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An integrative approach to link species- and environmental traits of invasive woody species. Precondition for classification and risk-analyses

Horst Tremp, University of Hohenheim - Institute for Landscape- and Plant Ecology Dept. of Landscape Ecology and Vegetation Science, Schloß-Mittelbau-West, D-70593 Stuttgart, tremp@uni-hohenheim.de

The a posteriori analysis of the invasiveness of introduced shrubs and trees - only due to their biological traits without site context - is a problematic venture. The same particularly applies in case of the classification of the sensivity or resistance of locations or plant communities to invasive species. It is to be assumed that similar biological traits may have a different meaning for invasion-success in different climates. Further, traits of perennial plants are ecologically interpretable only in spatiotemporal context.
Woody species (*Amorpha fruticosa*, *Nicotiana glauca*, *Buddleja davidii*) and their biological-ecological traits (water balance, leaf/stem-ratio, diaspore dispersal) are changing during the life cycle. Further their ecological potency exceed the usually surveyed site conditions manifold. So there is a inherent redundancy problem. While strategy types of herbaceous plants might be connected with the actually prevailing site conditiones, shrubs and trees running a sequence of different strategy phases. So it is not promising to explain the probability of invasiveness of just introduced but not spreading species on the basis of generalizations.
The only general ecological findings, which can be transferred to the investigated three woody species are: Anthropogen influenced locations offer better prerequisites for the establishment of the species, whereby the kind of disturbance regime is different. Thereby disturbance always enhances resource-availability to a specific period during the life cycle of all species. They profit on diverse biological levels from their opportunistic risky - compared to native woody plants - species traits which let them be more successful at appropriate - often anthropogenious influenced - sites. High seed production and above all the efficient diaspore propagation are most important for species success. Efficient short distance propagation as well as long-distance propagation are important.
Physiological data can secure findings on higher biological-ecological level. The sum of biological species traits alone can hardly have a predictive character, rather it's necessary to integrate several aspects. Thus frost tolerance - to a large extent physiologically determined - has to be seen in connection with the statistical probability of occurence of extreme winter frost and the autecological feature of reaching the generative phase. Despite some plant species show the same frost tolerance, the ecological meaning becomes obvious only if the specific life history is regarded and site factors are involved.
The here proposed onset is based on such linkages (Fig. 1). Thereby no general specifications of the species traits are required, but only such, which are regarded from the scientist as important for invasion success. Together with the site context this model should be graphically represented. So called 'conceptional models' have the purpose to organize our thinking about processes of plant invasions and not at least our ignorance concerning this. In a second step these purely descriptive life cycle models can be transferred to a concrete landscape-ecological situation.

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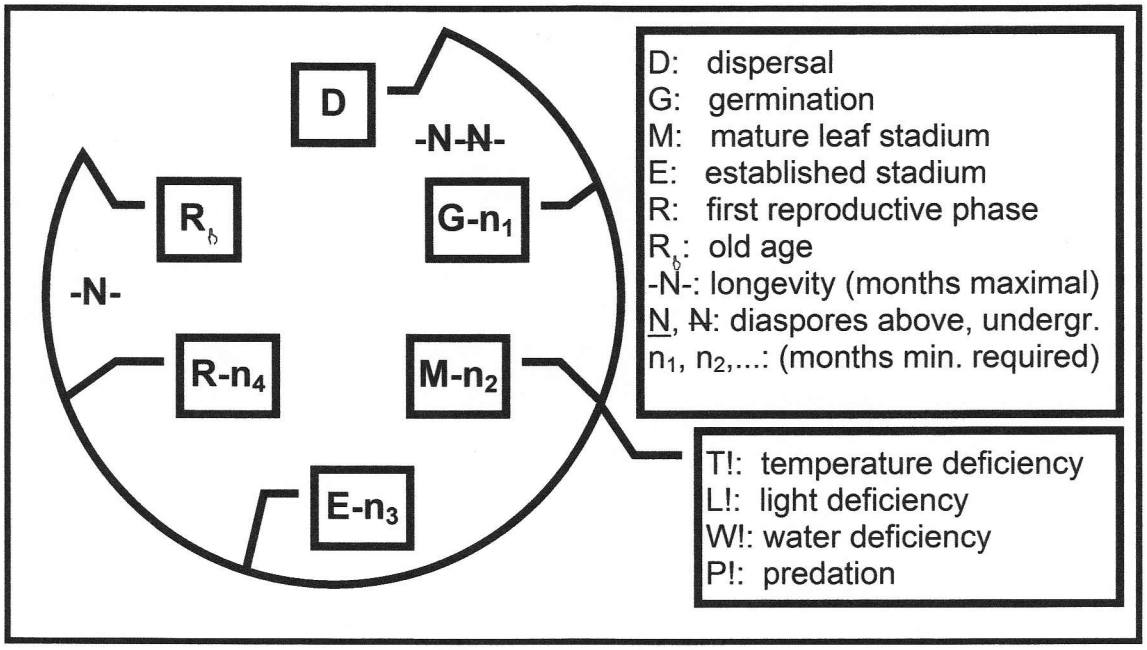

Fig. 1: Grafic representation of a simplified life-cycle of a perennial plant, to link the stages of development (within circle; upper legend) with abiotic and biotic environmental factors (outside circle; legend below). Examples are: temperatures which prevent germination; per cent predation of seeds; minimum light requirement for flowering and seed formation.

From these scenarios - not predictions - of the probability of spreading of an introduced plant species the need for action may be derived. Such scenarios offer the possibility to weight ecological and economic effects of an invasive plant species and to think about precautions if necessary. For introduced woody species a scientifically convincing scenario of invasion was proved, monitoring programms should be initiated. For the False Indigo (*Amorpha fruticosa*) such a monitoring program is recommended along the riparian corridor of the River Rhine and in former opencast mine areas with rising groundwater levels in the eastern part of Germany.