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# Exotic Species in the Great Lakes: A History of Biotic Crises and Anthropogenic Introductions

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## Abstract

Through literature review, we documented introductions of non-indigenous aquatic flora and fauna into the Great Lakes basin since the early 1800s. We focused on the origin, probable mechanism(s) of introduction, and the date and locality of first discovery of Great Lakes exotic species. The Laurentian Great Lakes have been subject to invasion by exotic species since settlement of the region by Europeans. Since the 1800s, 139 non-indigenous aquatic organisms have become established in the Great Lakes. The bulk of these organisms has been represented by plants (59), fishes (25), algae (24), and mollusks (14). Most species are native to Eurasia (55%) and the Atlantic Coast (13%). As human activity has increased in the Great Lakes watershed, the rate of introduction of exotic species has increased. Almost one-third of the organisms have been introduced in the past 30 years, a surge coinciding with the opening of the St. Lawrence Seaway in 1959. Five categories of entry mechanisms were identified: unintentional releases, ship-

related introductions, deliberate releases, entry through or along canals, and movement along railroads and highways. Entry mechanisms were dominated by unintentional releases (29%) and ships (29%). Unintentional releases included escapees from cultivation and aquaculture, bait, aquarium, and other accidental releases. Ship-related introductions included ballast water (63%), solid ballast (31%), and fouling. Introductions via canals represent a small percentage of entries into the Great Lakes. We have identified 13 non-indigenous species (9%) that have substantially influenced the Great Lakes ecosystem, both economically and ecologically. The apparent lack of effects of 91% of the exotic species in the Great Lakes does not mean that they have had little or no ecological impact. Alterations in community structure may predate modern investigations by decades or centuries, and the effects of many species have simply not been studied. As long as human activities provide the means through which future species can be transported into the Great Lakes basin, the largest freshwater resource in the world will continue to be at risk from the invasion of exotic organisms.



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## Index words

Great Lakes; exotic species; non-indigenous flora and fauna; transport vectors

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