

The Relationship between Bryde's Whales in Northern China and the Development of Xieyang Island in Beibu Gulf

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Abstract. The study explores the environmental risk to Bryde's whales in the Beibu Gulf because of habitat degradation, noise pollution, and poor population monitoring. These have led to a decline in the number of the whales. The research fills significant gaps in the conservation of marine mammals and focuses on Bryde's whale, which has previously not been adequately dealt with worldwide. Using satellite monitoring to monitor migration and foraging behavior, noise monitoring to evaluate the impact of noise pollution, and community-recollected data to promote stakeholder engagement, the study uses scientifically collected information from governments, as well as conservation communities on a local basis, to monitor the effectiveness of Marine Protected Areas (MPAs). Reinforcement and enforcement of MPAs. It will manage the noise pollution and stimulate population involvement, which is critical for the survival of Bryde's whales. They not only address the issue of habitat destruction but also promote a sustainable future for the species. The research contributes importantly to global marine conservation and provides a demonstration of bringing scientific research into alliance with community-based conservation practice.

Keywords: Bryde's whales, monitor migration, foraging behavior, noise monitoring, Marine Protected Areas.

1. Introduction

1.1. Research background and motivation

The Beibu Gulf is the only one of stable habitat for Bryde's whales, and it is a critical location for their survival. While human activities such as overfishing, shipping, and industrialization inevitably threaten this environment, these pressures lead to habitat degradation, which disrupts the sensitive environmental balance required for the health of the whales. Bryde's whales, which are a lesser-studied species, are especially susceptible since they rely on specific marine conditions for feeding and breeding. One must comprehend how human activity impacts their habitat. Proper research of the effects will be useful in developing conservation policies. It helps conserve both Bryde's whales and marine diversity wholly. It will assist researchers in comprehending the complex relationship between human life and marine organisms. Population differentiation in these species, i.e., Bryde's whales, is an important tool to develop region-specific conservation plans [1].

1.2. Literature review

Various investigations of the environmental drivers of Beibu Gulf's Bryde's whales were conducted. Chen et al. confirmed the general appearance of Bryde's whales in the northern Beibu Gulf, particularly near Xieyang Island, where whales' occurrence is threatened [2]. Volcanic island Xieyang has experienced drastic geological and environmental changes due to natural and human elements. Geochemical analysis of the volcanic rocks indicates that such differences have an effect on the marine fauna of the neighboring seas, which are highly nutritive for Bryde's whales [3]. Pressures of the natural environment on Bryde's whale populations were raised, further establishing the significance of such areas towards the survival of the species [4]. However, the increasing pressure from fishing and coastal development poses risks to this fragile ecosystem. Wang et al. observed the vocal behavior of Bryde's whales and reported that the sound is used by the whales for communication and orientation, which can be disrupted by anthropogenic noise [5]. The researcher depicts that passive acoustic monitoring plays a crucial rule in investigating the effect of human noise

on cetacean communication [6]. Zhang et al. included community-led monitoring to conserve large baleen whale populations, reporting that active conservation measures, such as the creation of Marine Protected Areas (MPAs), are crucial in the conservation of the whales [7]. In addition, Zhang et al. proposed the establishment of the first MPA in the Beibu Gulf for the express purpose of baleen whales in an attempt to minimize human impacts by intensified fishing, shipping, and habitat management [7]. However, all further development in such a place as Xieyang Island should be treated with care so as not to cause even more devastation to Bryde's whale habitats. Campos-Cerqueira and Aide emphasize that the combination of acoustic monitoring and occupancy modeling will improve data quality in areas such as the Beibu Gulf, which will be essential to conservation in the future [8]. By and large, though the Beibu Gulf remains a vital habitat for Bryde's whales, it is under escalating environmental pressures demanding urgent interventions for sustainable management.

1.3. Research contents

This study will investigate the impacts of the environment on Bryde's whales in the Xieyang Island, namely habitat degradation, noise pollution, and the effectiveness of conservation efforts. Chen et al.'s research confirmed the existence of Bryde's whales of the Beibu Gulf, particularly in water regions around Xieyang Island and Weizhou Island [1]. These areas are important as they consist of nutrient-rich waters that feed the whales' food chain. Again, another group of human activities in the form of coastal development and fishing threatens this fragile ecosystem. A geochemical survey of the area by Qi shows that environmental degradation can contribute to marine biodiversity, affecting the habitat of whales [3]. Wang et al. noted that whales utilize sound for communication and navigation, which is disrupted by anthropogenic noise, leading to behavioral disturbance and loss of habitat [5]. Disruption of whales' behavior and communication, according to Clapham et al., is detrimental to their viability, especially for areas that are beset by man-made noise pollution [9]. It is from this research that reasons for these along with whether existing MPAs are effective would be examined. The research would also examine community-based conservation with a focus on whether participation at the local level can contribute to sustainable management efforts. Through linking scientific study and community-based action, this project will help develop strategies to mitigate human impact and protect key habitats for Bryde's whales.

2. Analysis of the problems

2.1. Conservation breaks for bryde's whales in beibu gulf

Several human factors have brutally affected the population of the *Balaenoptera edeni* or Bryde's whales in China's Beibu Gulf. Although this area is one of the most important on the planet for Bryde's whales, survival chances are becoming less. Three major issues facing this population include: habitat destruction and disturbance by humans besides poor management. These challenges bring forth the immediate necessity for appropriate methods of conservation that would ensure the long-term survival of this species.

2.2. Breaks for vocalizations and communications

Bryde's whales are highly vocal for socializing, communicating as well as hunting. The calls let them find food and orientation in space and communicate with the other members of the group. However, shipping activities, construction works, and industrial processes around Beibu Gulf have been making the water noise rise, so communication is somewhat tricky for whales. Human-made noise disrupts whale speech, thereby reducing their ability to communicate [10]. This kind of noise interference may decrease animal activities such as finding food establishing a mate selection and maintaining the social network, which increases the stress factors on the animals.

2.3. Habitat degradation

The intense industrial and commercial activities of the Beibu Gulf are centered on fishing, shipping, mainly, and oil drilling.

This situation is a matter of grave concern because the area has destroyed key foraging and breeding grounds. According to Zhang et al., it was established that reductions in foraging habitat near Weizhou Island have displaced the population and forced the whales to forage under poor conditions [7]. Such changes increase the level of stress in whales, including competition with other species for whatever resources are made available. Furthermore, pollution via plastic waste, chemical runoff, and industrial waste further pressed the health of the marine ecosystem, impeding any ability of Bryde's whales to thrive. Although quite a few studies have been done, current knowledge of researchers concerning Bryde's whales in Beibu Gulf is still pretty inadequate, which means the research lacks complete population monitoring. In fact, the lack of such information inhibits the precise evaluation of species at the population size, migration route, and social structure. Zhang et al. stress community-based monitoring systems, but there are considerable challenges in collecting reliable and accurate data [7]. Poor funding, apart from the minimal expertise, does make their tracking systems poor and further complicates any form of effective population management or evidence-based conservation.

3. Solutions

3.1. Multi-pronged approach to bryde's whale conservation

Multi-pronged approaches are required for complex issues in habitat preservation and community involvement. Probably the most important for the protection of this endangered species and addressing emergent concerns described above is the Guangxi Beibu Gulf Bryde's Whale Research and Conservation Project. In fact, this collaboration of the Guangxi Academy of Sciences, officials of Beihai city, national research organizations, and international environmental organizations has identified three key avenues that are very important for conservation: the strengthening of MPAs, the involvement of local communities in monitoring and conservation, and the application of state-of-the-art satellite and acoustic researchers.

3.2. Strengthening MPAs

Among the most feasible kinds of protection for the critical habitats of Bryde's whales is the establishment of MPAs. MPAs are areas out at sea where human activities, such as fishing and shipping, are restricted to limit impacts on the adjacent ecosystem. For Bryde's whales, MPAs will afford them a haven for feeding, migrating, and reproducing unhindered by human activities. The Guangxi Beibu Gulf Bryde's Whale Research and Conservation Project has been striving to establish a specific MPA in the Beibu Gulf, especially around Weizhou Island, which is considered a habitat for Bryde's whales. Establishment is not the be-all and end-all, and what follows thereafter is its actual enforcement-that is, actual compliance with the regulations within these MPAs.

The pronged approach includes illegal fishing, sea traffic management, and waste management. Setting aside all the aforementioned, probably among the biggest challenges to the effective application of MPAs would be how conservation and protection of these sites could be balanced against the interests of the local community in a manner satisfying the economic needs of fisheries, among other sectors. This is the emphasis in the campaign wherein local government, environmentalists, and heads of industries have to work together for the successful implementation and conservation of MPAs. Such would be the case with the Guangxi Beibu Gulf Bryde's Whale Research and Conservation Project, which is already engaging local authorities in developing rules including responsible fishing in MPAs, such as no-go areas when the whales breed and feed, among others. This in turn gives a financial incentive to those fishermen who heed and follow more

sustainable methods. Most noticeably, MPAs may just be the remedy for the whale population, balancing with harmony the needs of conservationist goals and that of the local economy.

3.3. Strengthening community collaboration

Citizens' participation in monitoring Community-led monitoring of the Guangxi Beibu Gulf Bryde's Whale Research and Conservation Project possibly is the largest achievement. Locally, fishers navigate within the marine ecosystem. They can provide quite useful insights into places characterized by high-concentration hotspots of marine species. They were training involved in identifying whale species, recording sightings, and reporting changes seen in environmental conditions, programs successfully enrolled involvement in the local citizens' community-based continuous species conservation as part of the initiative. Of the educative process of the challenges Bryde's whales, along with other marine species go through, public engagement is also a very vital channel. These implemented educative activities, coupled with active participation at the community level, made it possible to value and appraise biodiversity by the sea; which is the contribution it could show to the cause of conserving it at local levels. The project promotes eco-tourism, such as whale-watching, to reduce local reliance on fishing and encourage the conservation of whales. It also engages communities by conducting outreach activities with schools and working in partnership with organizations, building a culture of conservation and guaranteeing long-term participation in protecting Bryde's whales.

3.4. Satellite tracking and acoustic research

Going one step further, technology has radically changed the very face of research methodology in the case of marine mammals. With satellite tracking, it's now possible to trace the movements of Bryde's whales almost in real time. In return, this gives information about routes of migration, locations of feeding, and use of habitat. Satellite tracking would eventually help find out how such oceanographic factors as fluctuation of sea temperature or, maybe even more probable, changes in prey availability might affect whale behavior. Acoustic research technologies complement satellite tracking in determining the effects of noise pollution problems on communication among Bryde's whales. These allow the researcher, assisted by various other acoustic monitoring equipment, to study the vocal patterns of Bryde's whales in their natural environment. Such devices would identify even minute fluctuations in the noise pattern that indicate stress or perhaps miscommunication attributed to shipping and industrial noise. It would be easier for a conservationist to determine the noise-polluting hotspots, and then the conservation efforts in the mitigation processes by offering to change courses or other quietening technologies.

Satellite tracking and acoustic research have formed a part of the Guangxi Beibu Gulf Bryde's Whale Research and Conservation Initiative by the Conservationist in the form of a marine species. While such techniques are an essential part of this initiative and also provide the crucial information with which the management strategies, in terms of protection of the key habitats, mitigating the impacts from human activities, etc., are drawn out, they are indeed becoming important. It helps in concentrating conservational efforts in the most important areas by identifying the migratory route of Bryde's whales by satellite tracking in the initiative.

4. Conclusion

The research examines the environmental dangers that confront Bryde's whales in the Beibu Gulf, focusing specifically on habitat deterioration, noise disturbance, and ineffective population monitoring. The study explains that the destruction of essential habitats due to anthropogenic activities supplemented by the disorienting aspect of noise pollution to whale behavior has been basically responsible for threatening the species' survival. By the use of advanced satellite tracking, acoustic monitoring, and local community-based data collection, the study has demonstrated that the conservation of Bryde's whales is dependent on the use of MPAs in combination with greater control

of human activity and greater local community participation. The study offers an integrated approach to avoiding these dangers and contributes to international marine conservation efforts. The cooperation between scientific inquiry, government action, and communities is a classic example of confronting the advanced complexities in the preservation of marine mammals.

In spite of its strength, this study has some flaws that need correction in future work. While the use of satellite and acoustic technology does provide useful information, greater accuracy in tracking methods and increased resolution of acoustic data will be required to ascertain more precisely whale behavior and habitat use. Additionally, while community outreach has been at the forefront of this project, difficulty in securing sustainable community participation remains a concern. Future studies must focus on improving the reliability and coverage of community-based monitoring systems, overcoming the hurdles posed by limited funding and technical skills. Greater priority must also be given to assessing the long-term effects of MPAs and simplifying policies to reconcile conservation with the economic needs of local communities. Expanding on these research studies will provide a more solid foundation for the future conservation of Bryde's whales and other marine life within the region.

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