

## *Opinion*

# The non-mystery of non-native species

JAMES T. CARLTON, Maritime Studies Program, Williams College – Mystic Seaport, Mystic, CT 06355, USA [jcarlton@williams.edu](mailto:jcarlton@williams.edu)

**Key words:** cryptogenic, native species, non-native species

IN ALL DISCIPLINES of endeavor, we create dichotomies or trichotomies in which we distribute phenomena or patterns. We do so because these silos are overwhelmingly practical and pragmatic. Organizing the natural world into distinct categories often serves to assist managers, and the regulatory community in general, in the labyrinthine challenges of decision-making. And yet, despite these useful bins, we quickly recognize that a great many things cannot be comfortably placed in one category or another—that the world is full of exceptions, imperceptible gradations, and fuzzy inconsistencies. But this does not mean we abandon our goal to find patterns in a sea of variation.

There's the "ocean" and "land," but many habitats aren't quite either, being classic ecotones. The supralittoral (high beach) zone is a superb example: here we have a fleet of species that drown if underwater for too long and die on dry land, and yet we do not abandon the ocean/land dichotomy. It remains useful, and we recognize exceptions. Indeed, a good deal of ocean is now land (we filled it in), and yet we still don't cast away the distinction between the two. And so it is with a vast number of other dualisms: indoor/outdoor (with every conceivable gradation in between), conservative/liberal (or somewhere in between), or the stock market—said to have gone either up or down, even as many individual shares went in the opposite direction on the same day. Local coastal weather stations refer to conditions for either inland or shore as if there were a clear delineation, but few are confused by the geography of the predictions. These and endless more dichotomies persist because we find them convenient and useful in

most contexts.

And so it is with native and non-native species. These are often elegantly practical and clear categories—with exceptions, of course. But because there are exceptions does not mean that there is any mystery about regarding and classifying many species as either native or non-native. The modern-day expansions of species into regions where they may have occurred prehistorically (but were gone by the time humans appeared on the scene) do not obfuscate the delineation of native and non-native for most species—nor does the expansion of a protected native species into a region where it did not previously occur (at least in modern times), and which extension does not necessarily degrade its conservation status, even if the expansion functions as a novel invasion.

Thousands of pages in the peer-reviewed scientific literature are devoted to the question of discerning which species are non-native; this is an exhaustively explored topic. A cornucopia of research explores the evolutionary and biogeographic history of terrestrial, freshwater, and marine species, deriving data from a staggering variety of disciplines: paleontology, archeology, historical biology, human cultural and social history, biogeography, community ecology, evolutionary biology, molecular genetics, and so on. Based upon mustering a strong suite of evidence, we then attempt to conclude whether a species is native (present in pre-historic time) or non-native (introduced by human activity in historic time). For the latter, a plethora of synonyms exist, including alien, introduction, exotic, non-indigenous, peregrine, transplant, and invasive.

Despite this work, we do not yet know

whether many species are native or not. These are referred to as cryptogenic species, but their existence does not impugn a native/non-native concept. Rather, the recognition of cryptogenic species permits us to question the extent to which we truly understand the history of modern-day communities, in terms of their structure, energy flow, and regulatory processes. Identifying those species that are cryptogenic (often classically regarded as native) permits us to then undertake the necessary historical, genetic, and other studies to determine whether they are actually native or not—and thus potentially significantly improve our understanding of community history (which, in turn, may contribute to elucidating questions of conservation, restoration, and preservation). A large degree of uncertainty does exist about many aspects of the natural world, but we do not abandon our goal of striving toward resolving that uncertainty.

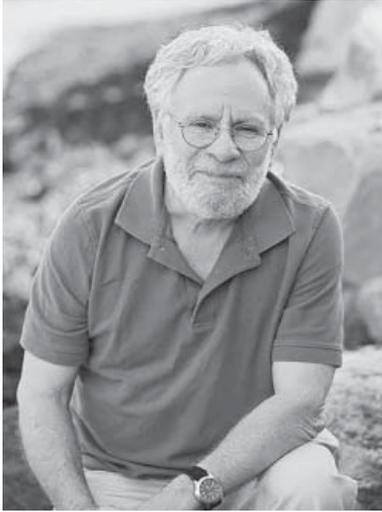
A good deal of literature has appeared in the past decade arguing that the concept of “non-native” is flawed. It is important to note, however, that the straw-man arguments often advanced to question the recognition of non-natives as a distinct category—these arguments being, amongst others, that native species can also have ecological, economic, or societal impacts—are typically not germane to the question about the nativeness of a given species. The impacts of a species have nothing to do with defining whether a species is native or not. Yet we continue to find the argument invoked that because many introduced species are not perceived as “harmful” (a concept like “invasive,” without objective quantitative boundaries), and because native species may be harmful, the dichotomy should not stand. A related argument advanced is that environmentalists, scientists, or others are said to regard all non-native species as pernicious (a statement that we do not find in the enormous amount of literature on invasions), while overlooking the impacts that native species may have. In fact, a significant amount of management attention has long been, and continues to be, paid to native species that also interfere with and impact societal, economic, industrial, health, or other goals and needs.

The arguments in older literature that “species move around naturally,” that “species

have been moving back and forth for millions of years,” and that “species distributions are constantly changing” are inapplicable to the modern cultural, societal, environmental, ecological and management concerns about exotic species invasions—past, present, or future. Most non-native species of concern, either retrospectively or prospectively, would never have gained and will never gain access to a given continent or ocean without being assisted by human transport, often with dire consequences. That species have shifted their geographic ranges over time along island chains, along continental margins, or in response to predators, habitat change, climate change, or other environmental shifts, is of no small interest but not germane to the concerns at hand. Rather, our interest concerns species such as zebra mussels (*Dreissena polymorpha*), house sparrows (*Passer domesticus*), and raccoons (*Procyon lotor*) in Japan—and thousands of other species—including a staggering catalogue of diseases, parasites, and pathogens, that have been moved around the world across impenetrable barriers, and that have fundamentally altered natural ecosystems and severely impacted human society. It is not a matter of listing a few examples of horrific invasions (such as the introduction of the New World oomycete fungus *Phytophthora infestans*, which caused the Great Famine in mid-19th century Ireland), followed by suggesting that most invasions have either no impact or even add to local biodiversity.

We can now move virtually any species anywhere in the world in 24 hours; our capacity to do so has no precedent whatsoever in Earth history. That is one of the most critical issues. Along with addressing the impacts of native species, we are thus required to tackle the economic, human health, and environmental impacts of non-native species, and spend hundreds of millions of dollars annually in the United States alone to do so. And it is because of these impacts that we are strikingly motivated to prevent future invasions whose impacts may be more devastating than we could imagine.

---



JAMES T. CARLTON is Professor of Marine Sciences Emeritus at Williams College (Williamstown, Massachusetts) and Director Emeritus (1989–2015) of the Williams College – Mystic Seaport Maritime Studies Program at Mystic Seaport in Mystic, Connecticut. His research focuses on the environmental history of coastal marine ecosystems, including invasions of non-native species and modern-day extinctions in the world's oceans.