Science-Based Biodiversity Mapping and Governance

——A Multidimensional Approach to Island Biodiversity Conservation in Nan'ao County, Guangdong Province, China

Abstract: Islands and their surrounding waters are centers of marine biodiversity, but they often face geographic isolation, ecological fragility, conflicts between human use and conservation, and limited conservation resources. To address these challenges, Nan'ao County, Guangdong Province, China, brought research and management institutions together to establish a biodiversity baseline using eDNA, real-time underwater video, and AI-assisted species identification. In addition, they built an intelligent marine biodiversity monitoring system—combining aerial, satellite, terrestrial, marine, and on-site surveillance—launched ecological restoration efforts, and delivered a public outreach campaign. Together, these efforts form a coordinated model for island biodiversity conservation that can inform similar work on other islands.

Keywords: Islands; intelligent monitoring; marine biodiversity; multidimensional conservation

I. Background

Islands are major reservoirs of global biodiversity and genetic diversity, but their ecosystems are fragile and highly exposed to climate change and human disturbance. China has more than 11,000 islands, among the largest numbers worldwide. Nan'ao County, the only island county in Guangdong Province, lies along an important migration corridor connecting the South China Sea, East China Sea, and western Pacific. It also serves as an important refuge for tropical species shifting northward as the climate warms. At the same time, climate change and human activities are placing local biodiversity under growing pressure. Nan'ao therefore faces a practical question: how can limited conservation resources be used to deliver precise and effective protection?



Figure 1. Aerial view of Nan'ao County
(Image Source: Guangdong Nanpeng Islands National Marine Nature Reserve Administration)

II. Key Measures

(1) Biodiversity Baseline Established through Science and Technology

- We conducted systematic marine biodiversity surveys to establish a comprehensive baseline for Nan'ao Island.
- We built an intelligent marine biodiversity monitoring system and establish the Guangdong Nanpeng Islands Marine Biodiversity Field Observation and Research Station.
- We applied targeted management to key human disturbances, including egg collection from seabird colonies and shellfish collection on rocky reefs.



Figure 2. Marine biodiversity of Nan'ao Island
(Image Source: Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou))

(2) Agencies Created an Integrated Patrol Network

- We established an integrated smart patrol system that combines aerial, satellite, terrestrial, marine, and on-site surveillance, enabling information sharing and coordinated enforcement among the coast guard, maritime authorities, and marine law enforcement agencies.
- We held more than 460 patrols over the past five years, strengthening protection for cetaceans, seabirds, corals, fishes, and other marine life.



Figure 3. Joint multi-agency enforcement patrol
(Image Source: Guangdong Nanpeng Islands National Marine Nature Reserve Administration)

(3) Public Outreach Campaigns and Community Participation

- We developed science outreach corridors, exhibition halls, and nature classrooms. Regular programs such as Bird-Loving Week average 13 events and attract more than 3,000 participants each year.
- We trained local volunteers to assist with cetacean monitoring and rescue, and establish an island-wide cetacean rescue network. These programs help residents move from observers to active participants and stewards.



Figure 4. Marine conservation outreach activity
(Image Source: Guangdong Nanpeng Islands National Marine Nature Reserve Administration)

III. Lessons Learned

Nan'ao's experience shows that island biodiversity conservation is more effective when science first establishes the baseline, technology and interagency coordination support targeted management, and public education and participation sustain community stewardship. This approach can improve conservation outcomes where resources are limited and provides a practical reference for other islands.

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