

## Current Estimates of Philippine Marine Mollusks Taxonomic Diversity

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Mollusks are among the most diverse and the most threatened invertebrate groups, with high records of recent extinctions. Yet, the assessment of mollusk diversity and records in megadiverse countries such as the Philippines greatly needs synthesis and updating. Here, we report on the current taxonomic diversity of the Philippine mollusk. Comprehensive records of mollusks in the Philippines from published literature, accessible museum records, and online databases were compiled and checked with the World Register of Marine Species. A total of 64,898 Philippine mollusk records were compiled, comprised of 14,482 distinct species. Of these distinct species records of Philippine mollusk, 51% have accepted names in WoRMS, whereas 35.8% had taxonomic name changes; 1.5% had unaccepted names in WoRMS but with no accepted names either (*e.g. taxon inquirendum, nomen dubium*, etc), and 11.7% did not have exactly matched records in WoRMS. After checking all Philippine mollusks records against WoRMS, there were 8,066 mollusk species in the Philippines belonging to 1,991 genera within 423 families and 51 orders, representing all molluscan classes. A total of 7,085 (88%) of the species records were marine (6,953 or 86% were strictly marine species) belonging to 1,780 genera, 368 families, and 50 orders, also representing all mollusk classes. This current account is the most comprehensive we know to date, but it certainly is an underestimate, as not all possible resources are accessible. A systematic national-scale survey of Philippine mollusk diversity is needed to improve the current account and to fill the gaps in [1] taxonomic status verification, and [2] the IUCN and conservation status of many Philippine mollusk species (which, to date, 96% of all species have no IUCN assessments).

Keywords: mollusk, mollusk checklist, mollusk diversity, mollusk taxonomy, Philippines

### INTRODUCTION

Mollusks are the second-largest phylum following Arthropoda and one of the most diverse invertebrate groups – with species dispersed across marine, terrestrial, and freshwater environments (Nybakken and McClintock 1997; Sierwald *et al.* 2018). Their diversity renders them

with various functions that make them ecologically and economically valuable. Mollusks are an invaluable source of food and livelihood, especially in coastal areas, wherein they are often harvested through gleaning, a fishing method of collecting (by hand) mollusks and other invertebrates in shallow waters or during low tide (del Norte–Campos *et al.* 2005; de Guzman *et al.* 2019; Grantham *et al.* 2020; Ordinario and Anticamara 2023). They are also

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good bioindicators of heavy metal pollution, acting as biomonitors of inorganic contaminants (Boening 1999). In medicine, mollusks are a vital source of numerous natural products that are crucial in the synthesis of tranquilizers and antispasmodic drugs (Kay 1995) and medications for chronic pain (conotoxin from *Conus* snails), which is several times more effective than morphine (Gao *et al.* 2017). Along with other marine invertebrates, they have been essential in establishing shellfish aquaculture, which has become an established industry and a potentially sustainable way to meet the increasing demand for seafood consumption, prompting employment opportunities in the coastal and rural communities (Chen 2021). Mollusks have also been used as raw materials for button and shell craft industries, and in prehistoric periods, their shells have also been used as an indication of high-rank status and a form of currency (Floren 2003; Laureta 2008). But diverse as their species and utilization in various aspects may be, there remains a general lack of a comprehensive and up-to-date mollusk diversity assessment (Bouchet 2006; Brehm *et al.* 2008) for many megadiverse countries like the Philippines.

In the Philippines, the general lack of a complete mollusk diversity assessment and baseline database is attributed to two significant factors: [1] the limited number of local scientists working on the taxonomy and systematics of Philippine mollusk and [2] the lack of comprehensive sampling coverage of mollusk in the country (Ramos *et al.* 2018; Berba and Matias 2022). With the mollusk diversity of the country, biodiversity studies focusing on the group would benefit if there were an ample number of experts working on its taxonomy and systematics. However, this is not the case, given that there are only a few mollusk taxonomists and systematists in the Philippines – with an even smaller number researching on mollusk groups (Ramos *et al.* 2018). The shortage of mollusk experts in the country considerably limits the knowledge of its species identification and diversity trends, both of which are essential in diversity assessments.

It also becomes problematic for diversity assessments when sampling coverage is narrow, usually limited to areas with the best-known biodiversity or that are conveniently accessible (Webb *et al.* 2010; Fisher-Phelps *et al.* 2017; Chen 2021). In the Philippines, mollusk collections are often comprised of specimens from localities with well-known biodiversity, leaving other areas underrepresented (Ramos *et al.* 2018). Moreover, charismatic mollusk groups such as gastropods and bivalves are more commonly studied than other mollusk groups. This existing spatial and taxonomic bias in Philippine mollusk research limits, to a great extent, the documentation of Philippine mollusk biodiversity at various levels.

The lack of a complete diversity assessment of mollusks also affects the estimations of existing species in the country. The most recent estimate of mollusk diversity in the Philippines is 22,000 species distributed across marine, freshwater, and terrestrial habitats (Ong *et al.* 2002). However, this diversity estimate may already be an inaccurate representation of the country's mollusk diversity. Recorded mollusk species in the country may have been duplicates, with misspellings, or may have undergone synonymy, considerably increasing any diversity estimations. These cases highlight the need to check the taxonomic status of species names alongside inventory assessments to generate an accurate species diversity estimate.

### **Need for Improved Biodiversity Assessments of Philippine Mollusks**

Mollusks are among the most exploited taxonomic groups since pre-historic times given their varied use (Floren 2003). In the Philippines, they are mainly a source of sustenance and livelihood for families in coastal communities, and are collected through gleaning. However, if consumption and livelihood activities involving mollusk groups remain unregulated, it could impact economically important species due to overfishing, significantly decreasing their population due to overexploitation to the point of extinction (Briggs 2015).

Because of their high tendency to be overexploited, mollusks are among the taxa suffering from rapid and high numbers of extinctions (Lydeard *et al.* 2004; Régnier *et al.* 2009). Many mollusk extinctions remain undocumented in the IUCN Red List (International Union for Conservation of Nature) (Régnier *et al.* 2009). In the Philippines, there is a significant decline (due to overexploitation) in populations of commercially important marine mollusk species such as *Nautilus* sp. (Dunstan *et al.* 2010), giant clams (Floren 2003), *Pholas orientalis* (Laureta 2008), *Malleus malleus*, and *Amusium pleuronectes* (del Norte–Campos *et al.* 2019) that was recorded in recent years. Yet, from a conservation perspective, these mollusks remain unassessed, and their conservation status in the country is unrecorded. Mollusk diversity assessments must be more than a simple identification of what species exist to address the problem of conservation status assessment; they should include [1] the updated taxonomic and nomenclature status of species, [2] the geographic distribution of species throughout the country, [3] the population status of species, and [4] the levels of exploitation of species to assess conservation status and to determine the best conservation strategies to implement (Webb and Mindel 2015).

The Philippines is among the megadiverse countries with mollusks as a taxonomic group of primary economic and ecological importance. The persistent gaps in

Philippine mollusk research – the lack of comprehensive and systematic assessment and accurate estimates of its mollusk diversity – are important aspects that must be addressed to effectively use, manage, and conserve the country’s overall mollusk biodiversity. By examining published literature and accessible museum collections and databases, this paper compiles and validates records of Philippine mollusk to provide the following: [1] total estimates of the Philippine marine mollusk taxonomic diversity based on compiled original records, [2] updated taxonomic names of recorded Philippine mollusks based on the World Register of Marine Species, and comments on cases of taxonomically unaccepted scientific names and records, and [3] significant research gaps and future directions for Philippine mollusk research.

## MATERIALS AND METHODS

### Compiling All Accessible Records of Philippine Mollusk Species

Mollusks are among the most recognized and numerous invertebrate groups, and the broad expanse of literature in which they are studied can be one drawback in compiling a comprehensive species list. In this respect, we limited the sources we reviewed. We included published literature and collection databases accessible through the internet using Google Scholar and Scopus for journal articles and online databases for museum collections. The screened sources did not include amateur collections and inaccessible museum online databases. These references can provide a considerable number of records of Philippine mollusk; however, access remained the main impediment in their inclusion as record sources.

The checklist scope consists of all the Philippine mollusk species, which is recorded in available and accessible literature, museum records, and online databases. Major sources of mollusk records include books, published journal articles, online collection records, and databases of museums commonly cited in mollusk research.

In assembling the checklist, we first screened published literature that contains Philippine mollusk records (PMRs). Records of mollusk species from books of Guido T. Poppe (Volumes I and II, 2008a and b; Volumes III and IV, 2010a and b; Volume V, 2017), Liberato V. Laureta (2008), and Rolando Garcia (1986) were collated – including their primary data such as taxonomic classification, brief species description, locality, and image (if provided).

Journal articles were collated using a combination of the keywords “Philippines,” “Mollusca,” “mollusk,” and “taxonomy” in Google Scholar and Scopus. These

publications were screened to include articles that [1] covered checklists of mollusks in Philippine regions, [2] reviewed specific taxonomic groups with descriptions of new species, and [3] conducted studies utilizing mollusk specimens with type localities from the Philippines. Articles that only mentioned Philippine species in passing and those not openly accessible were excluded from the shortlist.

Museums constantly cited in journal articles and usually housed type specimens were examined for mollusk records. PMRs in the following museums’ collection and online databases were obtained from the data previously collected by Ramos *et al.* (2018) and included in the analysis:

- [ANSP] Academy of Natural Science of Philadelphia, Philadelphia, PA, USA
- [BMNH] British Museum of Natural History, London, United Kingdom
- [CAS] California Academy of Sciences, San Francisco, CA, USA
- [FMNH] Field Museum of Natural History, Chicago, IL, USA
- [LACM] Los Angeles County Museum of Natural History, Los Angeles, CA, USA
- [MCZ] Museum of Comparative Zoology, Cambridge, MA, USA
- [MNHN] Museum National d’Histoire, Naturelle, Paris, France
- [NSMT] National Museum of Nature and Science, Tokyo, Japan
- [SBMNH] Santa Barbara Museum of Natural History, Santa Barbara, CA, USA
- [USNM] National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

PMR sources were categorized, each assigned with a distinct numeric code: books were coded as 1, and each book was labeled as 1.1 (Poppe), 1.2 (Laureta), and 1.3 (Garcia); journal articles were coded as 2, each journal labeled as 2.1 to 2.108; and museum databases were coded as 3, with each database labeled as 3.1 to 3.10. All PMRs from all accessed resources were compiled in Microsoft (MS) Excel (Supplementary Excel Data 1 available upon request from the authors).

### Checking Taxonomic Status of Philippine Mollusk Records (PMRs) Using WoRMS

PMRs from Supplementary Excel Data 1 were alphabetized by species name, and their taxonomic information (*e.g.* original taxonomic classification if indicated, habitat, type locality, distribution) was recorded and itemized into columns. For each PMR, taxonomic status was checked using the World Register of Marine Species database (<https://www.marinespecies.org/>; accessed from January 2022–October 2023). Species records [1] with

accepted names in WoRMS, [2] with unaccepted names but with correct and accepted names in WoRMS [3] with unaccepted names but with no accepted names in WoRMS (*e.g. taxon inquirendum* or *dubium*), and [4] species records that do not have an exactly matched record were noted. All the outputs of taxonomic status checking for all PMRs were compiled in MS Excel (Supplementary Excel Data 1). All the Philippine mollusk species that records no accepted names were removed in the succeeding stage of analysis.

### Checking the Habitats of Philippine Mollusk Species with Accepted Names and Their Final Taxonomic and Phylogenetic Information

Using their accepted names, the Philippine mollusk species records were checked in WoRMS in terms of their habitats – *e.g.* terrestrial, freshwater, brackish, *etc.* Non-marine species (*i.e.* freshwater, terrestrial, and freshwater-terrestrial species) were removed from the succeeding analysis. The complete records of Philippine marine mollusk with accepted names are compiled in MS Excel (Supplementary Excel Data 2: available upon request from the authors), including their accepted taxonomic rank or phylogeny information (*e.g.* Family, Class, Order, *etc.*). This file was then used to provide the diversity of Philippine marine mollusk.

## RESULTS

### Total Number of Philippine Mollusk Records (PMRs) Based on Published Literature and Museum Collections

A total of 64,898 species records of mollusk species

found in the Philippines were compiled from various published literature and accessible museum collection online databases, which were categorized into [1] books, [2] journal articles, and [3] museum databases.

The greatest number of species records came from museums (50,426 or 77.7%), followed by books (11,908 or 18.35%), and the least from journals (2,564 or 3.95%). Among the museums, the greatest number of species records (comprising about 56% of the total records) came from ANSP, followed by MNHN and MCZ (Figure 1a). In terms of books, most of the species records came from Poppe's Volumes I–V (Figure 1b). In terms of journals, the majority of the species records came from 10 journal publications with species records ranging from ~ 70–300 (Supplementary Excel Data 1).

### Taxonomic Status of Mollusk Species Records in the Philippines after Checking against World Register of Marine Species

Of the 64,898 species records, a total of 14,482 distinct species were recorded from the Philippines, 52.6% and 43% of which came from museum and book records respectively, and less than 5% from journal records (Supplementary Excel Data 2).

The majority of the distinct Philippines species records from the various sources have [1] accepted names in WoRMS (51%), whereas [2] 35.8% had unaccepted names but with correct and accepted names in WoRMS (*i.e.* undergoing various taxonomic name changes), [3] 1.5% had unaccepted names in WoRMS but no accepted names either (*e.g. inquirendum, dubium, etc.*), and [4] 11.7% did not have exactly matched records in WoRMS and,

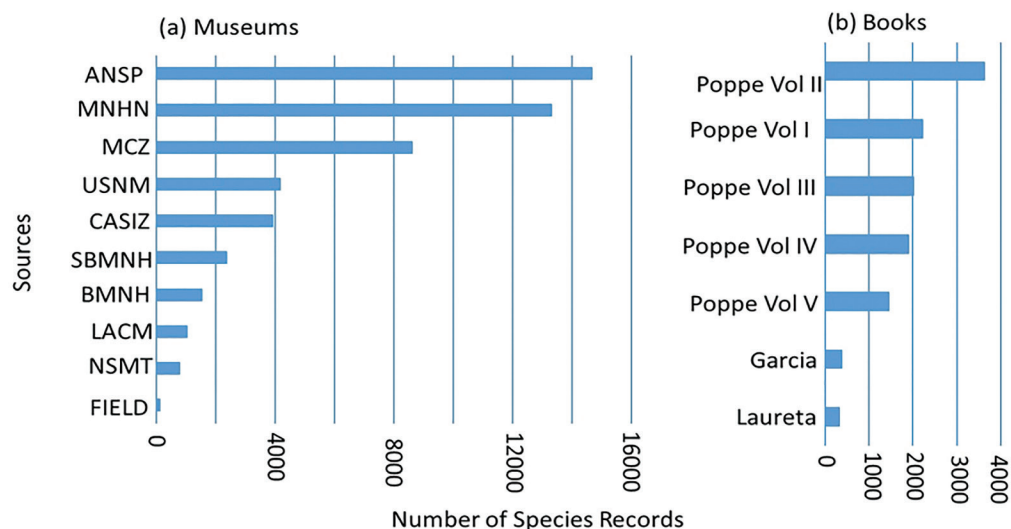


Figure 1. Bar plot showing the number of Philippine Mollusk species records compiled from museum collections (a) and published books (b), which comprised the majority of the records (> 90% of all records).



therefore, are difficult to check using WoRMS platform (Table 1; Supplementary Excel Data 2).

### Habitats of Philippine Mollusk Species

Using the distinct species records (*i.e.* removing duplicate records of species), a total of 8,066 mollusk species were recorded from the Philippines based on all accessible sources compiled. Of these 8,066 species, 6,953 (86%) were strictly marine, and 7,085 species were marine and partially marine (*i.e.* portion of their life history spent in marine or brackish environment or 88%) (Figure 2). A total of 870 (11%) species were strictly terrestrial and 109 (1%) species were strictly freshwater, whereas two species straddled between terrestrial and freshwater environments for part of their life history (Supplementary Excel Data 2).

### Philippine Mollusk Diversity

The 8,066 mollusk species recorded from the Philippines

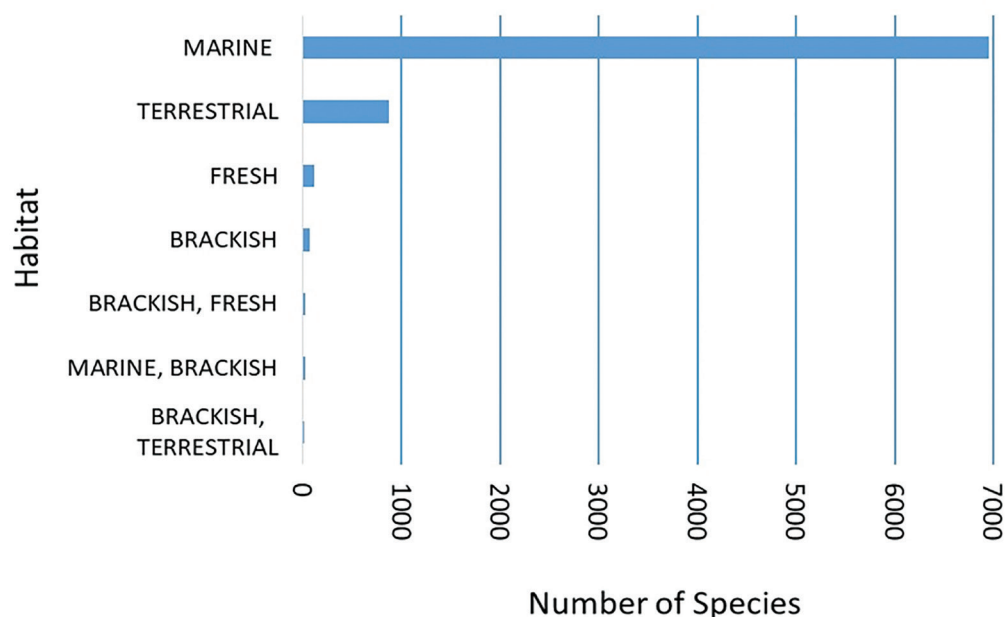
belonged to five classes, 51 orders, 423 families, and 1,991 genera (Supplementary Excel Data 2). The most species-rich classes were Gastropoda (6,851 species or 85%) and Bivalvia (1,227 species or 15%). The most species-rich orders were Neogastropoda (2,377 species or 29%) and Littorinimorpha (1,074 species or 13%). The most species-rich families were Muricidae (353 species or 4%), Camaenidae (308 species or 4%), and Conidae (297 species or 4%). The most species-rich genera were *Conus* (250 species or 3%), *Vexillum* (206 species or 3%), and *Nassarius* (125 species or 2%) (Supplementary Excel Data 2).

### Philippine Marine Mollusk Diversity

A total of 7,085 (88%) mollusk species were marine or partially marine (*i.e.* portion of its life history in other habitats – freshwater or terrestrial), with 6,953 (86%) species strictly marine in terms of habitat. These

**Table 1.** Table showing the number of distinct species records from the original source types that are categorized as follows: with original names accepted in WoRMS, unaccepted original names but with alternative accepted names in WoRMS, unaccepted original names without accepted names in WoRMS (*e.g.* *inquirendum*, *dubium*, *etc.*), and those with no exact matched records in WoRMS.

Source type	Accepted names	Unaccepted names with alternative accepted names	Unaccepted with no alternative accepted names	No records	Total
Museums	2782	3408	156	1280	7626
Books	4244	1585	47	362	6238
Journals	377	186	10	45	618
Total	7403 (51%)	5177 (35.8%)	213 (1.5%)	1687 (11.7%)	14482



**Figure 2.** Bar plot showing the number of mollusk species per habitat.

7,085 marine species belonged to 1,780 genera, 368 families, and 50 orders, representing all mollusk classes (Supplementary Excel Data 3: available upon request from the authors). The most species-rich marine mollusk classes were Gastropoda (5,609 species or 72%) and Bivalvia (1,218 species or 17%). The most species-rich marine mollusk orders were Neogastropoda (2,375 species or 33.5%) and Littorinimorpha (1,035 species or 14.6%). The most species-rich marine mollusk families were Muricidae (353 species or 5.0%), Conidae (297 species or 4.2%), and Costellariidae (245 species or 3.5%). The most species-rich marine mollusk genera were *Conus* (250 species or 3.5%), *Vexillum* (206 species or 2.9%), and *Nassarius* (125 species or 1.8%).

## DISCUSSION

### Gaps in Philippine Mollusk Diversity Publications and Assessments

Research and publication on Philippine mollusk diversity abound given the variety of mollusk species that the country has. However, most of these publications delve more into the local and regional biodiversity of Philippine mollusk, yielding only mollusk inventories of localities and regions of interest, and not at a national scale. These publications only present baseline data on the local presence of Philippine mollusk and barely cover the country's mollusk diversity. The lack of publications that cover countrywide diversity keeps our knowledge of Philippine mollusk diversity fragmented.

Publications on non-marine species are another evident gap in Philippine mollusk diversity research. The majority of the publication on Philippine mollusk involves marine species. This is expected as the country is mainly surrounded by marine waters and coastal areas abound. With this geographic setup, marine species are easily accessible compared to freshwater and terrestrial species; thus, they are frequently studied in various areas of mollusk research. This leaves non-marine mollusk diversity less known, with species left undocumented and unassessed.

Gastropoda and Bivalvia are the most numerous among molluscan classes, which explains the many publications on Philippine mollusks, wherein their diversity is more often assessed compared to other molluscan groups. Although there are research and publications on other taxonomic classes of mollusks, their diversity remains less known, undocumented, and under-represented in diversity studies on Philippine mollusks. These gaps in Philippine mollusk diversity publications would be effectively addressed by conducting a systematic nationwide sampling and exploration with more effort

extended toward non-marine species and other molluscan taxonomic groups to better understand the country's mollusk diversity.

For diversity assessments of Philippine mollusk, there are notable gaps that must also be addressed to generate extensive baseline data, including [1] taxonomic status assessments of documented mollusk species and [2] IUCN and Philippine conservation status of documented and important mollusks.

Most of the biodiversity assessments of Philippine mollusks focus on providing an inventory or checklist of mollusk species. While such listings generate data on species diversity, they lack other important information that will be instrumental in diversity research such as taxonomic status. Taxonomic names often undergo revisions, which places species from one genus or species to another. From our compiled list of Philippine mollusk alone, 5,177 species have already undergone taxonomic revisions and are known by an "accepted" name different from their previously published scientific name. Overlooking these changes in species identification can be problematic, as it can create confusion in correctly recognizing one species from another. This can further affect other areas of Philippine mollusk research such as conservation and management. At present, verifying and checking the taxonomic status of Philippine mollusk is made easy using global databases like the World Register of Marine Species. Such databases incorporate all necessary information about a species – including their status, currently assigned names, and images. This makes it easier for local researchers to verify the species names and examine images of specimens.

Conservation status is another critical data that must be included during diversity assessments. With the prevalent natural and anthropogenic factors affecting mollusk diversity, mollusks become susceptible to overexploitation and possible extinction. This greatly affects diversity, rendering species either partially or completely obliterated before they are even recorded and assessed. Including conservation status in diversity assessments of Philippine mollusk would be beneficial, especially for Philippine species with economic and ecological importance. This would allow appropriate authorities, agencies, and researchers to plan and implement suitable strategies for using, managing, and conserving Philippine mollusk.

### Unaccepted Mollusk Species Names and Their Implications on Philippine Mollusk Diversity and Taxonomic Assessments

Of documented mollusk species in the Philippines, 35.8% have unaccepted names based on the WoRMS database

and underwent taxonomic revision and re-assignments (*i.e.* have name changes or corrections). Moreover, 1.5% had unaccepted names in WoRMS but no accepted names either (*e.g.* *taxon inquirendum*, *nomen dubium*, *etc.*), and 11.7% did not have exactly matched records in WoRMS. These findings tell of how diversity assessments of Philippine mollusk focus more on generating species inventory and give minimal attention to taxonomic reviews of the identified and documented mollusk species in the country. Taxonomic assessments, which include verifying current nomenclature and biological specimens, provide a better identification of the country's mollusk species. This is made more accessible by online databases like WoRMS through their standardized method of validating and updating species status and scientific names, making taxonomic assessments straightforward. When mollusk species are accurately identified, a better picture and precise estimates of the country's mollusk diversity could be arrived at.

However, taxonomic assessment through checking biological specimens is a different challenge for researchers, particularly in the Philippines. Although online databases like WoRMS incorporate images in their references, not all species have available images, thereby necessitating the examination of specimens. Local museums serve as repositories for voucher specimens that can be used in species verification. However, access remains problematic for various reasons: [1] access requests and granting take time, [2] some species lack voucher specimens, and [3] collection inventory and verification are still ongoing. Foreign museums provide access to their collections of Philippine mollusk, albeit only for limited periods (Ramos *et al.* 2018). These obstacles in taxonomic verification result in skipping the process, affecting the validity of inferences made from the diversity assessment of Philippine mollusks.

This also highlights the methods through which diversity and taxonomic assessments are being done in the Philippines. While traditional methods (*i.e.* sampling surveys and specimen examination) remain the standards, combining various techniques from different disciplines (*e.g.* comparative morphology, phylogeography, genetics, ecology, *etc.*) or what is known as integrative taxonomy (Dayrat 2005) can yield a better outcome in diversity and taxonomic assessments of Philippine mollusk. Integrative taxonomy amalgamates procedures in delineating species, providing different perspectives to researchers and allowing them to assess and identify species precisely.

By including taxonomic verification in diversity assessments, improving access and specimen collection inventory and evaluation in local museums, and venturing into Integrative taxonomy in delineating mollusk species, diversity and taxonomic reviews of Philippine mollusk

can generate a more substantial and updated preliminary baseline data – thereby reducing duplication of species records, misidentification, and inaccurate diversity estimates.

### **Current Estimates of Philippine Mollusks and Their Major Gaps**

With a current estimate of 8,066 mollusk species, the Philippines has greater mollusk species documented compared to other Asian countries such as Vietnam, which has recorded 2,200 species (Hylleberg and Kilburn 2003), Singapore with 1,264 species (Tan and Woo 2010), and India with 866 species (Hylleberg and Kilburn 2002). Although this estimate provides a preliminary view of the country's mollusk biodiversity against neighboring countries, there are significant gaps in its diversity estimates that need to be addressed to improve approximation – including [1] lack of habitat coverage, [2] lack of taxonomic coverage, and [3] inclusion of mollusk collections from amateur magazines and other museum with inaccessible collection databases.

Most of the Philippine mollusks collated and screened from the references were marine species, making up 88% (7,085 species). Non-marine species comprised ~ 12% (870 terrestrial species and 109 freshwater species), mainly freshwater and terrestrial inhabitants. The wide margin between marine and non-marine species being reported in Philippine mollusk research indicates the narrow habitat coverage of diversity assessments in the country. Most of the Philippine mollusk research conducted was on marine species, focusing on provinces prominent for their marine biodiversity such as Palawan, Bohol, and Cebu. This evident research bias over marine habitats and biodiversity overlooks non-marine mollusk species, especially those in landlocked regions, undermining diversity estimates for Philippine mollusks. Taxonomic coverage has a similar effect on the country's diversity estimates. Of the 8,066 species identified, 85% comprised gastropods and 15% were bivalves, whereas other mollusk groups – mainly cephalopods, scaphopods, and polyplacophorans – only made up 1.4, 1.2, and 0.7%, respectively. Most publications on Philippine mollusks involved gastropods and bivalves, implying preferences for these taxonomic groups in research. This continuing research trend favoring dominant taxonomic groups similarly overlooks other mollusk taxonomic groups and compromises the accuracy of estimates made of Philippine mollusk diversity. As previously discussed, these interrelated gaps would be addressed effectively through a nationwide sampling to generate a comprehensive species inventory of mollusk in the country, where more significant effort should be directed to underrepresented regions across all habitat types and all taxonomic groups to estimate Philippine mollusk diversity precisely.

However, generating an accurate diversity estimate becomes complicated when it comes to amateur collections and mollusk collections from museums not commonly cited in research. Mollusk species from these collections, which may be a few hundred species, is a recurring gap in attempts to provide diversity inventory and estimates of Philippine mollusk. Accessing these collections requires additional effort since they are not referenced in scholarly websites like Scopus and Google Scholar or do not have collection online databases from which data can be referenced. For amateur and private collections of Philippine mollusk, unless these are absorbed by major institutional repositories like the Philippine National Museum, species records may not be thoroughly accounted for in mollusk diversity estimations. Data digitization is another major step toward making these collection records more available and accessible to researchers worldwide (Sierwald *et al.* 2018). This would allow collections of Philippine mollusks from amateur collections and lesser-known museums to be open for assessments, included in mollusk research, and covered in mollusk diversity estimates.

## CONCLUSION

By conducting an inventory assessment of the Philippine mollusk from published literature and accessible museum collection online databases, the researchers were able to generate a checklist and current estimate of Philippine marine mollusk, a preliminary baseline data on the invertebrate group's marine biodiversity in the country. After checking all Philippine mollusks records against WoRMS, a total of 8,066 species were identified (composed of 7,085 marine species) belonging to 1,991 genera, 423 families, and 51 orders across all molluscan classes. In analyzing records of Philippine mollusk species, it was determined that several species were not recorded in international databases like WoRMS, whereas others species had already undergone taxonomic revisions and re-assignments. Implications on the Philippine mollusk diversity and taxonomic assessments include [1] lack of geographic, habitat type, and taxonomic group coverage, and [2] lack of status assessments, *i.e.*, taxonomic status and both IUCN and Philippine conservation status of documented mollusk species (*i.e.*, 96% of the species recorded in the Philippines currently do not have assessments in IUCN).

Future diversity assessments should involve a countrywide systematic sampling that includes all taxonomic groups across all habitat types and geographic ranges to better cover and precisely estimate Philippine mollusk diversity. Additional effort must also be extended to include mollusk

collections from amateur collectors and museums not often cited in mollusk research; these can be more than a few hundred species often excluded from assessments and estimates due to their dispersed distribution, perhaps uncurated status, and the difficulty of access unless they are acquired by institutional repositories or made available online through data digitization. Taxonomic verifications must be regularly conducted to update status and other species information to ensure that the taxonomic data being circulated within Philippine Mollusk research and used as baseline data are valid and current. Lastly, diversity assessment of Philippine mollusk should include species conservation status in order to strategize conservation and sustainable use, and prevent overexploitation and possible extinctions of species in the country.

## ACKNOWLEDGMENTS

We thank the UP OVCRD (University of the Philippines Office of the Vice Chancellor for Research and Development) for providing funds to support a portion of this work *via* the Source of Solutions Grant (SOS 181823). We also thank Mr. Dino Ramos and Mr. John Alberto Ordinario for their contributions in various stages of this work.

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