

## **MARINE ECOSYSTEM SERVICES DISRUPTION AND SOCIAL VIOLENCE**

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### **ABSTRACT**

Marine ecosystem services support coastal communities by offering essential sustenance, protection, and cultural benefits. However, the global decline in these ecosystems has disrupted these services, impacting the communities reliant on them. The Archipelago of San Andres Providencia and Santa Catalina (ASAPSC) in the Colombian Caribbean exemplifies this decline, coinciding with a rise in violent crimes and homicide rates. This study employs an agent-based model (ABM) to simulate the ASAPSC case and examine the potential links between marine ecosystem depletion and the escalation of social violence. The simulation results suggest a link between disruption of ecosystem services and social violence and set the stage for future empirical research in environmental security.

### **1. INTRODUCTION**

Human well-being is intrinsically linked to the natural environment, which offers indispensable ecosystem services, encompassing clean air, water, sustenance, and climate stability. The disruption of these services can substantially impact individuals, a concern heightened in small islands and Small Island Developing States (SIDS), where the populace heavily depends on natural resources for sustenance and livelihoods. This reliance renders them acutely vulnerable to the consequences of ecosystem disruptions, which can manifest as challenges ranging from food insecurity to climate risk.

This research paper centers on investigating the repercussions of disrupted marine ecosystem services on the social dynamics of island communities. To exemplify this, the study utilizes the case of the Archipelago of San Andres Providence and Santa Catalina (ASAPSC) in the Colombian Caribbean. The ASAPSC land area covers approximately 57 square kilometers, and it is home to 65,228 persons who depend on the ecosystem services offered by four distinct coastal formations: beaches, coral reefs, mangroves, and seagrass beds, for their livelihoods. Employing an ABM simulation, this research explores the intricate correlations between the health of ecosystems and social stability by integrating insights from political science, ecology, and social systems research. As marine ecosystems are expected to change, understanding these interconnections becomes relevant for developing sound public policy tools.

### **2. THEORY**

Anthropogenic pressures have caused severe damage to the ecosystems in the Caribbean region (Burke & Maidens, 2004). The island communities in this region depend heavily on marine ecosystem services to support their livelihoods (Agard et al., 2007). The disruption of these services has led to livelihood crises, increased migration, and social violence (Burke & Maidens, 2004; Scheffran, 2012; Mobjörk, Krampe, et al.). Ecosystem services disruption can potentially increase "total deprivation," or insufficient access to resources for basic needs, and "relative deprivation," which arises from inequity in the distribution of wealth within society, which can positively correlate with homicide rates and social violence (Ouimet, 2012; Sun

et al., 2011). Since environmental degradation is evident in the Caribbean Islands, I argue that this condition has intensified violent crime.

### 3. THE SIMULATION

The model simulates a Caribbean island, inherently isolated and with limited food production due to its geographical conditions. This model was fed with governmental sources data from ASAPSC and involves two categories of actors. "Agents" are members of the general population and may be actively rebellious or not. "Cops" are the forces of the central authority who seek out and arrest actively rebellious agents. Each individual in the general population, referred to as "agents," possesses a unique level of grievance towards the central authority. Previous models have suggested that the level of grievance is determined by two factors: their perceived hardship, which is randomly assigned at startup, and the Government's legitimacy, which remains consistent across all agents. Additionally, this model considers the availability of food, which affects all individuals on the island. Although not all residents rely on fish for their livelihood, the absence of animal protein from marine ecosystem services will increase the demand for substitutes, resulting in scarcity and higher prices. The model was run in "NetLogo 6.3.0" 8100 times, doing variations in the parameter to analyze the results by a statistical test.

### 4. CONCLUSIONS

The results of the Agent-based Model indicate a positive correlation between the disruption of marine ecosystems and the increase in social violence. The model could be used to explain the social phenomena of violence observed in Caribbean islands like ASAPSC. The statistical test performed on the simulation output suggests a statistically significant relationship between marine ecosystem services disruption and the increase in social violence. Despite the promising results of ABM simulation on this issue, further simulations will require more detailed data to reproduce real-world scenarios accurately.

The present study suggests a promising potential in utilizing agent-based models to simulate the relationship between social and environmental variables. However, further research is required to develop more comprehensive models describing social phenomena emergence and their connection with marine ecological variables.

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