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MACHINE LEARNING AND SATELLITE DATA FOR PREDICTIVE MONITORING OF TROPICAL ORCAS IN THE PACIFIC: INSIGHTS INTO MANAGEMENT STRATEGIES.

Abstract

Orcinus orca, commonly known as killer whales, serve as crucial apex predators and keystone species, playing a vital role in regulating ecosystem dynamics within their habitat. Cetaceans' behaviors are correlated with environmental factors, such as climatic parameters and oceanographic properties. Satellite databases provide insights into the temporal dynamics of geographic zones, offering a comprehensive view of environmental changes over time. Climate change is disrupting the variability of these environmental factors leading to shifts in prey distribution, altered migration patterns, and changes in habitat suitability. It has been reported that changes in the patterns of orca sightings are occurring as a consequence of rising ocean temperatures. This underscores the necessity of establishing a novel framework for their active monitoring to establish effective management strategies. The project *Orcas en Costa Rica* has emerged as a pioneer in the research of tropical orcas in the Costa Rican Pacific. Working closely with rural, indigenous, and coastal communities, orca sightings from 1986 to 2023 have been documented, creating a comprehensive database with specific details, such as dates, coordinates, lunar cycles, and visual evidence of each sighting. This study aims to develop a predictive model using environmental satellite data and machine learning models for the active monitoring of tropical orcas in the Pacific. Climatic parameters and oceanographic properties were obtained from freely accessible satellite databases, along with trends in algal blooms and coral bleaching. These datasets allow for a detailed description of the temporal dynamics of the Pacific. The *Orcas en Costa Rica* database was conjugated with a collaborative database of insights on *Orcinus orca* in the Pacific. Temporal data were correlated with the geographic locations of these insights to identify parameters with statistical significance to the orcas' movements. Capitalizing on machine learning tools, a prediction model was created to determine possible geographic and temporal sighting points based on the correlation of environmental parameters. This makes it possible to study how the Pacific climatic and oceanographic conditions have changed through the years and more accurately address the impact that climate change has had on these cetacean communities. Furthermore, the results of this study can be utilized to support coastal communities by providing scientific evidence to advocate for government measures to preserve these vital ecosystems.