Technologies used to monitor and control the spread of invasive species

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Abstract. This work was done to outline the importance of monitoring and control through different technology. Modern technology allows scientists to thoroughly study, monitor and control invasive species. It is well known that invasive species can be dangerous for the environment and for humans as they introduce uncertainties into the system they are involved and hence negatively influence. Therefore, the article will look into the technologies that are used for control and monitoring. This work also explains what is the invasive species. In addition, the article will also look into the positive and negative effect these species can introduce.

1 Introduction

It is always believed that more vegetation means a healthy ecosystem. Indeed, most of the time, it can be true. However, there are always some exceptions that are important to be studied in favor to be prepared for unexpected outcomes. Our environment, due to different factors, goes through difficult stages. Late temperature shifts introduce events that harshly influences the environment we know. In some cases, it is altered dramatically and in some fully destroyed.

Populace increase is the main factor of environment disability. More people mean more food and goods to be produced, and most imploringly it takes more space out from nature for the transformation that humans desire. At the same time, new innovative ideas and technologies are implemented in different areas for the decision of such negative influences. Their applications in some cases guarantees reduction of unwanted events, but also can introduce new ones if used incorrectly [1].

There is one special case when nature could hurt itself through humans' intentional or unintentional deeds. Invasive species are the species that are introduced to the new ecosystem, through different events, which are not belonged to them. These species can greatly influence nature, equally to other disasters and human activities. Henceforth, it is important to be able to control the spread of such invaders that could potentially alter or destroy well established ecosystems [2, 3].

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2 Invasive Species

It is a common belief that more green has a great influence to the environment and similarly to the ecosystem. In reality, it is not always true and, in some cases, excess could mean danger to ecosystem, humans and for other form of livings too. The type of invaders that has dramatic impact on ecosystems is called invasive species. As one could notice, the word invasive explains the overall aim of these species. Invasive species are plants, animals, bacteria. In simple word, an organism that can occupy the territory of other native species and in the process alter or fully devour the area of spread. There are different species and type of invaders that can be classified into the categories, which have mild or severe effect on ecosystem and sometime positive effect too. However, the following work will mainly cover these species in terms of usage of technology for monitoring and controlling the spread [4].

3 The Danger of Invasive Species

The loss of uniqueness is the first effect of invasive species. Invasive species can occupy area (which is not belonging to them in the first place) with the native species and slowly alter the ecosystem in it. This could lead to the state where the initial system is being augmented and loss of the uniqueness of the environment. In some cases, this process is beneficial for the environment, but most of the time could lead to severe results. The change of the ecosystem will endanger these species that are native to the area. It is also will make it is harder for them to survive as the environment goes through changes. The end result of alternation of the ecosystem is the end of the ecosystem.

The danger of system collapse is one of the severe cases that can be introduced by the invaders. With a system collapse, there is chance that this effect will do harm on other systems too, similar to domino effect. In the end, all systems exist within other systems and similarly coexist with them. If the system is altered within, the effect (result) is the loss of its uniqueness and its role in the overall system. Meaning, the loss of one system will have influence on other systems, putting them in danger too.

Some invasive species are not only harmful for the environment, but they could have health related impact on humans. It is believed and also could be true in some cases that environmental changes or loss can have effect on human through introduction of new despises and standard of livings. There are species that are hazardous and can cause some serious issues and even fatal outcome for humans. And the quality of the environment is directly related to the humans' health that lives in area of the system. Therefore, it is important to monitor and control the spread of unwanted species in area that is new to them [5, 6].

4 Positive Impact of Invasive Species on Ecosystems

Everything can be viewed through different lenses. From one point of view, invasive species can be harmful for the environment and humans and from other, if used correctly, they can be beneficial in many ways. Invasive species, specifically plants, can be introduced to system, which lost its vegetation due to some factors. These species can adapt and be well in harsh environment and therefore beneficial in many ways. Although, monitoring and control must be implemented as well, even if it was introduced to enrich the system. If the introduced species get out of reach or control, there might be some severe consequences. The other example, if looking to animals or insects, they can be introduced to fight other pest that are hard to handle with the traditional methods. They can also be used to overcome problem with biodiversity. Most of the time, invasive species are related to biodiversity killer as it

outnumbers native species. However, in rare cases it can provide missing puzzle. Some species that are not native to the place can be placed there to fill the niche, as it allows some ecosystems to benefit from such intruders. For sure, there are other potential to the invasive species, but most of the time they are negative or neutral [7, 8].

5 Technologies Used to Monitor and Control the Spread Of Invasive Species

As it was mentioned many times in this work, invasive species are bad for the environment and for livings. Therefore, some approaches must be taken to stop the harmful side of these species. In modern days, technologies improved to degree, where their capabilities are so much vast that they can be utilized in any fields. They promise countless tools that can be utilized in controlling and monitoring the spread of invasive species. Therefore, this section will be devoted to exploring what are the common tools or technology used in this field and how they can be improved in the future [9].

5.1 Remote sensing and GIS

Different point of views opens a wider horizon of things to be studied. One can view the changes and other important parameters from the ground, although the whole picture cannot be scoped in this case. Consequently, more refine tools are needed and hence Remote Sensing and GIS. These technologies are capable of capturing the necessary information from above. Remote sensing can be reimagined as satellite or aerial (drones and other similar flying sources are included) photography that can capture valuable data for monitoring and control of invasive species. GIS used to map the ecosystem that are infested by the invaders and use it for the decision-making stage [10].

5.2 eDNA and T&M Devices

Environmental DNA is used for early tracing invasive species and Trap and Monitoring Devises for further interaction. eDNA uses the latest technological advancement for the detection of traces of DNA of organism in different states (water, soil and other states) of the environment. This approach can be used to identify any invasive species that are not belonging to the area. It also can identify invasive species even if they are not visible for the human's eye. T&M Devices are used for further involvement after some of the invasive species have been identified. These devises are used to trap, monitor and most importantly to control [11].

5.3 AI

AI is the most commonly used tool in latest decades. This technology advancement is related with the technological progress in different fields that gave it the capabilities it has today. This technology is adopted by almost any industry and its application are only rising despite the fact that there were cases where the technology was to be stopped or at least slowed in its development. However, nothing happened, and the technology is improving daily. Its use in the field of invasive species are no surprise as it perfectly suits for such case. Modern AI powered tools are so powerful and at the same time less time-consuming. It can detect any object if it was well-fed with data and programmed in the right manner. Using different sensors, it can detect different species and classify them into the categories. Using the technology mentioned above and other tools, it can easily identify the areas infested with

invaders and identify them as well. Then it can monitor and control and also provide prediction of the spread and the harm that the system will be influencing due to these invaders. Of course, there are other technological methods that are used in fighting invasive species. However, the main thing is to identify the issue and precisely chose the correct tools [12, 13, 14].

6 Conclusion

To conclude, the spread of invasive species must be monitored and controlled, as they can easily harm not just ecosystems but also humans and other forms of life. This work, first and foremost, illustrates what invasive species are and how they can be identified. This work also covers the positive and negative effects of invasive species. The main focus of the article is to illustrate which tools or technologies are used to monitor and control their spread in a new system.

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