

Importance of indian  
river lagoon  
biodiversity  
environmental  
sciences essay



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## 1. INTRODUCTION

The Indian River Lagoon (IRL) estuary system is the most complex, dynamic coastal estuary system on the North American continent. The blending of salt and fresh waters coupled with the lagoon's geographic location results in an exceptional habitat in which marine species from diverse environments can coexist (FDER, 1989; IRLNEP, 1991). The Indian River Lagoon National Estuary Program compiled a comprehensive species list to better manage conservation efforts (Swain, Hopkins and Thornton, 1994). Figure 1.

Overview image of the Indian River Lagoon. Image taken from Seaworld. org

The Indian River Lagoon estuary (IRL) is actually composed of three bodies of water, the Indian River Lagoon, the Mosquito Lagoon, and the Banana River.

The IRL system extends approximately 156 miles along the eastern Florida coastline and ranges from the Ponce de Leon Inlet to the Jupiter Inlet. The IRL system covers approximately 2, 284 square miles with more than 353 square miles of open surface waters (Figure 1). The IRL system of habitats range from: barrier and spoil islands (Parkinson, 1995); mangrove forest (Schmalzer, 1995); seagrass meadows (Dawes et. Al., 1995).

## 2. Importance of Indian River Lagoon Biodiversity

The potential decline of biodiversity in the IRL system was acknowledged as a matter of national importance (DeFreese, 1991). Understanding the complex interaction among such a diverse group of organisms in a fluctuating marine environment is crucial to insuring the longevity of the Indian River Lagoon and preventing the extinction of many of its inhabitants (Wilson, 1988).

## **2. 1 Ecological Value**

The diverse ecosystem of the IRL contains seagrass meadows, mangrove forest, spoil and barrier island habitats, oyster reefs, as well as species from temperate, tropical, and subtropical areas. The seagrass meadows of the Indian River Lagoon offers a substantial biomass that serves as a habitat, nursery, and food source for a wide arrangement of lagoonal marine organisms. Seagrass is an important factor in monitoring water quality and lagoon health because of its sensitivity to pollutants and nutrient changes in the water (Hill K., 2002). Due to the rich seagrass environment, many species benefit from the many smaller organisms that contribute to the lagoon food chain as well as a large manatee population. The IRL was declared to be one of the most important bull shark nursery habitats in North America (Adams and Curtis, 2012). Both young and juvenile bull sharks were most often located in the fresh water creeks, power plant outfalls, ocean inlets, and seagrass habitats (locations where temperatures were greater than 20 degrees Celsius, salinities range between 10 to 30 ‰, and dissolved oxygen range between 4 to 7mg/L) (Adams and Curtis, 2012).

## **2. 2 Economic Value**

The lagoon offers a unique environment that attracts many tourists every year, which equates to a huge financial gain for the IRL region. The popular wildlife such as manatees, dolphins, turtles, and fish attracts huge numbers of people. The estimated economic value of the Indian River Lagoon exceeds \$3. 7 billion dollars to date. This equates to an estimated \$630 million dollars of income to residents, \$112 million in state and local tax revenue, and over 15, 000 full and part time employment opportunities. The 72, 400 acres of

seagrass was assessed to be valued at \$329 million dollars per year through water quality improvements, recreational and commercial fishing industries. The U. S. Environmental Protection Agency projected that an estimated \$80 million dollars could be added to existing revenues annually through by improving the lagoons ecosystem. However, the high volume of traffic through the lagoon and exponentially increasing number of human population inhabiting the surround areas are drastically impacting the health of the lagoon's ecosystem and its inhabitants (EPA, 2011).

### **3. Potential Threats**

#### **3.1 Habitat Destruction**

Mosquito control impoundments were built on 93% of the lagoon's wetlands and is a chief cause of habitat destruction (Rey and Kain, 1989). Due to poor impoundment management, a mix of halophyte, seagrass meadows, and mangrove marshes were lost to areas that eventually flooded with fresh water and added additional instability to the lagoon (Schmalzer, 1995). Mangrove fish (*Rivulus marmoratus*) populations are declining, due to the loss of mangrove marshes in the lagoon (Davis et. al., 1995; Taylor et. al., 1995). The reduction of marsh habitats has caused a decline in polychaete populations (Fauchald, 1995). Species such as amphipods, isopods, mollusks, and fish are greatly impacted by the loss of seagrass meadow habitats (Clark, 1995; Matheson and Gilmore, 1995; Nelson, 1995; Virstein, 1995a; Winston, 1995). Intertidal oyster reefs are a major form of habitat within the lagoon system. The eastern oyster (*Crassostrea virginica*) for example is known to create extensive intertidal reefs in the lagoon. Large areas of oyster reefs were forming dead margins that were located in high boat traffic

areas including the Intracoastal Waterway. It is believed heavy traffic from boating activities, both recreational and commercial, are potentially having a significant impact in the oyster reefs (Grizzle, Raymond E., Jamie R. Adams, and Linda J. Walters, 2002).

### **3. 2 Habitat Fragmentation**

Habitat fragmentation can be the result of natural changes in the physical environment or more commonly an incursion by the human population. The reduction or fragmentation of a species physical environment also fractures the population and increases the possibility of extinction (DeFreese, 1995; Larson, 1995). Often the loss one habitat will cause additional strain on the associated habitats through interruption of ecosystem processes such as hydrological cycles (Niederoda, 1995). The construction of causeways in the Indian River Lagoon disrupted habitats, which decreased the dispersal of species and increased mortality (Larson, 1995). Impounding estuarine wetlands for mosquito control in the Lagoon caused major disruptions in the IRL ecosystem and resulted in substantial loss and fragmentation of habitat (Larson, 1995; Schmalzer, 1995).

### **3. 3 Degradation of Habitat**

The input of fresh water from canals constructed for storm water drainage and flood control has degraded the water quality of the lagoon and has had a negative impact on the Lagoon's ecological structure (Niederoda, 1995). Due to the physical aspects of the lagoon, a complex system of circulation and mixing of fresh and salt water has evolved. In order to better understand the varying brackish waters of the lagoon system, it is divided up into segments, where size, characteristics, and function of each segment can vary greatly.

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The hydrology of each segment depends on a complex relationship of saltwater, fresh water, bottom topology, and geographic location, which affects the degree of input and mixing, therefore dictating the salinity, nutrient levels, and water clarity of each segment within the lagoon. The distance from the saltwater inlets or fresh water tributaries determines how strong tidal or tributary influences will affect water currents, as distance from the inlet increases, the input influence decreases. In association with tidal and tributary influence, freshwater discharge, wind generated currents, and evaporation processes contribute to the circulation and mixing that influence the chemical makeup of the lagoon waters. Salinity and nutrient distribution of the lagoon varies from segment to segment, depending on location, time of day and year, and weather conditions. Currents carry the high salinity water and nutrients of the Atlantic Ocean into the lagoon through the inlets, which combine with the fresh water laden with nutrients entering the lagoon through tributaries, storm water runoff, and rainfall. The northern section of the lagoon has less freshwater inflows, therefore higher salinity than waters between Melbourne and Vero Beach which have higher freshwater inflow and the Sebastian Inlet, which is a small ocean water inlet and results in a lower salinity (Hench, J., and R. Luettich Jr 2003). An excessive influx of fresh water into the RL system will lower salinity; increase sediments, change pH levels, and can rapidly change water temperature (Fury and Harrison, 2011).

Declining water quality and the accumulation of contaminants are degrading the Lagoon's seagrass community and contributing to the loss of species (Virnstein et. al., 1983; Signa et. al., 2000). Studies performed by the Harbor Branch Oceanographic Institution suggest that waste water treatment

facilities are contributing to the decline of the Lagoons water quality with <https://assignbuster.com/importance-of-indian-river-lagoon-biodiversity-environmental-sciences-essay/>

discharges of excessive nutrient levels (Barile, Peter J., 2004). The seagrass of the IRL provides habitat to a diverse group of marine organisms such as macroalgae, provides a nursery habitat to developing marine organisms, and is used as a food source by epifauna, macrobenthos, and manatees (Dawes, Clinton J., Hanisak, Dennis, Kenworthy, Judson W., 1995). The resulting influx of nutrients such as nitrogen and phosphorus from storm water runoff draining onto the lagoon is becoming an increasing issue as unusually large algal blooms will form in the nutrient enriched lagoonal waters and out compete the other organisms for resources. Areas of Eutrophication called "dead zones" form and either kill or drive off the species within the area (Clark, 1995; Gilmore, 1995, Larson, 1995).

### **3. 4 Degradation of Species**

Figure 2. Dolphin with lobomycosis. Picture taken from Oceanriver.

Bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon have been identified with poxvirus lesions (Van Bresse, Marie-Françoise et al., 2008). The degraded water quality and declining habitat of the lagoon are associated with this epidemic condition (Geraci et. al., 1979). Dolphins within the lagoon during a period of fresh water flooding can be trapped in water where the salinity drops from 24 to 30 ‰ to 0 to 19‰. Dolphins rely on their protective epidermis to maintain an osmosis gradient with its aquatic environment (Anderson and Nielson, 1983). A dolphin can remain in low salinity water for up to one month before their skin will begin to bloat and slough, which can lead to necrosis, then epidermal ulcers and finally death. The fluctuating environmental conditions of the lagoon promote infections of the poxvirus in the dolphin community (Simpson and Gardner, 1972).

Reports of bacterial and fungal infections among the IRL dolphin population have shown a steady increase. A study performed by the Harbor Branch Oceanographic Institution suggests that an epidemic of lobomycosis is occurring among the dolphin population located within the southern section of the Indian River Lagoon system. Figure 2 shows a dolphin suffering from a case of lobomycosis. This section of the lagoon experiences regular intrusions of fresh water and salinity fluctuations, which creates environmental stressors that can contribute to such infections (Reif, John S., et al, 2006). The emergence of antibiotic resistant bacteria strains are on the rise. The release of antibiotics through wastewater drainage and contaminated storm water runoff into the Lagoon are contributing to the growing issue. *Escheria coli* are is of example of an antibiotic resistant organism (ABO) that is turning up in marine organisms throughout the IRL (Schaefer, Adam M., et al., 2009). In the northern section of the Lagoon there have been reported cases of puffer fish (*Sphoeroides nephelus*) poisoning due to toxic levels of saxitoxins (Bodager, 2002). Additional organisms that tested positive for saxitoxins include: Atlantic spadefish (*Chaetodipterus faber*), Sheepshead (*Archosargus probatocephalus*), Gulf flounder (*Paralichthys albigutta*), spotted sea trout (*Cynoscion nebulosus*), polychaetes (*Glycera dibranchiate*), gastropods (*Urosalpinx cinerea*), and blue crabs (*Callinectes sapidus*), however the toxic levels in all the other species were less than that of *S. nephelus*. Samples of *Pyrodinium bahamense* in the lagoon were found to contain the saxitoxins (Landsberg et. al., 2002). Futher testing is required to isolate the vectors for the saxitoxin and confirm its source (Abbott J. et al, 2003)Dinoflagellate *Pyrodinium bahamense* var. *bahamense* and diatom *Pseudo-nitzschia*

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pseudodelicatissima are two potentially toxic phytoplankton species that are increasing in number in the Indian River Lagoon (Philips E. J. et al, 2004).

Dinoflagellate *Karenia brevis* is a brevetoxin that produces what is called the red tide in the lagoon system. Brevetoxins typically affect the neural system by opening sodium channels, which produces abnormal neuronal stimulation causing a series of symptoms that can eventually lead to death (Van Dolah Frances M., 2005).

### **3. 5 Direct Exploitation**

The lagoon has been overexploited for many years. Issues from overharvesting, accidental, or indirect damages from human interactions have been the center of many issues faced by the lagoon system. Boating traffic injures or kills many manatee and sea turtles annually. As the level of traffic increases, so does the number of injuries to aquatic life on the lagoon waters (Ehrhart and Redfoot, 1995; Morris and Nodine, 1995). The oyster population of the lagoon was overharvested to the point that it was no longer economically viable to commercially harvest. The marine organisms that relied on the oyster reefs for substrate were severely impacted by the loss (Clark, 1995). The careless dumping of monofilament fishing line and discarded gillnets pose a huge threat to lagoonal wildlife (Erhart, 1995). The demands placed by the commercial fishing industries in the lagoon caused species such as spotted sea trout, striped mullet, Atlantic croaker, and many others to fall into decline, which adds pressure to the survival of the other species like the bottlenose dolphin. A large number of marine animals are caught and killed by the nets used by the commercial shrimp industry as well (Branstetter, 1995; Gilmore, 1995).

### **3. 5 Invasive Species**

Nonnative species are introduced into the lagoon via a variety of methods. Some arrive via intentional or unintentional human means, while others are attempting to expand territories and the environment permits. Often the invasive species will remain undetected until it has become well established and in some cases, posing a threat to the indigenous organisms. One such example is the green mussel (*Perna viridis*), which has had an ecological and economical impact on the mussel community (Masterson L., 2007). Another non-native species identified in the lagoon is the Australian spotted jellyfish (*Phyllorhiza punctata*).

### **4. Conservation Goals**

Concerted conservation goals are to retain, promote, and restore biodiversity levels of Indian River Lagoon system. Efforts must be made in addressing difficult areas such as exploitation, invasive species, loss of habitat, and a growing human population within the lagoon region.

#### **4. 1 Biodiversity**

Review lands surrounding the Indian River Lagoon system and assess any structure changes needed such as reclaiming lands previously impounded for mosquito control, in order to improve or protect the ecological and biological structure of the lagoon. Management efforts needs to place more emphasis on maintaining the habitats of endangered and threatened species located in the Indian River Lagoon system. Conservation emphasis needs to be placed on the current levels of finfish and shellfish populations and better manage the restoration of healthy levels for the region.

## **4. 2 Fresh Water and Storm Water Discharge**