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# Invasions of Isotopes and of Neobiota

*G. Vogl[1], M. Rennhofer[1], B. Sepiol[1], M. Smolik[1], F. Essl[2], I. Kleinbauer[3]*

[1]Fakultät für Physik, Universität Wien, Strudlhofgasse 4, A-1090 Wien, Austria
[2]Federal Environment Agency, Department for Nature Conservation,
Spittelauer Lände 5, A-1090 Wien, Austria
[3] V.I.N.C.A., Giessergasse 6/6, A-1090 Wien, Austria

Corresponding author:
Gero Vogl
Fakultät für Physik
Universität Wien
Strudlhofgasse 4, A-1090 Wien, Austria
E-Mail: gero.vogl@univie.ac.at

## Extended abstract

**Abstract**

We report on invasions with low diffusivity: one in materials science and one in ecology. What is interesting in materials science is to describe diffusivities in order to model technological important materials. In ecology on the other hand predictions into the future appear the most challenging issue.

**Keywords:**
Invasions, isotopes, neobiota, diffusion in materials science, diffusion in ecology, Mössbauer effect at synchrotron, warming of climate, Monte Carlo method

### 1. Materials science:

X-radiation from synchrotrons and in the future from free electron lasers offers a number of new possibilities for diffusion studies [1]. Here we report on a new method which takes advantage of the high brilliance of synchrotron radiation over a broad energy range. Due to its brilliance synchrotron radiation can excite even the energetically very narrow energy levels (here the first excited level of $^{57}$Fe) as has before only been possible by the Mössbauer effect. The radiation is reemitted with delay (the life time of the nuclear level) and can be used for diffraction studies. In the work reported here our aim was to understand diffusion in FePt which is a main candidate for next generation data storage devices. We have studied diffraction from the superstructure Bragg-peak of a multilayer sample composed of layers of FePt with the iron isotope alternating between natural iron and $^{57}$Fe. Diffusion of iron (the "invasion" of $^{57}$Fe isotopes into layers with natural iron and vice versa) leads to a disappearance of the preponderance of the $^{57}$Fe isotope concentration in every second layer and therefore to a decrease of the height of the Bragg peak. In this way Fe diffusivities in the range of $10^{-24}$ m²/s can be determined which is less than with any other method [2].

**2. Ecology:**

Ambrosia artemisiifolia, the American ragweed, is a short-lived vascular plant species which has been invading Central Europe for 150 years, but caused by the warming of the European climate [3] its spread process has accelerated in the last few decades. The pollen of ragweed evokes heavy allergies and – what probably counts even more – because of its spread rather late in summer causes a second wave of allergy when other pollen allergies have decayed. Since both historical distribution and spread of Ambrosia artemisiifolia are well documented, Ambrosia artemisiifolia is perfectly qualified as model species. We have tried to reconstruct the invasion process of Ambrosia artemisiifolia in Austria by collecting all records. By correlating distribution data and data sets on land use, road and railway networks, and climatic variables, a habitat layer for Austria was produced which is implemented in the simulations. Comparison of the observed and the modelled historical diffusive spread of Ambrosia artemisiifolia from 1990 to 2005 is used to test accuracy and applicability of the Monte Carlo method [4]. Furthermore, including regional climatic change scenarios yielded new habitat layers for increased July mean temperatures of up to +4.5°C. These new habitat layers can also be used for the simulations, enabling dispersal predictions with respect to different climatic scenarios.

**References**

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