

The spread of fish species is regulated via ecological characterization and specialized information systems

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AUTHORS' CONTRIBUTION: (A) Study Design · (B) Data Collection · (C) Statistical Analysis · (D) Data Interpretation · (E) Manuscript Preparation · (F) Literature Search · (G) No Fund Collection

ABSTRACT

Non-native creatures known as freshwater invasive alien species (IAS) were mistakenly or purposely discharged into nearby water bodies, where they disrupted the ecosystem and caused damage to the invaded habitat. Environmental deoxyribonucleic acid (eDNA) analyses have been utilised successfully in numerous research over the past few years to identify IAS. However, efforts to find IAS can be conducted more quickly and effectively with the aid of geographic information systems (GIS). In this article, we examine the history of IAS in Southeast Asia and management initiatives that involved the GIS mapping of known habitat-specific geographical features. This method makes it easy to detect and separate regions with IAS habitat traits from those without. Later, eDNA analysis can be used to validate the presence of IAS in places where it has been discovered, allowing for additional research and action. IAS can be used as an indicator to evaluate the environmental integrity of native rivers in certain places. This combined strategy is perhaps the first to be used to find freshwater IAS in nearby bodies of water. Integrating GIS and eDNA into the research of IAS not only improves the ecology and saves energy and resources, but also helps residents and authorities manage and take the required enforcement measures to stop its spread.

Keywords: Invasive alien species; Freshwater management; Environmental DNA; Geographic information system; Sustainability

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Word count: 976 **Tables:** 00 **Figures:** 00 **References:** 10

Received: 01.07.2023, Manuscript No. ipfs-23-13831; **Editor assigned:** 06.07.2023, PreQC No. P-13831; **Reviewed:** 20.07.2023, QC No. Q-13831; **Revised:** 24.07.2023, Manuscript No. R-13831; **Published:** 31.07.2023

INTRODUCTION

In general, nature and humans are interdependent. It is also possible to think of the interaction between people and the environment as somewhat mutualistic [1]. The loss of biodiversity and overexploitation are already having an adverse effect on freshwater ecosystems. One of the most harmful factors contributing to the loss in native habitat populations and the overall biodiversity of freshwater ecosystems is the presence of invasive species [2]. Invasive species that are unnecessarily introduced into native habitats would only exacerbate current problems with freshwater biodiversity, conservation efforts, and economy, including biological contamination, ineffective enforcement, habitat loss, and loss of income, respectively [3].

Anthropogenic activities are the main cause of invasive alien species (IAS) that are present in local ecosystems when it comes to non-native freshwater animal species. Such consequences are particularly noticeable in terrestrial habitats, where the introduction of non-native species is more likely to have hazardous repercussions for regional and global ecosystems and biodiversity due to constrained geographic borders and natural landscapes [4]. IAS have been developed locally in several nations, frequently for uses like food production (aquaculture industries), collection (ornamental), or recreational fishing [5].

Invasive alien species

Sport fishing is another factor in the spread of IAS into natural freshwater in Malaysia. A number of non-native fish, like peacock bass, have been placed into bodies of water by parties in the hopes that the fish may heighten anglers' interest in their sport [6]. Due to their ignorance of the negative impacts of IAS, these parties may initiate IAS. Whether the release of IAS was intentional or unintended, it may result in the extensive dispersal and establishment of alien species in nearby ecosystems [7].

IAS introduction generally has a negative impact on the overall health of ecosystems and natural habitat areas. The options for early IAS identification that can be used in this review were extensively covered, including the use of eDNA analysis and geospatial analytics using GIS [8]. In an effort to save local biodiversity in the face of IAS and other threats, Malaysia joined the Convention on Biological Diversity (CBD) in 1994. This initiative encouraged biodiversity protection as a crucial component of sustainable development. Malaysia is in favour of a sustainability strategy that promotes environmental protection while supporting economic expansion. In

contrast, the CBD mandates that each party should, to the maximum extent feasible and as necessary, avoid the introduction of and control or destroy alien species that pose harm to ecosystems, habitats, or species [9].

According to the CBD, preventing the establishment of IAS between and among states is far more effective and environmentally preferable than taking action once IAS has already been introduced. If an IAS has been released, early detection and prompt action are crucial to preventing its establishment and completely eliminating the organism. Furthermore, where eradication is not feasible or resources are not available, containment and long-term monitoring methods should be put into place. We recommend that local authorities, particularly for repeat offenders, impose harsher fines and penalties on individuals who violate the law and release IAS into local waters [10].

CONCLUSION

It has never been attempted in Malaysia to integrate GIS

mapping specifically for the detection of invasive alien species (IAS) in freshwater ecosystems, so we strongly suggested that future studies be conducted to thoroughly examine this technology from all relevant angles. In addition, using GIS analysis in conjunction with the existing trustworthy and effective environmental DNA (eDNA) analysis will be advantageous for the research of IAS, as well as for the environment, for cost savings, and for lowering personnel energy. This technique can therefore be incorporated into management and surveillance plans that are pertinent to the early detection of IAS, as well as into critical management activities that help in supplying information for important policy decisions by authorities. The National Action Plan for Prevention, Eradication, Containment, and Control of Invasive Alien Species, the Fisheries Act of 1985, the Malaysian Quarantine and Inspection Services Act of 2011, and other relevant laws and policies should all be strengthened and enforced fully in the future, according to our recommendation.

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