Review

Aquatic Life Sciences

Not Updated Since 2000? A Review of Biodiversity Assessments in Silot Bay, Liloan, Cebu, Philippines

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[The author informations are in the declarations section. This article is published by ETFLIN in Aquatic Life Sciences, Volume 3, Issue 1, 2026, Page 28-34. DOI: 10.58920/aqlis0301567]

Received: 26 January 2026
Revised: 24 February 2026
Accepted: 16 April 2026
Published: 20 April 2026

Editor: Nurfadilah

Keywords: Biodiversity assessment, Coastal ecosystem monitoring, Silot Bay, Liloan.

Abstract: Coastal ecosystems support high levels of marine biodiversity and provide essential services, including shoreline protection, carbon sequestration, and fisheries production. Silot Bay, Liloan, Cebu, Philippines, is an ecologically and socio-economically important embayment; however, biodiversity assessments in the area remain sparse and temporally fragmented. This study presents a narrative review with structured literature search elements to synthesize available ecological studies on major taxonomic groups, including mangroves, fish, meiofauna, and algae, and to evaluate methodological consistency among studies retrieved from Google Scholar, ScienceDirect, Philippine E-Journals, and institutional repositories from local universities. A total of nine studies met the inclusion criteria, the majority of which were conducted prior to 2000, with post-2000 research limited to a single study on algal communities. Substantial variation in sampling methods, effort, spatial coverage, and taxonomic resolution constrains direct comparison across studies and limits interpretation of temporal patterns. Differences in reported species richness and community composition are evident across taxa; however, these patterns cannot be confidently attributed to ecological change due to methodological inconsistencies and limited data availability. The small number of studies and reliance on partially inaccessible historical data further restrict the establishment of a reliable biodiversity baseline for Silot Bay. Overall, this review highlights significant knowledge gaps and emphasizes the need for standardized, multi-taxa biodiversity assessments to support long-term monitoring and evidence-based coastal management.

Introduction

Coastal ecosystems support a disproportionately high share of global marine biodiversity and provide essential ecosystem services, including shoreline stabilization, carbon sequestration, and fisheries production (1, 2). However, these systems are increasingly threatened by anthropogenic pressures such as coastal development, aquaculture, pollution, and resource overexploitation, leading to habitat degradation and biodiversity loss (3-5). In biodiversity-rich countries like the Philippines, situated within the Coral Triangle, these pressures are particularly concerning, as coastal ecosystems underpin both ecological integrity and the livelihoods of coastal communities (6, 7).

Silot Bay, located in the municipality of Liloan, Cebu, is an enclosed and shallow embayment covering approximately 100 hectares, with a narrow channel connecting it to the Camotes Sea (8, 9). The bay is characterized by a predominantly muddy substratum interspersed with sandy and rocky areas and is bordered by mangrove patches and fishponds. Its sheltered geomorphology results in relatively calm hydrodynamic conditions (10). Historically, Silot Bay included two islets, one of which has since been reclaimed (11), reflecting early anthropogenic modification of the system. The bay is currently classified as SB waters, supporting uses such as aquaculture, fisheries, and recreation (12, 13), which further contribute to ecological pressures.

Despite its ecological and socio-economic importance, biodiversity assessments in Silot Bay remain sparse and temporally fragmented. Existing studies on mangroves and fish communities were primarily conducted between 1970 and 1995 (9, 14-16), while meiofaunal assemblages were assessed only intermittently (9, 10). More recent work is limited to algal diversity (8), leaving a gap of over two decades without comprehensive, multi-taxa biodiversity assessments. Furthermore, these studies vary considerably in sampling methods, effort, and spatial coverage, ranging from structured quadrat-based vegetation surveys to opportunistic fish catch records, complicating direct temporal comparisons of biodiversity

metrics.

For the purposes of this review, biodiversity assessment is broadly and comprehensively defined as the systematic and structured evaluation of species richness, relative abundance or density, and community composition across key taxonomic groups, including mangroves, fish, meiofauna, and algae. Given the inherent heterogeneity and variability of the available data, this study adopts a primarily qualitative and comparative synthesis framework, integrating temporal and habitat-specific analyses while also critically evaluating differences in sampling methodologies, research effort, and spatial extent. In addition, a pressure–response perspective is further considered to more effectively contextualize the observed patterns in relation to potential anthropogenic drivers such as aquaculture expansion, coastal modification, and patterns of resource use.

Accordingly, this review aims to: compile available biodiversity data for Silot Bay across major taxonomic groups; examine temporal patterns in species richness, abundance, and community composition; evaluate methodological consistency and limitations among studies; and identify key knowledge gaps and research priorities for future biodiversity assessments. Peer-reviewed studies on mangrove rehabilitation in the Philippines show that well-implemented restoration can enhance ecosystem services and ecological function compared to degraded sites, highlighting the potential value of evidence-based conservation for coastal wetlands (e.g., rehabilitated mangroves exhibited higher carbon stocks and coastal protection potential than degraded or abandoned ponds) (17). However, the absence of a consolidated and critically evaluated baseline for Silot Bay limits comparable management efforts.

By synthesizing existing studies within a clearly defined analytical framework, this review seeks to provide a more robust understanding of Silot Bay's biodiversity status while highlighting the constraints associated with historical data. Such an approach is essential for informing future research, improving monitoring strategies, and supporting evidence-based management of this ecologically important coastal system.

Literature Search Approach

This study was conducted as a narrative review with partial systematic elements to synthesize available ecological literature on biodiversity in Silot Bay, Liloan, Cebu. While structured search and screening procedures were employed, this work does not constitute a formal systematic review, and no meta-analytic synthesis or PRISMA protocol was followed.

Search Strategy

A structured literature search was conducted between 1 January and 28 February 2026 to identify both published and grey literature (e.g., bachelor's theses). Electronic databases searched included Google Scholar, ScienceDirect, Philippine E-Journals, and institutional repositories from local universities. Additional sources were identified through reference list screening of relevant studies. Print-only and archival materials were sought from institutional libraries or, when necessary, by contacting journal editorial offices via email.

To ensure comprehensive retrieval, multiple spellings of Silot Bay were considered due to historical and orthographic variation in Philippine place names (18). Both "*Silot Bay*" and "*Silut Bay*" were used in searches. Search terms combined these place names with ecological keywords as follows: "*Silot Bay*" OR "*Silut Bay*" AND "*mangrove*" OR "*fish diversity*" OR "*algae*" OR "*benthic fauna*" OR "*ecological survey*" OR "*Liloan, Cebu*". Broader searches describing coastal biodiversity in Liloan, Cebu, were also conducted to capture studies not explicitly mentioning Silot Bay.

Inclusion and Exclusion Criteria

Studies were included if they met all of the following criteria: (1) reported primary ecological data from Silot Bay, Liloan, Cebu; (2) involved field-based biodiversity assessments or ecological surveys, including species composition, richness, abundance, or community structure; (3) were published as peer-reviewed journal articles or academic theses; and (4) were written in English. Whereas, the exclusion criteria were as follows: (1) studies without primary data or conducted outside Silot Bay; (2) review articles, commentaries, or opinion pieces; (3) studies lacking sufficient methodological information to verify location or biodiversity metrics. Studies not accessible online due to access restrictions (e.g., institutional policies) were included only if relevant data could be extracted from secondary citations, with results interpreted cautiously.

Study Quality Assessment

To account for differences in methodological rigor, each study was qualitatively evaluated for: (1) sampling method; (2) sampling effort; and (3) spatial coverage. Grey literature and undergraduate theses were included to maximize coverage but were treated as lower in methodological rigor compared to peer-reviewed studies.

Data Extraction and Synthesis

Data on species composition, abundance, and other biodiversity-related metrics were systematically and carefully extracted into a standardized spreadsheet where possible. Due to the considerable heterogeneity across studies—including differences in temporal coverage, sampling methods, spatial extent, and taxonomic resolution—quantitative aggregation was not undertaken. Variations in sampling season, gear type, plot or transect dimensions, and levels of taxonomic resolution were also explicitly considered when interpreting cross-temporal trends. Data synthesis was therefore primarily qualitative in nature, with a more detailed and comprehensive descriptive interpretation of patterns over time.

Limitations and Bias

Several limitations were noted. The review may be affected by potential publication bias, as studies not publicly accessible or not indexed in the searched databases could have been inadvertently missed. The inclusion of grey literature helps mitigate this issue to some extent but also introduces additional variability in methodological quality and consistency. Cross-temporal comparisons are therefore considered tentative due to differences in sampling methodology, spatial coverage, and taxonomic resolution among studies. Furthermore, the relatively small

number of studies included (n = 9) limits the overall strength and generalizability of ecosystem-level conclusions, and interpretations should be made and considered with appropriate caution.

Table 1. Summary of biodiversity results from studies conducted in Silot Bay.

Taxonomic Group	Study (Author, Year)	Total Species Recorded	Sampling Method	Sampling Effort	Spatial Coverage	Key Notes
Mangroves	Hamoy (1970)[1]	7	NR	NR	NR	Original study inaccessible; details from secondary citation.
	Hamoy & Garciano (1975)[1]	10	NR	NR	NR	Original study inaccessible; details from secondary citation.
	Dacles *et al.* (1995)	8	10 x 10 m quadrats; PCQM; vegetation metrics	multi-month sampling	4 sites within a 2.8 ha mangrove patch (inner, middle, outer zones)	Structured, quantitative sampling.
Meiofauna	Pilapil (1987)	10*	PVC corer (3 cm diameter); 20 µm sieve; Rose Bengal staining; decantation	4 replicates per station (three used for final means); 6 cm core depth; single sampling event	2 stations (North sandy and South muddy); 10 m from shoreline	Identified to major taxa; limited coverage.
	Dacles *et al.* (1995)	~6*	sediment corer (2 cm x 5 cm); 5% formalin and Rose Bengal solution; decantation; 40 µm sieve	4 stations; depth-segmented sampling	4 stations	Identified to major taxa; sampled a smaller sediment volume and yielded fewer taxa than Pilapil (1987).
Fish	Mantilla (1970)[1]	53 identified (from 73 samples)	NR	NR	NR	Original study inaccessible; details from secondary citation.
	Miller (1972)[1]	34	NR	NR	NR	Original study inaccessible; details from secondary citation.
	Dacles *et al.* (1995)	29	fisher catch inspection; interviews	UN	UN	Effort and coverage not specified.
Algae	Zarsuelo (1975)[2]	30	extensive taxonomic survey including associated ecological factors	baseline collections conducted during 1969–1970; covered both Southwest and Northeast monsoon seasons	stations distributed throughout the bay, forming a ring around the center island	Original study inaccessible; secondary citation used.
	Bataan *et al.* (2021)	15	gleaning and snorkeling; taxonomic identification via herbarium comparison	4 collection events (2 per monsoon season) across 6 stations	100-ha area; 6 stations on sandy substrata around the center island	Post-2000; systematic sampling.

Note: [1]as cited in Dacles *et al.* (1995); [2]as cited in Bataan *et al.* (2021); *identified only by major taxa; UN - Unspecified; NR - Not Reported.

Overview of Available Biodiversity Studies in Silot Bay

A total of nine relevant studies met the inclusion criteria, the majority of which (n = 8) were conducted prior to 2000 and focused primarily on mangroves, fish, and meiofauna. In contrast, only one more recent study conducted after 2000 specifically assessed algal biodiversity, highlighting a clear and pronounced temporal gap in biodiversity monitoring within Silot Bay. Notably, no recent studies have systematically revisited mangrove, fish, or meiofaunal communities, thereby limiting the ability to robustly evaluate long-term ecological changes across these key taxa.

A substantial proportion of early studies were accessed only through secondary citations e.g., (14-16, 19, 20), with methodological details frequently reported as not available or not reported. This lack of transparency constrains the reproducibility and comparability of historical data. In contrast, later work, particularly (8) and (9), employed more structured and explicitly described sampling approaches.

Marked heterogeneity exists among studies in terms of sampling design, effort, and spatial extent. For example, a study implemented quadrat-based vegetation surveys combined with the Point-Centered Quarter Method across multiple sites, whereas earlier mangrove studies lack verifiable methodological detail (9). Similarly, fish diversity assessments ranged from undocumented historical surveys to fisher catch inspections and interviews, with limited information on sampling effort and spatial coverage. Meiofaunal studies also differed in sediment core dimensions, sieving techniques, and depth stratification, while taxonomic identification was restricted to higher-level groupings.

Taxon-Based Synthesis

Mangrove Communities

Mangrove assessments in Silot Bay are based on three studies with varying levels of methodological detail (**Table 1**), limiting robust temporal comparison. Early reports documented 7–10 species (14, 19), while a recent study recorded eight species using structured quadrat-based sampling across four sites within a 2.8 ha mangrove patch (9). However, the earlier studies are accessible only through secondary citations and lack verifiable information on sampling design, effort, and spatial coverage.

As shown in **Table 1**, one provides the most methodologically explicit dataset, incorporating standardized vegetation surveys and defined spatial coverage (9). The study also noted reduced mangrove extent relative to earlier estimates (~55 ha), along with field observations such as cut stumps and conversion to aquaculture ponds. While these observations may suggest changes in mangrove condition, direct temporal comparison is constrained by differences in methodology and the absence of verifiable baseline data.

Available evidence provides a limited and methodologically uneven account of mangrove diversity in Silot Bay. The more recent study (9) serves as the most reliable reference point; however, the lack of recent assessments prevents evaluation of current status or long-term trends.

Meiofauna Composition

Meiofaunal studies in Silot Bay are limited to two assessments with differing methodologies and low taxonomic resolution (**Table 1**). A study (10) identified 10 major taxa using a 3 cm PVC corer and fine mesh sieving, while another study (9) employed a smaller corer with depth-segmented sampling across four stations. Both studies identified organisms only to higher taxonomic levels, limiting detailed ecological interpretation.

As indicated in **Table 1**, differences in sampling protocols, including core dimensions, sediment depth, sieving mesh size, and preservation techniques, complicate direct comparison between studies. In addition, spatial coverage was restricted to a small number of nearshore stations, which may not represent the broader meiofaunal community within the bay.

Both studies consistently report nematodes as the dominant group, a pattern commonly observed in soft-sediment and estuarine environments (9). However, the absence of species-level identification and standardized sampling limits the ability to detect ecological change or assess community structure in detail. Overall, meiofaunal data for Silot Bay remain sparse and insufficient for robust temporal or spatial analysis.

Fish Diversity

Fish diversity assessments in Silot Bay are derived from three studies with limited methodological comparability (**Table 1**). Early reports recorded 53 species (identified from 73 samples) (15) and 34 species (16), while the more recent study (9) documented 29 species based on fisher catch inspection and interviews. However, the earlier studies lack accessible methodological details and are known only through secondary citations.

As summarized in **Table 1**, differences in sampling approach—ranging from undocumented historical surveys to catch-based assessments—limit comparability across studies. The absence of standardized sampling effort, gear type, spatial coverage, and temporal replication further constrains interpretation of apparent differences in species richness.

While the observed pattern may suggest changes in fish diversity, such interpretations remain tentative. Ecological factors such as habitat condition, including the extent of mangrove areas that function as nursery habitats, may influence fish assemblages; however, no integrated datasets are available to directly evaluate these relationships in Silot Bay. Consequently, current understanding of fish diversity trends remains provisional.

Algal Composition

Algal diversity in Silot Bay has been assessed in only two studies separated by several decades (**Table 1**), limiting robust evaluation of temporal change. An earlier study (20) reported 30 species based on extensive baseline collections conducted during 1969–1970 across both monsoon seasons, whereas the more recent study (8) recorded 15 species from four collection events across six stations. While this difference in species richness may suggest changes in algal communities, direct comparison is constrained by substantial differences in sampling design, effort, and spatial coverage.

As shown in **Table 1**, the earlier study (20) involved broad, seasonally inclusive collections, whereas the more

recent study (8) employed station-based sampling within a defined 100-ha area. These methodological differences, along with the lack of detailed spatial coverage in the earlier study, likely influence species detectability and recorded richness. Additionally, the earlier dataset is accessible only through secondary citation, further limiting verification.

Despite these limitations, qualitative differences in community composition are apparent. Earlier records included several large brown *algae* associated with stable substrata, whereas the more recent study reported dominance of opportunistic taxa such as Ulva, Halimeda, and Amphiroa. These patterns may reflect changes in habitat conditions; however, interpretations remain inferential.

Cross-Taxa Synthesis

Across all taxonomic groups, the available literature reveals a fragmented and methodologically heterogeneous body of work (**Table 1**). Most studies were conducted prior to 2000, with limited follow-up assessments, resulting in a substantial temporal gap in biodiversity data for Silot Bay. Post-2000 research is restricted to algal communities, leaving mangroves, fish, and meiofauna largely unassessed in recent decades.

Comparisons across taxa and time are constrained by incomplete reporting of sampling design, effort, and spatial coverage, particularly in earlier studies accessible only through secondary citations. In addition, variation in taxonomic resolution—from species-level identification to broad taxonomic categories—limits integration of findings across studies.

Although some patterns, such as differences in recorded fish species richness and changes in mangrove extent, are suggested in the literature, these cannot be conclusively established due to methodological inconsistencies. Overall, current understanding of biodiversity in Silot Bay remains provisional and highlights the need for coordinated, standardized, multi-taxa assessments.

Methodological Limitations and Uncertainty

This review is subject to several methodological limitations inherent to the available literature (**Table 1**). A number of historical studies could not be directly accessed and were interpreted through secondary citations, limiting verification of sampling design, effort, and analytical methods. Among accessible studies, there is substantial variation in sampling techniques, spatial coverage, temporal scope, and taxonomic resolution. These differences constrain cross-study comparability and make it difficult to distinguish true ecological patterns from methodological artifacts. In particular, the absence of standardized protocols limits reproducibility and robust temporal analysis. The small number of studies (n = 9) and their uneven distribution across taxa further restrict the strength of ecosystem-level conclusions. The inclusion of grey literature, while necessary to improve data coverage, introduces additional variability in methodological rigor. These limitations highlight the need for future biodiversity assessments in Silot Bay to adopt standardized, transparent, and replicable methodologies. Consistent sampling design, spatially explicit coverage, and seasonal replication are essential to establish reliable baselines, enable long-term monitoring, and support evidence-based coastal management.

Conclusion

This review highlights the fragmented and temporally discontinuous nature of biodiversity assessments in Silot Bay, with most available studies conducted prior to 2000 and only limited recent research focusing on algal communities. Across mangroves, fish, meiofauna, and *algae*, substantial variation in sampling methods, spatial coverage, and taxonomic resolution constrains robust comparisons and limits the ability to detect definitive ecological trends over time. Although available evidence suggests potential declines in mangrove cover and fish species richness, these patterns remain tentative due to methodological inconsistencies and incomplete reporting in earlier studies. The reliance on secondary citations for several key datasets further introduces uncertainty, emphasizing the lack of a verifiable and standardized baseline for biodiversity in the bay. The absence of recent, comprehensive, multi-taxa assessments represents a critical knowledge gap, particularly given the increasing anthropogenic pressures associated with aquaculture, coastal development, and resource use in the area. Without updated and methodologically consistent data, it remains difficult to accurately evaluate the current ecological condition of Silot Bay or to inform effective conservation and management strategies. Future research should prioritize the implementation of standardized, transparent, and replicable sampling protocols across multiple taxonomic groups, consistent with national and international guidelines for coastal biodiversity assessment. Long-term monitoring programs integrating spatially explicit and seasonally replicated data are essential to establish reliable baselines, detect ecological change, and guide evidence-based management. Strengthening research efforts in Silot Bay will not only address existing data gaps but also contribute to broader understanding of biodiversity dynamics in small, human-impacted tropical embayments.

Declaration

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Contribution: Conceptualization, Methodology, Writing - Original Draft, Writing - Review & Editing, Writing – Original Draft, Data Curation.

Conflict of Interest

The author declares no conflicting interests.

Data Availability

All data analyzed in this review were obtained from previously published studies, which are cited in the reference list. No new datasets were generated during this study.

Ethics Statement
Ethical approval was not required for this study.

Funding Information
The author declares that no financial support was received for the research, authorship, and/or publication of this article.

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Additional Information

How to Cite
APA 7th Edition: Angulo, K. E. (2026). Not Updated Since 2000? A Review of Biodiversity Assessments in Silot Bay, Liloan, Cebu, Philippines. Aquatic Life Sciences, 3(1), 28-34. https://doi.org/10.58920/aqlis0301567

Vancouver: Angulo KE. Not Updated Since 2000? A Review of Biodiversity Assessments in Silot Bay, Liloan, Cebu, Philippines. Aquatic Life Sciences. 2026;3(1):28-34. https://doi.org/10.58920/aqlis0301567

Harvard : Angulo, K. E. (2026)'Not Updated Since 2000? A Review of Biodiversity Assessments in Silot Bay,

Liloan, Cebu, Philippines', Aquatic Life Sciences, 3(1), pp. 28-34. doi: 10.58920/aqlis0301567

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