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ECOLOGY

Global trends in plant naturalization

Many naturalized non-native plants pose ecological and economic threats. A quantitative analysis of the global distribution of naturalized plants confirms some anticipated trends and exposes new patterns. **See Letter p.100**

MARCEL REJMÁNEK

Naturalized species are non-native species that form self-sustaining populations following their introduction into an area by human agency[1]. Some naturalized species are considered a major threat to biodiversity and have been the focus of many biologists over the past three decades. However, even casual observers may notice that the distribution of naturalized species is highly uneven within and among different regions. Attempts to summarize global geographical distributions of naturalized organisms have included birds[2], ungulates[3] (large mammals such as pigs and camels) and bryophytes[4] (non-vascular plants), but a comprehensive assessment of naturalized vascular plants has been missing. In this issue, van Kleunen *et al.*[5] (page 100) provide the first global analysis of the numbers and distributions of naturalized vascular plants and their exchange between continents.

The authors used hundreds of data sources of various kinds to characterize the alien floras of 843 non-overlapping regions worldwide (481 mainland and 362 island areas). Characterization included the origin of the naturalized species and estimates of the numbers of native and non-native species per continent. The resulting database includes 13,168 plant species — 3.9% of the world's currently known vascular flora — that have become naturalized in at least one region. The authors suggest that this figure may be an underestimate, given the lack of data (or adequate data) for some regions.

One of the most striking results of this study comes from the authors' comparisons between large continental areas. These revealed that North America has accumulated the largest number of naturalized species of vascular plant (5,958), followed by Europe (4,140). This finding undoubtedly reflects more intensive introduction processes — both deliberate, for example for ornamental horticulture and erosion control, and accidental, as a result of frequent trade between these regions and the rest of the world.

Simple numbers of naturalized species do not, however, quantify the actual level of invasion. Previous work[6] has shown that, in North America, non-native species account for 51.3% of the 120 most widely distributed plant species, but account for only 2.1% in Europe. One possible explanation for the striking difference between Europe and North America is that the European flora, being part of the Eurasian flora, has been exposed to countless plant migrations over time, so that the resulting plant communities are less 'naive' and more resistant to new plant invasions. It is also likely that some European plant species have been selected for quick colonization of human-disturbed habitats, the habitats in which they are most often found naturalized in North America (Fig. 1).

Van Kleunen and colleagues' data also show that the Pacific Islands region exhibits the steepest increase in the cumulative number of naturalized species with respect to the total area involved. This result provides the first global verification of an expected pattern: that oceanic islands harbour more naturalized plant species than mainland areas of similar size. A primary reason for this may be that native communities on islands represent only a limited sample of the species that could potentially match the habitat, and they are therefore more open to the naturalization of introduced species.

At the same time, the data confirm previous preliminary analyses showing that continental regions with large tropical areas (Africa, South America, tropical Asia) have fewer naturalized plant species than predominantly temperate regions. Higher resistance to non-native species establishment, faster vegetation

50 Years Ago

It is probable that only those who have themselves been concerned with scientific research will appreciate all the fine nuances of Sir Cyril [Hinshelwood]'s address, but the picture he paints of the scientist as a creative worker, of the need for freedom of expression and appropriate conditions of work, and of public understanding if his work is to be fully effective, is intelligible to any layman. It is no picture of a scientist working and living in some 'ivory tower', or even of Thomson's Newton, "stemming alone vast eternity's unbounded sea", but rather of a happy voyager of strange seas of thought, in company with others trained in the same or many other disciplines.
From *Nature* 4 September 1965

100 Years Ago

In his presidential address, read at the Association of Museums, San Francisco, Dr. O. C. Farrington gave an able summary of the origin and evolution of natural history museums, which should be widely read in this country. More especially is this to be urged in view of the danger which threatens such institutions in the immediate future in regard to the policy of national retrenchment which is now in process of formation. There is a danger that the pruning-hook may be used too ruthlessly, thereby inflicting material harm. For reformers are generally enthusiasts, and therefore are to be carefully watched, experience having shown that a sense of proportion is not usually among their attributes. Museums, as he remarks, are even now commonly regarded as a luxury, but he leaves no uncertainty as to the vitally important part which the modern museum plays, and must continue to play, in ever-increasing force, in our national life.
From *Nature* 2 September 1915