Biological Invasion in the Era of Globalization

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Abstract

The objective of the article was to show how the diversity of the planet seems to get blurred due to the ongoing process of homogenization of flora and fauna on Earth. This was done by exploring the literature that provides a link between a globalized world and biological invasion. Though the literature on the subject is rather limited, but provides some insightful details into the matter. The article succeeded in showing that some of the innate tendencies of human behavior have actually made the problem of invasion worse. What remains to be investigated is the outcome of this continuous process of homogenization, whether it would lead to a complete destruction of diversity that the planet is known for, or whether the system would settle on a different equilibrium, where the term "native" would no longer hold relevance.

Keywords : **biological invasion, globalization, invasive alien species, propagule pressure, ballast water**

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Just like globalization, biological invasion is not a new phenomenon. There has been a continuous movement of people and commodities across geographical boundaries since prehistoric times. The phenomenon of biological invasion is not something unique to today's era of globalization. However, it goes back to the time when *Homo sapiens* started to move. The dispersal of seeds by animals wherever they travel is a centuries old process, which is also responsible for the continuation of life on the planet. *Homo sapiens* have carried forward this process by spreading species of animals and plants across the globe (Low, 2001). As humans started spreading to distant lands, their reliance on trade of commodities increased. This kinesis of commodities along with that of organisms led to the introduction of species to the ecosystems in circumstances that created in them the potential to become invasive. Such species can be categorized into alien, naturalized, invasive, and transformer according to the threats they pose on the basis of their ability to influence the ecosystem in which they are introduced. While alien and naturalized species may not necessarily invade an area or ecosystem, transformer and invasive species can produce reproductive offspring in such large numbers, which is sometimes sufficient to change the nature and characteristics of that area (McGeoch, Chown, & Kalwij, 2006).

The introduction of species can sometimes be deliberate - for example, the first mention of potatoes in the history of India, a crop without which no ordinary Indian household can think of preparing a meal, is a very recent introduction dating back only to the seventeenth century. However, very often, the introduction is unintentional and is realized only when the effects of the alien species on the ecosystem come up to the surface. Whether it is cocoa in Africa, wheat or rice in North America, or tomatoes and oranges in Europe - all have been a result of intentional introductions of species in these regions and have now become an integral part of their ecosystems (McNeely, 2001). On the other hand, we see that species like *Euphorbia esulain* in the United States are responsible for huge economic losses in terms of livestock production (Eiswerth & Johnson, 2002). According to

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Pimental et al. (2000) (as cited in McGarry, Shackleton, Fourie, Gambiza, Shackleton, & Fabricius, 2005), the total estimated cost of damages caused by invasive species is US$ 1.4 trillion per year.

Even though these invasions have been going on since centuries, it has come to the limelight only recently. Not only ecologists and environmentalists, but also economists are now trying to find ways of including the costs of the externalities imposed by these species on the environment at the time of framing different policies. The question that now raises curiosity is that even though both trade or movement of various species across territories and invasion of distant lands by them were a feature of societies from very historic times, what is so peculiar to the current phase of globalization that has made biological invasion and its relation to globalization an area of concern? The unprecedented increase in the importance and value of merchandise trade, especially in the last 50 years (Hulme, 2009), growth in global consumerism, and the increased role of military (McNeely, 2001) are some of the factors that can provide a reason for distinguishing the current era of globalization from other historical phases. The point to be noted is that this period also coincides with the predominance of capitalism along with greater reliance on "freer" markets and search for newer markets for products that can have demand in the global arena. The issue of sustainable development is increasingly finding it difficult to coexist with the motive of achieving higher profits by capitalists, resulting in higher pace of reaching the limits on the ecological front as the drive for surplus value often leads to a neglect of the frontiers of natural resources. To put it in the words of Hulme (2009), "…in recent decades, the world has entered a new phase in the magnitude and diversity of biological invasions: The Era of Globalization" (p. 10).

Link Between a Globalized World and Biological Invasion

(1) Improvements in Transportation Technology : The improvements in transportation technology with the coming of ships, railways, airplanes have all contributed to the spread of IAS (invasive alien species) (Staples, 2001). Trade and transport are also responsible for the spread of diseases from one part of the world to another, especially in the times of war. Hulme (2009) identified two primary drivers of globalization - transport efficiency and income growth and related them with the invasion process. The transference of ballast water that carry species to the ports ; the use of containers for cargo along with which these species can enter a region as a stowaway ; and better means of inland transportation facilitate the introduction of alien species. It was claimed by Streftaris et al. (2005) (as cited in Hulme, 2009) that ballast water alone is responsible for transporting 10,000 species every day.

It has also been shown that well-connected roads have a higher probability of receiving infected vectors from other areas. Hence, pathways like roads, bridges, and canals help in the penetration of species by connecting various areas and breaking the bio-geographical barriers that exist naturally.

Regarding income growth and its relation with biological invasion, Hulme (2009) observed that there exists a positive correlation between alien plant richness and GDP, which is stronger for island states than continents. The explanation for this relationship can come from the argument of Staples (2001) that a higher income in the hands of consumers in the developed world implies a higher ability to spend on luxuries like ornamental plants, and so forth. The demand for ornamental plants from any part of the globe through online nurseries, and the trade of exotic pets can be seen as a deliberate attempt to bring in exotic species. However, along with these targeted species come the unwanted weeds, pests, and disease causing organisms unintentionally. The theory suggests that the demand for exotic species is driven by the innate characteristic of human behavior to live near other species. This theory is know an 'Biophillia Hypothesis' (Edward O.Wilson 1984 as cited in Staples, 2001, p. 172), and to embellish their surroundings by gathering species from distant lands.

The hypothesis was justified by Staples (2001) by providing evidence to show that there is a cultural and behavioral trait that inspires people to shape the biota in a desirable way, but at the same time, he proposed that if the hypothesis actually holds, and it is possible to trace the reason for alien invasions to the science of human

behavior, then it would be very difficult to eliminate this tendency of humans altogether. However, it could be molded in a way that we face less dire consequences. The prediction by Mack (2001) that the greatest threat of invasion would come from the introduction of alien species for aesthetic purposes was derived from the "call home syndrome" (Mack, 2001, p. 29). In this respect, it becomes important as "…one of the most consistent among colonists has been the importation of aesthetic or ornamental plants" (J. Brown, 1999 as cited in Mack, 2001, p. 29).

(2) Revolution in Communications Technology : An additional reason that Staples (2001) provided for the rise in the movement of species across borders is the revolution in communications technology, that is, the development of new forms of media like the Internet that has intensified the process of globalization and has helped in reinforcing "…powerful messages about what is trendy, beautiful, luxurious, tasteful and so forth" (Staples, 2001, p. 175) in the minds of the consumers. Advertisements through print media, television, radio, and the World Wide Web indirectly affect the flow of invasive species by assisting in the formation of choices of consumers. Advertisements provide information that helps in shaping the perceptions of people around the globe regarding the "necessities" and "requirements" of life ; whereas, improvements in transportation technology allow people to access these "necessities," even by sitting miles away from the original source of the products. Communication technology also plays a crucial role in detaching people from their environment. Greater attraction towards television and the Internet leads to a higher disconnectedness of people from their natural surroundings - one reason for why they are unable to distinguish between what is native and what is alien (Staples, 2001). As long as this unawareness persists, people cannot go deeper into the problem of invasion and would not be able to identify their own role in escalating the problem.

(3) Propagule Pressure : Other authors who recognized trade as a major factor leading to biological invasions are Meyerson and Mooney (2007), who cited the example of China and USA (Jenkins & Mooney, 2006 as cited in Meyerson & Mooney, 2007) as the two major nations having the largest share in world's trade and are also the largest recipients of IAS. The other factors taken into account by them are propagule pressure, which is a direct result of trade and globalization, and the degree of disturbance of the area, that is, the greater the disturbance in an area, the easier it becomes to invade it. "…Anthropogenic disturbance, natural disturbance, soil, environmental conditions, or current vegetation cover" (Holle B. Von & Motzkin, 2007 as cited in Meyerson & Mooney,2007, p. 202) could be some of the factors influencing the level of disturbance in an area. When the same species is introduced repeatedly, propagule pressure rises and so does the probability of it becoming invasive.

The role of humans in disturbing ecosystems was captured by Low (2001). According to the author, there are two ways in which invaders can benefit from it- first, humans work to suppress native species and secondly, invaders learn to use disturbed environments after a period of time .

(4) Tourism : This era of globalization has seen a boom in the services sector of most economies. One of the main services that has benefited from the opening of economies to each other and the creation of a global economy is the tourism industry. Not just the trade of commodities, but the movement of people across borders, which has turned the world into a global village poses a significant challenge for management of IAS. The density of naturalized species was found to be positively correlated to the number of tourists that visit a country, the HDI, and GDP per capita (Vilà & Pujadas, 2001). Tourists can increase the number of alien species entering a region and also increase the costs of managing them (McNeely, 2001).

The other characteristics of a globalized world are the "love of mobility, freedom, speed, diversity, progress, familiarity, and a mechanistic view of nature" (McNeely, 2001, p. 37). According to Low (2001), the opposition to restrictive trade comes from the belief that it is a basic right of consumers to demand and consume products that they like. Till the time we value this freedom, it would not be possible to restrict the mobility of people and goods,

which is the major cause of alien invasion. It has also become increasingly difficult for the individual nation-states to control the flow of goods under pressure from global communities. The rise of transnational companies and international capital has further undermined the power of a state (Hattingh, 2001) and has homogenized the colours of local cultures. In a world where interdependence among nations has become inevitable because of the new concept of commodity chain production in which factories are outsourced to areas that can produce goods most cheaply, the opportunities of invasion get strengthened (Low, 2001).

Comparing the displacement of local drinks industry by Coca- Cola, Low (2001) emphasized on the possibility of *"McDonaldization"* of ecology (G.L. Lovei, 1997 as cited in McNeely, 2001, p. 40). Along with globalization comes the need and desire for greater speed as put in the words of Doughlas (1997) (as cited in McNeely, 2001) "…the costs of delay exceed the costs of mistakes" (p. 38). He pointed out that as people become more familiar with species that do not prove to be harmful to them, they come to be widely accepted as a native species. This acceptance further helps in spreading them.

The ignorance of people regarding the differences between native and alien species and regarding the costs associated with them adds fuel to fire. It is a general tendency of people to think about this problem in isolation, and the issue is often perceived to be important only for farmers (Low, 2001). According to Staples (2001), "Apathy, skepticism, and ignorance are powerful opponents to overcome" (p. 179). It is often seen that these invasive species are adopted by the local people into their cultures either when the cost of favoring indigenous species over them increases as indigenous varieties become more and more extinct, or as the time period of their existence increases (McGarry et al., 2005).

Managerial Implications

The concept of native and alien species that got evolved due to the geographical boundaries which protected the diversity of the planet seem to get blurred due to the ongoing process of homogenization of flora and fauna on the Earth. McNeely (2001) provided various solutions to the problem of IAS, mainly covering the human dimensions to it. Some of these are as follows:

- Placing a higher value on community including native varieties which can act as a counter to globalization.
- Ensuring internalization of costs of managing IAS and its payment by those benefitting from both intentional and unintentional introductions.
- Encouraging people to support conservation measures.
- Developing conservation practices, ethics, and societal values that focus on using ecosystems without degrading them and that could develop a sense of respect in the minds of people towards the environment.
- Assessing risks and detrimental effects according to the changes in future usage, when introducing a species deliberately.
- Inclusion of human dimensions into various conventions and global agreements.
- Management of global trading systems to reduce the noxious impact of IAS.

Low (2001) called for "…publicity campaigns all over the world to explain the threat posed by alien invaders, and the human processes contributing to them" (Low, 2001, p.42) and suggested that in order to show that trade and travel are uneconomical activities and should be banned, we need to do a cost- benefit analysis that includes the true cost of trade and travel.

The internalization of a problem calls for international cooperation and arbitration for its solutions. Though there have been attempts for international cooperation through conventions and protocols on the matter, but

success remains doubtful. The Convention on Biological Diversity and Global Invasive Species Program are two such steps taken up in this regard; however, the dissemination of information to general public regarding IAS still remains far from complete (McNeely, 2001). As put forth by Hattingh (2001), "Within the economic rationality of globalization, money, or figures - that which can be quantified - will always win, and aesthetic, recreational, cultural, and spiritual values that cannot be translated into monetary terms will always lose out " (p. 186). This economic rationality in itself may prove to be dangerous.

Jenkins (2001) suggested that if taxes are appropriated from the beneficiaries of globalization and are transferred to an international fund that works for preventing harmful invasions and carrying out global educational programs on the issue, the taxes would not be viewed as restrictions on free trade or an impediment to the freedom of people. He called for imposition of fees on three categories of people, first, on those who intentionally import a living plant, animal, or seed; second, on those who travel intercontinentally by ship or plane; and the third category comprises of ship and plane cargo, which is responsible for unintentional introductions of IAS.

The same technological innovations in transport, commerce, and communication, that have induced alien invasions, can also be used as a tool against them. Communication technology must be used to reach to the global audience and make them aware of the nature of this global problem. Efficient ways to prevent cross border transportation of species need to be invented (Staples, 2001).

Limitations of the Study and Scope of Further Research

Literature has provided us great insights into the role of globalization in promoting alien invasion and the human aspects to it. What remains to be investigated is the outcome of this continuous process of homogenization, whether it would lead to a complete destruction of diversity that the planet is known for or whether the system would settle on a different equilibrium, where the term "native" would no longer hold relevance.

Furthermore, a greater emphasis needs to be paid on the positive impacts associated with the process of invasion. It is only after a proper comparison of these positive and negative bearings that answers to some important questions related to biological invasions could be found. While most authors and researchers have focused on the negative impacts of invasion on the native environment like introduction of weeds, pests, and disease-causing organisms, loss of biodiversity and competition with native species for food and space; there are some positive externalities to the invasion process as well.

Rodriguez (2006) found that in many cases, interactions between exotic and native species can lead to facilitation of native species. Some of the ways through which exotic species are found to facilitate native species are :

- Habitat modification, which is defined as "the physical modification, maintenance, and creation of habitats" (C.G. Jones et al., 1997 as cited in Rodriguez, 2006, p. 929) either through 'creation of novel habitats,' or through the 'replacement of existing habitats'. For example, in the Azores and Madeira islands, the non-native plant community has completely replaced the native endemic forest and now, the native varieties of land snails depend on this new habitat formed by them (Riel P.Van et al. , 2000 as cited in Rodriguez, 2006).

- **Trophic Subsidy :** Invasion by other species can sometimes lead to nutrient enrichment as they increase the availability of nutrients to the native species. Also, they lead to food diversification, as manyatime, native species can depend on them as a food resource.

- Exotic species can act as pollinators and thereby facilitate natives.

- **Competitive Release:** Inferior native species benefit from the reduction in the population of their superior competitors.

↳ **Predatory Release:** Some native species benefit from a reduction in the number of their predators.

McGarry et al. (2005) defined a set of invasive species that are beneficial for the local environment and serve as a substitute for the indigenous species. The example that he provided is that of *Anagyrus lopzei,* that has positive impacts for the rural community. Most often, however, IAS creates a mix of costs and benefits, and ecologists and economists try to strike a balance between the two so that there are net benefits. Hence, it would be wrong to generalize the impact of IAS as they get "influenced by a number of local and contextual factors such as extent and density of infestation, availability of alternatives, costs and mechanisms of alien control, land tenure, discount rates, severity of loss of ecosystem goods, etc." (McGarry et al., 2005, p. 2).

Ecologists have argued that a restriction on trade and movement of people across regions is the only solution to the problem, but the question of its feasibility continues. It becomes even more difficult to incentivize people to support restrictive policies through a cost- benefit analysis when it is impossible to calculate the actual costs associated with it. However, an assessment needs to be made by the authorities regarding the management options of IAS and risks associated with these options. The dynamics of the invasion process and its long-term implications for the native species must be taken into account while framing policies for its control. The limited availability of data and the extensiveness of the study required have made research difficult on this topic. This paper tries to prove why research on this topic is important, but the above mentioned questions remain unanswered due to dearth of data and sources.

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