

projections of the models suggest much slower spread than has typically been observed for *Microstegium*. The relatively small scale of natural dispersal suggests that human-mediated dispersal, likely influenced by forest road management, is responsible for the rapid spread of this invasive species.

641. Changes in Seed Bank Communities Associated with Plant Invasions. Margherita Gioria¹, Bruce Osborne²; ¹Arizona State University, Tempe, Arizona, United States of America; ²University College Dublin, Dublin, Ireland

Despite increasing appreciation of the ecological and evolutionary importance of soil seed banks, little information is available on the impacts of invasive species on this dynamic component of plant communities. In this study, the effects of three major invaders in Ireland (*Gunnera tinctoria*, *Fallopia japonica* and *Heracleum mantegazzianum*) on whole seed bank species assemblages were investigated using a multi-site comparative approach. The seed bank of invaded and uninvaded areas was sampled at three sites per invader, from four random plots (4 m²) and three soil depths (0-5, 5-10, 10-15 cm). Soil samples were collected in May and October, and the seedling emergence approach was used to assess the viable seed bank. Permutational multivariate analysis of variance (PERMANOVA) and analysis of dispersion (PERMDISP) were applied to the analysis of seed bank data, enabling the partitioning of variation and the use of different transformations and resemblance measures. The structure of invaded seed bank communities was significantly different from that of uninvaded ones, at each soil depth. A total 79 forbs and 14 grasses were recorded in the seed bank of uninvaded areas, compared to 62 and 9 species found in the invaded seed bank, respectively. Diversity and evenness were significantly lower in invaded seed bank communities. Species characterised by a persistent seed bank and/or by effective dispersal mechanisms were still found in the invaded seed bank. Conversely, species producing only transient seeds virtually disappeared. The seed bank of *Gunnera tinctoria* was large and persistent (60 428 ± 47 131 seedlings m², mean ± SD), whereas that of *Heracleum mantegazzianum* was transient (9,762 ± 390 seedlings m²) and only found in October, in the top soil layer. No seedlings of *Fallopia* spp. were recorded at the study sites. Comparative multivariate analyses combining data for the three invaders showed that *Fallopia japonica* had the greatest impact on seed bank communities, suggesting a higher invasive potential for this species. The results of this study have important implications for the development of management strategies. Removal of the seed bank of *G. tinctoria*, for instance, may be unrealistic because of a large number of long-lived viable seeds. Clear objectives on the composition of the vegetation after the restoration of invaded sites should also be set and should account for the composition of the seed

bank of invaded areas, since disturbance could promote the emergence of undesirable species, such as *Juncus* spp. and other agricultural weeds.

642. Establishment of a Precaution and Control Program for Invasive Alien Plants-A Case Study of Goldenrod (*Solidago canadensis*) in China. Sheng Qiang¹; ¹Nanjing Agricultural University, Nanjing, Jiangsu Province, China (Peoples Republic of)

Goldenrod (*Solidago canadensis*), native to North America, has invaded China and caused a big ecological trouble in eastern China. It has been regarded as one of main eradication targets in Plan of Action of the Eradication of IAS in China launched by the Ministry of Agriculture, China in 2003 and 2005. A quantitative survey of goldenrod was made in Jiangsu Province. Morphological characteristics and ecological distribution of 40 populations collected from eastern China were comparatively studied. The character of its reproductive biology was observed through LM and ESM. The distribution pattern of this weed was quantitatively described in this province. Through AFLP and ITS marker techniques, genetic diversity was studied and moreover a kind of cutflower ?Hungyinhua? widely grown in China was identified as *Solidago canadensis* complex. An inhibitor for flower bud differentiation was developed and applied at a large scale so that it completely halted seed set through inhibition of microspore and megaspore development. As a result, it is helpful to slow down speed of the weed spread to new areas. We screened five different combinations of herbicides such as glyphosate, 2,4-D and sulfometuron-methyl to extend to whole province, established eradication programs and trained administrators, farmers and extension agents at local plant protection units. A total of 10,000 ha areas of invaded goldenrod were eradicated, out of which the first tenth land was reclaimed. Five natural enemies, found on goldenrod, were evaluated as potential biological control agents. A technique was developed using stalk of goldenrod as media to culture more than ten kinds of edible mushrooms. The information system of invasive alien plants on web was built with the most species in China, providing information about biology, monitoring prevention of the worst invasive weeds including goldenrod (<http://weed.njau.edu.cn>). It has become a hot website that has been visited 0.75 million times since 2004. The knowledge of alien plants has been spread through the internet, TV, newspaper, broadcast and short training courses in order to enhance public awareness. In conclusion, we have established integrated management system with combination of precaution and emergent eradication including biological control for long-term management, utilization through ecological way for prevention, chemical control for rapid response, building information system and enhancement of public consciousness for prevention. The international collaborative