HIGH SCHOOL EDITION
Journal of Student Research
Volume 13 Issue 4 (2024)

Invasive Species in Washington State

Kaustubh Maheshwari

North Creek High School, USA

ABSTRACT

This research aims to study the rate of advancement of invasive species that have made their way into the state of Washington and their harmful effects on the ecosystem. The climate of the state of Washington is temperate, which is primarily caused by the Pacific Ocean. The ecosystem is marked by mountain ranges such as the cascades, which harbor dense forests all the way to coastal lowlands. Due to the relatively wet climate of the Pacific Northwest, the ecosystem is home to a diverse amount of Flora and Fauna, fostering growth around coastal areas as well as the creation and continuation of estuaries and rivers. The state of Washington faces multiple challenges such as habitat degradation, climate change, and the elimination of indigenous species. One of the major causes of these challenges is the increasing presence of multiple invasive species over the last few decades. Invasive species can drastically change the dynamics of the ecosystem by outcompeting native species for essential resources. This can have an adverse effect on biodiversity leading to not only an ecological imbalance but also incurring significant economic costs. The presence of invasive species can impact sectors like agriculture, forestry, fisheries etc. The effect of invasive species often can result in diseases impacting human health. It is therefore crucial to study the impact of invasive species so that we can understand what steps we can take to safeguard biodiversity, human health, and the economy from their impact.

What Is an Invasive Species?

Before we move further, we need to understand what an invasive species is. An invasive species is a plant, animal, fungi, or microorganism that doesn't grow naturally in a region and is capable of harming the species that grow natively. In the absence of their natural predators, diseases or conditions that put a check on their population, the invasive species tend to overpopulate and therefore compete with native species for resources. This can lead to an adverse effect on the ecological balance of that region.

The most common reasons due to which invasive species spread are activities like trade of goods and services between places of different ecosystems. The species when taken to a different ecosystem may find the suitable conditions to thrive in. For example, Bullfrogs which are native to the central and eastern US, entered Washington state through aquarium and pet trades and are invasive to West coast ecosystem. Figure 1 shows bullfrogs as an invasive species on the West Coast including Washington.

Figure1. Bullfrog distribution in USA in 2016 provided by United States Geological Survey

Scope of Analysis

Invasive species can drastically change the dynamics of the ecosystem by outcompeting native species for essential resources. This can have an adverse effect on biodiversity leading to not only an ecological imbalance but also incurring significant economic costs. The presence of invasive species can impact sectors like agriculture, forestry, fisheries etc. The effect of invasive species often can result in diseases impacting human health. It is therefore crucial to study the impact of invasive species so that we can understand what steps we can take to safeguard biodiversity, human health, and the economy from their impact. The scope of this research is to study the following

1. Collect geospatial data of invasive species in Washington state and analyze the spread of invasive species over the years
2. Study the impacts of invasive species on biodiversity
3. Study the impacts of invasive species on the economy
4. Study the impacts of invasive species on recreation

Methods

As part of this research, I looked into various literature, Washington, and US government sites to understand what invasive species are and how they can impact us. I collected geospatial datasets from government portals to study the progression of invasive species.

Impact Of Invasive Plant and Animal Species on Biodiversity, Economy, And Recreation

I first collected the major species information that are impacting Washington state from portals like Washington Invasive Species Council. I further studied the impact of these species on biodiversity using the information available in King County and Washington government Sites. Then gathered the data on the economic impact of invasive species from a report “Direct Costs Estimates and Economic Impacts for Washington State” published in 2017.

Geospatial Datasets

To study the spread of invasive species over different time intervals, I first took Washington County's geospatial data from the Washington Geospatial Open Data Portal. I also downloaded the Invasive species data for the US from the

USDA Forest Service database. Then I used the QGIS Geospatial data tool to layer the above datasets to see the spread of invasive species in Washington. I could study the progression of invasive species over different time intervals by using the filter option to create different datasets for different time intervals.

Analysis

When an invasive species is introduced to a new environment, it leaves behind its natural predators and controlling factors in its original home. Due to this, it quickly spreads in the new environment outcompeting the native species. Depending on species and location, they can harm food chain dynamics, change habitat, accelerate soil erosion, endanger wildlife, and reduce agricultural and farmland production.

Geospatial Invasive Data for Washington State

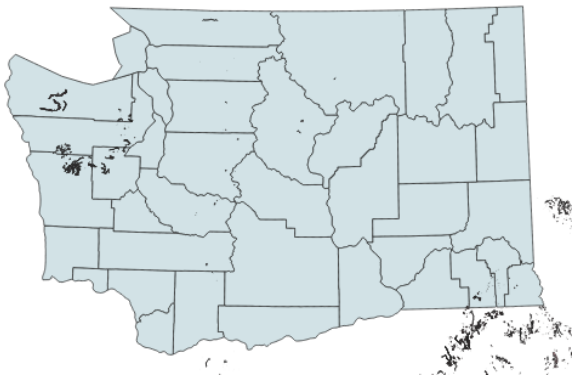
In order to analyze the spread of invasive species, I downloaded the following datasets

1. Washington County geospatial dataset
2. Invasive Species USA geospatial data set - This dataset contains invasive Plant Infestation polygons collected by the National Invasive Plant Inventory Protocol from the year 2000 to 2017
3. Noxious weed survey dataset for WA State Parks

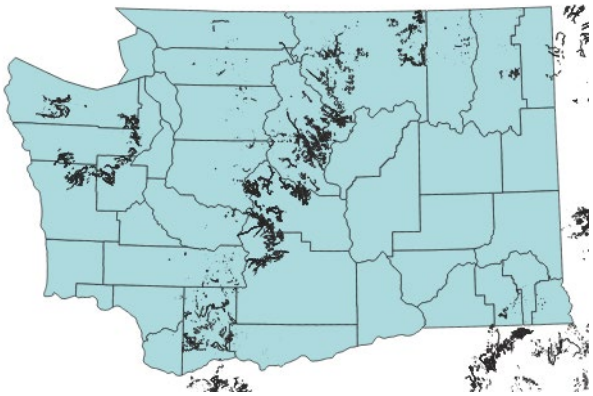
I used QGIS and online ArcGIS to analyze the invasive species datasets by layering the Washington County dataset.

Invasive Species Spread in Washington State Over the Years

I filtered the invasive species dataset by years to obtain their distribution with time progression. Figure 2, shows the invasive species distribution in Washington state in the year 2000, year 2010, 2020, and then in 2024.



Invasive species in WA before the year 2000



Invasive species in WA by year 2010

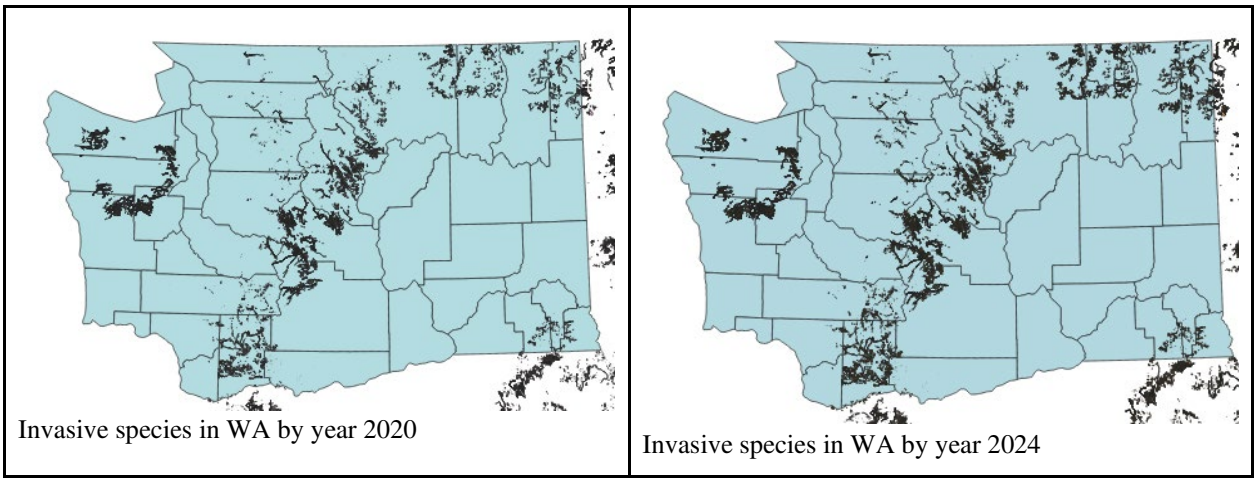


Figure 2. The spread of invasive species from the year 2000 to 2024

Invasive Species Distribution in Washington State Parks

By layering the noxious weeds dataset over Washington counties dataset, I obtained the invasive species distribution in Washington state parks as shown in Figure 3. The red highlighted dot in the figure has details on the right pane. This shows the presence of Himalayan Blackberry in Rockport State Park with other details.

Identify Results

Feature	Value
Noxious_Weed_Points [16]	
Other Weeds	NULL
(Derived)	
(Actions)	
OBJECTID	327
Observer	Lmk
Date	9/13/17 15:41:41 (UTC)
Affiliation	WA State Parks
Park	Rockport
Location Description	Intensive recreation (picnic area, swim bea...
Soil Disturbance	Slight signs of soil alteration/erosion.
Fire Disturbance	No fire damage present
Weed Species	Himalayan blackberry
Other Weeds	NULL
Treatment Priority	Medium Priority
Comments	Dig blackberry as soon as possible. Picnic ...
GlobalID	{B611882C-7944-4132-9825-13A397F1B...
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL
Other Weeds	NULL

Figure 3. The distribution of invasive species in WA state parks using QGIS

Results

Impact on BioDiversity

Invasive species can drastically change the dynamics of the ecosystem by outcompeting native species for essential resources. This can have an adverse effect on biodiversity leading to not only an ecological imbalance but also incurring significant economic costs. It's been noticed that around 25% of Washington's state plant species are under threat due to invasive species.

The following Figure 4 shows a strong correlation between the spread of the invasive species in Washington state and the burn probability projections.

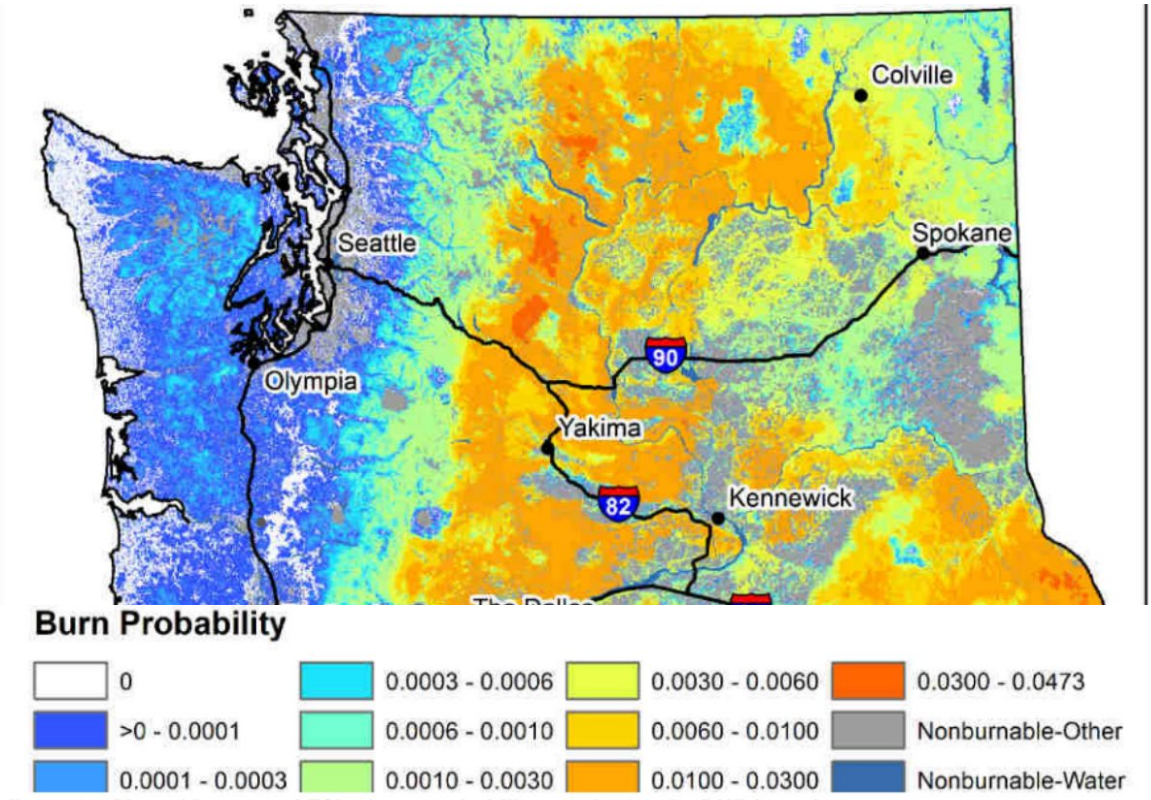


Figure 4. Shows a strong correlation between the spread of the invasive species in Washington state and the burn probability projections.

Invasive Plant Species

Approximately 650 invasive plant species have already been documented in Washington, major ones are listed in the Table 1 below.

Table 1. Invasive plant species, their distribution and impact on biodiversity

Species	Area	Impact
Scotch Broom	It is present in many parts of Washington.	Scotch Broom affects the farmland and also increases fire hazards. Scotch Broom can also affect wildlife as it is mildly poisonous.
Cheat-grass	Cheatgrass is predominantly present in the in-termountain west area which is the east of the Cascade Mountains	Cheatgrass increases the fire frequencies and their magnitude.
English Ivy	English Ivy is present in Western	English Ivy covers forests and kills trees as it can weigh them down making them more likely to fall.

Butterfly bush	It is present in Western Washington including Clallam, Clark, Cowlitz, King, Lewis, Skagit, Snohomish, Thurston, and Whatcom counties	It is pretty looking and provides nectar sources to insects instead of native plants thus affecting pollination.
Brazilian elodea	It is present in the water bodies of western Washington.	These form dense mats in water bodies that choke the native aquatic plants. In the Chehalis River in Western Washington, it is responsible for blocking the passage of salmon.

Invasive Animals

The following Table 2 shows the invasive animal species, their distribution, and impact on biodiversity

Table 2. Invasive Animal species, their distribution, and impact on biodiversity

Invasive Animals	Area	Description
The African clawed frog	Identified in 2015 in King County	They compete for resources with native species. They may carry harmful pathogens and affect fish populations including salmon.
Gypsy moths	It has been introduced since 1974.	It is one of the worst pest insects. It is responsible for defoliating the hardwood tree species. Washington State Department of Agriculture invests significant effort each year to detect and eradicate any new infestations.
European green crab	It is found in Washington's Pacific Coast.	The European green crab eats smaller crustaceans and many other plants which adversely impacts crab, clam, and oyster populations.
American bullfrog	It is present in the lowlands of Washington state.	Bullfrogs can eat practically anything from tree frogs to amphibians like western pond turtles, minnows, small birds, and young snakes.
New Zealand mud snail	It is present in the lower Columbia River, Long Beach peninsula, and in King County.	These are very tiny snails and compete with other snails and insects. They impact food chains and fish populations.
Nutria	Nutria is a rodent that lives in freshwater environments in western Washington and central Washington.	Nutria constructs burrows that cause waterbody bank collapse and erosion. They carry parasites and pathogens.

The following graph (Figure 5) shows the threat to the number of native species of conservation concern by invasive species in different regions of Washington State.

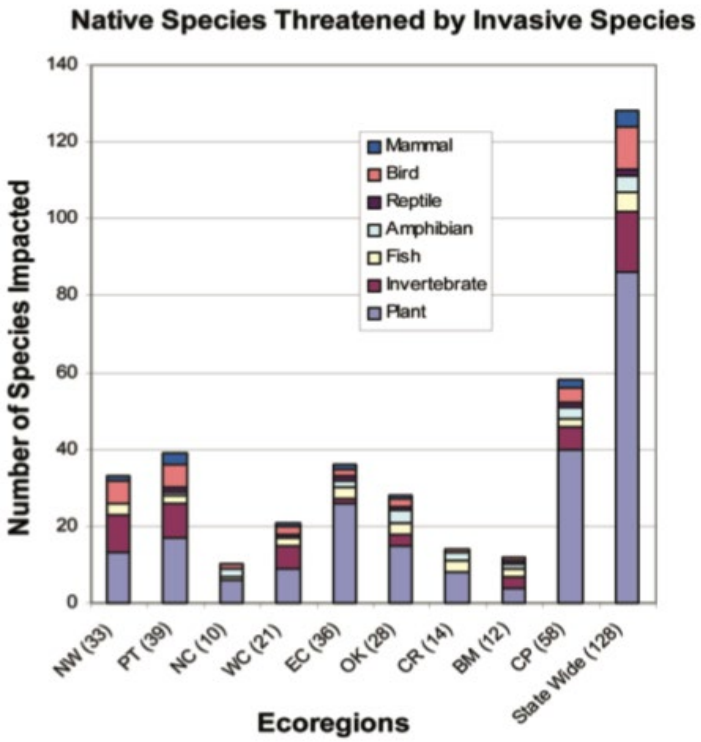


Figure 5. Native species threatened by invasive species in different regions of Washington

I downloaded a geospatial dataset for areas of unprotected biodiversity importance of imperiled species in the United States. Using ArcGIS, layered this with Washington County's dataset to analyze the threats to biodiversity in Washington state as shown in Figure 6.

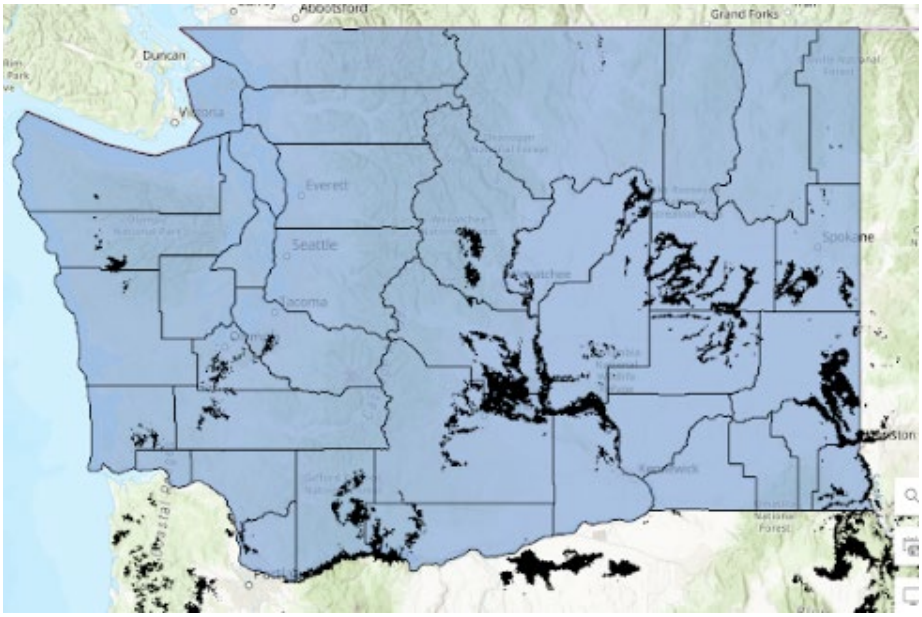


Figure 6. Areas in Washington state with a concern for biodiversity

Since the invasive species could be a threat to biodiversity, it would be advisable to take preventative measures in these threat-prone areas.

Impacts on Economy

As per research conducted on potential economic damages caused by 23 select invasive species in Washington state, the economic impact translates to lost jobs, lost wages, and lost business sales. Table 3 lists the direct economic cost associated with invasive species for areas like crops, livestock, timber, and recreation.

Table 3. Direct economic cost associated with invasive species for Washington state in 2017

Impacted Area	Annual cost	Description
Crops	$239.5 million	Crops can be easily infested by invasive plants or destroyed by invasive animals.
Livestock	$120.1 million	Invasive noxious weeds can displace the desirable native forage required for livestock and horses
Timber	$124.8 million	Invasive noxious weed species scotch broom adversely affects timber production by out-competing new saplings.
Recrea-tion	$20.5 million	Invasive species that affect livestock can also impact the population of elk and deer, Aquatic invasive species can impact the fish population and some can even clog the boat propellers making public boats unusable.

Impact on Recreation

Finally, Table 4 lists the impact on recreational activities due to invasive plant species.

Table 4. Impact on recreation due to invasive species for Washington state

Invasive Plants	Impact on Recreation
Fragrant water lily	It spreads out in ponds and wetlands, adversely affecting boating and other water recreation.
Brazilian elodea	These grow in mats affecting recreational activities such as swimming and fishing.
Himalayan black-berry	The dense bushes of Himalayan blackberry affect access and increases park management costs.

Conclusion

Based on the geospatial and other data sources mentioned in the previous sections we clearly see the proliferation of invasive species over the time periods specified. We can posit that this change will exert significant negative impacts

on recreation, biodiversity, and the economy. Further analyzing the graphs, we can see that the initial regions of where invasive species were found seemed to have darkened (increase in invasive species density), as well as a further spread of these species toward the relatively urbanized areas.

1. Greater amounts of invasive species will spread into areas of recreation (Ex. State Parks), damaging not only the ecosystem around it but also posing a hazard to public health. Recent estimates about the amount of money lost due to species in the recreation sector suggest that we will see inflated numbers relative to those we have seen in the past.
2. As for the economic impacts, the greatest affected sector will be that of the agricultural sector. Crops and livestock have been profoundly affected in the past, and the spread of these species into previously protected regions will further decrease the gross output. This will ultimately result in a greater loss of revenue and increase the overall cost of reparations.
3. In areas prone to biodiversity loss we can assume to see greater displacement of indigenous species. Further destabilization of ecosystems could take place if preventative measures aren't taken. With species spreading into these prone habitats, we can also assume that these habitats will facilitate a greater spread of invasive species in the rest of the state, almost acting as a gateway.

However, with the increasing amount of species, there has also been an increasing amount of awareness regarding the field. The extent to which the species have spread will be difficult to combat due to the rapid growth (due to factors such as commerce) that have outcompeted our devices to protect the environment. However, with innovation, it is possible that we see the graph plateau later on.

In the meantime, we continue to posit that we will see an increase in the spread and density of invasive species, alongside the impacts on each variable.

Acknowledgments

I am very thankful to my school teacher, Mr. Raymond Barber for being my advisor on this study.

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