POLICY BRIEF

Non-detriment Finding Assessment for Giant Clam (Family Tridacninae) Shells in the Philippines

Marie Antonette Juinio-Meñez[1,7*], Nadia Palomar-Abesamis[2,7], Oasis Atuel[3], Myron Gavriel Baring[3], Renalyne Acosta[3], Eunice Bognot[3,4]

[1] *Marine Science Institute, University of the Philippines Diliman, Quezon City 1101 Philippines*
[2] *Biology Department, Silliman University, Dumaguete City, Negros Oriental 6200 Philippines*
[3] *National Fisheries Research and Development Institute, Fisheries Building Complex, BPI Compound, Visayas Avenue, Quezon City 1128 Philippines*
[4] *Member, Philippine Aquatic Red List Committee – Invertebrates Sub-Committee*

KEY POINTS

- Populations of all giant clam species in the Philippines have declined significantly over the past four decades, with a collective decline of 98%.
- Despite massive culture and restocking efforts for the true giant clam (*Tridacna gigas*) since the 1980s, recruitment rates for the species are still very low, mainly because of persistent threats from anthropogenic activities, habitat degradation, and extreme weather events.
- The harvest and trade of giant clams and their derivatives have been completely banned in the Philippines since the 1990s; however, live giant clams, meat, and shells are still sold illegally around the country up to the present.
- Based on the best available information gathered, the assessment showed that the harvest and trade of giant clam shells pose a high risk to all species and are detrimental to the survival of wild giant clam populations in the Philippines.
- The Scientific Authority is, therefore, unable to issue a positive non-detriment finding (NDF) for giant clam shells at this time, and trade must be confined to certified captive-bred specimens and their derivatives.

*Corresponding Author: *ajmenez@msi.upd.edu.ph*
Received: *January 17, 2025*
Accepted: *July 11, 2025*

Keywords: *CITES Appendix II, Tridacna, Hippopus, threatened species, giant clam shell trade*

1. Rationale for the NDF Assessment

Giant clams are valuable because they provide a wide array of ecological services essential for the maintenance of the health of reef ecosystems. They provide shelter for various organisms, improve water quality through filtration, and are important sources of calcium carbonate for coral reef formation and maintenance (Cabaitan et al. 2008; Neo et al. 2015). They are protected and conserved at the global and national levels through several regulations. In October 2024, the conservation status of *Tridacna gigas* (the true giant clam) was elevated from vulnerable to critically endangered under the International Union for the Conservation of Nature (IUCN) Red List (Neo and Li 2024a). This is the highest Redlist level for a species before it becomes extinct in the wild. Other giant clam species that had their conservation status raised in 2024 were *Tridacna derasa* (from vulnerable to endangered), *Hippopus hippopus* and *H. porcellanus* (from least concern to vulnerable) (Neo and Li 2024b-d).

In the Philippines, eight species of giant clams are present, and several laws have been enacted to protect and conserve all of them for the past 34 years. These include Republic Act 8550 and 10654 (Philippine Fisheries Code), Republic Act 9147 (Wildlife Act), Fisheries Ordinances 168 (Rules and regulations governing the gathering, culture, and exportation of shelled mollusks in Phylum Mollusca), 208 (Conservation of rare, threatened & endangered fishery species), and 233 (Aquatic Wildlife Conservation). Philippine legislation has collectively prohibited (or banned) the harvesting, possession, sale, purchase, transport, export, or shipping of giant

clams in the country, including parts (e.g., shells) or derivatives of the species. Exceptions are given to the harvest and trade of giant clams in relation only to scientific research, conservation and commercial breeding, and the export of hatchery-bred individuals.

Since 2017, however, the number of giant clam shell seizures has significantly increased in the Philippines (Feltham and Capdepon 2021). Tons of shells were recovered by government authorities from several provinces and placed in the custody of the Bureau of Fisheries and Aquatic Resources (BFAR). There was no evidence that the clam shells stockpiled were fossilized. As part of its response to the request of traders, BFAR issued a memorandum in April 2020 that ordered the inventory and documentation of confiscated shells in regional offices and those illegally stockpiled in warehouses nationwide. Additionally, it called for a temporary suspension of any search and apprehension activities related to giant clam shells until the results of the inventory were obtained. In 2022, BFAR requested the National Fisheries Research Development Institute (NFRDI), through the Philippine Aquatic Red List Committee (PARLC), to conduct a non-detrimental finding (NDF) assessment of dead giant clam shells to serve as a guide in the formulation of appropriate policy regarding the possible export of these derivatives.

Giant clams of the family Tridacninae are included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which the Philippines is a signatory. In accordance with the provisions of CITES, the export of any specimen of a species included in Appendix II shall require the prior grant and presentation of an export permit. In the Philippines, an export permit for an aquatic species and its derivatives shall only be granted when the following conditions have been met: (1) BFAR (as a CITES Management Authority of the State) is satisfied that the specimen was not obtained in contravention of the laws of the State for the protection of fauna and flora, and (2) NFRDI and the PARLC (as a CITES Scientific Authority of the State) has advised that such export will not be detrimental to the survival of that species and issues a positive NDF.

2. Assessment Process

The NDF assessment for giant clam shells was conducted based on a comprehensive review of relevant published and unpublished literature on the population status, monitoring, management, utilization, and trade of giant clams and derivatives in the Philippines. Additional information was also compiled from site validation observations, news reports, consultations with scientific experts and key researchers, national and local government agencies, non-government organizations, giant clam hatcheries, shell craft traders, and key informant interviews from sites (Palawan, Cebu, and Zamboanga) reported to have the largest giant clam shell seizures.

The assessment is essentially a risk or impact assessment based on the best available information for the species. It evaluates the vulnerability of the species in the wild relative to the type and volume of trade. Since the available data obtained for this study were predominantly on *Tridacna gigas* and the majority of the shells were from *T. gigas*, this species was used as the basis for the NDF assessment. We employed a semi-quantitative approach and evaluated 16 indicators, comprising 8 for biological characteristics, 2 for threats and conservation status, and 6 for management and control measures. The semi-quantitative approach was adapted from the evaluations of Rosser and Haywood (2002) and the Spanish CITES Authority (2017). Each indicator was assessed based on the increasing degree of natural vulnerability or risk to the extraction of the wild population and used a scale of increasing risk, ranging from 0 to 3 (Table 1). The highest score that can be obtained by applying all 16 variables is 48 points. Therefore, the mean value of 24 will be considered as the threshold for determining the sign of the evaluation of the semi-quantitative analysis. The thresholds for determining the results of the assessment of the NDF are as follows:

- Total points = 24-26 points = Decision deferred; it is not possible to guarantee that the harvest of shells will not have a harmful effect on the population of origin; the decision can be reassessed at a later time on the basis of new information available to determine whether the harvest is harmful or not
- Total points = < 24 points = Positive NDF (+); harvest and trade of shells is not detrimental to the survival of wild populations of the species
- Total points = > 24 points = Negative NDF (-): harvest and trade of shells is detrimental to the survival of wild populations of the species

3. Results of the assessment

3.1 Status of giant clam populations, management, and local trade

Based on available survey information from different localities, the average density of all giant clam species in the Philippines has declined sharply over the

Table 1. Semi-quantitative NDF assessment for giant clam shells. The values in column S correspond to the score of each answer that is offered for each of the variables that need to be evaluated (0=no risk, 1=low risk, 2=medium risk, 3=high risk). The chosen score per variable is marked in column V. The sum of the scores is in the lowest row of the table.

Biological characteristics			**S**	**V**	**Source/Justification**
1	Biological traits	High reproductive rate, long- lived	0	2	Ellis 1997; Neo 2020; Soo and Todd 2014
		High reproductive rate, short-lived	1		
		Low reproductive rate, long- lived	2		
		Low reproductive rate, short- lived; or unknown	3		
2	Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)?	Extreme generalist	0	2	Hean and Cacho 2003; Enricuso et al 2018; Sayco et al. 2023
		Generalist	1		
		Specialist	2		
		Extreme specialist	3		
	Remarks: Giant clams require clean waters with minimal pollution and siltation				
3	Dispersal efficiency: How efficient is the species' dispersal mechanism at key life stages?	Very good	0	2	Neo 2020; Soo and Todd 2014
		Good	1		
		Medium	2		
		Poor	3		
4	Interaction with humans: Is the species tolerant to human activity other than harvest?	No interaction	0	3	Hean and Cacho 2003; Calumpong and Solis-Duran 1993; Calumpong et al. 2002; Sayco et al. 2023; Focus Group Discussions (FGDs)
		Pest/Commensal	1		
		Tolerant	2		
		Sensitive	3		
	Remarks: Sensitive to pollution, siltation, extreme temperature & acidity, severe weather disturbance e.g. typhoons				
5	Percentage of range of the species in the country relative to the range of the species in the world	< 10 %	0	0	Neo et al. 2017
		10-40 %	1		
		40-80%	2		
		>80% or unknown	3		
6	National distribution: How is the species distributed nationally?	Widespread and continuous distribution; or ≥ 75% of the national territory	0	3	Dolorosa et al. 2024; Juinio et al. 1989; scientific experts, FGDs
		Widespread and fragmented distribution; or between 75% and 40% of the national territory	1		
		Restricted and fragmented distribution; or between 40% and 15% of the national territory	2		
		Localized distribution; or ≤ 15% of the national territory; or unknown	3		
	Remarks: It is extremely rare to find the giant clams (except for the boring species) outside of MPAs or protected restocking sites				
7	National abundance: What is the abundance nationally?	Very abundant	0	3	Dolorosa et al. 2024; Juinio et al. 1989; scientific experts, FGDs
		Common	1		
		Uncommon	2		
		Rare	3		
8	National population trend: What is the recent national population trend?	Increasing	0	3	Dolorosa et al. 2024; Juinio et al. 1989; scientific experts, FGDs
		Stable	1		
		Reduced, but stable	2		
		Reduced and still decreasing	3		

Continuation of Table 1. Semi-quantitative NDF assessment for giant clam shells. The values in column S correspond to the score of each answer that is offered for each of the variables that need to be evaluated (0=no risk, 1=low risk, 2=medium risk, 3=high risk). The chosen score per variable is marked in column V. The sum of the scores is in the lowest row of the table.

Threats and conservation status			**S**	**V**	**Source/Justification**
9	Conservation status according to IUCN, preferably at the scale of the population from which the specimens will be extracted, if not at the country or globally	N/A (it is not VU, EN, CR or DD)	0	3	IUCN Redlist
		VU – Vulnerable	1		
		EN – Endangered	2		
		CR – Critically endangered or	3		
		DD – Data deficient			
10	Threats to the population from which the specimens will be extracted*	No threats	0	3	AMTI 2019; Cowan 2024; Ellis 1997; Gomez 2017; Muallil 2024; Neo 2020; Feltham and Capdepon 2021; scientific experts, FGDs
		1 out of the 6 types of threats listed	1		
		2-3 out of the 6 types of threats listed	2		
		≥ 3 out of the 6 types of threats listed (or without information on threats)	3		
	*Threats include: - habitat loss and fragmentation - pollution - resource utilization or exploitation for purposes other than international trade (e.g. hunting, poaching, illegal trade, domestic consumption...) - antagonism with other species (e.g. invasive exotic species, genetically modified organisms, disease, predation, herbivorism...) - reduced fecundity and genetic variability because of too low population numbers - climate change effects (high temperature, acidity…)				
Management and control for its conservation and use			**S**	**V**	**Source/Justification**
11	Percentage of population distribution or size (locally exploited or nationally, in default) included in protected natural areas or regulated areas (including those regulated for extractive purposes)	> 15%	0	0	Published papers, scientific experts, FGDs
		15-5%	1		
		< 5%	2		
		0% or unknown	3		
	Remarks: Most giant clams are only found in protected areas				
12	Existence and implementation of a management plan or equivalent for the conservation and sustainable use of the resource	There is a plan and it is fully implemented	0	1	Philippine laws (FAO 168, RA 10654 & 9147)
		There is a plan and it is partially implemented	1		
		There is a plan but no evidence that it is being implemented	2		
		There is no plan	3		
13	Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from harvest?	> 15%	0	0	Philippine laws (FAO 168, RA 10654 & 9147)
		15-5%	1		
		< 5%	2		
		0% or unknown	3		
	Remarks: Giant clams are fully protected from harvesting in its entire range in the Philippines				
14	Illegal harvest or trade: How significant is the national problem of illegal or unmanaged harvest or trade?	None	0	3	Feltham and Capdepon 2021; Lee and Wong 2023; BFAR; CITES, TRAFFIC, Wildlife Justice, FGDs
		Small	1		
		Medium	2		
		Large	3		

Continuation of Table 1. Semi-quantitative NDF assessment for giant clam shells. The values in column S correspond to the score of each answer that is offered for each of the variables that need to be evaluated (0=no risk, 1=low risk, 2=medium risk, 3=high risk). The chosen score per variable is marked in column V. The sum of the scores is in the lowest row of the table.

15	Existence of mechanisms to control extractions (both for international or domestic trade) and to monitor the state of the resource in the area where the extraction takes place	Administrative and in situ mechanisms exist	0	2	Key informant interviews, FGDs
		There are in situ mechanisms but not administrative ones	1		
		There are administrative mechanisms but not in situ ones	2		
		There are no control mechanisms	3		
	Remarks: Administrative mechanisms exist but are not implemented consistently or effectively in situ				
16	Illegal harvest or trade: How effective are any restrictions on harvesting or trade?	Very effective	0	2	Feltham and Capdepon 2021; Lee and Wong 2023; Muallil et al. 2024; Mecha and Dolorosa 2020; Balisco et al. 2022; CITES, TRAFFIC, Wildlife Justice, FGDs, social media, news reports
		Effective	1		
		Ineffective	2		
		None	3		
SUM OF SCORES			**32**		

past four decades, with an overall decrease of 98.2% from 1983 to 2023 (PARLC Invertebrate Subcommittee 2024). Surveys in the 1980s already indicated that the *Tridacna gigas* population has been extirpated in many localities (Alcala 1986; Juinio et al. 1989). Alarmingly, despite full protection by the law in the last 35 years, there has been a decrease of 40 to 98% in densities for the smaller giant clam species *T. squamosa* (40%; 23 individuals/ha to 16 individuals/ha), *T. crocea* (98%; 4164 individuals/ha to 79 individuals/ha), and *T. maxima* (93%; 656 individuals/ha to 55 individuals/ha). Significant population declines were also recorded for other giant clams: *T. derasa* decreased by 85% (175 individuals/ha to 26 individuals/ha), *Hippopus hippopus* by 73% (109 individuals/ha to 29 individuals/ha), and *H. porcellanus* by 65% (52 individuals/ha to 18 individuals/ha). There is limited information available on *T. noae*, which was recently distinguished from *T. maxima* and reported to be found in the Philippines (Borsa et al. 2015; Mecha, in press; Su et al. 2014).

The culture and restocking of giant clams in the Philippines initially began in the 1980s to supply the international marine aquarium trade, but later shifted toward preventing the extinction of *T. gigas* in the country (Gomez and Mingoa-Licuanan 2006). Currently, there are five hatcheries in the country established by various groups (both public and private) that primarily culture *T. gigas*. Other species of giant clams are being cultured, but in much smaller quantities. Some of the sites that have restocked with *T. gigas* have become ecotourism destinations. These are mostly marine protected areas (MPAs) managed by local government units (LGUs), community groups, private sectors (dive resorts), and academic institutions (Calumpong et al. 2002; Gumanao 2014; Requilme et al. 2021; Vivares 2015). However, despite the tens of thousands of *T. gigas* seeded across numerous sites around the country and the aid of natural spawning of broodstocks (Anda 2019; Gumanao et al. 2023; PCSD 2019), recruitment rates are still very low, with successful recruitment documented in only two sites around the Philippines (Cabaitan and Conaco 2017; Requilme et al. 2021).

Giant clams in the wild are threatened by both natural threats and anthropogenic activities. Extreme weather conditions cause bleaching, low salinity, and mechanical stress that result in mortalities (Enricuso et al. 2018; Sayco et al. 2019; Sayco et al. 2023). This was particularly reported in *T. gigas* restocking areas that were affected by recent severe typhoons (Calumpong and Solis-Duran 1993; Calumpong et al. 2002). Despite the complete ban on the harvest and trade of giant clams and their by-products in the Philippines, live giant clams and meat are still sold in local markets or on a house-to-house basis and around beach resorts, according to social media reports (Lokalpedia 2024; Dong Calaycay Fam 2023) and as verified by key informants.

Between 2001 and 2024, a total of 129 confiscations of giant clams occurred throughout the Philippines, along with 24 offshore seizures, with the Philippines being reported as the exporting country (Figure 1). This is based on the information provided by TRAFFIC, BFAR, the Criminal Investigation and Detection Group (CIDG) of the Philippine National Police, Palawan Council for Sustainable Development (PCSD), and open-source media. The majority of the seizures involved giant clam shells. Starting in

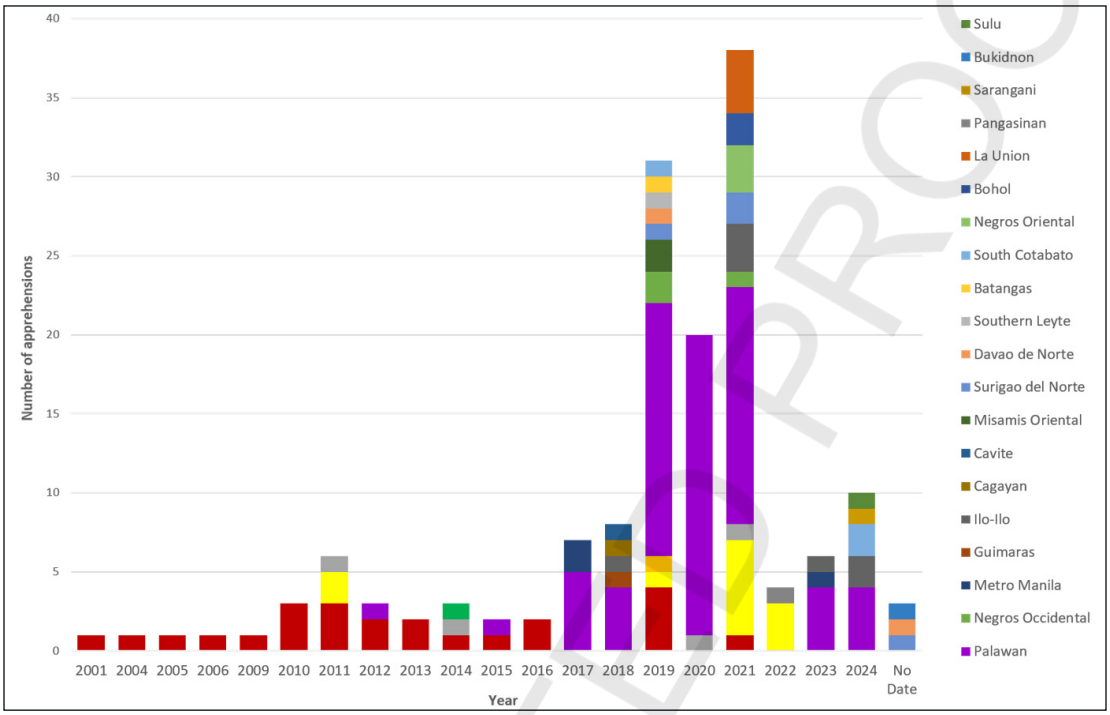

Figure 1. Number of giant clam apprehensions in the Philippines and abroad from the years 2001 to 2024 grouped by location. (Sources of information: TRAFFIC, BFAR, CIDG, PCSD, and open-source media reports

2017, there was an increase in the incidence and volume of confiscated giant clam shells. The volumes of confiscated giant clam shells cannot be directly compared across years due to the use of different units (e.g., number of shells, number of sacks, kilograms, or cubic meters) in different reports (Ballarta 2021; Cabico 2024). Nonetheless, based on the overall data, there was an evident increase in confiscated volumes of giant clam shells over the years, i.e., <12 pieces of giant clam shells annual confiscation between the years 2000-2016 to >1700 pieces from 201 to 2024. Almost 50% of the seizures occurred in Palawan, while the largest giant clam shell confiscation took place in General Santos City, South Cotabato, with roughly 120,000 tons. This was also considered the largest seizure of giant clam shells internationally (Lee and Wong, 2023; Feltham and Capdepon 2021). Based on published studies (Balisco et al. 2020; Mecha and Dolorosa 2020; Dolorosa et al. 2024; Muallil et al. 2024) and key informants, giant clam shells are collected from coastlines, shallow and deep reefs, and mountainous areas. Stockpiled shells observed during site validation surveys varied in species and size. Some shells were clearly from juveniles, some were freshly harvested, while others were very old, but not necessarily fossilized. Although the specimens were not carbon-dated, they did not appear to be mineralized or petrified (Figure 2).

Figure 2. Seized giant clams stockpiled at the Palawan Council for Sustainable Development compound in Puerto Princesa City, Palawan (A, B, C), and on the shore of Green Island, Roxas, Palawan (D).

Shells are collected for prospective export trade, which involves a network of agents/spotters across localities. The widespread collection of shells was also catalyzed by social media posts and word of mouth. In turn, large stockpiles of shells were accumulated, and numerous apprehensions were made all over the Philippines. Despite the massive stockpiling of shells and pervasive news about the trade, the supply chain remained vague, and most importantly, there is no concrete data on the final market for the shells.

3.2 Non-detriment finding for giant clam shells

The assessment generated medium to high-risk values for most of the 16 indicators (Table 1). A total score of 18 for the biological indicators was obtained because giant clams are long-lived, have low reproductive rates, and are highly sensitive to human activity, requiring habitats with minimal pollution and siltation. In terms of national distribution, abundance, and population trends of giant clams, all indicators were given high-risk values. Based on published and unpublished reports, the consensus of key stakeholders, and experts' opinions, giant clam populations in the country are now more common inside MPAs, severely fragmented, and have declined significantly and consistently over the past 30 years. The larger species (*T. gigas* and *T. derasa*), in particular, are still rare in the wild despite full protection and decades of restocking efforts. The only site that was reported to have relatively widespread, contiguous, and abundant giant clams is the Tubbataha Reefs Natural Park (TRNP), an offshore MPA strictly protected by the government.

High-risk values were also given to the threats and conservation status of giant clams, with a total score of 6 points. This is based on the recent IUCN Red List global assessment, which raised the conservation status of 4 giant clam species. The persistence and increasing magnitude of natural and anthropogenic threats to giant clams also justified the high-risk score. Large-scale threats from pollution, increasing sea surface temperatures, and extreme weather events are coupled with the persistence of habitat degradation, illegal harvesting, and the trade of giant clams. Moreover, due to the very low numbers of breeding clams present in MPAs, recruitment is very low to non-existent.

For the last set of indicators on management and control measures, scores were a mix of low-, medium-, and high-risk values. The existence of national legislation to protect and conserve giant clams in the Philippines since the 1990s and the successful efforts to culture and restock some of the species in protected areas have certainly helped maintain giant clam populations in the country. Restocked clams have also been used effectively for ecotourism and education campaigns about the importance of conserving marine biodiversity. However, despite these positive efforts, the illegal harvesting and trade of giant clams continue to exist and appear to be rampant in some parts of the country. In recent years, anecdotal reports from key informants and validated reports by wildlife NGOs revealed large-scale efforts to harvest giant clam shells in the Philippines and trade them internationally despite being illegal. This reflects the ineffectiveness of restrictions, laws, and education campaigns aimed at protecting and conserving giant clams.

Overall, the assessment yielded a total score of 32 points. This is equivalent to a negative NDF, as it exceeds the threshold score of 24-26 points. The results, therefore, show that any harvest and international and/or local trade of giant clam shells poses a high risk to the wild populations of giant clams in the Philippines. The PARLC is unable to issue a positive NDF for trade of all giant clam species at this time, and trade must therefore be confined to captive-bred specimens consistent with the implementing rules and regulations of DA-AO No. 10 (2015). The justification for this decision is based on three major points. First of all, the stockpiled giant clam shells were clearly not legally acquired due to the fact that giant clams and their derivatives have been completely protected by national laws since 1990. Secondly, the continued harvesting of live clams and extraction of shells poses a clear threat to the survival of endangered giant clams, particularly large species like *T. gigas*, *T. derasa*, and *Hippopus* spp. The extraction of giant clam shells has caused coral reef degradation and threatens other reef-associated flora and fauna. This was evident in the large-scale harvesting of giant clam shells, which were the foundations of reefs that the Chinese dredged to build artificial islands in the West Philippine Sea (Asia Maritime Transparency Initiativ 2019; Cowan 2024). Additionally, the existence of aggregate local-scale extraction of giant clam shells on land (e.g., mountains) can also contribute to habitat degradation on land. Finally, the harvesting of giant clam shells has detrimental socio-economic impacts. The stockpiling of shells disadvantaged local people who were apprehended due to the illegal collection and possession of giant clam shells in violation of national laws. The shell brokers cum buyers, who are usually not from the area of collection, were not apprehended.

Only the local suppliers and stockpilers were arrested, and they now hold the burden of the filed cases. The burden is also on the enforcers and regulatory agencies due to the cost of transport, impoundment, and case filing of the confiscated shells.

4. Challenges in giant clam protection and conservation

Significant challenges were observed in the protection and management of giant clams in the Philippines. Monitoring programs for these protected species remain limited, and the lack of baseline data in some areas poses difficulty in effectively assessing the true population status and trend of giant clams in the country. Monitoring of giant clams is conducted in only certain provinces or localities, such as in Palawan MPAs every 2-3 years and in Bohol MPAs annually. The status of giant clam populations in sites affected by extreme weather events is also unknown. This could have caused further substantial and undetected declines in giant clam populations in recent years.

Meanwhile, discussions with law enforcement agencies revealed that there were some operational concerns in enforcement that affected the effective handling of cases concerning giant clam apprehensions. The Fisheries Law Enforcement Manual of Operation (FLEMO) is not actively observed. There is a lack of coordination among concerned agencies, as each follows different procedures. This issue is also observed to be caused by confusion over which agency holds the proper jurisdiction over seized items, e.g., marine organism specimens and their derivatives, which are already found on land. Additionally, there was also a disruption in case buildup due to law enforcement being transferred to different stations, resulting in cases not being fully filed. Instead, only fines were imposed most of the time, and criminal case filing was uncommon; hence, there was a lack of information in the supply chain. Furthermore, some MPAs with giant clams were not protected effectively due to the lack of local capacity and tenure.

5. Policy recommendation

Based on the current population status of giant clams in the Philippines, the pervasive threats to their survival, and the observed challenges in effectively protecting and managing their wild stocks, the following are highly recommended to enhance the management of giant clam species and ensure their long-term sustainability:

1. Adoption of the new IUCN Redlist status for *Tridacna gigas* (critically endangered), *T. derasa* (endangered), and *Hippopus* (vulnerable) in the National Redlist. Moreover, considering that *H. porcellanus* is very rare and was documented to have a population decline of more than 65% in the country, this species is recommended to be classified as endangered. Our findings also indicate that the smaller species *T. squamosa*, *T. crocea* and *T. maxima,* and possibly the newly identified species *T. noae,* are threatened and should be classified as vulnerable instead of least concern because of the observed sharp decline in their populations in a span of 35 years.
2. Improved implementation and enforcement mechanism of national laws pertaining to giant clams (all forms and derivatives). This may involve:
    - Targeted information campaigns to educate various sectors, including fishers, traders, tourists, and the general public. These campaigns should not only include the penalties for illegal activities but also emphasize the ecological importance of giant clams.
    - Implementation of uniform enforcement protocols among different agencies in each region, province, and Fishery Management Area (FMA).
    - Regular monitoring of wild populations and utilization of giant clams should be conducted, including various giant clam products.
3. Explicitly clarify to the public that extraction/ excavation and stockpiling of all giant clam shells, both from coastal areas and land, are illegal and strictly prohibited.
4. For the confiscated and illegally stockpiled giant clam shells found all over the country and those under the custody of regulatory agencies, shells may be used for local industrial purposes like raw/filling materials, or they may serve as reef shelters and natural substrates for coral reef restoration projects.

ACKNOWLEDGMENTS

The following are acknowledged for providing information and/or support critical to this assessment: BFAR – Central Office, Region 7, Region 8, Region 9, Bohol Provincial Environment Management Office, Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC), DENR-Mines and Geosciences Bureau, Conservation International Philippines, Palawan Council for Sustainable Development, Philippine National Police – Criminal Investigation and Detection Group (PNP-CIDG), Dr. Patrick Cabaitan, Dr. Roger Dolorosa, Nino Mecha, Ludivina Labe, Atty. Dalton Dacal, Dr. Richard Muallil, Christine Mae Edullantes, Dr. Hilly Ann Roa-Quiaoit, Provincial Fisheries Office (PFO) of Palawan, City Agriculture Office of Puerto Princesa City, Municipal Agriculture Office of Roxas, LGU-Narra, LGU-Roxas, Philippine National Police – Maritime Group (PNP-MG), Philippine Coast Guard (PCG), Western Philippines University, Pandan Marine Products Marketing Cooperative, PFO Cebu, LGU-Cebu City, Cebu City Bantay Dagat, PCG Cebu, PNP-MG Cebu, University of San Carlos, Oceana Philippines, Killer Trends Trading, PFO Zamboanga del Norte, PFO Zamboanga del Sur, PFO Zamboanga Sibugay, Office of the Provincial Agriculturist Zamboanga Sibugay, City Fisheries Office Zamboanga, LGU-Taluksangay, and LGU-Talabaan, PCG Zamboanga and Southwestern Mindanao, PNP-MG Region 9, PNP-CIDG Zamboanga City Field Unit, Zamboanga del Sur Provincial Government College, and Zamboanga State College of Marine Sciences and Technology. This work was funded by the Department of Agriculture – Bureau of Fisheries and Aquatic Resources (DA-BFAR).

AUTHOR CONTRIBUTIONS

Juinio-Meñez MA: conceptualization, supervision, methodology, formal analysis, investigation, writing – original draft, review & editing. **Palomar-Abesamis N:** conceptualization, supervision, methodology, formal analysis, investigation, writing – original draft, review & editing. **Atuel O and Baring MV:** Data gathering, formal analysis, investigation, visualization, writing – original draft, review & editing. **Acosta A and Bognot E:** Funding acquisition, project administration, investigation, writing – review and editing.

CONFLICTS OF INTEREST

The authors declare no competing interests.

ETHICS STATEMENT

No animal or human studies were carried out in this work.

REFERENCES

Alcala AC. 1986. Distribution and abundance of giant clams (Family Tridacnidae) in the South-Central Philippines. *Silliman Journal. 33*:1–9.

Anda R. 2019. Surge in giant clam population seen as spawning starts in Palawan. Inquirer.net. Retrieved June 18, 2024, from https://newsinfo.inquirer.net/1128784/surge-in-giant-clam-population-seen-as-spawning-starts-in-palawan

Asia Maritime Transparency Initiative. 2019. China's most destructive boats return to the South China Sea. Retrieved May 30, 2024, from https://amti.csis.org/chinas-most-destructive-boats-return-to-the-south-china-sea/

Balisco RA, Gonzales B, Dolorosa R. 2020. Species composition, abundance and conservation status of some economically important macrobenthic invertebrates in Pag-asa Island, Kalayaan, Palawan, Philippines. Asian Fisheries Science. 33(4):357–365. https://doi.org/10.33997/j.afs.2020.33.4.007

Ballarta A. 2021. P250 million worth of giant clams confiscated during raid in island resort. Palawan News. Retrieved June 24, 2024, on https://palawan-news.com/p250-million-worth-of-giant-clams-confiscated-during-raid-in-island-resort/

Borsa P, Fauvelot C, Tiavouane J, Grulois D, Wabnitz C, Abdon Naguit MR, Andrefouet S. 2015. Distribution of Noah's giant clam, *Tridacna noae*. Marine Biodiversity. 45:339–344. https://doi.org/10.1007/s12526-014-0265-9

Cabaitan PC, Conaco C. 2017. Bringing back the giants: juvenile *Tridacna gigas* from natural spawning of restocked giant clams. Coral

Reefs. 36(2):519–519. https://doi.org/10.1007/s00338-017-1558-9

Cabaitan PC, Gomez ED, Aliño PM. 2008. Effects of coral transplantation and giant clam restocking on the structure of fish communities on degraded patch reefs. Journal of Experimental Marine Biology and Ecology. 357(1):85–98. https://doi.org/10.1016/j.jembe.2008.01.001

Cabico GK. 2024. Giant clams worth P8.1M recovered in Palawan. Philstar.com. Retrieved June 26, 2024, on https://www.philstar.com/headlines/climate-and-environment/2024/02/19/2334541/giant-clams-worth-p81m-recovered-palawan

Calumpong HP, Solis-Duran E. 1993. Constraints in restocking Philippine reefs with giant clams. In: Fitt WK, editor. The biology and mariculture of giant clams: a workshop held in conjunction with the 7th International Coral ReefSymposiwn 21-26 June 1992, Guam. USA. ACIAR Proceedings No. 47. pp. 94–98.

Calumpong HP, Apao AB, Lucanas JR, Estacion JS. 2002. Community based giant clam restocking—hopes for biodiversity. In *Proceedings of the Ninth International Coral Reef Symposium* (Vol. 2327).

Cowan C. 2024. Island-building and overfishing wreak destruction of South China Sea reefs. Retrieved May 30, 2024, from https://news.mongabay.com/2024/04/island-building-and-overfishing-wreak-ction-of-south-china-sea-reefs/

DA-AO No. 10. 2015. Department of Agriculture Administrative Order No. 10 Series of 2015 Implementing rules and regulations of the Fisheries Code or Republic Act 8550 as amended by Republic Act 10654

Dolorosa RG, Mecha NJMF, Bano JD, Ecube KMA, Villanueva EG, Cabaitan PC.2024. Declining population of giant clams (Cardiidae: Tridacninae) in Palawan, Philippines. Ocean and Coastal Research. 72:e24010. https://doi.org/10.1590/2675-2824072.22130

Dong Calaycay Fam. 2023. Wow! Ganito Pala ang Taklobo (Clam) #clam #seafood #eating #nature #natural #shorts #4k #wow #viral [Video]. YouTube. Accessed October 03, 2024, from https://www.youtube.com/shorts/xf8NqgiUrbE

Ellis SC. 1997. Spawning and early larval rearing of giant clams (Bivalvia: Tridacnidae) (Vol. 130). Waimanalo, Hawaii: Center for Tropical and Subtropical Aquaculture. p. 55

Enricuso OB, Conaco C, Sayco SG, Neo ML, Cabaitan PC. 2018. Elevated seawater temperatures affect embryonic and larval development in the giant clam *Tridacna gigas* (Cardiidae: Tridacninae). Journal of Molluscan Studies. 85(1):66–72. https://doi.org/10.1093/mollus/eyy051

Feltham J, Capdepon L. 2021. Giant Clam Shell, Ivory, and Organised Crime: Analysis of a potential new nexus. Wild Justice Commission. pp. 40. https://wildlifejustice.org/wp-content/uploads/2021/10/Giant-Clam-Shells-Ivory-And-Organised-Crime_A-Potential-New-Nexus_WJC_spreads.pdf

Gomez ED, Mingoa-Licuanan SS. 2006. Achievements and lessons learned in restocking giant clams in the Philippines. Fisheries Research. 80(1):46–52. https://doi.org/10.1016/j.fishres.2006.03.017

Gomez ED. 2017. Destroyed reefs, vanishing giant clams: Marine imperialism. In: Hiebert M, Poling GB, Cronin C, editors. In the wake of arbitration: Papers from the Sixth Annual CSIS South China Sea Conference. Center for Strategic and International Studies (CSIS).

Gumanao GS, Edullantes CMA, Sobradil RB, Lopez XN, Anobong Jr. AG. 2023. Trophic mobbing of reef fishes on naturally spawned ova of *Tridacna gigas* in Samal Island, Philippines. Galaxea, Journal of Coral Reef Studies. 25(1):5–6. https://doi.org/10.3755/galaxea.G25-3

Gumanao G. 2014. DOST-PCAARRD awards Taclobo Tours Project. Retrieved July 24, 2024, from https://www.pcaarrd.dost.gov.ph/index.php/quick-information-dispatch-qid-articles/dost-pcaarrd-awards-taklobo-tours-project-

Hean RL, Cacho OJ. 2003. A growth model for giant clams *Tridacna crocea* and *T. derasa*. Ecological Modelling. 163(1-2):87–100. https://doi.org/10.1016/S0304-3800(02)00400-3

Juinio MAR, Meñez LAB, Villanoy CL, Gomez ED. 1989. Status of giant clam resources of the Philippines. Journal of Molluscan Studies. 55(4):431–440. https://doi.org/10.1093/mollus/55.4.431

Lee MA, Wong R. 2023. Trading Giants: A rapid assessment of giant clam Tridacninae seizures implicating Southeast Asia 2003-2022 (Report). Cambridge: TRAFFIC.

Lokalpedia. 2024. Every Saturday in the port of Brgy. Batu-Batu in Panglima Sugala, a municipality in the southernmost province of the Philippines, Tawi-Tawi [Image Attached]. Facebook. Accessed October 03, 2024, from https://www.facebook.com/photo/?fbid=523011776769767&set=pcb.523028793434732

Mecha NJMF, Dolorosa RG. 2020. Searching the Virtually Extinct *Tridacna gigas* (Linnaeus, 1758) in the Reefs of Palawan, Philippines. The Philippine Journal of Fisheries 27(1):1–18. https://doi.org/10.31398/tpjf/27.1.2019-0005

Mecha NJMF. in press. Distribution, habitat characteristics, and conservation status of Noah's clam *Tridacna noae* (Röding, 1798) in the reefs of Palawan, Philippines. *The Palawan Scientist.* 17(2):43–51. https://doi.org/10.69721/TPS.J.2025.17.2.05

Muallil RN, Injani AS, Abduraup YT, Saddari FJ, Ondo ER, Sakilan AJ, Allama HA. 2024. Recent record of True Giant Clam *Tridacna gigas* from the Sulu Archipelago and insight into the giant clam fisheries and conservation in the southernmost islands of the Philippines. Journal of Threatened Taxa. 16(3):25006–25009. https://doi.org/10.11609/jott.8917.16.3.25006-25009

Neo ML. 2020. Conservation of giant clams (Bivalvia: Cardiidae). In: Goldstein MI, and DellaSala DA, editors. Encyclopedia of the world's biomes. Vol. 4. pp. 527–538. Elsevier.

Neo ML, Li R. 2024a. *Tridacna gigas*. The IUCN Red List of Threatened Species 2024: e.T22137A119167161. Accessed on 25 December 2024. https://dx.doi.org/10.2305/IUCN.UK.2024-2.RLTS.T22137A119167161.en

Neo ML, Li R. 2024b. *Hippopus hippopus*. The IUCN Red List of Threatened Species 2024: e.T10105A117405498. Accessed on 25 December 2024. https://dx.doi.org/10.2305/IUCN.UK.2024-2.RLTS.T10105A117405498.en

Neo ML, Li R. 2024c. *Hippopus porcellanus*. The IUCN Red List of Threatened Species 2024: e.T10106A117405656. Accessed on 25 December 2024. https://dx.doi.org/10.2305/IUCN.UK.2024-2.RLTS.T10106A117405656.en

Neo ML, Li R. 2024d. *Tridacna derasa*. The IUCN Red List of Threatened Species 2024: e.T22136A119167048. Accessed on 25 December 2024. https://dx.doi.org/10.2305/IUCN.UK.2024-2.RLTS.T22136A119167048.en

Neo ML, Eckman W, Vicentuan K, Teo SLM, Todd PA. 2015. The ecological significance of giant clams in coral reef ecosystems. Biological Conservation. 181:111-123. https://doi.org/10.1016/j.biocon.2014.11.004

Neo ML, Wabnitz CCC, Braley RD, Heslinga GA, Fauvelot C, Van Wynsberge S, Andréfouët S, Waters C, Tan ASH, Gomez ED, Costello MJ, Todd PA. 2017. Giant clams (Bivalvia: Cardiidae: Tridacninae): A comprehensive update of species and their distribution, current threats, and conservation status. Oceanography and Marine Biology: An Annual Review, 55(Special Issue), 87-387. ISSN 0078-3218./

[PCSD] Palawan Council for Sustainable Development. 2019. Malampaya Foundation spawns native, biggest giant clam. Retrieved June 18, 2024, from https://pcsd.gov.ph/malampaya-foundation-spawns-native-biggest-giant-clam/

[PARLC] Philippine Aquatic Redlist Committee Invertebrate Subcommittee. 2024. Non-detrimental finding assessment for dead giant clam shells in the Philippines - Terminal Report.

Requilme JNC, Conaco C, Sayco SLG, Roa-Quiaoit HA, Cabaitan PC. 2021. Using citizen science and survey data to determine the recruitment envelope of the giant clam, *Tridacna gigas* (Cardiidae: Tridacninae). Ocean and coastal management. 202:105515. https://doi.org/10.1016/j.ocecoaman.2020.105515

Rosser AR, Haywood MJ. 2002. Guidance For CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports. Gland, Switzerland and Cambridge, UK: IUCN. xi + 146 pp. https://portals.iucn.org/library/sites/library/files/documents/SSC-OP-027.pdf

Sayco SLG, Cabaitan PC, Kurihara H. 2023. Bleaching reduces reproduction in the giant clam *Tridacna gigas*. Marine Ecology Progress Series. 706:47–56. https://doi.org/10.3354/meps14251

Sayco SLG, Conaco C, Neo ML, Cabaitan PC. 2019. Reduced salinities negatively impact fertilization success and early larval development of the giant clam *Tridacna gigas* (Cardiidae: Tridacninae). Journal of Experimental Marine Biology and Ecology, 516:35–43. https://doi.org/10.1016/j.jembe.2019.04.004

Soo P, Todd PA. 2014. The behaviour of giant clams (Bivalvia: Cardiidae: Tridacninae). Marine Biology. 161:2699–2717. https://doi.org/10.1007/s00227-014-2545-0

Su Y, Hung JH, Kubo H, Liu LL. 2014. *Tridacna noae* (Röding, 1798)–a valid giant clam species separated from *T. maxima* (Röding, 1798) by morphological and genetic data. Raffles Bulletin of Zoology. 62:124–135.

Spanish CITES Authority. 2017. Methodology for drawing up non-detriment findings for CITES species (Species of Annex B of the Regulation 338/1997). CITES. https://cites.org/sites/default/files/vc-files/files/AC29-Inf-10_Spain.pdf

Vivares N. 2015. Clam seeding effort in Macajalar Bay: Ensuring the survival of giant clams. Retrieved July 24, 2024, from https://www.xu.edu.ph/xavier-news/25-2015-2016/1655-clam-seeding