Invasiveness of small balsam (*Impatiens parviflora*) in Poland: causes and effects

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INTRODUCTION

Small balsam (*Impatiens parviflora*) is an invasive plant species which has successfully colonized Europe and had a large impact on the environment. This quintessential invader arrived from the Himalayan region, and has since spread rapidly throughout Poland and in other European countries (Coombe, 1956; Perrins *et al*., 1993). At the same time, a diminution in the range of yellow balsam (*Impatiens noli-tangere*) (a native species in Poland) has been observed.

In 2003–2004, there was a sudden and large-scale decline in the population size of yellow balsam across central Poland. However, no such decline occurred in northern Poland, or in populations of small balsam in either region. This situation may be connected with the presence of the netted carpet moth (*Eustroma reticulatum*) (Lepidoptera: Geometridae), whose larvae feed on yellow balsam (Hatcher *et al.*, 2004), but are not known to attack small balsam.

The aim of the current project, in which all aspects of invasion will be compared, is to investigate probable causes and results of the success of small balsam in Poland.

HYPOTHESES

The 'enemy release' hypothesis argues that unusual success of invasive plants results from reduced natural enemy attack (Elton, 1958). Allelopathy may be a mechanism by which small balsam may interfere with its neighbours (Hierro & Callaway, 2003). Soil biota in some invaded ecosystems may promote invasions; plant-soil feedback processes are also important. In this study it may be possible to prove that soil fauna numbers, their diversity and the release of chemical compounds into the environment are host-specific.

Diversity of arbuscular mycorrizal fungi, rhizosphere bacteria in and around the roots and different communities of non-mycorrizal fungi coexisting with seeds and seedlings of these species have all been suggested as reasons for the spectacular success of small balsam in Poland.

MATERIALS AND METHODS

The investigation consisted of both laboratory experiments and field observations in the Kampinos Forest, near Warsaw (the Mazowsze region), and in the Piska Forest, in Mikolajki (the Mazurian Lakeland).

Experiments were designed from spring to autumn 2004 at four adjacent experimental sites. All samples were taken three times a season (before bloom, during bloom and at seed maturity).

Using a steel soil corer, samples of 10 cm^2 in surface area and 10 cm depth were taken from each site. Springtails (Collembola) and mites (Acari) were extracted from soil cores using a Tullgren apparatus. The arbuscular mycorrhizal status of both species was also investigated. In summer 2004 an assessment of the presence of population of netted carpet moth was made in all known and surveyed sites for yellow balsam in the Piska Forest. Seed productivity of small balsma and yellow balsam was calculated only in the Mazurian Lakeland.

CONLUSIONS

Previous results have demonstrated that the success of small balsam may depend on the better ecological adaptation of this species (e.g. higher capacity of seed production) and lower susceptibility to pathogens. Also, it is possible that small balsam may exude chemicals from their roots and leaves that are detrimental to the growth of other plants.

Population crashes of yellow balsam in the Mazowsze region may linked to this species being particularly prone to attack by fungal pathogens. Important fluctuations in the size of yellow balsam population in the Piska Forest have also been associated with the presence of the endangered netted carpet moth. (Yellow balsam is believed to be the sole food plant for this moth.) Compared with small balsam, yellow balsam also accumulates more soil mezzofauna, which have an influence on its roots.

Arbuscular myccorhiza symbiosis is typical of both small and yellow balsam, but there are differences between the diversity of mycorrizal fungi in the roots of both species in both the Kampinos Forest and the Piska Forest. This situation may be connected with an increase in root colonisation by dark septate endophytic fungi, which is generally observed in cold-stressed environments in the Mazurian Lakeland.

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