The Spread of Invasive Alien Species in Natural Forest Reserves (NFR) in Austria

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FORESTS IN EUROPE

In the year 2015, there were 186 mn. hectares of forests throughout the EU-28, representing coverage of 40 % of the total European landmass (EEA, 2016).

Since 1990, the area of Europe covered by forests has grown by 6% (Ramage et al., 2017).
The rotation period reaches from 35 to 70 years (Liski et al., 2001).

375,000 km² of forests are included in the Natura 2000 network (EU, 2017).

The four biggest current strains on the European forests are

1. Habitat loss and degeneration,
2. Invasive alien species(IAS),
3. Pollution and nutrient load,
4. Climate change

PRIMARY FORESTS IN EUROPE

Definition: Primary forests
Forests whose natural structure, composition and function have developed exclusively through natural forest dynamics and **without human intervention** over a long period of time, thereby allowing natural **species compositions and processes** to be restored (FAO, 2015 & EEA, 2016).

The European primary forests cover an area of around 1.4 mn. hectares in 32 countries, representing 0.7% of the forested area of Europe (Sabatini et al., 2018).

There are 192 Natural Forest Reserves (NFR) in Austria—forest areas designated for natural development of the forest ecosystem and in which no silvicultural measures are allowed. Goals include incorporating the diversity of Austrian forests into a representative network of Natural Forest Reserves and supporting the development of biodiversity and natural forest growth. Existing since 1995, the Austrian NFR programme currently comprises a total area of 8,355 ha (approximately 0.2% of the Austrian forest area). The sizes of the individual NFR range from 0.9 to 966.8 ha.

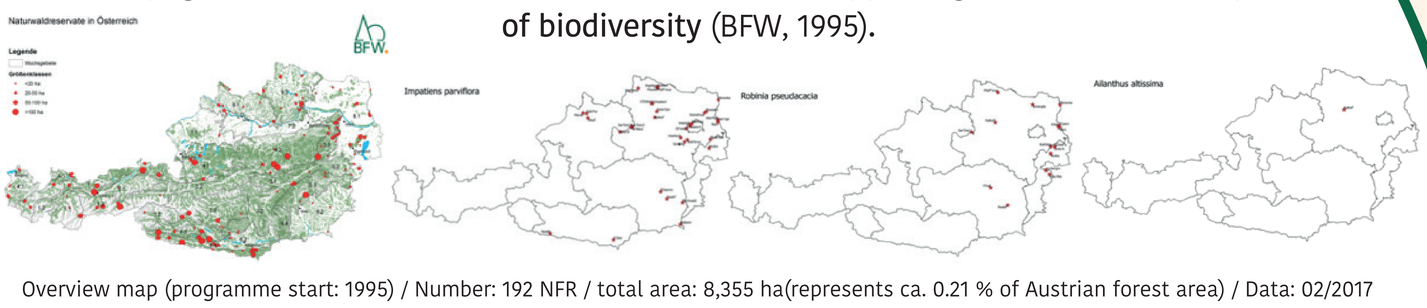
NATURAL FOREST RESERVES IN AUSTRIA

(8,355 ha) (data: March 2018)

192 NFR in totat

0,2% of Austrian forest area

Natural forest reserves (NFR) are forest areas designated for natural development of the forest ecosystem and in which no anthropogenic influence is allowed. NFR contribute to supporting the natural development of biodiversity (BFW, 1995).



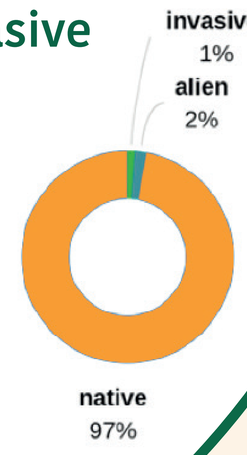
Overview map (programme start: 1995) / Number: 192 NFR / total area: 8,355 ha(represents ca. 0.21 % of Austrian forest area) / Data: 02/2017

ALIEN PLANT SPECIES IN NATURAL FOREST RESERVES

Number of species: 1,586 native, 30 alien & 16 invasive

n=2344 ground vegetation survey plots

Methods



Field survey in the Natural Forest Reserves — for angle count sampling, one tree per species is drilled to determine the increment at breast height.

INVASIVE PLANTS IN FOREST ECOSYSTEMS

Non-native plants have a significant effect on endemic species, plant communities, and ecosystems (Pyšek et al., 2008; Vila et al., 2011, Blackburn et al (2011).

Invasive alien plant species have a negative influence on the regenerationof endemic tree species, which in turn has long-term consequences for succession processes in forests and can ultimately lead to a loss of biodiversity (Shine et al., 2010).

Invasive species represent a major threat to endemic tree and shrub species in Europe (Seidl et al., 2014; IUCN, 2018; BGCI, 2013).

Non-native tree species (Robinia pseudoacacia, Acer negundo, and Ailanthus altissima) are increasingly colonizing forested areas, in particular riparian forests (Berg et al. 2016).

Red ash (Fraxinus pennsylvanica), also known as Pensylvanian ash or green ash, in the NFR Dirndlparz, 2013.

In which forest communities are invasive and non/ invasive alien species documented?

Which invasive and non/ invasive vascular plants occur in Austrian NFR?

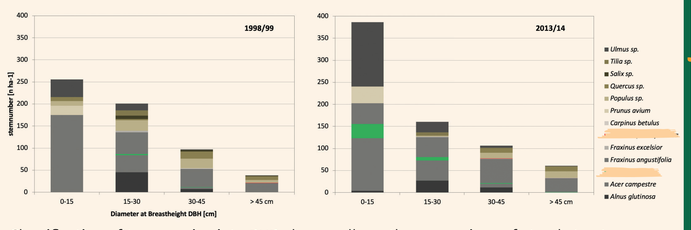
#	Scientific name	Landolt et al. (2010) Flora indicativa	DAISIE * Distribution	GRIIS* status	Easin (impact)	EU risk assessment
1	*Acer negundo*	Neophyte	alien/ established	alien	high	yes
2	*Ailanthus altissima*	invasive neophyte	alien/ established	alien	high	yes
3	*Aster novi-belgii*	Neophyte	alien/ established	alien	low	no
4	*Bidens frondosa*	Neophyte	alien/ established	alien	low	no
5	*Elaeagnus angustifolia*	invasive Neophyte	alien/not established	alien	high	no
6	*Erigeron annuus*	Potentially invasive n.	alien/ established	alien	low	no
7	*Erigeron canadensis*	Neophyte	alien/ established	alien	high	no
8	*Fallopia japonica*	invasive neophyte	alien/ established	alien	high	yes
9	*Fraxinus pennsylvanica*	invasive neophyte	alien/ established	alien	low	no
10	*Impatiens glandulifera*	invasive neophyte	alien/ established	alien	high	yes
11	*Impatiens parviflora*	Neophyte	alien/ established	alien	high	no
12	*Phytolacca americana*	Potentially invasive n.	alien/ established	alien	low	no
13	*Robinia pseudoacacia*	invasive neophyte	alien/ established	alien	high	yes
14	*Solidago canadensis*	invasive neophyte	alien/ established	alien	high	no
15	*Solidago gigantea*	invasive neophyte	alien/ established	alien	high	no
16	*Symphyotrichum lanceolatum (Aster lanceolatus)*	Neophyte	alien/ established	alien	low	no

Table of invasive alien plant species in NFR.

How do forest stands in NFR in which vascular plant IAS occur develop?

AUWÄLDER – RIPARIAN FORESTS

Fraxino pannonicae-Ulmetum



Classification of tree species into BHD classes allows the comparison of stand structures over the observation period. A significant change in the tree species composition is discernible especially in the smallest diameter class (0-15 cm). The share of *Acer campestre* decreases (from 159 to 119 trees/hectare), while that of *Ulmus sp.* Increases (from 40 to 146 trees/hectare).

Acer negundo occurred with only three individuals each in the BHD classes 15-30 cm and 30-45 cm in 1998. A noticeable increase in occurrence and size of individuals of this species occurred in the 15 years until 2013: the number of individuals rose, as did their average BHD class (0-15 cm: 18, 15-30 cm: 8, 30-45 cm: 2, >45 cm: 1).
It should be noted that angle count sampling is not an adequate method to determine the growth or spread of *Acer negundo*. Individuals counted in 2013 were already present in 1998, but were too small to be registered in the angle count sampling at the time.

Regeneration was surveyed in around 40 NFR. To do this, 4 m² per survey area were examined (4 crossways satellite samples of 1 m² each), the regeneration determined, the individuals assigned to height classes (in 10-cm-steps) and their game foraging damage determined.

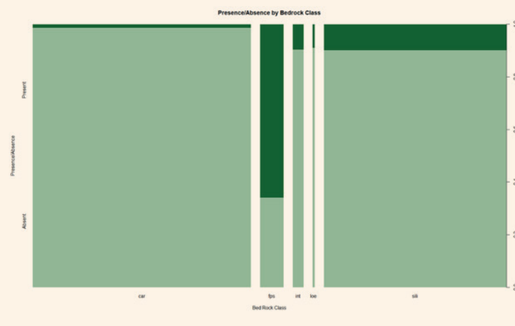
In three of the examined NFR, the invasive tree species robinia (ash forest), tree-of-heaven (oak-hornbeam forest) and box elder (riparian forests) were documented in one 1 m² PFL each.

Since the information base is too small for a separate evaluation, vegetation surveys were therefore used to analyse the spread of alien species in the associations. Their information bases are larger and the surveyed areas more representative (300 m²). This allows the occurrence of invasive vascular plant species in NFR to be estimated.

Which factors affect the occurrence of invasive alien vascular plants in NFR?

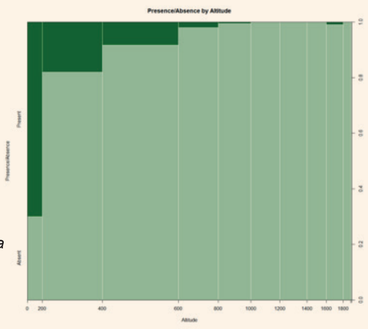
Binary logistic regression model
(Data summary by presence/absence)

The probability of IAS occurring is highest on riparian forest floors (B = 3.013 (0.40)***, OR = 20.35, df = 1).



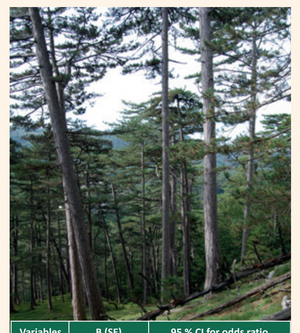
	B (SE)	Odds Ratio
Flood plain sediments	3.01 (0.50)***	20.35
Intermediate	2.2 (0.64)***	9.058
loess soil	0.18 (1.16)	1.20
silicate	1.91 (0.32)***	6.78

The probability of IAS occurring in NFR decreases with altitude
(B = -0.006***, OR = 0.99, df = 1).



Invasive alien plant species with an occurence in sites above 800m are:

- *Erigeron annuus*
- *Impatiens glandulifera*
- *Impatiens parviflora*
- *Solidago gigantea*
- *Telekia speciosa*



Variables Included	B (SE)	95 % CI for odds ratio		
		Lower	Odds Ratio	Upper
Altitude	-0.0060349 (0.0007623)***	0.99240 315	0.993983 3	0.995377 0

Conclusion

- In total, 1.632 vascular plant species occur in the Austrian NFR, of which 30 are alien species and 16 are invasive alien species.
- Altitude, exposure, relief, grade, and substrate depth affect the probability of the occurrence of invasive alien plant species.
- A vital occurrence of Acer negundo and Fraxinus pennsylvanica was determined in riparian forest stands of the forest community Fraxino pannonicae-Ulmetum in particular.
- In the course of the regeneration surveys (n=40), the invasive tree species robinia (ash forest), tree-of-heaven (oak-hornbeam forest) and box elder (riparian forest) were documented on one 1 m² PFL each in 3 NFR.

OUTLOOK

- Continued surveys within the Natural Forest Reserve programme
- Comparison with cultivated forest locations
- Neobiota monitoring

LITERATURE

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