

Introduced tree species to European forests: challenges and opportunities
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Quantifying invasiveness of Douglas fir on the basis of natural regeneration in southwestern Germany

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Douglas fir – *Pseudotsuga menziesii* (Mirb.) Franco

- ***one of the most commercially significant tree species of non-native origin in the State of Baden-Württemberg Germany***

State forest:
40 000 m³ timber
€4 million value
average/year

- ***importance expected to increase due to climate change***



Douglas fir in the city forest of Freiburg, State of Baden-Württemberg (photo: L. Vitkova)

Controversial discussions on the species' status

Nehring et al. 2003

non-native **invasive tree species** in Germany based on its dominance on rocky locations and acidophilous sessile oak forest sites.

Spellmann et al. 2015

Tree species **cannot be invasive** because of its regeneration ecology and controllability of its expansion.

different criteria used for the assessment of invasiveness



Naturally regenerating Douglas fir in sessile oak forest and on a cliff in Southwestern Germany (Photos: A. Reif).



In Douglas fir–Beech–mixed forests Douglas fir rarely establishes (Photo: T. Vor).

Assessment of invasiveness

- Lack of empirical-scientific data
- Expert opinions or small case studies
- No agreed consistent approach in European countries

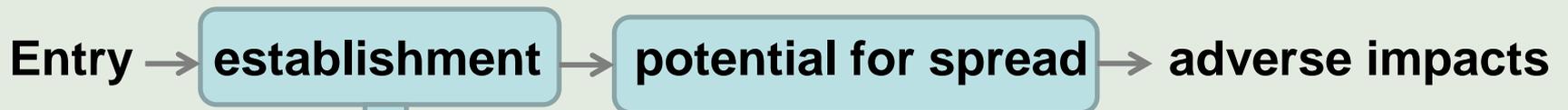
➔ Assessment of invasiveness often not sound-evidence based, replicable and transparent

Aim

Case study based on available quantitative data for evaluating the potential of Douglas fir to be or become invasive in a specific area

Case study Douglas fir

- Risk protocols: criteria matching main stages of invasion



Our research aim

assess the current potential of Douglas fir to naturally regenerate in specific forest habitats

Data

currently available data on natural regeneration of Douglas fir derived from different inventory systems

Study area



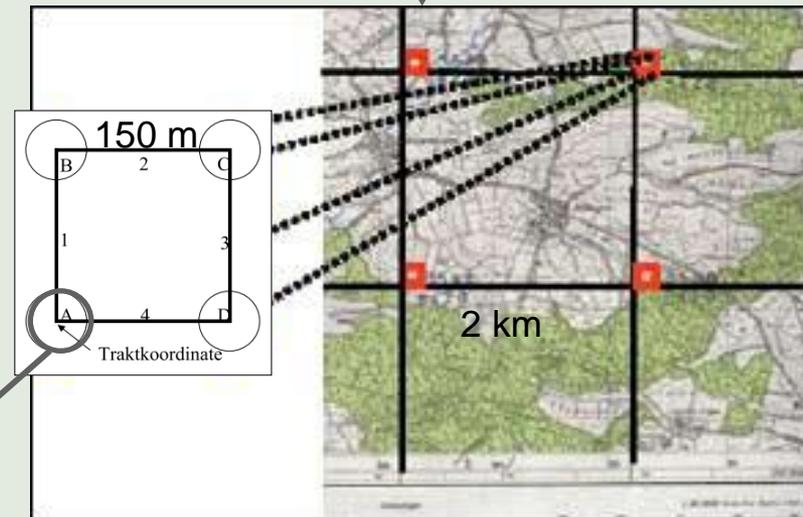
State of Baden-Württemberg
38% forest cover

Provide an improved basis for the assessment of invasiveness of Douglas fir, thus, for identification of appropriate management approaches

Inventory data sets

1. German National Forest Inventory

- data on the state of the forests
- 2 x 2 km grid, covering 1.3 Mio ha forest
- Forest stand type: dominant tree species (>50% cover)



Plots 0.03 ha
natural regeneration:
stand area (ha) covered by
young stems (trees > 20 cm
and < 4 m in height)

Inventory data sets

2. Forest Structure Mapping

- protected and unmanaged forests
- 4 298 ha sampled area
- 50 x 50 m grid, circle sampling points 0.1 ha
- Forest stand type for each plot by dominant species or mixtures
- **Natural regeneration**
trees < 7 cm dbh

3. Selective Forest Habitat Mapping

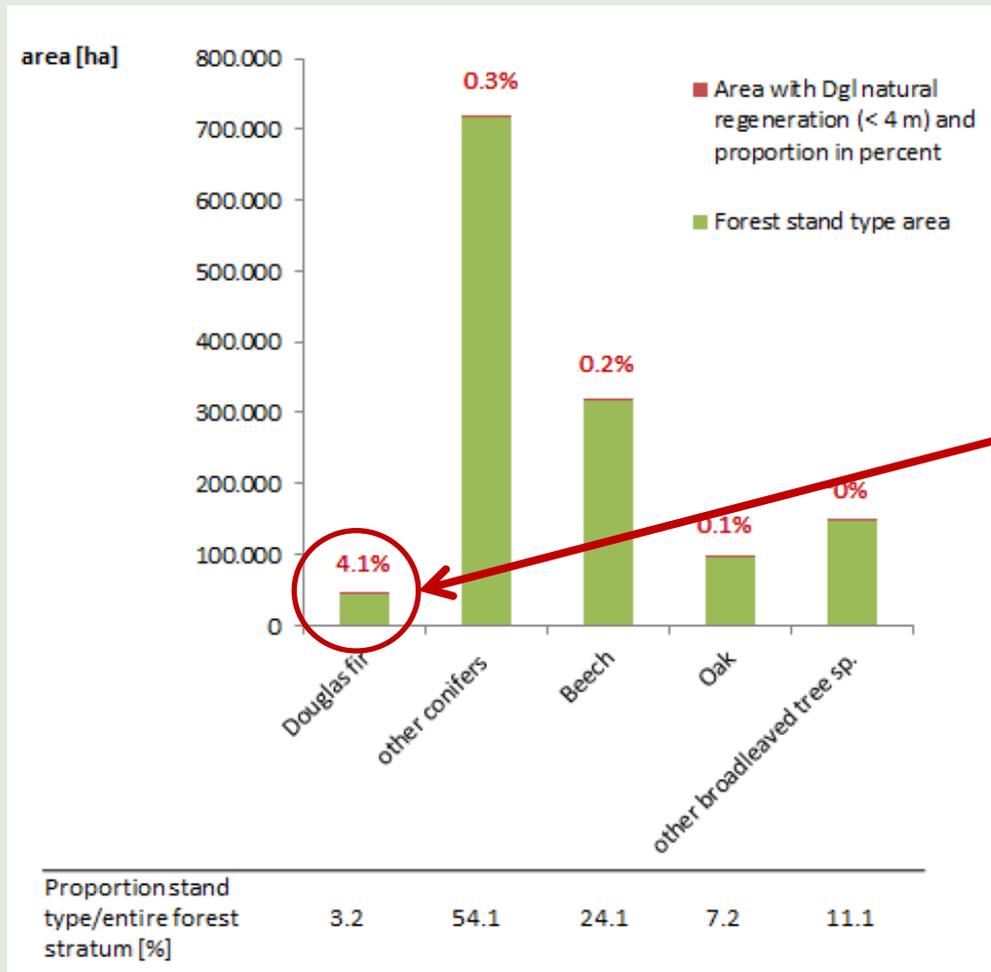
- Rare and protected habitats
- 81.795 ha sampled area
- 26.450 ha rare near natural forest habitats
- Recording of plant associations for each habitat
- **Natural regeneration**
distinguished from artificial regeneration

1. *Proportion of Douglas fir natural regeneration according to the three different inventories*

	National Forest Inventory		Forest Structure Mapping	Selective Forest Habitat Mapping
Reporting year	2002	2012	1994–2010	2015
Total area where sampling was carried out (ha)	1 323 119	1 323 958	4 298	81 795
Inventoried area with Douglas fir regeneration (ha)	2 112	4 346	71	165.9
Proportion of forest area with Douglas fir natural regeneration (%)	0.2	0.3	1.7	0.2

Natural regeneration of Douglas fir occurs only on a very small proportion of the forest area in the State of Baden-Württemberg

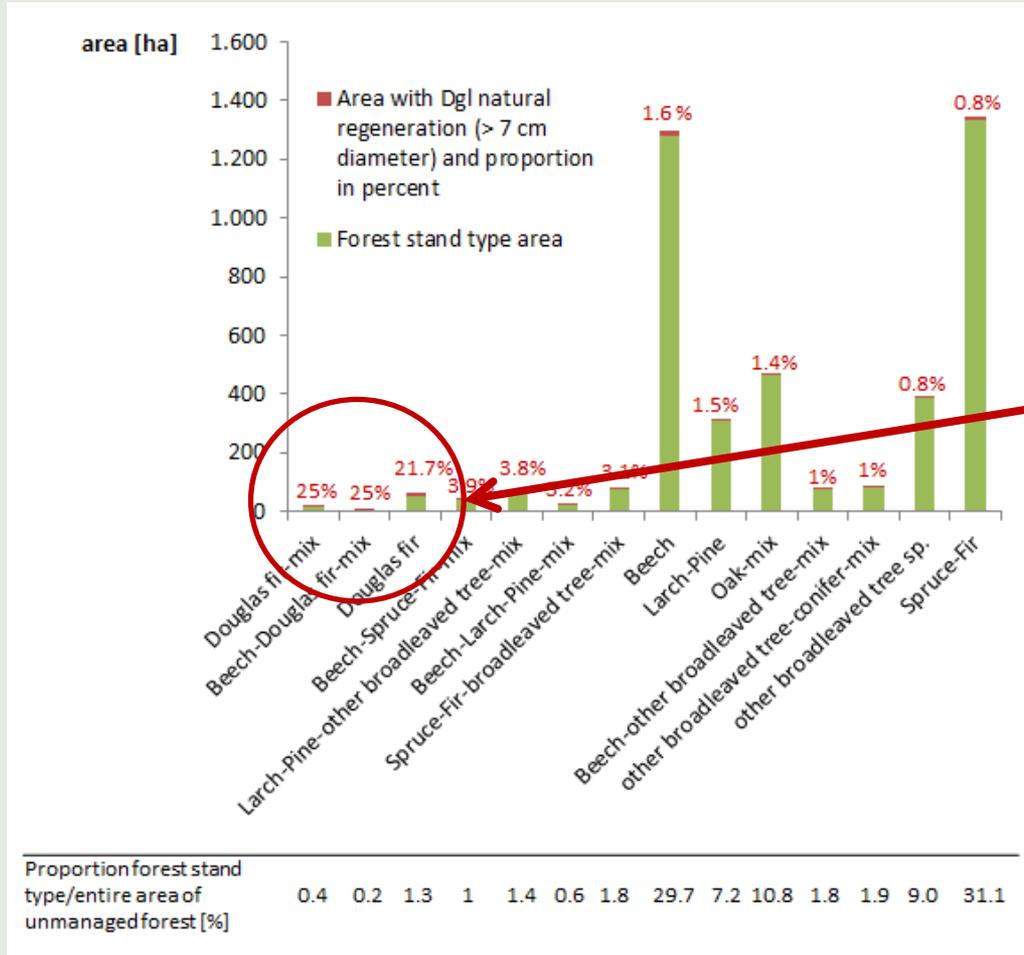
2. Natural regeneration according to National Forest Inventory



Largest proportion of natural regeneration found in Douglas fir dominated forest

Bindewald & Michiels 2016; National Forest Inventory 2012

3. Natural regeneration in unmanaged forest areas



Largest proportion of natural regeneration in Douglas fir dominated forests and Douglas fir-mixes

The natural regeneration of Douglas fir is negligible in managed as well as in unmanaged forests with the exception of areas where Douglas fir is the dominant tree species in the canopy.

Bindewald & Michiels 2016; Forest Structure Recording 1994-2010

4. Natural regeneration in rare protected forest habitats – 2015

Selective forest Habitat Mapping 2015

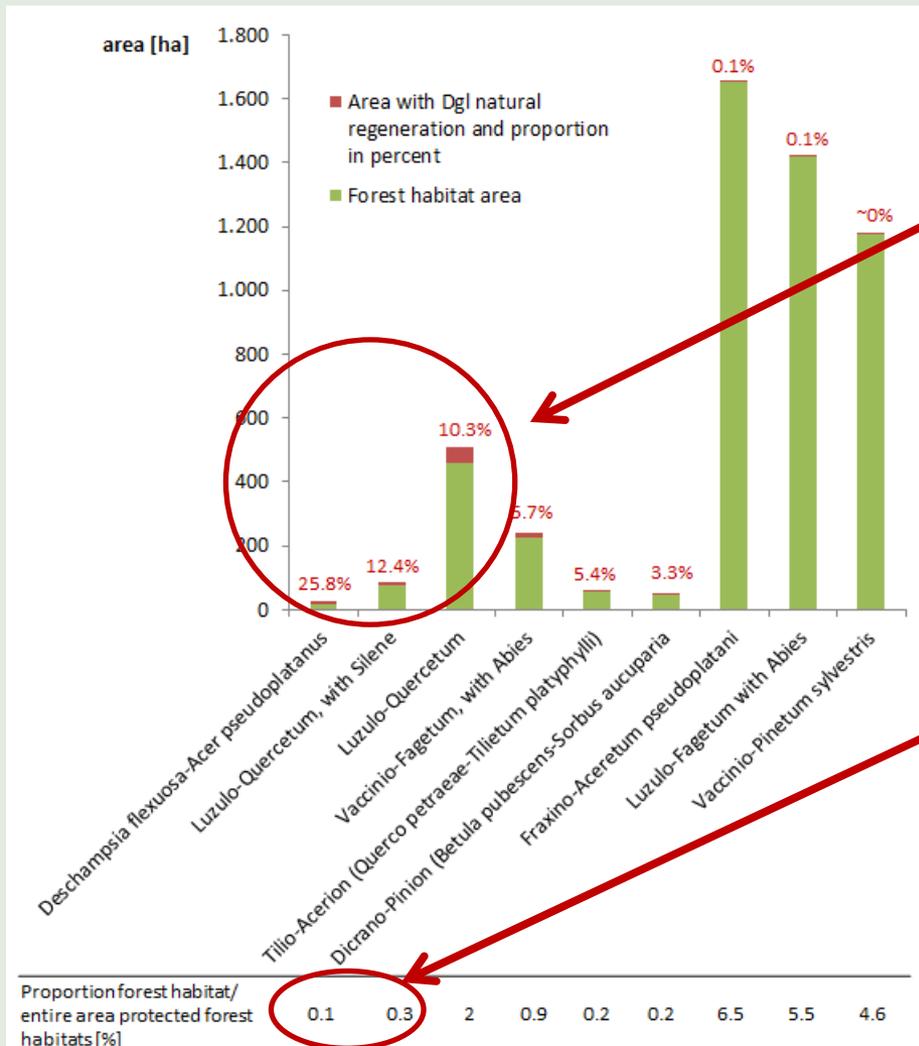
Habitat type	Habitat with Douglas fir (ha)	Entire size habitat (ha)	Portion of habitat with Douglas fir (%)
Natural formations	40.6	8 904	0.46
Rare near-natural forest types	98.8	26 450	0.37
Forest with animals worthy of protection	6.3	4 356	0.14
Forest with plants worthy of protection	5.6	4 143	0.14
Structurally rich forests	11.4	10 500	0.11
Succession areas	2.5	5 453	0.05
Dry habitats	0.2	4 585	~0.00
Running water	0.4	9 234	~0.00
Marsh and wetland habitats	0.1	4 936	~0.00
Sum	165.9	*81 795	0.20

Natural formations covering only small areas, e.g. open rock formations (Photo: Wikipedia; Cliff Scharfenstein, Southwestern Germany.)

Douglas fir regenerating on cliff (photo: A. Reif)



4. Natural regeneration in rare protected forest habitats



Largest proportion of natural regeneration in sessile oak forest communities & mixed broadleaved forest dominated by sycamore

Very rare habitats in Baden-Württemberg: forests with sparse tree cover on acidic nutrient poor sites

The natural regeneration of Douglas fir can be found only in several protected forest habitats such as natural formations and rare near-natural forest types

Bindewald & Michiels 2016; Selective Forest Habitat Mapping 2015

Discussion case study – managed and unmanaged forests

Natural regeneration currently occurs at a rather low level

- Natural regeneration primarily in forest areas where Douglas fir forms a dominant species in the canopy
- In Douglas fir stand types natural regeneration typically desired
- Potential to spread associated with forest management practices, no overwhelming evidence of its wider spread detected
- Number of seed producing trees may increase in future
 - currently 45 % of Dgl stand types less than 40 years old (NFI 2012)

Discussion case study – protected forest habitats

Douglas fir may be considered as invasive tree species in special protected rare habitats

- Tree species may have negative influence on native biodiversity
- control of natural regeneration still possible
 - natural regeneration found in 98 ha protected forest habitats

***Set up appropriate buffer zones around valuable habitats
(what is appropriate?)***

Discussion case study – assessment of invasiveness

- **Case study** highlighted the need to differentiate invasiveness between different forest ecosystems
- **Data on natural regeneration** as valuable factor when assessing invasiveness
 - Can indicate establishment success in specific forest ecosystems
 - Improve management of protected habitats
- But of course...
 - ...data covers only one aspect of the invasiveness of an introduced tree species

Research efforts are necessary in order to collect/analyse additional data and further develop solid standardised risk assessment tools

Questions?



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