The status and causes of alien species invasion in China

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Abstract. Data of classification, origin, pathway and environmental impacts of invasive alien micro-organisms, invertebrates, amphibians and reptiles, fish, birds, mammals, weeds, trees, and marine organisms in terrestrial, aquatic and marine ecosystems of China, were analyzed, based on literature retrieval, field survey and consultation. Some 283 invasive alien species were recorded in China, including 19 invasive alien micro-organisms, 18 aquatic plants, 170 terrestrial plants, 25 aquatic invertebrates, 33 terrestrial invertebrates, 3 amphibians and reptiles, 10 fish, and 5 mammals. Of the invasive alien species, 55.1% originated from North and South America, 21.7% from Europe, 9.9% from Asia, 8.1% from Africa and 0.6% from Oceania. Many institutions and individuals in China lack adequate knowledge of ecological and environmental consequences caused by invasive alien species, with some ignorance of the dangerous invasion in the introduction of alien species. For instance, 50.0% of invasive alien plants were intentionally introduced as pasture, feedingstuffs, ornamental plants, textile plants, medicinal plants, vegetables, or lawn plants, 25% of alien invasive animals were intentionally introduced for cultivation, ornament, or biological control. In addition, more efforts are being made in the introduction of alien species, and little attention is paid on the management of introduced alien species, which may cause their escape into natural environment and potential threats to the environment. There were also gaps in quarantine system in China. All microorganisms were unintentionally introduced, through timber, seedling, flowerpot, or soil; 76.3% of alien invasive animals invaded through commodity or transportation facility because of the failure of quarantine. Therefore, quarantine measures should be strictly implemented; and meanwhile the intentional introduction of alien species should be strictly managed and a system of risk assessment should be implemented.

Although the invasion and dispersion of species is part of the history of earth before the appearance of human beings, human beings expedite the course of invasion. Economic globalization, modern transport facilities and global climate change exacerbate the invasion of invasive alien species. Invasive alien species have become one of the serious environmental issues in the world. Invasion of alien species is one of the most important factors endangering global biodiversity, which reduces the uniqueness of regional fauna and flora,
and breaks down geographical barriers that maintain global biodiversity (Lovei 1997; Fang 2000). China suffers from insufficient baseline data, knowledge and sound control measures for invasive alien species. Therefore, it is necessary to launch nationwide investigation on invasive alien species, so as to compile baseline data, identify causes of invasion, and put forward effective control strategies and measures.

**Nationwide investigation of invasive alien species in China**

An alien species is a species occurring outside its normal distribution. An invasive alien species is an alien species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity (Williamson 1996; IUCN, 2000; Shine et al. 2000; McNeely et al. 2001). This investigation of invasive alien species in China was initiated in December 2001, and ended in October 2003. The investigation was focused on invasive alien species from other countries.

The targets of the investigation are invasive alien microorganisms, invertebrates, amphibians and reptiles, fish, mammals, weeds, trees, and marine organisms, which cover terrestrial, aquatic and marine ecosystems in China. The investigation was implemented through literature analysis, field survey and expert consultation. Twenty data fields were designed for the investigations, including:

1. Taxonomic name
2. Chinese common name
3. English common name
4. Status of classification: Class, order, and family which invasive alien species belongs to
5. Ecological categories: Major ecological/taxonomic group (micro-organisms, aquatic plants, terrestrial plants, aquatic invertebrates, terrestrial invertebrates, amphibians and reptiles, fish, and mammals)
6. Morphological characteristics
7. Status of establishment of population: established, unestablished, unknown
8. Distribution area
9. Economic and ecological impacts: Impacts on agriculture, forestry, fishery, husbandry, tourism, and ecosystems and their economic losses, including area and values of losses
10. Year and location of first observation of invasion
11. Origin: Known or Probable donor area
12. Invasion pathways to china: (a) intentional introduction, including introduction for cultivation, plantation, biological control, soil conservation and environmental protection; (b) unintentional introduction, including transported through aircrafts, road vehicles, boats, ballast water, goods, packaging materials; and (c) natural dispersion