

Yixuan Wang  
MSCI 270-02 Ecology  
Prof. Chris Jensen  
March 1<sup>st</sup>, 2017

### The Double-Edged Sword of Invasive Species

When we look at the word “invasive” in the dictionary, the meaning of this adjective is very negative. It means something that tends to spread prolifically and undesirably. When it is used to describe species, we think about species are very harmful and not ecological-friendly. However, I think “invasive species” is actually a term that scientists give to those non-native species in order to give people a sense of what role they play in the ecosystem. Invasive species have tendency to do harm to our environment, but that is just part of them. Nowadays, when people talk about those non-native species, all we talk about are the negative effects that those invasive species bring to our environment. People don't know that by-product of invasive species can be positive. We must admit that some invasive species have had disastrous effects on the ecosystem, but we still need to re-define those non-native species closely and discover the real function of them. Even a invasive species that is disastrous in one context can be beneficial in another.

In my proposal, I try to bring in scientific studies or case studies to convey the idea that invasive species are not extremely evil to our ecosystem. They may have some benefits that are waiting for us to discover. Different from what scientists wrote in their articles by using case studies and scientific data to explain invasive species, I want to use more efficient method, which based on their scientific studies, to create a project to tell people that invasive species are not all evil to our ecosystem. Because not all people can read scientific article and understand those terminologies. Hence, I believe my way to introduce invasive species to normal people is more efficient than scientific articles and datas.

In Pearce's book, *New wild: Why Invasive Species Will Be Nature's Salvation*, he writes that there are horror stories about alien takeovers. Of course, most of those stories are set on small remote islands with only a few native species, where carnivorous rats, cats, and others hop off ships and cause mayhem [1]. I found a field experiment that talks about how invasive species affect native species richness in Fernando de Noronha Island. Scientists selected two main native species, *Capparies flexuosa L.* and *Erythrina velutina Willd.*, to be planted with the invasive species, *Leucaena leucocephala* which was introduced to Fernando de Noronha as an alternative food supply source for livestock because of its fast growth, drought tolerance and nitrogen assimilation capabilities [2]. The results of different treatments are interesting. *Capparis*, as the native specie, actually can live with *Leucaena* harmoniously. *Leucaena* was absent from only 39.5% of the plots sampled in the island, and 10.5% of the plots sampled were highly invaded, with *Leucaena* plants forming mixed stands with other species [2]. The invasive species *Leucarna* indeed threatened native tree species and caused the 50% lower tree species richness on the island [2]. However, this field study remind me of what Pearce said in his

book, the entire phenomenon occurred only on a small island. There is no other huge disaster caused by *Leucaena*. The percentage of invade area is more lower than where it absents. Moreover, the results of the field study are not all negative. When scientist did germination studies, they did not find allelopathic effects(an organism produces one or more biochemicals that influence the germination, growth, survival, and reproduction of other organisms) of *Leucaena* on *Erythrina* germination. But they also said this positive effect between *Leucaena* and *Erythrina* needs further investigations [2]. From this article, scientists not only study the negative effects of invasive species, but also seek to find invasive species' positive aspects in our environment. Scientists showed great level of materials and datas to convince us that they are very positive about invasive species. Hence, I think I can take this kind of idea into my creative work to convince people that scientists are now discovering positive effects of invasive species.

Despite what invasive species did on this small island, we need to expand our horizon to more global activities. Following the development of international commerce, the movement of species became more and more active intercontinentally. In the article, *The evolutionary impact of invasive species*, scientists claim that the actual numbers of individuals and species being transported across biogeographical barriers every day is enormous [3]. There are now as many alien established plant species in New Zealand as there are native species. Many countries have 20% or more alien species in their floras [3]. Geographically, those invaded places are mainly island. However, only a few transported species become established and only about 1% of them become pests [3]. Pearce writes in his book that fewer and fewer ecologists believe nature is either stable or perfectible. Real nature, they say, is often random, temporary, and constantly being remade by fire, flood, and disease—with species coming and going, fitting in, adapting, or losing out. Change is the norm [1]. I strongly agree with what Pearce said in his book. The earth changed a lot in the past and many species came and went in different ways. The whole world is changing and it won't stop changing. Indeed, many scientists now are tending to move their focus more on studying and excavating the positive effects that invasive species bring to our ecosystem. They also prefer to find methods to properly manage those invasive species. This kind of new ecological thinking is very crucial for us to understand the meaning of conservation and how can we protect our nature by using those benefits that we discovered from invasive species.

A study of positive effect of non-native grasses on the growth of a native annual in a southern California ecosystem gives us an example. Positive interactions between invasive and native species actually have potential in structuring plant communities. This kind of interaction occurs when a species is able to either improve the growth, survival or fitness of another [4]. In the article, we can know that non-native species can act as food sources or pollinators and can reduce predation pressure for native species. The main experiment of in this article is to test the effects of non-native grasses on a native species called *Cryptantha muricata*, which widely distributed throughout California. Because *Cryptantha muricata* is loosing its seed bank, scientists in this article find ways to conserve its seed. Scientists tried different ways to plant two species together. The final result is that *C. murucata* reproduction was greatly enhanced by non-native grasses. It

produces 6 times more flowers and also more inflorescences in the control treatment than in the treatment that grasses were removed [4]. From this study we can know that invasive species not only can be transported accidentally by human activities, but also can be intentionally used by humans to conserve our ecosystem. Scientists nowadays are intentionally finding ways to use those benefits that invasive species have and try to manage them properly. So far, should we call all non-native species as invasive species? The answer for me is definitely no.

Scientists nowadays are discovering different approaches to manage invasive species. The landscape-scale management may be one of the commonly used choices. It is about how to prioritise management efforts from local to regional scales in order to identify effective strategies for invasive species control. Other managements like Metapopulation theory which is a management strategy for invasive species based on metapopulation structure and control capacity is also efficient [5]. Those managements above indeed work at some point, but they are actually focused narrowly to control spread and infestation. Continental scale estimates suggest that thousands of invasive species have generated billions of dollars in economic losses [6]. Because a lot of these losses due to association with human activities. Scientists in another way try to manage invasive species more by associating them with human activities. Following this clue, I think it is more effective to let people know about invasive species' pros and cons in order to prevent unnecessary situation. In another word, people's knowledges in managing invasive species is the strongest strategy to manage invasive species. Invasive species are mainly caused by human activities. If we want to properly control them, we need everyone in the world to care about and learn about them. But it is impossible that if we want everyone to learn invasive species as what scientists do. Hence, all researches I did in this proposal are mainly want to support the idea that invasive species have both negative and positive effect on our environment. People cannot only focus on their negative aspect just because of its name called "invasive species." Moreover, scientist are finding ways to help people to better control and use them. Therefore, I want to design a logo that people all over the world can understand it. This logo can be simple, but the meaning behind this logo is significative. The information about positive invasive species can be spread person by person through communication, but the trigger to talk about this topic is what I really want to create. After people see this logo, they can start to learn what is real "invasive species". Making majority people in the world know about this logo is hard. But once the logo is designed, I want them to be printed on badges, rings, t-shirts and other similar products that everyone can have in their daily life. This logo will become an "invasive" product that "invades" into many people mind. If a person who does not know about this logo, he or she may see it on someone's bag and ask about the meaning of the logo. Then once the information spread to one person, it might have a chance to spread to other thousands of people in the world. Once they know about that invasive species have both positive and negative effects on our ecosystem, they are more willing to cooperate with scientists and governments.

## Annotated Bibliography:

### 1. New Wild: Why Invasive Species Will Be Nature's Salvation

The main idea of this book is about the positive effects that those invasive species brought to some land in recent years. The author of the book holds very positive attitude towards those invasive species. He admits that invasive species may cause some disasters to environment, but people also need to find their benefits and use them for people's advantage; most newcomers also provide ecological services.

Pearce, Fred. *New Wild: Why Invasive Species Will Be Nature's Salvation*. Boston, Massachusetts: Beacon, 2016. Print.

### 2. Making a Bad Situation Worse: An Invasive Species Altering the Balance of Interactions between Local Species

This source gives me a basic sense of what is invasive species and why they do harm to our environment. Scientists did field experiment that talks about how invasive species affect native species richness in Fernando de Noronha Island. Scientists selected two main native species, *Capparies flexuosa* L. and *Erythrina velutina* Willd, to be planted with the invasive species, *Leucaena leucocephala*. The results shows that even *Leucaena* do harm to that island, but there is still some positive effect.

Mello TJ,Oliveira. 2016. Making a Bad Situation Worse: An Invasive Species Altering the Balance of Interactions between Local Species. *PLOS ONE* 11(3): e0152070. doi: 10.1371/journal.pone.0152070

### 3. The Evolutionary Impact of Invasive Species

There are examples of invasive species altering the evolutionary pathway of native species by competitive exclusion, niche displacement, hybridization, introgression, predation, and ultimately extinction. In the course of this review, scientists have discussed the mechanisms by which invasive species evolve in response to their new biotic and abiotic environments, and how invasive species have altered the evolutionary trajectory of native species with which they interact.

H. A. Mooney\* and E. E. Cleland. 2001. The evolutionary impact of invasive species. *Proceedings of the National Academy of Sciences* vol. 98 no. 10:H. A. Mooney, 5446–5451, doi: 10.1073/pnas.091093398

### 4. Positive Effects of Non-Native Grasses on the Growth of a Native Annual in a Southern California Ecosystem

This article is about a A field manipulative experiment with control, litter, and bare ground treatments was used to examine the impact of non-native grasses on growth and establishment of a native herbaceous species. Total biomass and number of fruits were greater in the plants growing in the presence of non-native grasses. Total biomass and reproductive biomass was also greater in late germinants than early

germinants growing in the presence of non-native grasses. This study suggests a potential positive effect of non-native grasses on the performance of a particular native annual in a southern California ecosystem.

Pec GJ, Carlton GC. 2014. Positive Effects of Non-Native Grasses on the Growth of a Native Annual in a Southern California Ecosystem. *PLOS ONE* 9(11): e112437. doi: 10.1371/journal.pone.0112437

#### 5. A Landscape Approach to Invasive Species Management

This article talks about two management actions to invasive species. Effective management requires knowledge on the interplay between metapopulation network topology and management actions. Scientists address this knowledge gap using simulation models to explore the effectiveness of two common management strategies, applied across different extents and according to different rules for selecting target localities in metapopulations with different network topologies. The two management actions are: (i) general population reduction, and (ii) reduction of an obligate resource.

Lurgi M, Wells K, Kennedy M, Campbell S, Fordham DA. 2016. A Landscape Approach to Invasive Species Management. *PLOS ONE* 11(7): e0160417. doi: 10.1371/journal.pone.0160417

#### 6. Incentivizing the Public to Support Invasive Species Management: Eurasian Milfoil Reduces Lakefront Property Values.

This article talks about the economic evaluations of invasive species are essential for providing comprehensive assessments of the benefits and costs of publicly-funded management activities, yet many previous investigations have focused narrowly on expenditures to control spread and infestation. They use hedonic modeling to evaluate the economic effects of Eurasian milfoil (*Myriophyllum spicatum*) invasions on lakefront property values of single-family homes in an urban-suburban landscape.

Olden JD, Tamayo M. 2014. Incentivizing the Public to Support Invasive Species Management: Eurasian Milfoil Reduces Lakefront Property Values. *PLOS ONE* 9(10): e110458. doi: 10.1371/journal.pone.0110458