), by pooling occurrences of the representative species of each PFG and relating them to seven topo-climatic variables (slope, percentage of calcareous soil, and five climatic variables). These were calibrated over the entire French Alps in order to increase the robustness of projections into future climatic conditions. The native species observations were derived from the database of the Conservatoire Botanique National Alpin (CBNA), which includes all records of the Ecrins National Park and additional records in the entire region of the French Alps (Fig. S1a, see Boulangeat et al. 2012 and 2014 for all details). Further, in FATE-HD, pixels are connected by seed dispersal. For each PFG, a dispersal kernel is approximated using three parameters:

the distance within which 50% of the seeds fall, the distance for 99% of the seeds and the maximum long distance dispersal (see Vittoz and Engler 2007 for parameterization). Finally disturbances are included in the model under two forms: grazing and mowing (Fig. S2). Both grazing and mowing affect vegetation once a year, based on binary maps of disturbed pixels. Grazing has three levels of intensity, low (1), medium (2) and high (3). They affect the abundance of juvenile and mature plants differently, depending on PFG responses to these disturbances and on an annual basis (see Boulangeat *et al.* 2014 for more information).

Simulation workflow for initialization of native vegetation

To reconstruct the current native vegetation of the ENP that represents the baseline for our invasion scenarios we simulated an initialization phase for 800 years. It started with the seeding of all PFGs across the whole landscape for 300 years every year, followed by 300 years without any land use management. Then, past deforestation was simulated by cutting all PFGs in the third stratum or above (taller than 1.5m) from areas that are currently managed (years 600 and 800). Current management practices (grazing, with three levels of intensity and mowing) were implemented after year 600. We used the outputs at year 850, the last initialization year, as baselines for our invasion, land use management and climate change scenarios (see below and main text for details).

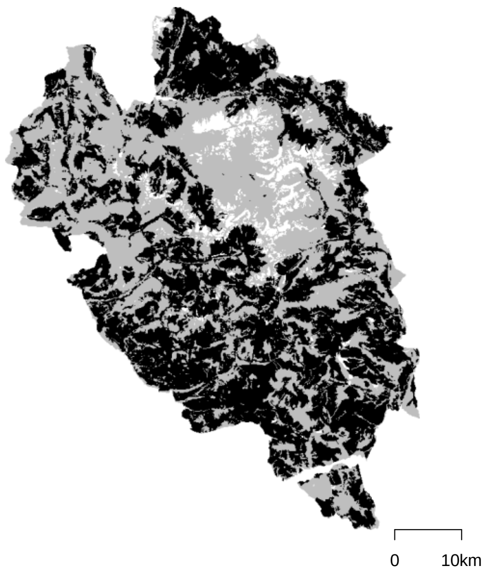


Figure S2. Grazed and mown areas under current management (in black). The grey background represents the study area, which excludes glaciers (in white).

Native PFGs and parameters

Table S1. Native plant functional groups (PFGs) and their main parameter values. Life form classes are herbaceous (nH1-10), chamaephytes (nC1-6) and phanerophytes (nP1-8). PFGs with larger values of 'Light', 'Disp' and 'Palatability' are, respectively, light-loving, long distance dispersers and preferred by grazers (thus more affected by grazing).

PFG	Description	Disp	Light	Height (cm)	Palata-bility	Life Span
nH1	Alpine species (which do not tolerate shade, and have a short dispersal distance)	3	8	17	3	11
nH2	Mountainous species which tolerate nitrophilous soils and have a long dispersal distance	6	7	42	3	10
nH3	Mountainous to lowland species found in wet niches and which have a long dispersal distance	7	7	50	3	9
nH4	Undergrowth and shadow species which do not tolerate full light	3	5	76	0	7
nH5	Mountainous to subalpine species which have a short dispersal distance and tolerate dry soils	3	7	40	3	7
nH6	Tall plants typical of megaphorbs, which can form undergrowth	3	6	73	3	8
nH7	Plants species found in rocky habitats and undergrowth at all elevations	5	6	19	0	7
nH8	Subalpine to alpine species not usually grazed and which have a short dispersal distance	3	8	19	0	8
nH9	Short subalpine to alpine species which have long dispersal distance	7	8	19	3	9
nH10	Mountainous species which have a long dispersal distance and tolerate shade	7	6	100	3	9

nC1	Thermophilous chamaephytes which have a long dispersal distance	6	7	27	3	27
nC2	Alpine and subalpine chamaephytes species	4	8	13	3	19
nC3	Chamaephytes which have a short dispersal distance	1	8	7	0	45
nC4	Tall shrubs	6	6	209	2	158
nC5	Mountainous to subalpine heath found in dry climates	6	6	76	0	39
nC6	Mountainous to subalpine heath found in wet climates	7	6	18	2	92
nP1	Thermophilous pioneer trees (deciduous trees and pines)	6	6	1175	2	193
nP2	Small deciduous pioneer trees (e.g. colonizing riversides)	5	6	750	2	177
nP3	Tall forest edge trees	4	5	1667	2	351
nP4	Tall pioneer (larch)	6	7	2500	0	600
nP5	Late succession trees found in wet climates	6	4	2500	2	450
nP6	Intermediate succession trees found in dry climates	4	8	1650	2	160
nP7	Small forest edge trees	4	5	600	2	310
nP8	Small pioneer found in cold climates (white birch)	4	7	800	2	100

Appendix S2 | Simulation workflow for invasion scenarios

Starting from the output of the validated simulations of the equilibrium vegetation of the ENP we simulated alien invasions in a set of scenarios, which we ran for additional 800 time-steps. We simulated the introduction of the invader functional groups through annual seeding as done for the natives in the vegetation reconstruction phase. However for the invader PFGs we based introduction sites on the current Human Footprint rather than on the whole area of the park, as a proxy of potential propagule pressure in each pixel (Sanderson et al. 2002, Figure S3). We simulated two scenarios of propagule pressure (PP). In the current PP scenario introductions were a proportion of a set maximum number of seeds (here 10000 seeds, as for the seeding of the natives) depending on the human footprint value in each pixel (i.e. highest introductions in the pixels of the most densely populated centres, lowest introductions in the pixels along mountain footpaths). In the increased PP scenario the maximum introduction strength was applied throughout the human footprint map (simulating a maximum exploitation of all areas suitable to humans, Figure S3). Simulations were run for 800 years in order to allow reaching quasi-equilibrium and stabilization of the long-lived alien PFGs, as well as for comparability with the natives. However, to assess the naturalization potential of the introduced PFGs independently of propagule pressure, in one additional set of simulations the yearly introductions were stopped after the first 300 years of initialization (Appendix S5). Each alien PFG was introduced in separate simulation runs in order to focus only on biotic interactions with the natives.

We thus simulated one baseline scenario with the persistence of the current conditions in the ENP (current climate, current management and current human footprint), and several scenarios with combinations of changing conditions (see details in main text).

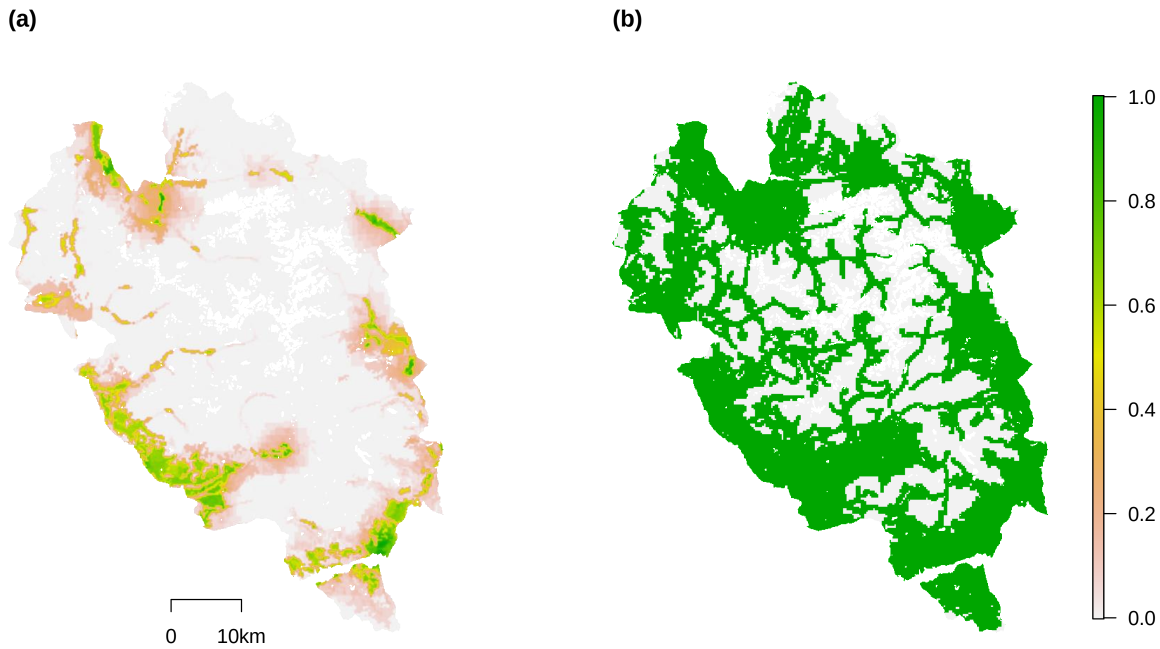


Figure S3. Map of the Human Footprint in the park used for the two introduction scenarios of propagule pressure (PP). In panel (a) current PP scenario with introductions proportional to current human footprint. In panel (b) the increased PP scenario with maximum introduction strength throughout the human footprint map.

Appendix S3 | PFG building of alien and ornamental species and parameterization for FATE

Species dissimilarities based on ecological characteristics

We chose the same set of characteristics used by Boulangeat et al. (2012, 2014) for the natives of the ENP in order to identify functional groups of alien and ornamental invaders. These are related to the processes implemented in FATE-HD (tolerance to shade, vegetative height, dispersal distance class, resistance to grazing, life form and tolerance to environmental conditions). Data used was obtained from a number of sources (Table S2).

In FATE-HD species interactions are depicted in terms of competition for light. To quantify response to competition we thus used an ecological indicator value for species *tolerance to shade*, mirroring the one used to classify the natives (Landolt et al., 2010). For the naturalized aliens in the French Alps this value was available directly from Landolt et al. (2010). For the ornamental species we used a shading experiment to directly estimate species tolerance to shade (Haeuser, Dawson & van Kleunen, unpublished data) and obtained an indicator value on the same scale as Landolt's.

Species' competitive abilities for light were represented by *plant vegetative height*. For the naturalized aliens this was available through the ANDROSACE database, which compiles trait values from field measurements in the study area and other trait databases containing species from the study area (Boulangeat et al. 2012). For the ornamental species height was directly measured in a competition experiment across different watering treatments (Conti et al. submitted).

Dispersal was represented by distances classes, assigned through expert knowledge by following the protocol by Vittoz & Engler (2007). This classification is based on the most efficient dispersal mode, plant height, preferred habitat type (e.g. forest, grassland), seed mass and dispersal attributes (e.g., wings, pappi). It identifies seven classes that discriminate a logincrease of dispersal distances. The necessary trait data was obtained through the ANDROSACE and TRY databases.

To quantify *resistance to grazing* we used a palatability index following the one based on pastoral values used for the natives (Jouglet, 1999). This was filled in from expert botanists and managers from the CBNA by relying on information on toxicity, texture, record of animal consumption, from a number of sources (ANDROSACE, online literature search, etc., Table S2).

Finally in order to estimate similarity among species in their *tolerance to environmental conditions*, we fit SDMs for each species based on 19 BIOCLIM variables (biologically meaningful variables derived from temperature and rainfall values) following the same approach outlined in detail in Appendix S4 for the PFGs. Pairwise similarities of species abiotic niches were then estimated from the overlap of their distributions (D-metric, Schoener, 1970).

PFG Building procedure

As for the native species we used the approach outlined by Boulangeat et al. (2012) to build plant functional groups of alien and ornamental invaders. Specifically, we used an emergent group approach to classify alien species based on the environmental preferences and five functional traits outlined above. For each life form (phanerophyte, chamaephyte, and herbaceous) we built a cumulative pairwise distance matrix using Gower's formula (Gower, 1971) to combine the separate ecological distance matrices: squared-transformed height, light class, exponentially transformed dispersal class, palatability class and climatic overlap. We then used a clustering algorithm to identify groups of species (UPGMA, Kaufman & Rousseeuw, 1990) and a set of indices to choose the best number of groups: the Dunn index, the R-squared, the index of Calinski & Harabasz (Calinski & Harabasz, 1974), and the average silhouette (Kaufman & Rousseeuw, 1990).

Table S2. Databases used for species traits or characteristics.

Database	References
ANDROSACE	Boulangeat, I., Philippe, P., Abdulhak, S., *et al.* (2012) Improving plant functional groups for dynamic models of biodiversity: at the crossroads between functional and community ecology. Global change biology, 18, 3464-3475.
VISTA	Garnier E, Lavorel S, Ansquer P *et al.* (2007) Assessing the effects of land-use change on plant traits, communities and ecosystem functioning in grasslands: A standardized methodology and lessons from an application to 11 European sites. Annals of Botany, 99, 967-985.
LEDA	Knevel IC, Bekker RM, Bakker JP, Kleyer M (2003) Life-history traits of the Northwest European flora: the LEDA database. Journal of Vegetation Science, 14, 611-614.
BiolFlor	Kühn I, Durka W, Klotz S (2004) BiolFlor: a new plant-trait database as a tool for plant invasion ecology. Diversity and Distributions, 10, 363-365.
Flora Indicativa	Landolt E, Bäumler B, Erhardt A *et al.* (2010) Flora indicativa. Ecological indicator values and biological attributes of the flora of Switzerland and the Alp, Berne, Haupt Verlag.
TRY	Kattge, J., Diaz, S., Lavorel, S. et al. (2011), TRY – a global database of plant traits. Global Change Biology, 17: 2905–2935. doi:10.1111/j.1365-2486.2011.02451.x
Experimental measurements	Conti, L., Block, S., Parepa, M., et al. Functional similarity and trait plasticity mediate biotic resistance to future plant invaders. Submitted to Journal of Ecology
Experimental measurements	Haeuser, Dawson & van Kleunen, unpublished data

Plant functional group clustering results

The functional group classification led to the identification of a total of 18 functionally homogenous invader groups: 13 PFGs for the naturalized aliens (four phanerophytes, ‘P’, one chamaephyte, ‘C’, eight herbaceous, ‘H’; Table S3) and 5 PFGs for the ornamentals (one chamaephyte ‘C’, and four herbaceous, ‘H’; Table S4). Parameters used in FATE-HD were estimated by taking the (rounded) median value for the species in each group (Table S5).

Table S3. Naturalized alien species in the French Alps and their trait values used for clustering into PFGs. Life form classes are herbaceous (aH1-8), chamaephytes (aC1) and phanerophytes (aP1-4). Species/PFGs with larger values of 'Light', 'Dispersal' and 'Palatability' are, respectively, light-loving, long distance dispersers and preferred by grazers (i.e. more affected by grazing). Height is in cm.

PFG	Species	Dispersal	Light	Height	Palatability
aC1	*Senecio inaequidens*	5	8	50	0
aH1	*Amaranthus albus*	7	8	40	1
	Amaranthus hybridus	7	8	60	1
	Amaranthus retroflexus	7	8	60	1
	Panicum capillare	7	8	45	1
aH2	*Ambrosia artemisiifolia*	6	8	60	0
	Bunias orientalis	3	7	80	0
	Euphorbia lathyris	3	7	70	0
	Juncus tenuis	1	6	30	0
aH3	*Artemisia annua*	1	8	60	0
	Euphorbia maculata	3	9	0	0
	Datura stramonium	3	8	60	0
	Tragus racemosus	3	9	8	1
aH4	*Bidens frondosa*	6	8	100	1
	Conyza sumatrensis	5	8	80	2
	Arundo donax	5	8	400	1
	Sorghum halepense	6	8	90	2
aH5	*Conyza canadensis*	5	8	60	2
	Solidago canadensis	5	7	100	1
	Solidago gigantea	5	7	100	1
	Oenothera biennis	3	8	100	2
	Oenothera glazioviana	3	8	80	2
aH6	*Erigeron annuus*	5	8	60	2
	Impatiens balfouri	2	6	50	1
	Impatiens glandulifera	2	6	110	1
	Galega officinalis	2	7	60	3
	Oxalis fontana	3	6	22	2
	Bromus catharticus	4	7	60	2
	Panicum dichotomiflorum	4	7	60	1
aH7	*Phytolacca americana*	6	6	150	1
	Reynoutria japonica	6	7	200	2
	Reynoutria sachalinensis	6	7	200	3
aH8	*Sporobolus vaginiflorus*	3	9	30	2
aP1	*Buddleja davidii*	2	8	250	1
	Robinia pseudoacacia	4	7	1000	3
	Syringa vulgaris	4	6	400	1
aP2	*Pyracantha coccinea*	6	7	100	1
	Parthenocissus inserta	6	6	350	1
aP3	*Ailanthus altissima*	4	8	1000	0
aP4	*Cedrus atlantica*	4	7	2500	0

Table S4. Ornamental species and their trait values used for clustering into PFGs. Life form classes are herbaceous (oH1-4) and chamaephytes (oC1). PFGs with larger values of 'Light', 'Dispersal' and 'Palatability' are, respectively, light-loving, long distance dispersers and preferred by grazers (i.e. more affected by grazing). Height is in cm.

PFG	Species	Dispersal	Light	Height	Palatability
oC1	*Potentilla argyrophylla*	2	7.2	13	2
oH1	*Centaurea americana*	6	7.2	102	1
	Centaurea macrocephala	6	7.2	30	2
	Zinnia peruviana	6	7.2	106	2
oH2	*Eritrichium canum*	6	5.4	40	1
	Iris domestica	6	5.4	48	1
oH3	*Helenium bigelovii*	5	6.3	28	0
oH4	*Heliotropium arborescens*	2	6.3	33	1
	Nepeta racemosa	2	7.2	44	2
	Persicaria capitata	1	5.4	53	2

Table S5. Parameters for FATE-HD for the naturalized alien and ornamental PFGs

PFG	Disp	Light	Height	Palata-bility	Life span	Maturity
Naturalized Aliens						
aC1	5	8	50	0	2	2
aH1	7	8	51	1	1	1
aH2	3	7	60	0	2	2
aH3	3	8	32	0	1	1
aH4	6	8	90	2	3	2
aH5	5	8	85	2	2	2
aH6	4	7	52	2	2	1
aH7	6	7	183	2	15	2
aH8	3	9	30	2	1	1
aP1	4	7	550	1	80	8
aP2	6	6	225	1	25	12
aP3	4	8	1000	0	120	13
aP4	4	7	2500	0	900	17
Ornamentals						
oC1	2	7	13	2	7	3
oH1	6	7	79	2	6	2
oH2	6	5	44	1	15	3
oH3	5	6	28	0	10	1
oH4	2	6	43	2	12	3

Appendix S4 | SDMs for naturalized alien and ornamental PFGs

Data and calibration of SDMs

For each invader PFG, we produced environmental suitability maps through the ensemble platform biomod2 (Thuiller *et al.* 2009), by pooling occurrences of the representative species. We considered a PFG to be present where at least one of its representative species was observed.

For the "naturalized alien" group we used exactly the same approach as the natives and based the SDMs on occurrence data from the CBNA in the entire French Alps, in order to account for the realized niche in the adventive range in the study region. Note that this dataset contains both presences and absences. Additionally, in order to avoid spurious predictions on glaciers we manually added additional 50 absences on glaciers for each PFG. Focusing on presence-absence data in the adventive range has been shown to provide equal performance for predicting potential presences of alien species in the French Alps as models that contemporarily account for global occurrences (Gallien *et al.* 2012). We used the same environmental data used for the natives including seven topo-climatic variables (slope, percentage of calcareous soil, and five bioclimatic variables). The slope was obtained from the French Digital Elevation Model at 50x50m resolution, made by the IGN-France (http://professionnels.ign.fr/bdalti). The percentage of calcareous soil was calculated from the European Soil Database (http://eusoils.jrc.ec.europa.eu/data.html) at a 1km resolution. The five bioclimatic variables (isothermality, temperature seasonality, temperature annual range, mean temperature of coldest quarter, and annual precipitation) were downscaled to a resolution of 100m, from the 1 km Worldclim climate grids available online (Dullinger et al. 2012). All models were built using the biomod2 package (Thuiller et al. 2009) using three different algorithms with default settings: Generalized Linear Model, Boosted Regression

Trees and Random Forest. The models were calibrated using a random data sample (70%) and evaluated using the remaining 30% with True Skill Statistics (TSS, Allouche et al. 2006). The whole cross-validation process was repeated 5 times. We then used an ensemble forecasting strategy to derive the probability of occurrence (i.e. habitat suitability value) for each PFG across the national park using the following method: (1) All models were used to project the potential habitat suitability for each PFG; (2) We transformed the probabilities of presence into presences and absences using the threshold that maximized the TSS in the evaluation procedures. (3) We calculated the sum of all binary projections weighted according to their TSS score. (4) We rescaled the projection to fall between 0 and 1. This latter projection gives the habitat suitability map for each PFG (Fig. S4). This ensemble forecast gives the percentage of agreement between the different algorithms and the different cross-validation datasets for predicting a presence. The higher the value, the more plausible the presence.

For the “ornamental” group we could not follow the same approach given that these species have not yet naturalized in the region, and we therefore used the world-wide occurrence data available through GBIF (within 10’ x 10’ grid cells) as the best available approximation. We acknowledge that this likely represents an overestimation of the realized environmental niche for these species in the ENP region (as shown by Gallien et al. 2012 for the French Alps), but in our approach the environmental suitability only represents the fundamental climatic constraints, while the limits imposed by dispersal and biotic interactions are explicitly modeled in FATE-HD and should reduce this bias. Since we had no information on true absences of species through GBIF we generated 1000 ‘pseudo-absences” outside a radius of 40 km but no further than 500 km of each occurrence point (to only include environmental conditions where the species could have potentially dispersed). For comparability with the naturalized aliens we also added additional 50 absences on glaciers for each PFG. We used a bioclimatic variable set to span a range of influential temperature and precipitation conditions with negligible multicollinearity effects, obtained from WorldClim (Hijmans *et al.* 2005), obtained from WorldClim (Hijmans *et al.* 2005): BIO6 – Min temperature of coldest month, BIO10 – Mean temperature of warmest quarter, BIO12 – Annual precipitation , BIO14 – Precipitation of driest month. We then followed the same steps used for the naturalized aliens. We used three different modeling algorithms using the biomod2 package (GLMs, GBMs and Random Forest), based on repeated sample splitting for calibration and evaluation, followed by the same ensemble forecasting strategy to derive the probability of occurrence in the ENP.

Table S6. Model evaluation for the Naturalized Aliens based on all data

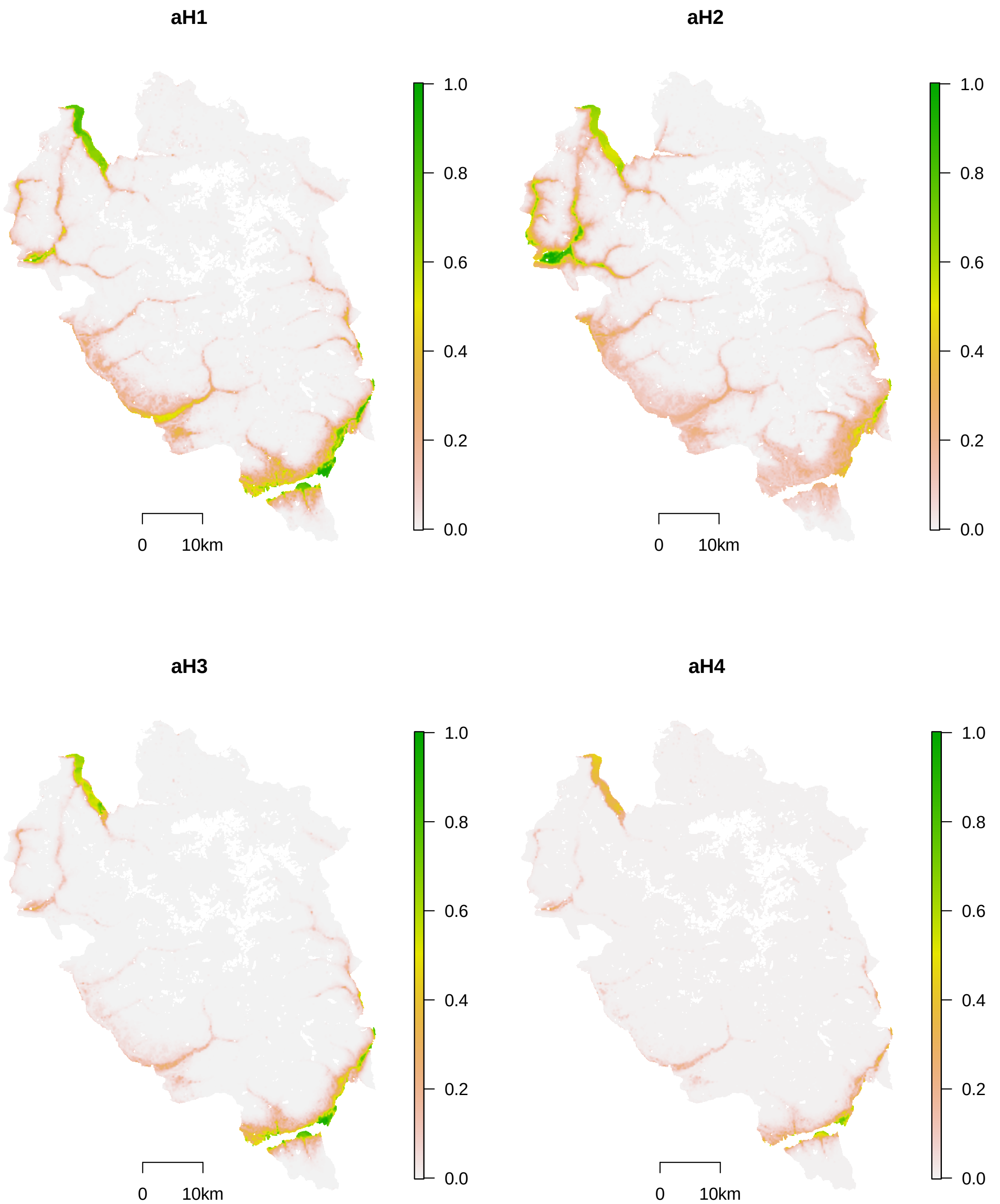
PFG	ROC	TSS	Sensitivity	Specificity
aC1	0.984	0.867	93.06	94.02
aH1	0.973	0.796	90.24	89.42
aH2	0.979	0.821	88.66	93.44
aH3	0.988	0.874	96.79	90.72
aH4	0.986	0.866	93.77	92.84
aH5	0.973	0.812	91.49	89.83
aH6	0.978	0.817	95.14	86.65
aH7	0.976	0.833	93.38	90.13
aH8	0.998	0.979	100.00	97.89
aP1	0.965	0.782	92.50	85.75
aP2	0.979	0.828	90.63	92.33
aP3	0.976	0.827	86.82	96.08
aP4	0.98	0.832	91.80	91.58

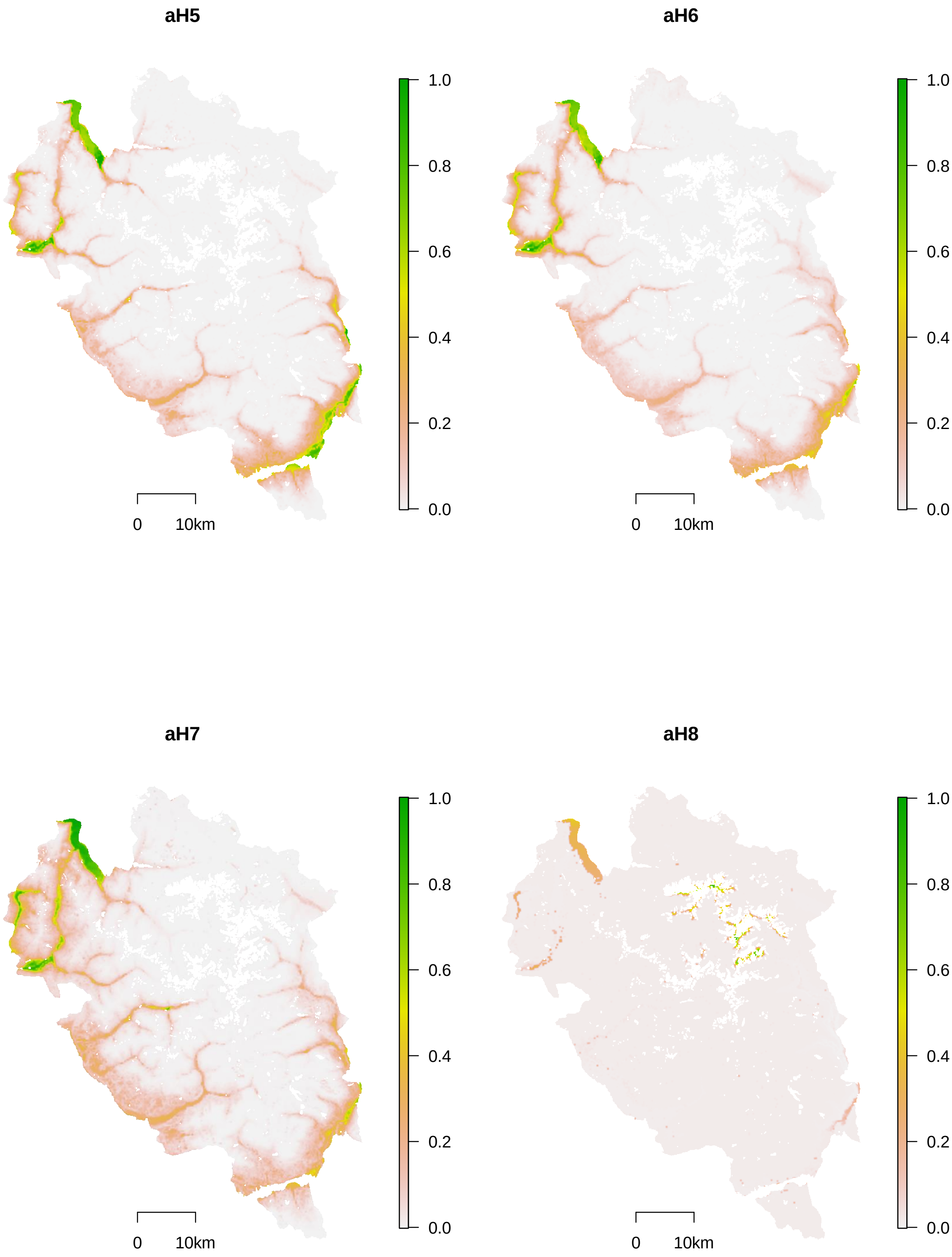
Table S7. Model evaluation for the ornamentals based on all data

PFG	ROC	TSS	Sensitivity	Specificity
C1a	0.971	0.853	96	89.721
H1a	0.943	0.732	87.258	86.203
H2a	0.966	0.804	89.241	91.538
H3a	0.994	0.927	97.101	95.662
H4a	0.945	0.725	87.198	85.325

Figure S4. Habitat suitability map for each naturalized Alien PFG. The following set of figures represents the habitat suitability under current conditions for (a) Herbs, (b) Chamephytes and (c) Trees. The habitat suitability varies from 0 (unsuitable area, light grey) to 1 (high suitability, green). The interpretation of each PFG is given in Table 1 (main text).

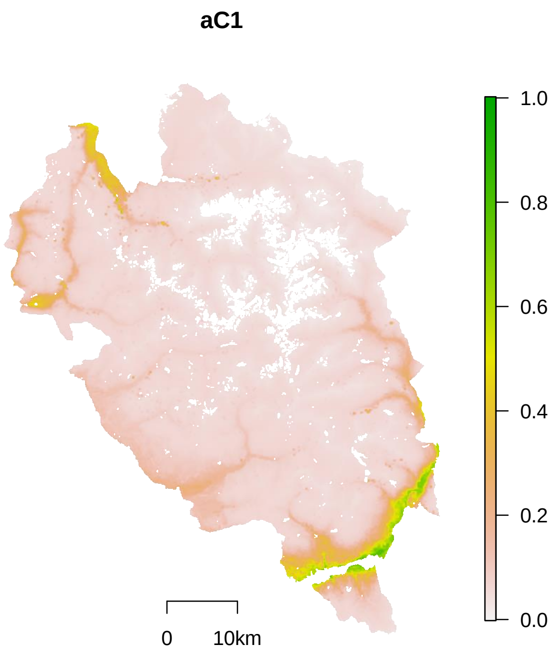
(a)





aH5
aH6
aH7
aH8
0 10km
0.0
0.2
0.4
0.6
0.8
1.0

(b)


aC1
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10km
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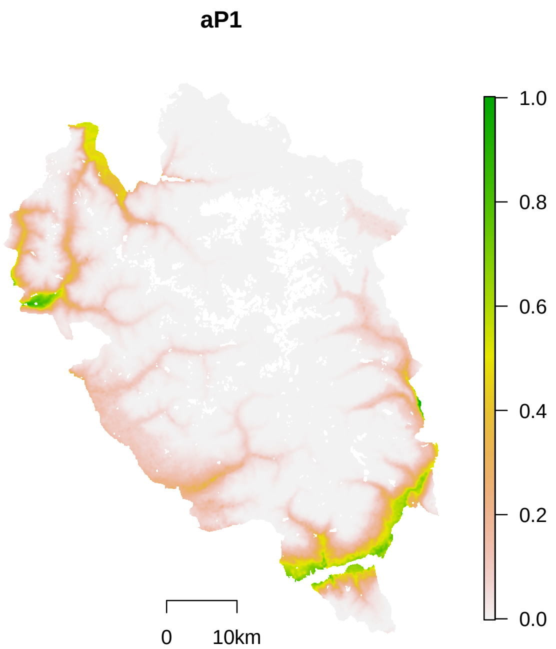
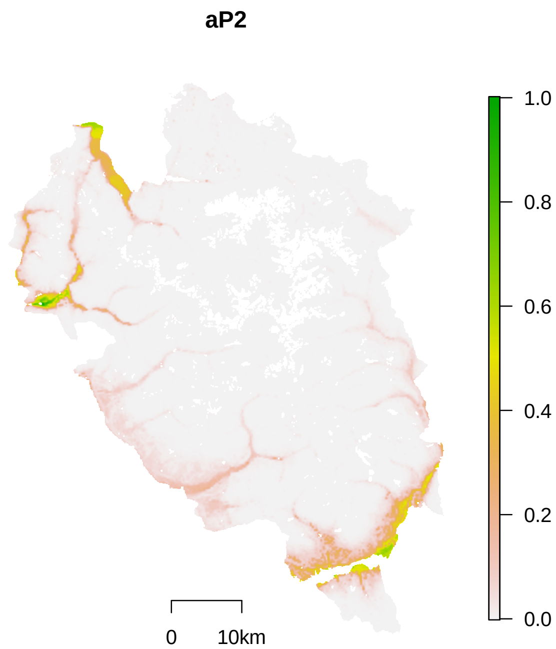
0.8
0.6
0.4
0.2
0.0

(c)


aP1
0
10km
1.0
0.8
0.6
0.4
0.2
0.0


aP2
0
10km
1.0
0.8
0.6
0.4
0.2
0.0

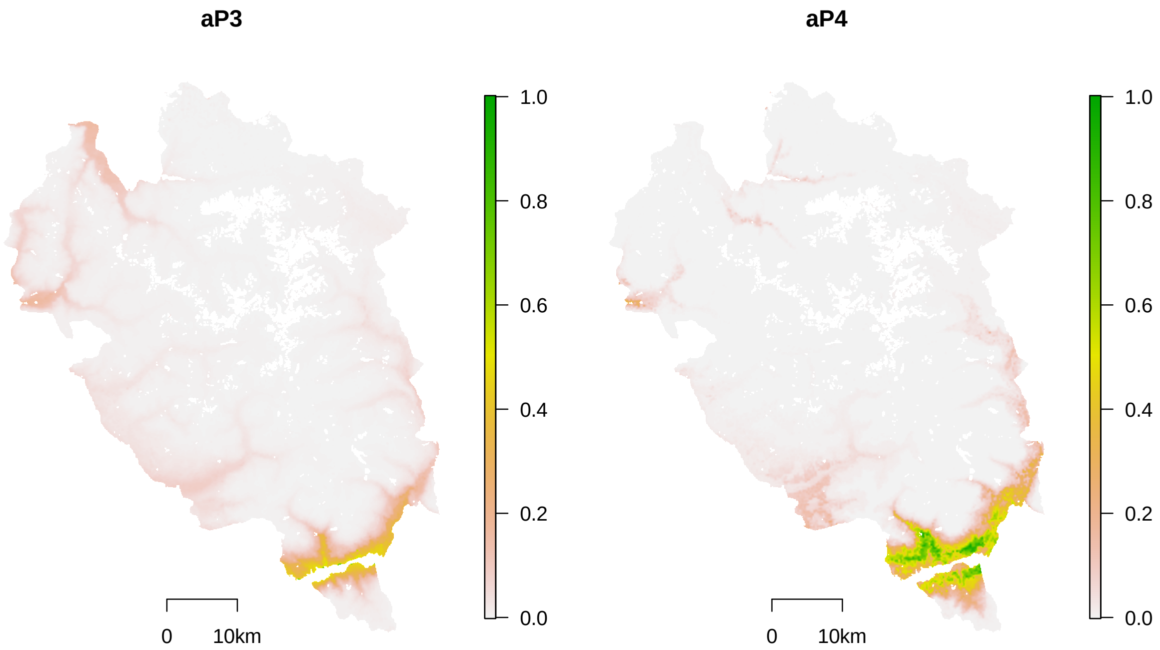
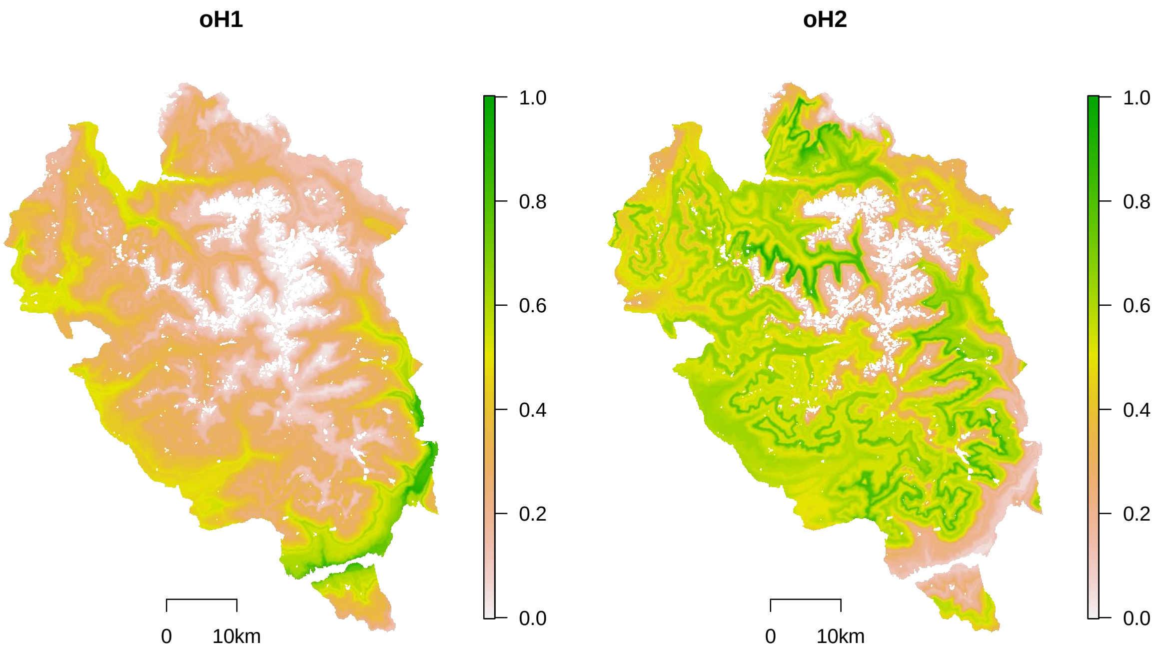
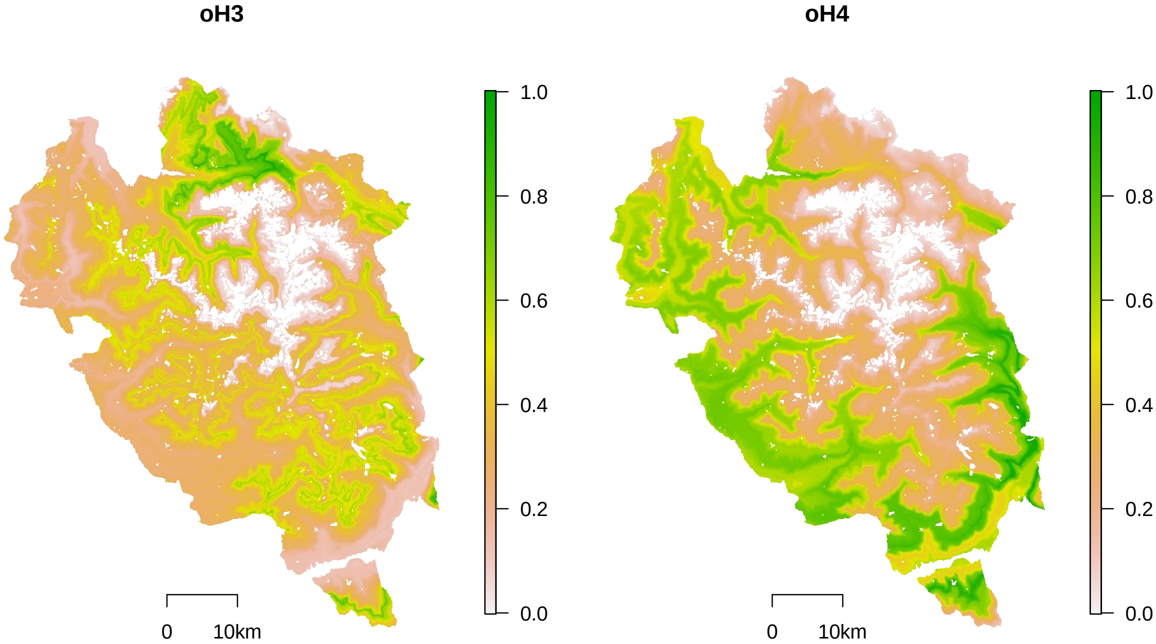


Figure S5. Habitat suitability map for each Ornamental PFG. The following set of figures represents the habitat suitability under current conditions for (a) Herbs and (b) Chamephytes. The habitat suitability varies from 0 (unsuitable area, light grey) to 1 (high suitability, green).

(a)





(b)

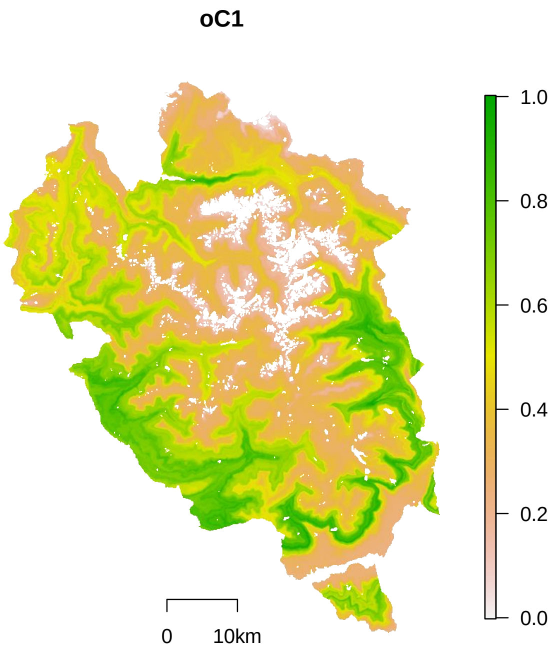
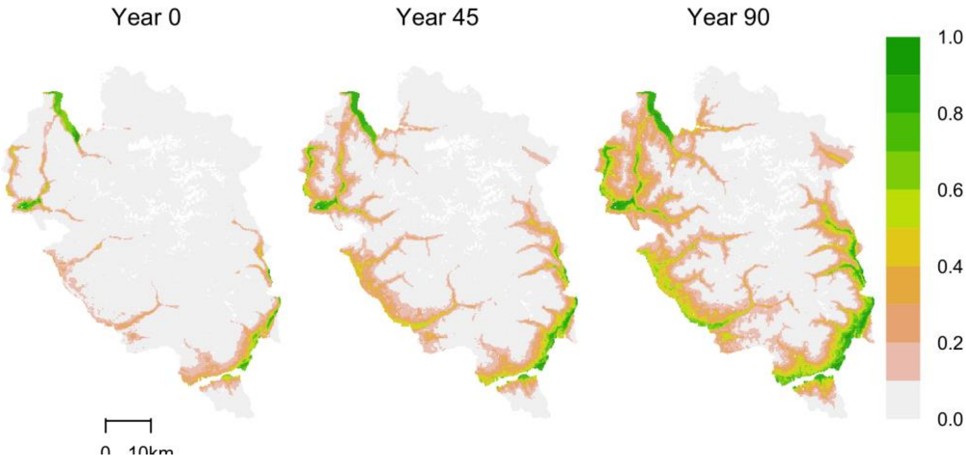
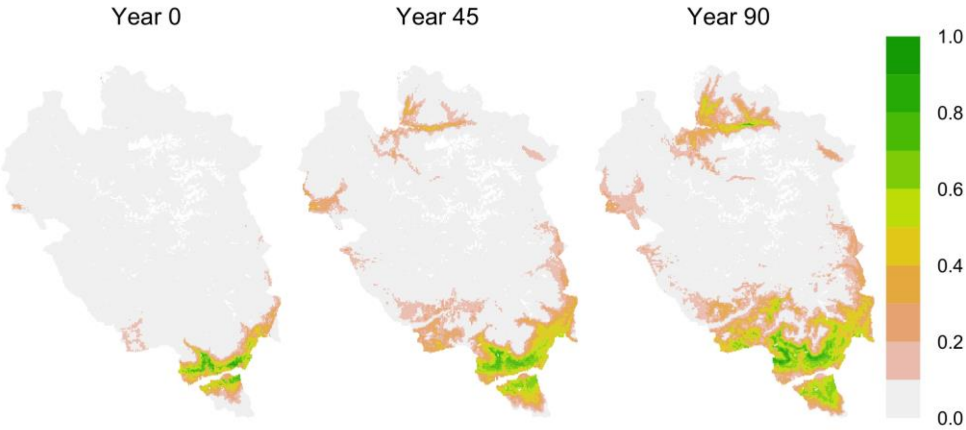


Figure S6. Examples of evolution of habitat suitability maps under Climate Change. The following set of figures represents the habitat suitability under current conditions, after 45 years and after 90 years of gradual CC for (a) the herbaceous naturalized alien "aH5", (b) the woody naturalized alien "aP4", and (c) the herbaceous ornamental "oH4". The habitat suitability varies from 0 (unsuitable area, light grey) to 1 (high suitability, green).

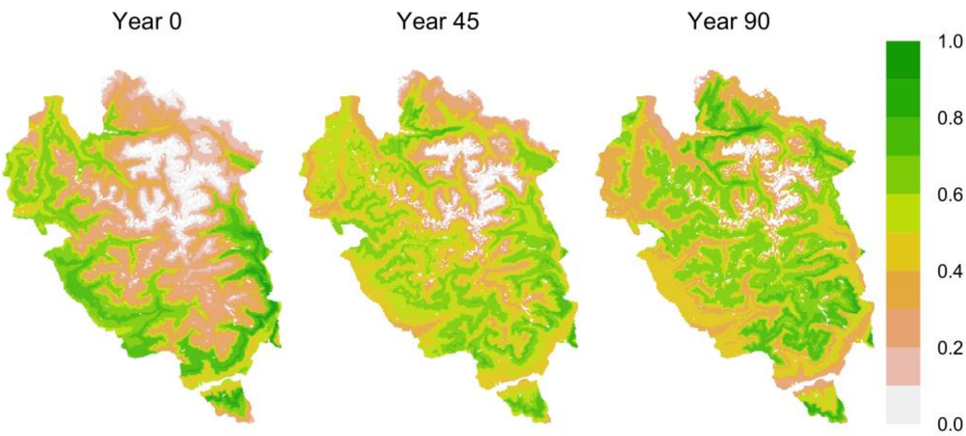
(a)



(b)



(c)



Appendix S5 | Results of simulations when yearly introductions were stopped after the first 300 years of initialization.

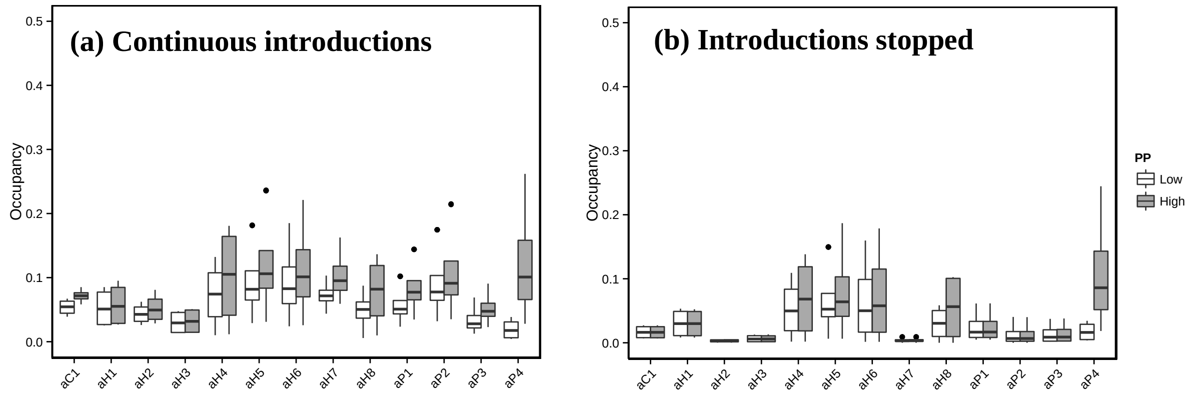


Figure S7 Effects of propagule pressure (PP) scenarios on area of occupancy of the alien plant functional groups (PFGs) in the Ecrins National Park at the end of the simulations after reaching quasi-equilibrium. Shown are results for already naturalized alien PFGs, on the same scale as Fig.2 in the main text for comparability. See Table 1 for the PFG codes and the species included in each group and Table S5 for their parameter values

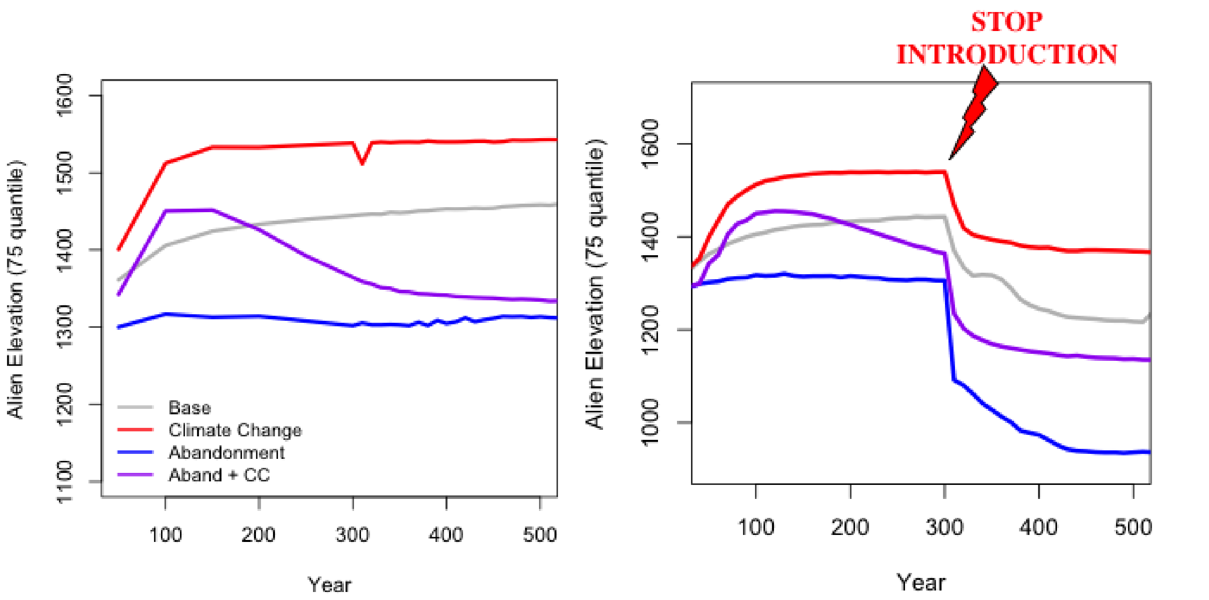


Figure S8 Changes in the upper altitudinal invasion limit under different climate and land-use scenarios and under constant (current) propagule pressure (1 repetition). Shown are the changes of the upper quartile of PFG's elevation occurrence for the naturalized aliens (averaged across PFGs) over time for the first 500 years of simulation with continuous introductions (left panel), and stopping introductions after 300 years (right panel).

Appendix S6 | PFG level elevation dynamics

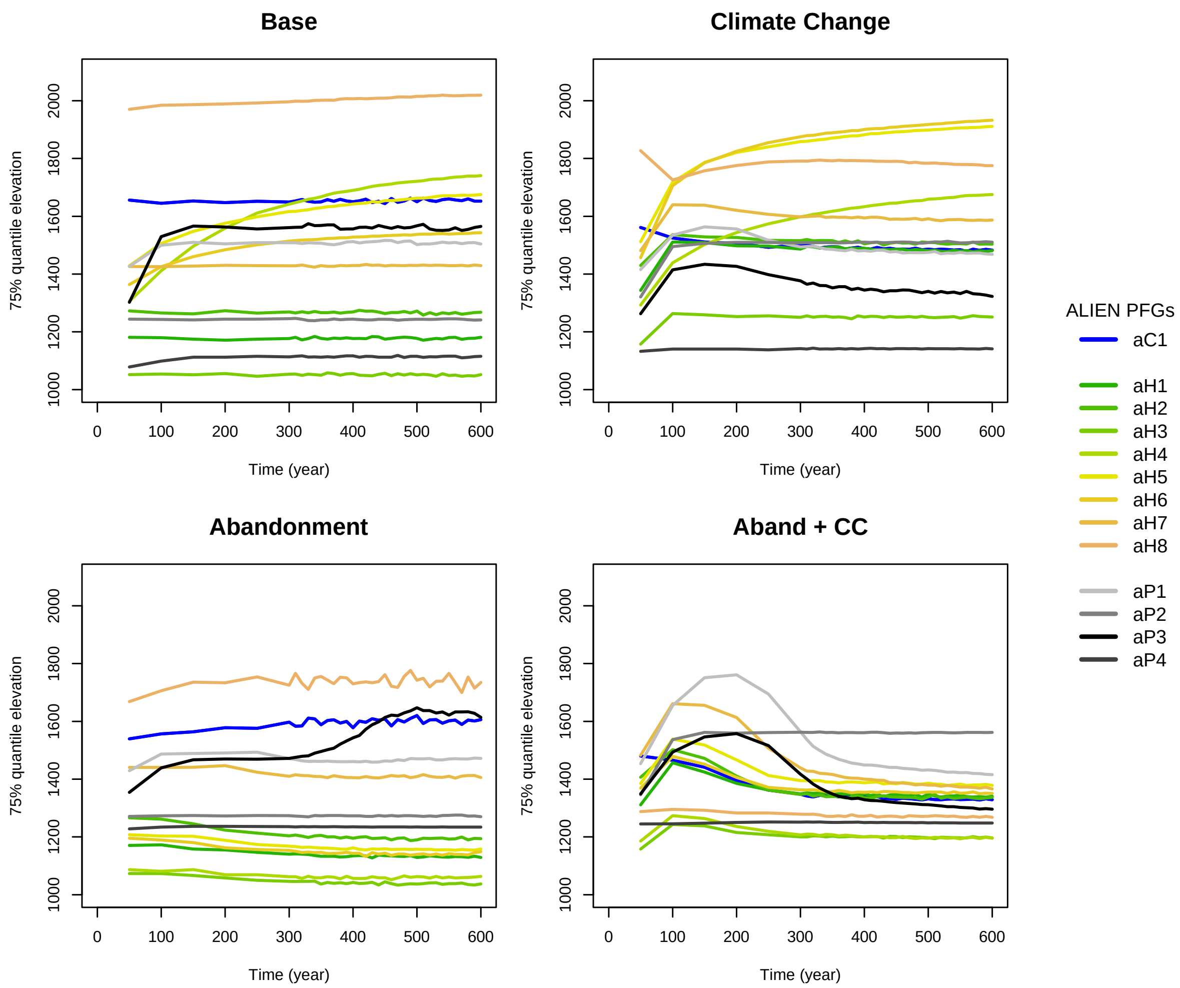


Figure S9: Elevation patterns for all naturalized alien PFGs through simulation time across scenarios with low propagule pressure (1 repetition). *Ailanthus altissima* (aP3), which is driving many of the patterns for the woody aliens is in black in this figure and in Figure S10.

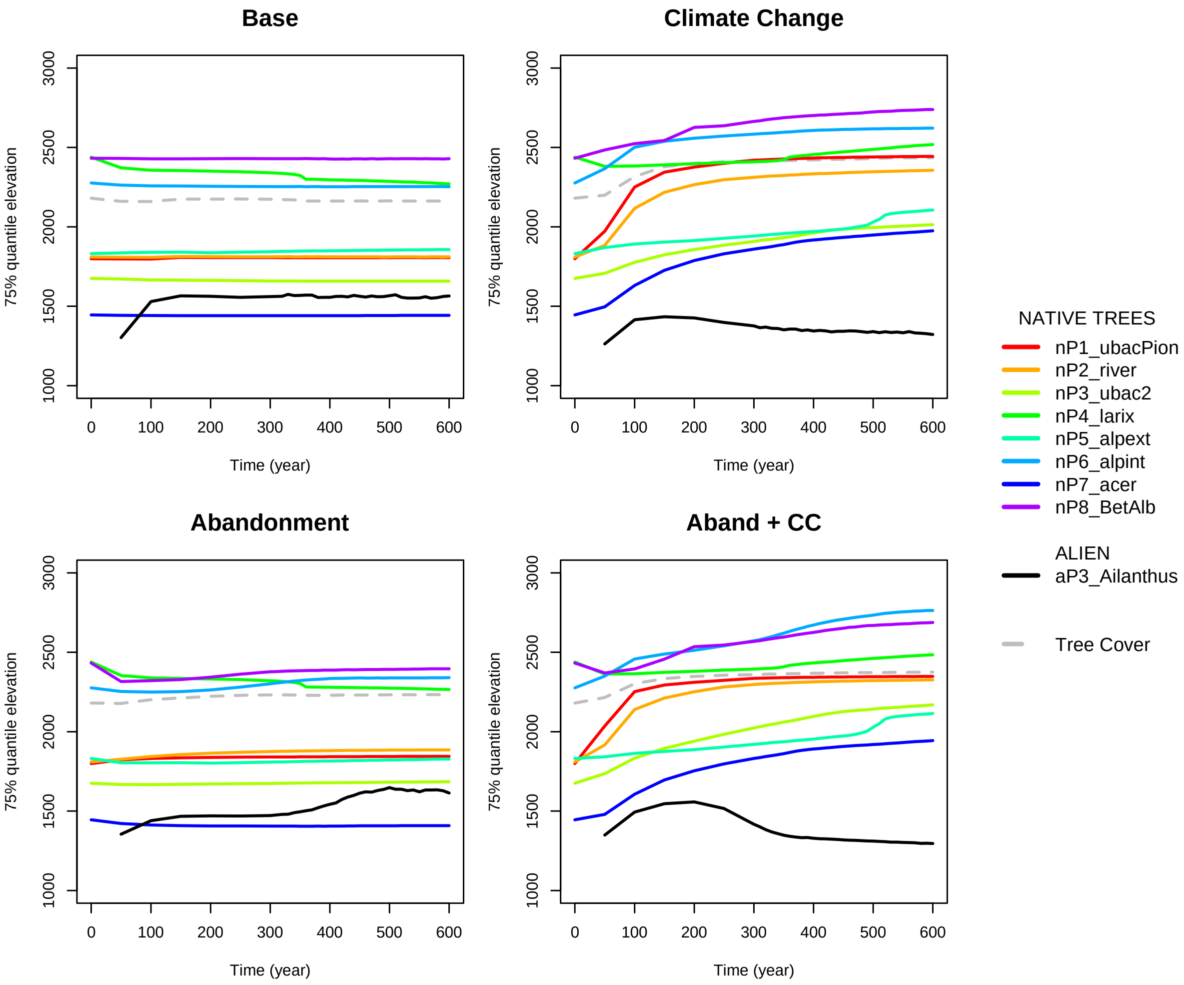


Figure S10: Elevation patterns for *Ailanthus altissima* (P3, black line) and the native woody PFGs through simulation time across scenarios with low propagule pressure (1 repetition).

Appendix S7 | Temporal dynamics of spatial patterns of richness of aliens

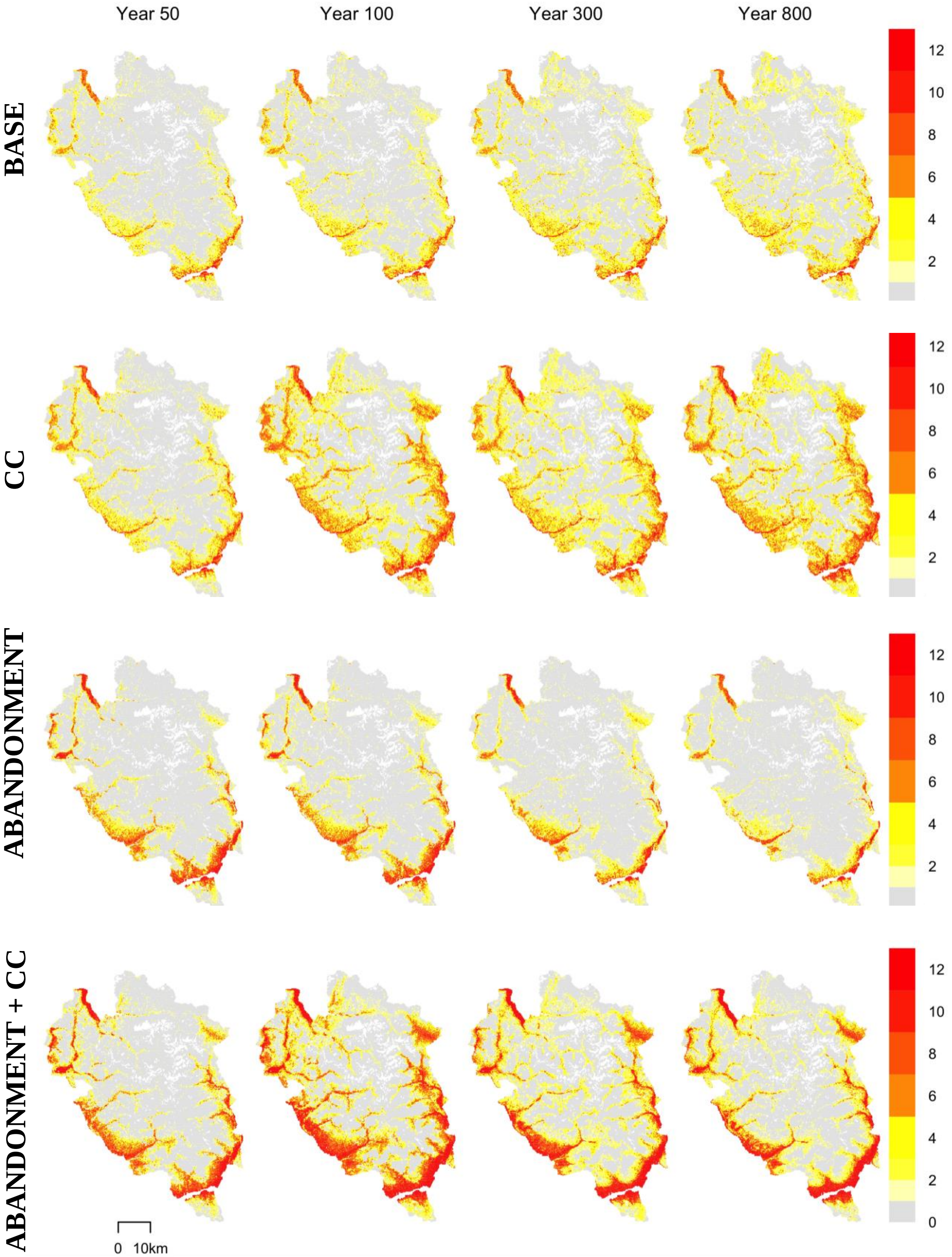


Figure S11: Evolution of the number of naturalized aliens predicted to occur in each pixel in the ENP at three simulation time steps across scenarios (shown for one repetition under current propagule pressure).

Appendix S8 | Spatial patterns of richness of Ornamentals across scenarios

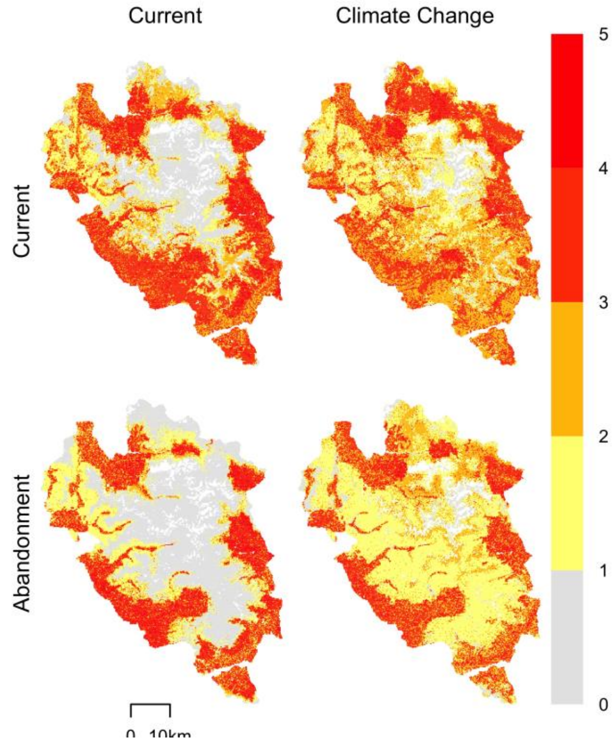


Figure S12: Number of ornamental plant functional groups predicted to occur across the Ecrins National Park at the end of the simulation (shown for one repetition), after reaching quasi-equilibrium under different combinations of climate (current or climate change) and land-use scenarios (current or abandonment). The baseline scenario represents the persistence of the current conditions in the ENP (current climate and current land-use under current propagule pressure).

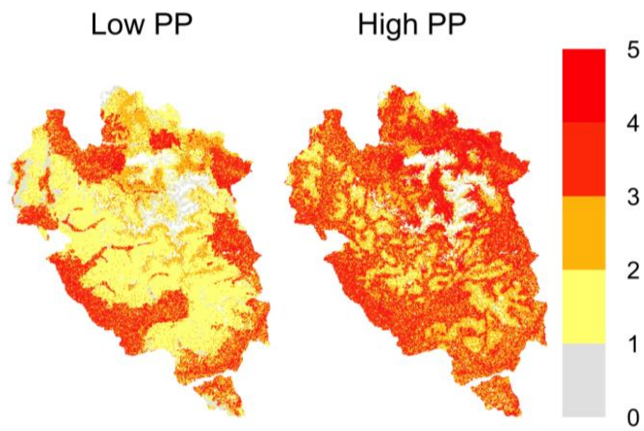


Figure S13: Number of ornamental plant functional groups predicted to occur across the Ecrins National Park at the end of the simulation in the land-use abandonment and climate change scenario after reaching quasi-equilibrium (shown for one repetition), across two Propagule Pressure scenarios (current low or high PP).

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