

Research Article

The Status, Trends, and Limitations of Philippine Mollusk Production and Trade Based on Available Databases and Publications

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ABSTRACT

Mollusk trade is vital in many coastal areas and island communities throughout the Philippines because it provides livelihoods, food, and incomes to millions of Filipinos via fisheries (e.g., shellfish fishing and gleaning), shell craft, arts, shell trading and collections, and aquaculture. However, the assessments of the national trends and status of mollusc production and trade in the Philippines are largely non-existent in peer-reviewed literature. The main purpose of this paper is to present and evaluate the status and trends of traded Mollusks in the Philippines based on available online databases and a systematic review of published literature. To date, available databases on Philippine mollusk trade showed an initial increase in traded volume (the 1970s to 2006), but decreased afterward. In contrast, the traded mollusk value continued to generally increase over time (albeit the observed decrease between 2011 and 2016), indicating value increase as mollusk volume decreased. However, there is a great need to (1) resolve many of the obvious inconsistencies in data entries across all the available mollusk trade databases (BFAR, PSA, and CITES) and (2) provide field assessment of the Philippine mollusk trade and the conservation status of all traded mollusk taxa in the country.

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INTRODUCTION

The trade of aquatic products such as mollusks can significantly contribute to the economic development of the country (Kartika 2014; Jing et al. 2018; Mohsin et al. 2017). In 2018, the global contribution of mollusks and other aquatic invertebrates was around 12% in fish trade in terms of value (FAO 2020). These include Cephalopods, Bivalves, and other shelled mollusks. China is the leading producer with 14.4 million Metric Tons (MT) of the 2018 marine and coastal aquaculture of mollusks and the Philippines ranked 14th with 55,000 MT (FAO 2020). Mollusk trade is very important in many coastal areas and island communities throughout the Philippines. It provides livelihoods, food, and incomes to millions of Filipinos via fisheries (e.g., shellfish fishing and gleaning), shell craft and arts, shell trading and collections, and aquaculture (Salamanca & Pajaro 1996; Salayo 2000; Floren 2003; De Guzman et al. 2020). However, the assessments of the national trends and status of Philippine mollusk production and trade are largely non-existent in peer-reviewed literature.

To date, few outdated and limited scopes of assessment have evalu-

ated the mollusk trade in the Philippines, and they all indicated that this industry is largely ignored in terms of scientific assessments. The International Trade Patterns and Trade Policies in the Philippine Fisheries by Salayo (2000) provided recent accounts of Philippine mollusk trade, albeit over two decades old (Salayo 2000). However, this analysis is aggregated and mixed with crustaceans, making it difficult to accurately assess the status and trend of mollusks trade in the Philippines. Floren (2003) analysed the shell trade industry, but was limited to analyses of Cebu, Philippines data from 1985 to 2002. Moreover, he reported that the shell industry is a significant income earner, but there is a decline in the export volume of shelled mollusks due to the low supply, highlighting the concern of insufficient biological data of the species harvested and poor management. Besides shelled mollusks, there is also a decline in octopus harvests and exports in the Philippines, although catch per unit effort data and population stock analyses for octopuses are largely unknown in the Philippines (Monterey Bay Aquarium 2017). The declining volume of exports and incomplete assessment of the mollusk trade show a strong need to assess the mollusk trade systematically and comprehensively.

A systematic compilation of published literature on mollusk trade was done using SCOPUS to assess the published trends and gaps in mollusk production and trade globally and in the Philippines. A total of 196 papers were reviewed, but few (12 publications) appeared relevant to this paper. Unfortunately, even for the 12 publications, the values were incomparable to the data and analyses provided in this paper. We, nonetheless, used the insights from these 12 publications in our discussion of key results.

Although databases on the national mollusk trade exist, they remained un-evaluated in terms of the status and trends of the trade and the quality of the datasets available in online national and international databases. The main purpose of this paper is to present and evaluate the status, trends, and limitations of traded mollusks in the Philippines based on available online databases. Here, we ask the following questions: (1) What are the status and trends of mollusk trade based on the Bureau of Fisheries and Aquatic Resources (BFAR) annual reporting; (2) What are the status and trends of mollusk trade based on Philippine Statistics Authority (PSA) data; (3) What are the status and trends of Philippine mollusk trade based on the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); and (4) How limited are available information on the status and trends of mollusk Trade based on published literature compared to our analyses.

MATERIALS AND METHODS

Data Compilation

To assess the mollusk trade in the Philippines, three online databases and published literature were compiled, processed, and analysed.

The first dataset compiled was from the Bureau of Fisheries and Aquatic Resources (BFAR) Annual Fisheries Report from 1977 to 2018 (accessible at <https://www.bfar.da.gov.ph/publication>, accessed 25 May 2020). The BFAR Annual Reports presented annual Fisheries data for the entire country by Sector and Region (e.g., Marine Fisheries, Inland Fisheries, and Aquaculture) (Anticamara & Go 2016). However, the BFAR Annual Report for mollusks only provides the National Total Volume (Metric Ton MT) and Value (Philippine Pesos PHP) without regional breakdown. The BFAR dataset reported different types of mollusk products grouped as follows: (1) Shells and Articles: Shells and By-products, Ornamental Shells, and Shell craft Article. (2) Bivalves: Scallops, Clams, Capiz Shells, and Pearls. (3) Gastropods: Abalone Shells. (4)

Cephalopods: Octopus and Cuttlefish. To date, all BFAR reports and analyses focused only on the annual production or short-term (2-3 years) trend analyses. There are no peer-reviewed publications or scientific analyses that have been done on Philippine mollusk production and trade over the past decades. However, there were two reports on the shell industry in the Philippines, but these mainly focused on Cebu and Zamboanga mollusk trade (Salamanca & Pajaro 1996; Floren 2003).

The second database was accessed from the Philippine Statistics Authority (PSA) 1977 to 2015 Foreign Trade Statistics (FTS) of the Philippines (<https://psa.gov.ph/content/foreign-trade-statistics-fts-philippines>, accessed 25 May 2020). The PSA process and publish all the product trade information in the Philippines containing the volume (Kilograms kg) and value (Philippine Pesos PHP and US dollars USD) of mollusk products. In connection with BFAR, both local institutions produce data for mollusk products, but the BFAR data mainly focuses on Fisheries and Aquatic Resources (seaweed, fish, mollusks, squids). Meanwhile, PSA represents the whole foreign and local trade product industry in the Philippines. The PSA dataset was used to check the consistency of trends of the BFAR because of its data similarity. The dataset from PSA provided different mollusk products, but was grouped the same way as the BFAR dataset: Shells and Articles, Bivalves, Gastropods, and Cephalopods.

The third database analysed was taken from the CITES. The data obtained was from 1983 to 2018 CITES Philippine trade database (<https://trade.cites.org>, accessed 25 May 2020). CITES is a non-government organization with a multilateral treaty that protects the survival of plants and animals. It provides an online international database that records and regulates the trade of plants and animals. It presents the trading countries, quantity, purpose, and mollusk taxa traded – i.e., exported from and imported into the Philippines.

Lastly, we systematically compiled published literature on mollusk trade using SCOPUS to assess the published trends and gaps in mollusk trade globally and in the Philippines. We compiled and organized the published literature by compiling the following: (1) Country/Countries where the study was conducted, (2) objectives of the study or their major questions, (3) the methods used to answer the questions, (4) the key findings in terms of mollusk production and trade per unit area and time, by taxa or broader categorizations (e.g., shells and articles), and (5) the major knowledge gaps identified by the paper.

Data Analysis

To show the status and trends of Mollusk Trade of BFAR annual reports over time, the following were performed: (1) We computed the total mean over time of each category of Volume and Values; (2) then plotted the annual time series of the total exported Volume (Metric Ton MT) and Value (Philippine Pesos PHP, with USD conversions; conversion rate was 49.45 PHP = 1 USD as of 10 July 2020); (3) We then presented the Mean traded Volume and Values (\pm standard error SE) to show the magnitude changes over time; (4) Lastly, we presented a time series of mollusk Volume and Values by Categories with Standard Error (i.e., Cephalopods, Shells and Articles, Bivalves, and Gastropods).

The PSA dataset were also analysed to show the status and trends of the mollusk trade in the Philippines. Before plotting the data, the volume data from PSA was converted from kg to MT (1 kg = 0.001 MT) to match the units with the BFAR dataset. The total volume, value, and categories were analysed using the same framework analysis implemented with the BFAR dataset.

The CITES dataset primarily focused on the trend of mollusk production and trade in the Philippines. Based on the different reported unit of measurement from the database, the unit with the least data gaps was the number of individuals or pieces. Using the CITES database, the following were done: (1) annual amount of trade per country was plotted; (2) mean average of each country every five years was computed from the total sum of each country; and (3) we then presented a series of world maps indicating the volume traded over time.

To assess the conservation status and list of species traded in the Philippines, a list of species was obtained from the CITES database, then checked for their conservation status using the IUCN online website (<https://www.iucnredlist.org/>).

To systematically evaluate the published peer-reviewed journals on mollusk production and trade, the keywords 'Mollusk + Trade' were used in the Scopus search (www.scopus.com; 26 June 2020). We only focused on studies assessing the trends and gaps in mollusk production and trade. As a result, there were 196 publications, and each was reviewed to find if there is information on mollusk production and trade (such as Geographical Scale-Global/National/Local, Temporal Scale-Years Covered, Species/Taxa Traded, Volume, and Value of Trade). Only 12 publications contained the information needed as specified above. However, the 12 publications are not comparable to our analyses, but we used the information in our discussion of key results.

RESULTS AND DISCUSSION

Status and Trends of Mollusk Trade Based on BFAR and PSA Data

Mollusk Trade Volume

Based on the BFAR Annual Fisheries Report, the trend of mollusk trade from BFAR showed an overall increasing trend. The mean annual exported mollusk volume increased from 1986 to 2006, then decreased until 2016, followed by an increase until 2018 (Figure 1). We used mean annual volume for every five years because annual volume shows a fluctuating pattern (Figure A1). The lowest export volume was in 1986 with 4,237 MT. Its peak was in 2006 with 18,526 MT. (Figure 1; Appendix A1). Afterward, the average export volume decreased from 2007 until 2016 from 14,716 MT to 12,716 MT. Followed by an increase in 2018 with 17,692 MT.

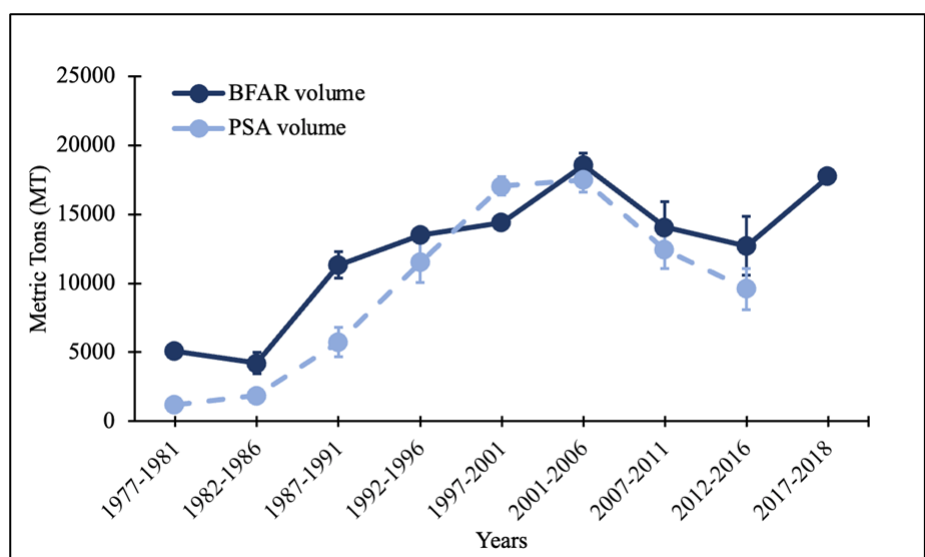


Figure 1. Mean annual volume for every five years of mollusk export trade in the Philippines from 1977 to 2018 based on the BFAR annual Fisheries Report and PSA Foreign Trade Statistics.

In comparison, the PSA Foreign Trade showed a similar trend. The average annual exported volume increased from 1977 until 2006, then decreased afterward. The lowest export volume was in 1977 with 1,205 MT. Its peak was in 2006 with 17,494 MT (Figure 1; Appendix B1).

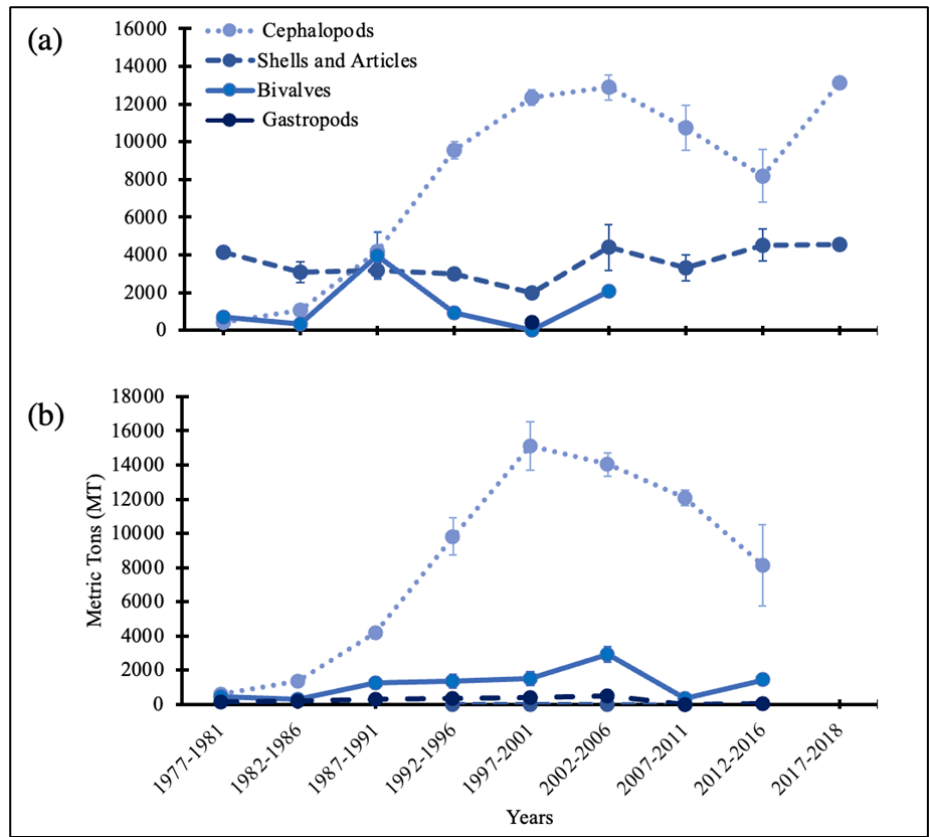


Figure 2. Mean annual volume for every five years of each group on mollusk export trade in the Philippines. Dataset is from (a) 1977 to 2018 BFAR Annual Fisheries Report and (b) 1977 to 2015 PSA Foreign Trade Statistics.

Among the mollusk products that were specified or categorized, the BFAR database indicates that Cephalopods export volume trade increased from 1977 to 2006, but continually decreased from 2007 until 2016, followed by an increase in 2018 (Figure 2a; Appendix A2). Cephalopods were the highest contributor to the Philippine mollusk export trade, with a total volume of 332,978 MT by 2018 (Appendix A3). Shells and Articles initially decreased from 1977 to 2001, followed by an increase in 2006. After 2011 the Shells and Articles trade stabilized until 2018. The total Shell and Article export volume was 147,216 MT by 2018 (Appendix A3). The volume trade of Bivalves fluctuated from 1977 to 2006, having a total volume export of 34,011 MT by 2005. Gastropods were only reported in 1998, with a total amount of 416 MT.

The categorized mollusk products in the PSA database show that the volume from Cephalopods increased from 1977 until 2006, but decreased afterward from 2006 until 2015 (Figure 2b; Appendix B2). Cephalopods are the highest contributor in volume trade, with 318,648 MT by 2015 (Appendix B3). Bivalves continuously increased from 1982 until 2006, then decreased in 2011, followed by an increase in 2015. Bivalves were the second-highest contributor, with a total volume of 46,554 MT. Meanwhile, Gastropods remained unchanged from 1977 to 2015. It is ranked third with 9,770 MT by 2015. Shells and Articles export volume slightly increased from 1992 to 2006. The data reports for Shell and Article were only from 1996 until 2010, with a total volume trade of 68 MT, making it the lowest contributor.

Mollusk Trade Value

In the BFAR database, the average export value trade of mollusks increased from 1977 to 2006, but it decreased from 2006 until 2016, followed by an increase until 2018 (Figure 3). In 1977, the average export value was 115 million PHP (2.33 million USD), which was its lowest value recorded, and then it continuously increased in 2006 to 2.95 billion PHP (59.7 million USD) (Figure 3; Appendix A1). However, after 2007, the value decreased to 1.77 billion PHP (35.8 million USD), then it increased again in 2018 with 3.4 billion PHP (68.9 million USD), its highest peak mean value (Figure 3; Appendix A1).

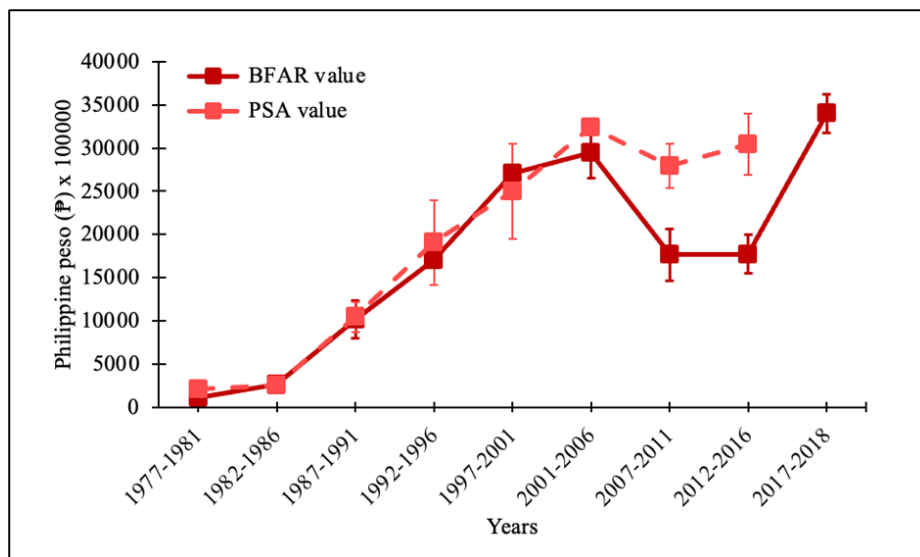


Figure 3. Mean annual value for every five years of mollusk export trade in the Philippines from 1977 to 2018 based on the BFAR annual Fisheries Report and PSA Foreign Trade Statistics.

In comparison, the PSA mean export value increased from 1977 to 2006 and then decreased from 2006 until 2010, followed by an increase until 2015 (Figure 3). In 1977, it reached its lowest value trade of 215 million PHP (4.36 million USD), then it increased to 3.24 billion PHP (65.6 million USD) in 2006 (Figure 3; Appendix B1). Afterward, the value decreased from 2007 to 2011 to 2.79 billion PHP (56.5 million USD), but it again increased to 3.04 billion PHP (61.5 million USD) by 2015, its highest peak mean value.

The categorized mollusk products in BFAR show that the trend of the average value export trade on Cephalopods increased from 1977 to 2006, then decreased from 2007 to 2016, and was followed by an increase in 2018 (Figure 4a). The total Cephalopod trade value from 1977 to 2018 reached around 44.7 billion PHP (904.3 million USD) (Appendix A5). The Shells and Articles trade value initially increased from 1977 to 2005, but decreased from 2006 until 2015 (Figure 4a). The Shells and Articles export value yielded an amount of 16.6 billion PHP (335.2 million USD) by 2018 (Appendix A5). The average trade value of Bivalves initially increased from 1977 to 1986, then slightly decreased in 1996. Afterward, it continuously increases from 1987 to 2006 with a total value of 6 billion PHP (120.3 million USD) (Figure 4a; Appendix A5). The Gastropods reported an export value of 139 million PHP (2.81 million USD) in 1998 (Appendix A5).

In contrast, the PSA dataset shows that the Cephalopod trade value increased from 1977 to 2007, then decreased from 2007 to 2015 (Figure 4b). In the PSA dataset, Cephalopods were the highest contributor for value trading, with a total amount of 48 billion PHP (970.4 million USD)

by 2015 (Appendix B5). The Bivalve export value decreased from 1977 to 1986, but continuously increased from 1987 until 2006, then stabilized afterwards. Yielding a total export value of 21.4 billion PHP (970 million USD) by 2015 (Figure 4b; Appendix B5). Gastropods remained unchanged from 1977 until 2015, with a total value of 2.6 billion PHP (51.7 million USD) by 2015. Lastly, the Shells and Articles export value also remained unchanged from 1996 to 2010, with a total value of 24 million PHP (489.6 USD) by 2010 (Figure 4b; Appendix B5).

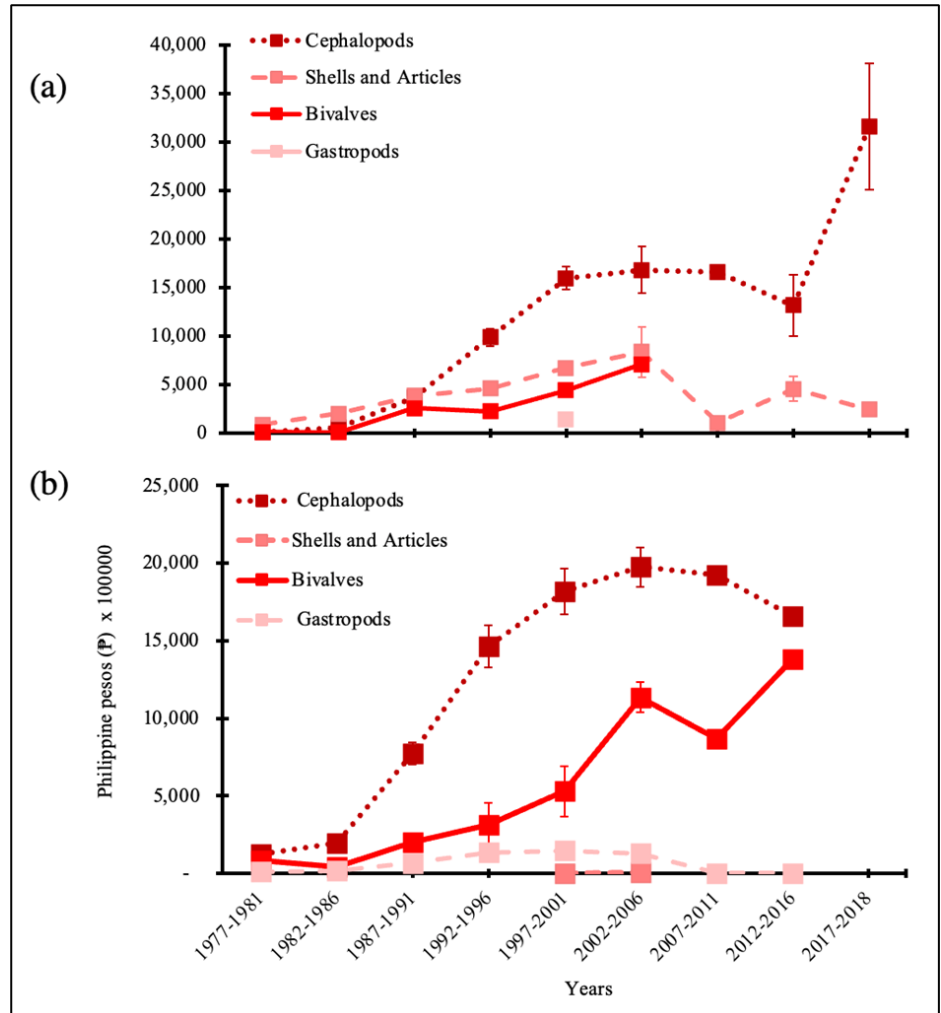


Figure 4. Mean annual value for every five years of each group on mollusk export trade in the Philippines. Dataset is from (a) 1977 to 2018 BFAR Annual Fisheries Report and (b) 1977 to 2015 PSA Foreign Trade Statistics.

Status and Trends of Mollusk Trade based on CITES data.

Based on the CITES dataset, export countries and the pieces of Philippine mollusk exported to them increased from 1984 to 1987 and continuously decreased from 1988 to 2003, but then stabilized afterward (Figure 5). In the CITES dataset, the Philippines recorded its highest amount of mollusk exported in 1989, with 26,788 pieces, while the lowest was in 2009, with 102 pieces (Appendix C1). In 1989, the Philippines exported mollusk to 31 countries - the highest mean mollusk exported was to the United States of America (USA) with 357,388 pieces, while the lowest was to Thailand with 16 Pieces (Figure 5a; Table S1). In 2009, the Philippines exported mollusk to seven countries, with the highest amount sent to Malaysia with 500 Pieces, while the lowest was sent to the Republic of Korea with four Pieces (Figure 5f; Table S1). Due to the small coverage of the country, the colour highlighted may not be observed in the figures presented (Figure 5-6).



Figure 5. Series of maps showing the amount of export trade per Piece for every five years from 1984-2018 CITES Database. The standardized amount per time frame is 0 to 376,095. (a) 1984-1988, (b) 1994-1998, (c) 1999-2003, (d) 2004-2008, (e) 2004-2008, (f) 2009-2013, and (g) 2014-2018.

Meanwhile, the number of countries where the Philippines imported mollusk (and the volume of imports) increased from 1984 until 1998, but decreased from 1999 until 2013, followed by an increase on its way to 2018 (Figure 6). The highest total amount of mollusk imported by the Philippines was in 2004, with 16,181 Pieces, while the lowest was in 2009, with two Pieces (Appendix B2). A total of two countries served as the major source of Philippine mollusk import: the USA, with 17,362 Pieces imported by the Philippines, while the lowest was Nicaragua, with 15,000 Pieces imported by the Philippines (Figure 6c; Table S2). In 2009, the Philippines imported mollusk from two countries: the USA and Palau imported two Pieces each (Figure 6f; Table S2).

The CITES dataset were provided the species name of the traded mollusk. Based on the list of taxa obtained from the CITES dataset, a total of 17 species were reported for the Philippine mollusk trade. Most species belong to Bivalves, with 12 species, while the lowest was from Gastropods, with two species. Meanwhile, the conservation status of the taxa reported seven species as Not Assessed, while two species each are Critically Endangered and Vulnerable (Table 1).

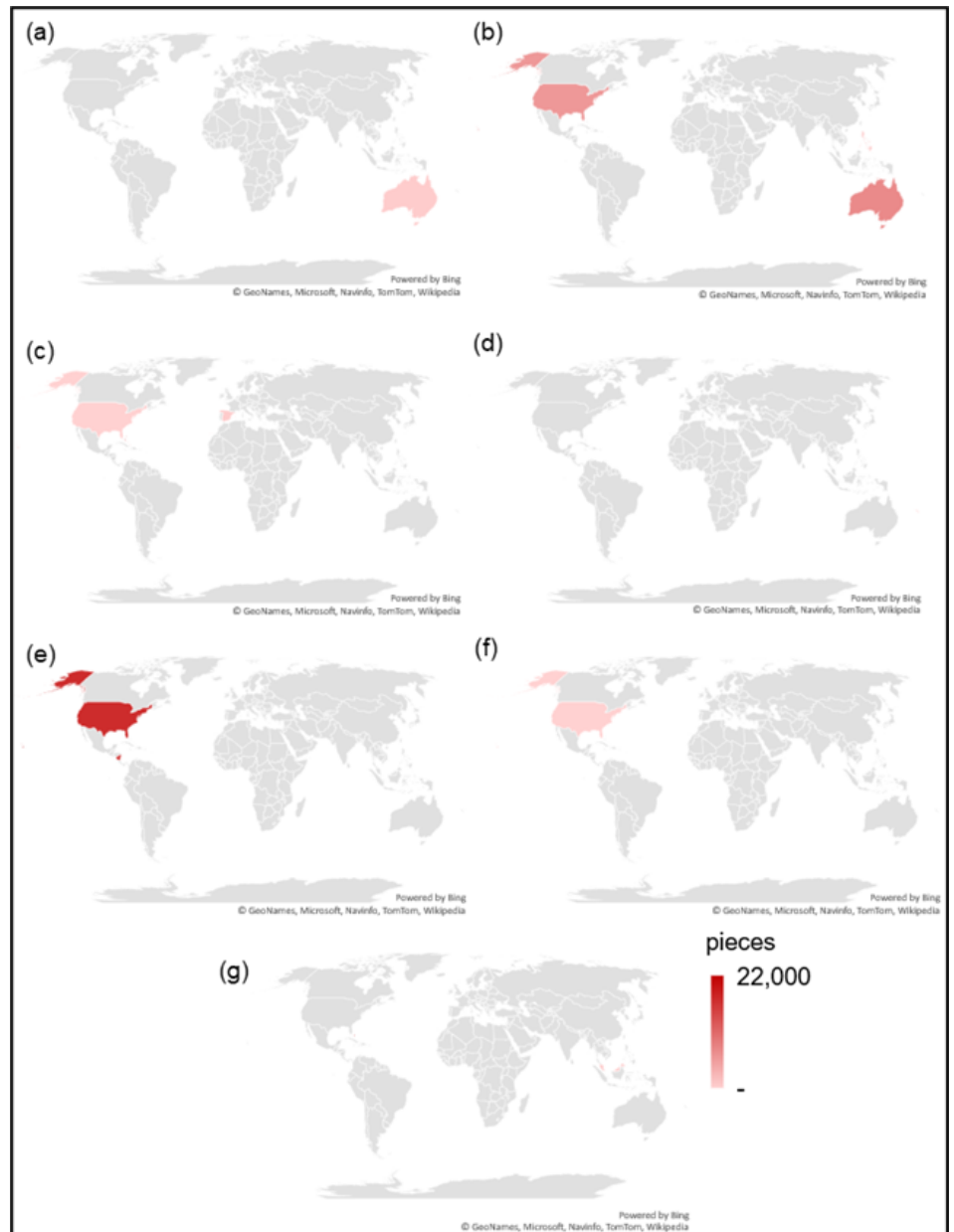


Figure 6. Series of maps showing the volume of mollusk import trade per Piece for every five years from 1984–2018 CITES database. The standardized range of volume per Piece for all time frames is between 0 to 22,000. (a) 1984–1988, (b) 1989–1993, (c) 1994–1998, (d) 1999–2003, (e) 2004–2008, (f) 2009–2013, and (g) 2014–2018.

Volume of Philippine Mollusk trade

The BFAR and PSA database general trend of mollusk trade volume in the Philippines is either stabilizing or declining. The initial increase followed by a decline in mollusk volume exported has a similar pattern to the findings of the Philippine fisheries reports (Salayo 2000; Floren 2003; Anticamara & Go 2016). Although, this is not entirely comparable since they do not have the same scale and variables used in this study. The general trend is most likely true since the Philippines has poor enforcement of fisheries management against overfishing and destructive fishing practices that have led to the fishery species decrease (Alcala & Russ 2002; Muallil et al. 2014). Gleaning of invertebrates in the shallow reef flats is a common activity by women and children living in the coastal area (Ciasico et al. 2008). The Philippines is an archipelagic country with thousands of islands that can provide aid in household income and food (De Guzman et al. 2020). However, gleaning can be destructive and cause environmental impacts. Ciasico (2008) reported that despite the concern-

Table 1. Conservation status of species on Mollusk Traded from the Philippines based on CITES database from 1984–2018.

Species	IUCN status
Bivalves	
<i>Dromus dromas</i> (I. Lea, 1834)	Critically endangered
<i>Epioblasma rangiana</i> (I. Lea, 1838)	Critically endangered
<i>Hippopus hippopus</i> (Linnaeus, 1758)	Lower Risk, conservation dependent
<i>Hippopus</i> spp.	Not assessed
<i>Lampsilis brevicula</i> (I. Lea, 1852)	Near Threatened
<i>Tridacna crocea</i> (Lamarck, 1819)	Least Concerned
<i>Tridacna derasa</i> (Röding, 1798)	Vulnerable
<i>Tridacna gigas</i> (Linnaeus, 1758)	Vulnerable
<i>Tridacna maxima</i> (Röding, 1798)	Lower Risk, conservation dependent
<i>Tridacna</i> spp.	Not assessed
<i>Tridacna squamosa</i> (Lamarck, 1819)	Lower Risk, conservation dependent
<i>Tridacnidae</i> spp.	Not assessed
Gastropods	
<i>Haliotis midae</i> (Linnaeus, 1758)	Not assessed
<i>Strombus gigas</i> (Linnaeus, 1758)	Not assessed
Cephalopods	
<i>Nautilidae</i> spp.	Not assessed
<i>Nautilus pompilius</i> (Linnaeus, 1758)	Not assessed
<i>Nautilus</i> spp.	Not assessed

ing extraction of Conch in Eastern Samar, there are no regulations existing for the conservation of resources. A decline in populations of mollusks in their area occurs when there is unsustainable management, no control in fishing, and overfishing (Galeana-Rebolledo et al. 2018; Alati et al. 2020). Unregulated harvesting of invertebrates leads to a sharp decline in abundance over a relatively short period because the maximum sustainable yield exceeds the time for mollusks to recover (Fröcklin et al. 2014).

The databases used in this study do not entirely reflect the same trends and magnitudes. The volume reported between PSA and BFAR showed a similar trends, but with slight differences. Floren (2003) discovered that the BFAR data for Shell and shell by-products in Cebu, Philippines is not reflective of the reports from PSA (Floren 2003). The highest volume exported of mollusk products in the Philippines was from 2001 to 2005, with 17,710 MT in BFAR database and 17,923 MT in the PSA database (Table 2). In the global context, FAO (2020) reported that mollusk production via aquaculture continuously increased from 4 million MT in 1990 to 17.7 million MT in 2018, but with reports of slow increase and decrease of supply from other countries (FAO 2020). The highest producer is China with 14.4 million MT, and the Philippines ranked at 14 with 55,000 MT of world marine and coastal aquaculture of mollusks by major producers in 2018 (FAO 2020). It is far off from our findings since the volume of mollusk exported of BFAR in 2018 was 15,699 MT, and PSA no data for 2018 (Table 2). On the other hand, CITES volume data used Pieces as their measurement for volume trade. This limitation has led to CITES data being incomparable to other databases. Although, the CITES data import and export volume per Piece showed a fluctuating pattern, which is not reflective of the BFAR and PSA trend pattern. The CITES database shows sudden declines of 26,788 Pieces of mollusks to 2 pieces. This pattern can be a result of inconsistency and unreported trade data. The Philippines needs to consolidate CITES records of animal trade in the Philippines and the local institu-

Table 2. Comparison of volume (Metric Tons / MT) export from BFAR and PSA database showing the mean volume with \pm Standard Deviation from 1977 until 2018. (-) no available data.

Year	BFAR Export Volume	PSA Export Volume
1977-1981	5,074 \pm 331	1,209 \pm 197
1982-1986	4,237 \pm 772	1,889 \pm 322
1987-1991	11,328 \pm 960	5,737 \pm 1076
1992-1996	13,487 \pm 473	11,514 \pm 1445
1997-2001	14,406 \pm 446	17,055 \pm 685
2001-2006	18,526 \pm 901	17,494 \pm 888
2007-2011	14,074 \pm 1853	12,441 \pm 1382
2012-2016	12,716 \pm 2130	9,588 \pm 1477
2017-2018	17,692 \pm 280	-

tions (Cruz & Lagunzad 2021). Blundell and Mascia (2005) and Russo (2015) discovered that the CITES database in their country is unreliable because their findings show a high level of discrepancies and inaccuracy in the reported volume of wildlife trade (Blundell & Mascia 2005; Russo 2015; Robinson & Sinovas 2018). To better understand this issue, further investigation is needed in the future.

The top exported volume category were Cephalopods from both BFAR and PSA databases, with an initial increase then decrease in the recent years of Cephalopods exported. This trend is similar to the global and national analysis available. The global trend of Cephalopod catches declining since 2013, with the prices and volume increasing (Ospina-Alvarez et al. 2022). The trend pattern of Octopus trade in the Philippines in our analysis is very similar to the findings of Monterey Bay Aquarium (2017) indicating the decline of the trend over the past decades is due to the shortage of supply and smaller catch sizes for exportation (Monterey Bay Aquarium 2017). The growing global demand for Cephalopods in the market can significantly contribute to the income and food of families around the world (Monterey Bay Aquarium 2017; Ospina-Alvarez et al. 2022). Furthermore, most commercial cephalopod species are short-lived and quick to reproduce, making them a target for intensive harvesting, that if not carefully assessed and monitored can actually be unsustainable (Rodhouse et al. 2014; Clark 2019).

The lowest exported category was Gastropods in the BFAR database, while Shells and Articles were in the PSA database. Gastropods, Shells and Articles, and Bivalves are shelled mollusk has a lower export volume than Cephalopods. These groups of invertebrates are used for food, Shell craft, handicraft, ornaments, souvenirs, jewellery, and many more (Floren 2003; Alves et al. 2018). The shell industry involves about 5,000 species of Gastropods and Bivalves worldwide, with the Indo-Pacific region having the rarest and most beautiful shells (Dias et al. 2011). Floren (2003) reported 32 species of mollusks (Gastropods and Bivalves) involved in the Philippine Shell Industry (Floren 2003), with multiple reports of overharvesting of gastropods and bivalves in the Philippines (Floren 2003; Tabugo et al. 2013; Abarquez et al. 2019; Vito 2019). Most of the species reported are easily gleaned, which can contribute to the declining trend and low volume export.

Value of Philippine Mollusk trade

The value trade of exported mollusks in the Philippines from the BFAR and PSA database shows a general increase in time. This growth in value over the years can reflect inflation of food prices or an increase in price value due to scarcity of supply with increasing demand (Anticamara & Go 2016; Mohsin et al. 2017; Galeana-Rebolledo et al. 2018). Floren (2003) reported that when the supply for shells decreased, the prices of

Table 3. Comparison of value export in PHP from BFAR and PSA database showing the mean volume with \pm Standard Deviation from 1977 until 2018. (-) no available data.

Year	BFAR Export		PSA Export	
1977-1981	115,251,600	\pm 3,136,989	215,208,790	\pm 100,819,738
1982-1986	262,036,000	\pm 56,902,542	244,338,097	\pm 28,825,912
1987-1991	1,015,861,200	\pm 215,327,730	757,232,401	\pm 396,445,788
1992-1996	1,702,066,400	\pm 65,612,685	1,642,559,229	\pm 1,094,601,010
1997-2001	2,710,587,200	\pm 78,828,845	2,585,368,703	\pm 1,232,135,404
2001-2006	2,946,631,200	\pm 293,675,364	3,173,784,343	\pm 225,714,746
2007-2011	1,766,467,021	\pm 299,448,817	2,622,468,203	\pm 583,560,577
2012-2016	1,773,339,600	\pm 227,368,461	3,199,358,064	\pm 705,401,342
2017-2018	3,402,231,000	\pm 221,595,000	-	-

the shell increased over time. At the same time, the increase in prices can be attributed to the increase in fishing efforts (Anticamara & Go 2016). Fishers tend to spend more resources to harvest more, while fish stocks are decreasing. This entails, increase consumption of gas fuel, new fishing technology, and more time.

The BFAR and PSA database export value trade show slight differences in exported value, while CITES has no data available for traded value. In the global context, the 2020 State of world fisheries and aquaculture report of FAO indicates that the share in value of mollusk exported worldwide in 2018 is 12% with an amount of 34.6 billion USD (FAO 2020). The average peak value of mollusk exported in the Philippines was 3.10 billion PHP (62.8 million USD) from 2016 to 2018 in the BFAR database and 3.20 billion PHP from 2011 to 2015 (64.7 million USD) (Table 3). Our comparison is limited because we were not able to see the breakdown of value production of each country in the 2020 State of world fisheries and aquaculture report of FAO.

The highest value exported category is Cephalopods in both PSA and BFAR databases. Cephalopod industry is a multi-billion-dollar industry that the world participates in (Ospina-Alvarez et al. 2022). The high volume traded and increasing demand for Cephalopods products by the food community has made this the highest value exported mollusk category in the Philippines (Monterey Bay Aquarium 2017). Furthermore, Cephalopods such as squids are economically important in the Philippines, but highly susceptible to overfishing (Hernando & Flores 1981; Monterey Bay Aquarium 2017). Based on our findings, Cephalopod's export value generally continued to increase despite the decrease in volume.

The lowest exported value categories are Gastropods in the BFAR database and Shells and Articles in the PSA database. The explanation of the value trend for shelled mollusks is the same as previously mentioned. The shelled mollusks, such as gastropods and Shells and Articles have low value because of the low volume exported and low supply with reports indicating shelled mollusk populations are declining in the Philippines due to overharvesting and exploitation. These shelled mollusks are highly vulnerable to gleaners since gleaning is easily accessible in coastal areas in the Philippines and the weak enforcement of fishery management.

Caveats and ways forward

One of the caveats of this paper is the lack of taxonomic resolution of mollusk trade in the Philippines. The databases are fragmented and highly variable when categorizing and organizing mollusks trade data. There were no available data from BFAR and PSA showing the volume and value of traded mollusk species. Thus, making it difficult to properly assess and manage mollusk trade in the Philippines and their populations.

Moreover, a multispecies approach was used when recording the data on both BFAR and PSA databases, which was also observed in the assessment of Octopus trade assessment by [Monterey Bay Aquarium \(2017\)](#). The use of multiple species approach or lumping of multiple species in one common name or taxa has important consequences for the conservation status of the mollusks. One is that this can prevent consumers from making informed decisions whether the species is sustainably caught or overfished. Another consequence is that this can bring taxonomic confusion, making it difficult to determine the status of a concerned mollusk. This event of mislabelling and taxonomic confusion has brought the decline of population and risk of extinction to the European Common skate (*Dipturus batis*) ([Iglésias et al. 2010](#)). Hence the use of the scientific name is crucial to properly support the assessment of the conservation status of traded mollusk and reveal whether it is sustainable or not ([Logan et al. 2008](#)). Species-level identification of each mollusk traded enables us to understand the trend and magnitude of mollusks.

Another caveat is that the BFAR, PSA, and CITES data are presented at a highly aggregated level with no regional or local production volume and value information. This limitation inhibits us from accurately reflecting the true extent of mollusk declines in source fishing grounds and can mask the true declines ([Anticamara & Go 2016](#)). This challenge along with poor enforcement of fisheries management hinders us to distinguish the actual pattern of decline in local fishing and the source grounds (e.g., increase in fishing effort sustaining same production volume or serial depletion) ([Cardinale et al. 2011](#)). Furthermore, we also suspect that the current volume and value reported in BFAR and PSA data are underestimated. It does not reflect many other mollusk categories, considering that there is a wide range of mollusk being locally consumed and exploited in the Philippines ([Salamanca & Pajaro 1996](#); [Rodhouse et al. 2014](#); [del Norte-Campos et al. 2019](#)) and that some categories (e.g., Gastropods and Bivalves) only appeared in the reports in few periods and in recent times.

Lastly, the lack of available information about the fishing effort, catch information, and separation of production between local fishers and commercial fishers contributes to the obscurity of the true trends, magnitudes, and impacts of actual mollusk fisheries in the Philippines. This limitation is also observed by Monterey Aquarium when assessing the Cephalopod trade in the Philippines ([Monterey Bay Aquarium 2017](#)). This is the first paper that provides a comprehensive and systematic analysis of the mollusk trade. Other reports about the mollusk trade in the Philippines do not accurately represent the mollusk trade in the Philippines because it only represents a portion of the mollusk trade ([Salayo 2000](#); [Floren 2003](#); [Monterey Bay Aquarium 2017](#)). This paper can also be used for future detailed analyses of Philippine mollusk fisheries and trade. Therefore, we recommend field survey data to obtain the data from each region in the Philippines. This will allow us to better examine the trend of the populations of the species and verify if the decline of mollusk trade volume is due to overfishing. Furthermore, this will allow us to correlate the coastal community activities and population with the trend respective to its region. For example, where there is an increasing trend of mollusc population decline and tourism activity in the region, we can infer that this anthropogenic activity can affect the decline of mollusc species, and can investigate such case in details.

CONCLUSIONS

To date, available databases on Philippine mollusk trade showed an initial increase in traded volume (1970s to 2005), but indicated stagnantly

or decrease trends and magnitudes in recent decades. In contrast, the traded mollusk value generally continued to increase over time (albeit observed decreases from 2007 to 2016), indicating value increase as mollusk volume decreased. Alarmingly, we have observed that the databases used are inconsistent, highly variable, and incomplete. This limitation inhibited us from accurately assessing the true extent of the trend, magnitude, and impact of the mollusk trade in the Philippines. The BFAR and PSA database shows similar results, but have slight differences, while CITES was incomparable because the metric used in its recording was Pieces and not Metric Tons, unlike the BFAR and PSA database.

This is the first paper that provides a comprehensive and systematic assessment of the Philippine mollusk trade. We observed that there is a great need to resolve and field validate the inconsistencies in the data entries across all the available mollusk trade databases (BFAR, PSA, and CITES). Furthermore, we recommend that conducting a comprehensive field assessment is needed in improving our understanding of the Philippine Mollusk trade status, trends and conservation status. Such study can also improve the estimation and monitoring of the economic benefits that Filipinos derived from the mollusk trade.

AUTHOR CONTRIBUTION

This study was conducted and conceptualized by JA. He participated in data gathering, analysis, and write-up. JO did the data gathering, processing, analysis, and write-up.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ADDITIONAL INFORMATION

The mean volume of each country for CITES export and import dataset can be accessed as supplementary information (Table S1 & S2).

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APPENDICES

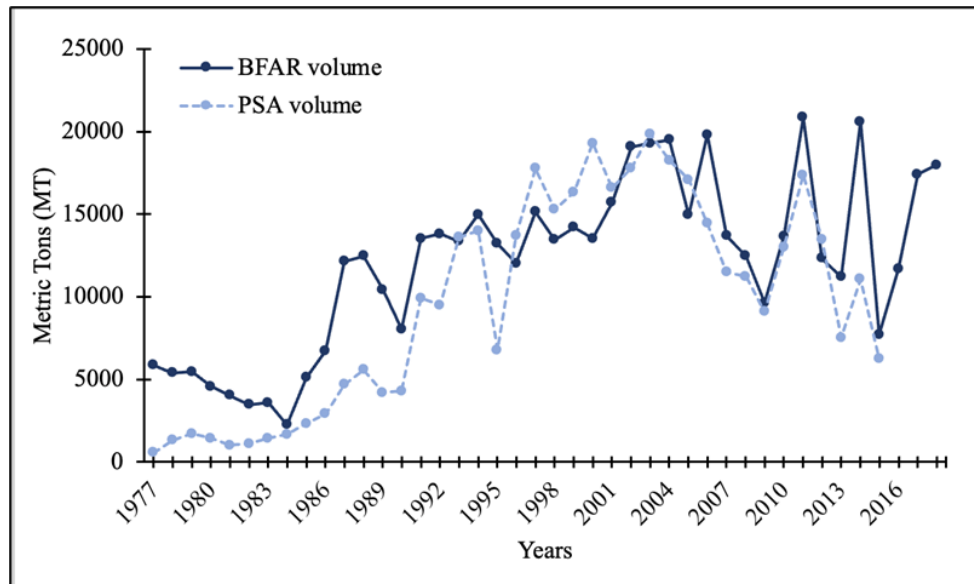


Figure A1. Time-series of total volume of mollusk trade in the Philippines from 1977 to 2018 from BFAR Annual Fisheries Report and PSA Foreign Trade Statistics.

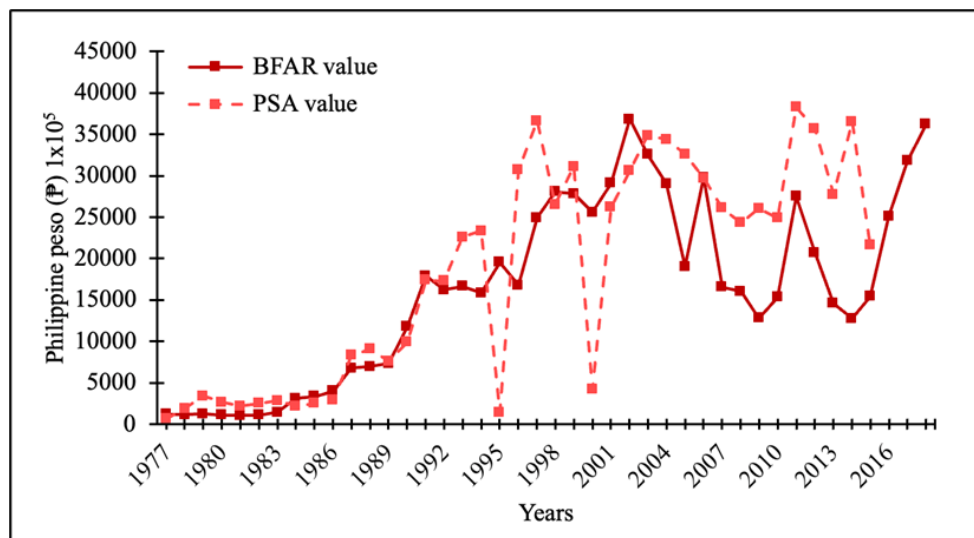


Figure A2. Time-series of total value of mollusk trade in the Philippines from 1977 to 2018 from BFAR Annual Fisheries Report and PSA Foreign Trade Statistics.

Appendix A1. Mean volume (Metric Tons= MT) and Mean Value (Philippine Pesos= PHP) of mollusk trade per five years showing the mean \pm Standard Deviation (SD) from 1977-2018 BFAR Fisheries Annual Report.

Year	Volume	Value
1977-191	5,074 \pm 331	115,251,600 \pm 3,136,989
1982-1986	4,237 \pm 772	262,036,000 \pm 56,902,542
1987-1991	11,328 \pm 960	1,015,861,200 \pm 215,327,730
1992-1996	13,487 \pm 473	1,702,066,400 \pm 65,612,685
1997-2001	14,406 \pm 446	2,710,587,200 \pm 78,828,845
2001-2006	18,526 \pm 901	2,946,631,200 \pm 293,675,364
2007-2011	14,074 \pm 1853	1,766,467,021 \pm 299,448,817
2012-2016	12,716 \pm 2130	1,773,339,600 \pm 227,368,461
2017-2018	17,692 \pm 280	3,402,231,000 \pm 221,595,000

Appendix A2. Mean volume (MT) of each group showing the mean \pm Standard Deviation (SD) from 1977-2018 BFAR Fisheries Annual Report. (-) means no data report.

Year	Shells and Articles		Bivalves		Cephalopods		Gastropods	
1977-1981	4,161	\pm 547	710	\pm 166	432	\pm 42	-	-
1982-1986	3,090	\pm 1,223	356	\pm -	1,075	\pm 626	-	-
1987-1991	3,167	\pm 954	3,978	\pm 2,759	4,182	\pm 2,374	-	-
1992-1996	2,985	\pm 745	942	\pm 458	9,560	\pm 1,059	-	-
1997-2001	1,969	\pm 261	1	\pm 0	12,353	\pm 939	416	\pm -
2002-2006	4,400	\pm 2,717	2,070	\pm 428	12,884	\pm 1,511	-	-
2007-2011	3,314	\pm 1,511	-	-	10,760	\pm 2,681	-	-
2012-2016	4,526	\pm 1,918	-	-	8,190	\pm 3,108	-	-
2017-2018	4,576	\pm 371	-	-	13,116	\pm 25	-	-

Appendix A3. Annual export volume of mollusk trade per category in the Philippines from 1977 to 2018 BFAR Annual Fisheries Report. (-) means no data report.

Year	Shells and Articles	Bivalves	Cephalopods	Gastropods
1977	5,015	845	-	-
1978	4,179	763	464	-
1979	4,242	764	470	-
1980	3,735	468	382	-
1981	3,632	-	411	-
1982	2,568	356	558	-
1983	2,804	-	786	-
1984	1,494	-	761	-
1985	3,982	-	1141	-
1986	4,603	-	2130	-
1987	3,747	5,523	2886	-
1988	2,228	7,096	3158	-
1989	2,163	5,043	3221	-
1990	4,341	480	3225	-
1991	3,357	1,750	8422	-
1992	4,141	1,585	8088	-
1993	2,818	1,189	9361	-
1994	3,250	900	10824	-
1995	2,387	537	10311	-
1996	2,329	498	9215	-
1997	2,226	-	12910	-
1998	1,978	-	11060	416
1999	1,765	1	12437	-
2000	1,654	2	11865	-
2001	2,223	1	13493	-
2002	2,714	2,123	14240	-
2003	3,224	1,618	14462	-
2004	5,478	2,469	11552	-
2005	1,933	-	13019	-
2006	8,650	-	11147	-
2007	3,554	-	10146.87	-
2008	2,430	-	10051	-
2009	1,552	-	8086	-
2010	3,449	-	10233	-
2011	5,587	-	15281	-
2012	3,622	-	8717	-
2013	5,273	-	5945	-
2014	7,388	-	13217	-
2015	2,308	-	5398	-
2016	4,041	-	7673	-
2017	4,314	-	13098	-
2018	4,838	-	13133	-
Total	147,216	34,011	322,978	416

Appendix A4. Mean value (₱) of each group showing the mean ± Standard Deviation (SD) from 1977-2018 BFAR Fisheries Annual Report. (-) means no data report.

Year	Shells and Articles		Bivalves	
1977-1981	90,414,250	± 5,180,783	15,900,250	± 2,511,799
1982-1986	164,089,600	± 75,234,482	10,696,000	± 0
1987-1991	336,458,000	± 138,508,564	198,983,000	± 138,990,284
1992-1996	487,785,600	± 52,058,498	300,899,400	± 124,897,024
1997-2001	622,762,600	± 115,625,365	351,804,000	± 46,610,858
2002-2006	696,944,200	± 581,153,731	631,695,750	± 236,173,291
2007-2011	346,324,083	± 59,087,522	-	-
2012-2016	306,718,600	± 284,181,040	-	-
2017-2018	469,088,667	± 71,841,342	-	-

Year	Cephalopods		Gastropods	
1977-1981	15,000,000	± 1,732,051	-	-
1982-1986	36,496,800	± 25,627,118	-	-
1987-1991	242,013,200	± 92,112,865	-	-
1992-1996	938,944,600	± 205,048,581	-	-
1997-2001	1,424,437,600	± 263,826,463	139,144,000	± 0
2002-2006	1,730,019,200	± 532,776,942	-	-
2007-2011	1,466,157,138	± 149,281,613	-	-
2012-2016	1,514,391,200	± 702,034,596	-	-
2017-2018	2,636,802,000	± 920,088,056	-	-

Appendix A5. Annual export value of mollusk trade per category in the Philippines from 1977 to 2018 BFAR Annual Fisheries Report. (-) means no data report.

Year	Worked Shells and Articles	Bivalves	Cephalopods	Gastropods
1977	99,657,000	19,601,000	-	-
1978	87,000,000	15,000,000	16,000,000	-
1979	92,000,000	15,000,000	16,000,000	-
1980	83,000,000	14,000,000	13,000,000	-
1981	90,000,000	-	16,000,000	-
1982	79,242,000	10,696,000	20,542,000	-
1983	114,849,000	-	30,374,000	-
1984	280,015,000	-	35,328,000	-
1985	256,342,000	-	80,240,000	-
1986	277,466,000	-	125,086,000	-
1987	302,449,000	160,816,000	214,398,000	-
1988	275,557,000	197,610,000	223,546,000	-
1989	275,665,000	188,207,000	269,308,000	-
1990	551,153,000	249,299,000	377,728,000	-
1991	528,718,000	501,404,000	763,448,000	-
1992	498,736,000	421,022,000	702,488,000	-
1993	426,677,000	264,882,000	974,015,000	-
1994	517,417,000	187,361,000	1,059,494,000	-
1995	467,380,000	129,828,000	1,195,278,000	-
1996	400,282,000	115,845,000	1,004,614,000	-
1997	514,298,000	-	1,672,022,000	-
1998	700,389,000	-	1,543,186,000	139,144,000
1999	762,754,000	456,574,000	1,563,735,000	-
2000	736,090,000	482,993,000	1,338,631,000	-
2001	649,878,000	392,361,000	1,868,337,000	-
2002	952,920,000	616,876,000	2,112,773,000	-
2003	710,861,000	537,264,000	2,009,120,000	-
2004	1,130,127,000	980,282,000	795,266,000	-
2005	40,935,000	-	1,864,600,000	-

Appendix A5. Contd.

Year	Worked Shells and Articles	Bivalves	Cephalopods	Gastropods
2006	1,353,123,000	-	1,629,009,000	-
2007	145,237,417	-	1,512,672,689	-
2008	80,790,000	-	1,525,813,000	-
2009	52,242,000	-	1,229,886,000	-
2010	100,228,000	-	1,433,405,000	-
2011	170,763,000	-	2,581,298,000	-
2012	189,832,000	-	1,882,455,000	-
2013	343,173,000	-	1,115,902,000	-
2014	310,165,000	-	966,921,000	-
2015	519,660,000	-	1,025,380,000	-
2016	920,369,000	-	1,592,841,000	-
2017	192,649,000	-	2,987,987,000	-
2018	294,248,000	-	3,329,578,000	-
total	16,574,336,417	5,956,921,000	44,717,704,689	139,144,000

Appendix B1. volume (MT) and Value (₱) of mollusk trade showing the Mean ± Standard Deviation (SD) from 1977-2015 PSA Foreign Export Trade Report.

Year	Volume			Value		
1977-1981	1,209	±	441	215,208,790	±	100,819,738
1982-1986	1,889	±	719	244,338,097	±	28,825,912
1987-1991	5,737	±	2,406	757,232,401	±	396,445,788
1992-1996	11,514	±	3,231	1,642,559,229	±	1,094,601,010
1997-2001	17,055	±	1,532	2,585,368,703	±	1,232,135,404
2001-2006	17,494	±	1,987	3,173,784,343	±	225,714,746
2007-2011	12,441	±	3,091	2,622,468,203	±	583,560,577
2012-2015	9,588	±	3,302	3,199,358,064	±	705,401,342

Appendix B2. Mean volume (MT) of each category showing the Mean ± Standard Deviation (SD) from 1977-2015 PSA Foreign Export Trade Report. (-) means no data report.

Year	Shells and Articles			Bivalves			Cephalopods			Gastropods		
1977-1981	-			428	±	181	616	±	295	164	±	36
1982-1986	-			314	±	152	1,365	±	605	209	±	53
1987-1991	-			1,270	±	599	4,182	±	465	285	±	86
1992-1996	1	±	1	1,365	±	925	9,823	±	2,404	326	±	247
1997-2001	2	±	2	1,509	±	956	15,128	±	3,167	415	±	238
2002-2006	11	±	11	2,926	±	1,067	14,040	±	1,525	516	±	107
2007-2011	-			350	±	511	12,072	±	1,027	19	±	26
2012-2015	-			1,436	±	462	8,128	±	4,767	25	±	40

Appendix B3. Annual export volume of mollusk trade per category in the Philippines from 1977 to 2015 PSA Foreign Trade Statistics. (-) means no data report.

Year	Shells and Articles			Bivalves			Cephalopods			Gastropods		
1977	-			221			215			127		
1978	-			514			673			127		
1979	-			678			857			187		
1980	-			436			818			175		
1981	-			293			519			205		
1982	-			270			686			159		
1983	-			302			863			273		
1984	-			352			1,091			223		
1985	-			112			2,056			152		
1986	-			534			2,130			240		
1987	-			1,677			2,886			136		
1988	-			2,065			3,158			359		
1989	-			674			3,221			298		

Appendix B3. Contd.

Year	Shells and Articles	Bivalves	Cephalopods	Gastropods
1990	-	746	3,225	313
1991	-	1,186	8,422	319
1992	-	1,113	8,087	300
1993	-	1,670	11,375	548
1994	-	1,404	12,443	145
1995	-	41	6,702	34
1996	1	2,596	10,509	602
1997	2	2,600	14,584	595
1998	5	2,055	12,649	568
1999	4	1,780	14,060	493
2000	-	185	19,091	9
2001	1	926	15,257	409
2002	5	1,180	16,175	436
2003	29	2,862	16,445	529
2004	2	4,008	13,629	634
2005	6	3,465	13,018	600
2006	13	3,118	10,934	380
2007	-	114	11,375	-
2008	-	187	11,036	-
2009	-	38	9,068	1
2010	-	1,258	11,706	43
2011	-	152	17,174	53
2012	-	1,945	11,533	6
2013	-	1,525	6,012	-
2014	-	1,448	9,545	84
2015	-	825	5,420	10
Total	68	46,554	318,648	9,770

Appendix B4. Total value of each taxonomic Class showing the Mean \pm Standard Deviation (SD) from 1977-2015 PSA Foreign Export Trade Report. (-) means no data report.

Year	Shells and Articles		Bivalves	
1977-1981	-	-	82,384,449	\pm 42,466,340
1982-1986	-	-	45,519,876	\pm 25,696,938
1987-1991	-	-	203,072,136	\pm 99,473,830
1992-1996	-	-	311,675,681	\pm 316,747,877
1997-2001	242,459	\pm 205,131	531,403,816	\pm 362,496,209
2002-2006	4,577,771	\pm 2,334,458	1,136,162,682	\pm 220,919,380
2007-2011	-	-	867,144,143	\pm 99,330,534
2012-2015	-	-	1,382,856,572	\pm 198,363,058
Year	Cephalopods		Gastropods	
1977-1981	122,850,643	\pm 10,240,917	10,240,917	\pm 3,847,918
1982-1986	196,066,130	\pm 17,896,992	17,896,992	\pm 4,590,983
1987-1991	774,646,418	\pm 68,815,506	68,815,506	\pm 35,330,200
1992-1996	1,462,447,262	\pm 134,427,285	134,427,285	\pm 109,433,347
1997-2001	1,816,127,767	\pm 148,249,198	148,249,198	\pm 112,308,127
2002-2006	1,974,327,048	\pm 129,058,462	129,058,462	\pm 30,151,018
2007-2011	1,924,612,165	\pm 1,638,539	1,638,539	\pm 2,087,393
2012-2015	1,657,485,938	\pm 1,739,975	1,739,975	\pm 1,827,422

Appendix B5. Annual export value of mollusk trade per category in the Philippines from 1977 to 2015 PSA Foreign Trade Statistics. (-) means no data report.

Year	Shells and Articles	Bivalves	Cephalopods	Gastropods
1977	-	23,522,268	34,758,187	6,789,306
1978	-	75,098,154	111,408,461	6,772,312
1979	-	140,055,478	187,271,944	11,535,966
1980	-	99,542,781	148,044,969	16,035,334
1981	-	73,703,565	132,769,656	10,071,668

Appendix B5. Contd.

Year	Shells and Articles	Bivalves	Cephalopods	Gastropods
1982	-	54,947,508	180,248,130	14,747,995
1983	-	72,270,534	186,602,157	24,550,265
1984	-	14,796,777	187,879,019	17,861,870
1985	-	21,839,189	216,711,589	12,690,560
1986	-	63,745,373	208,889,755	19,634,267
1987	-	285,317,523	526,152,649	21,655,959
1988	-	308,741,856	534,950,013	65,062,323
1989	-	77,232,715	625,484,292	57,552,298
1990	-	127,946,186	782,534,664	81,262,134
1991	-	216,122,402	1,404,110,470	118,544,817
1992	-	210,368,927	1,392,274,025	127,623,661
1993	-	272,185,581	1,795,222,775	193,549,975
1994	-	224,073,138	2,046,240,278	66,563,667
1995	-	4,130,790	140,359,939	1,425,697
1996	113,695	847,619,967	1,938,139,294	282,973,423
1997	56,647	531,021,550	2,835,235,295	300,247,419
1998	442,447	458,898,419	1,994,840,385	201,017,440
1999	423,498	1,020,450,518	1,945,292,946	143,880,519
2000	-	11,398,040	413,995,246	796,766
2001	289,701	635,250,551	1,891,274,963	95,303,847
2002	5,303,102	867,188,419	2,047,100,910	141,286,893
2003	7,715,157	927,015,360	2,412,659,046	138,343,911
2004	1,223,924	1,251,367,692	2,030,137,319	157,684,266
2005	4,162,545	1,319,251,874	1,806,642,790	129,719,446
2006	4,484,129	1,315,990,064	1,575,095,177	78,257,793
2007	-	996,132,394	1,616,143,526	-
2008	-	735,806,457	1,699,282,327	-
2009	-	814,796,379	1,788,474,475	587,724
2010	-	920,401,074	1,563,978,549	2,910,949
2011	-	868,584,412	2,955,181,948	4,694,023
2012	-	1,404,170,891	2,163,412,235	2,542,594
2013	-	1,516,912,323	1,258,104,038	-
2014	-	1,514,394,545	2,137,773,497	3,927,284
2015	-	1,095,948,529	1,070,653,982	490,021
Total	24,214,845	21,418,240,203	47,985,330,921	2,558,594,394

Appendix C1. Mean annual exported volume per piece of mollusk products showing the mean and standard deviation from the Philippines from 1983 to 2019 CITES database.

Year	Exported Mollusks
1984-1988	19,213 ± 66,153
1989-1993	26,788 ± 66,041
1994-1998	3,784 ± 8,755
1999-2003	407 ± 421
2004-2008	2,216 ± 5,308
2009-2013	102 ± 183
2014-2018	4,605 ± 7,271

Appendix C2. Mean annual imported volume per piece of mollusk products showing the Mean ± Standard deviation in the Philippines from 1983 to 2019 CITES database.

Year	Imported Mollusks
1984-1988	500 ± 0
1989-1993	4,620 ± 3,765
1994-1998	7,502 ± 12,558
1999-2003	40 ± 0
2004-2008	16,181 ± 1,670
2009-2013	2 ± 0
2014-2018	10,100 ± 14,001

Supplementary Table 1. Mean exported mollusk per piece from the Philippines 1984 to 2018 CITES database.

Year	Argentina		Australia		Austria		Bahamas	
1984-1988	538	± -	13,521	± 19,502	-	-	-	-
1989-1993	-	-	9,462	± 9,041	-	-	500	± -
1994-1998	-	-	105	± 134	100	± -	-	-
1999-2003	-	-	247	± -	7	± -	-	-
2004-2008	-	-	-	-	-	-	-	-
2009-2013	-	-	-	-	-	-	-	-
2014-2018	-	-	-	-	-	-	-	-
Year	Belgium		Brazil		Canada		China	
1984-1988	14,334	± 10,686	-	-	8,753	± 7,928	6,606	± -
1989-1993	30,220	± 35,153	52	± -	7,808	± 11,606	-	-
1994-1998	300	± -	-	-	1,164	± 819	-	-
1999-2003	-	-	-	-	-	-	-	-
2004-2008	-	-	-	-	-	-	-	-
2009-2013	-	-	-	-	-	-	-	-
2014-2018	-	-	-	-	-	-	-	-
Year	Cyprus		Czech Republic		Denmark		Fiji	
1984-1988	-	-	-	-	2,769	± 3,153	718	± -
1989-1993	212	± 285	-	-	306	± 36	310	± -
1994-1998	-	-	150	± -	747	± 261	-	-
1999-2003	-	-	50	± -	-	-	-	-
2004-2008	-	-	-	-	-	-	-	-
2009-2013	-	-	-	-	-	-	-	-
2014-2018	-	-	-	-	-	-	-	-
Year	Former Pacific Trust Territory		France		French Polynesia		Germany	
1984-1988	218	± -	8,985	± 14,083	-	-	27,275	± 13,649
1989-1993	-	-	74,580	± 45,128	2,653	± 2,899	63,276	± 63,258
1994-1998	-	-	500	± 141	-	-	22,806	± 15,103
1999-2003	-	-	-	-	-	-	-	-
2004-2008	-	-	-	-	-	-	-	-
2009-2013	-	-	-	-	-	-	-	-
2014-2018	-	-	-	-	-	-	-	-
Year	Greece		Guam		Hong Kong		Iceland	
1984-1988	829	± -	29	± 17	4,865	± 4,448	577	± -
1989-1993	2,696	± 2,779	-	-	6,452	± 4,367	-	-
1994-1998	-	-	-	-	40	± 14	-	-
1999-2003	-	-	-	-	-	-	-	-
2004-2008	-	-	-	-	-	-	-	-
2009-2013	10	± -	-	-	-	-	-	-
2014-2018	4	± -	309	± -	-	-	-	-
Year	India		Israel		Italy		Japan	
1984-1988	1,400	± -	-	-	16,126	± 16,136	52,896	± 54,742
1989-1993	-	-	3,499	± 3,615	19,712	± 8,861	66,404	± 71,809
1994-1998	-	-	200	± -	-	-	8,804	± 7,528
1999-2003	-	-	-	-	-	-	267	± 157
2004-2008	-	-	-	-	-	-	300	± -
2009-2013	-	-	-	-	-	-	-	-
2014-2018	-	-	-	-	-	± 40	-	-

Supplementary Table 1. Contd.

Year	Korea, Republic of	Luxembourg	Malaysia	Malta
1984-1988	5,330 ± -	-	-	-
1989-1993	50 ± 54	-	-	100 ± -
1994-1998	830 ± 269	50 ± -	150 ± -	-
1999-2003	-	-	-	-
2004-2008	-	-	115 ± -	-
2009-2013	4 ± -	-	500 ± -	-
2014-2018	-	-	153 ± -	-
Year	Mauritius	Morocco	Netherlands	New Caledonia
1984-1988	256 ± -	4,107 ± -	27,188 ± 19,011	-
1989-1993	7,828 ± -	-	53,996 ± 39,013	1,100 ± -
1994-1998	-	-	7,072 ± 8,497	-
1999-2003	-	-	-	-
2004-2008	-	-	-	-
2009-2013	-	-	-	-
2014-2018	-	-	-	-
Year	New Zealand	Norway	Poland	Portugal
1984-1988	100 ± -	2 ± -	-	1,500 ± -
1989-1993	55 ± 64	-	-	1,100 ± -
1994-1998	15 ± 12	-	-	-
1999-2003	10 ± 3	-	-	-
2004-2008	16 ± 1	-	636 ± -	-
2009-2013	-	-	8 ± 4	-
2014-2018	-	-	17,128 ± -	-
Year	Saudi Arabia	Singapore	Spain	Sweden
1984-1988	1,420 ± 618	270 ± 307	1,210 ± 1,119	39 ± -
1989-1993	-	1,701 ± 2,410	50,261 ± 54,337	1,537 ± -
1994-1998	-	-	4,359 ± 2,716	80 ± -
1999-2003	-	900 ± -	739 ± 493	-
2004-2008	-	200 ± -	2 ± -	-
2009-2013	-	42 ± 25	6 ± -	-
2014-2018	-	-	-	-
Year	Switzerland	Taiwan, Province of China	Thailand	United Kingdom of Great Britain
1984-1988	4,384 ± 4,574	-	-	27,756 ± 29,157
1989-1993	100 ± -	1,066 ± 972	16 ± 21	65,980 ± 73,548
1994-1998	248 ± 342	163 ± 53	100 ± -	2,436 ± 902
1999-2003	-	-	-	-
2004-2008	-	-	-	-
2009-2013	-	-	-	-
2014-2018	-	-	-	-
Year	United States of America		Unknown	
1984-1988	376,095 ±	289,679	4,722 ±	3,298
1989-1993	357,388 ±	250,876	-	-
1994-1998	36,606 ±	44,313	-	-
1999-2003	1,039 ±	2,069	-	-
2004-2008	14,245 ±	11,325	-	-
2009-2013	144 ±	198	-	-
2014-2018	9,903 ±	13,497	-	-

Supplementary Table 2. Mean imported mollusk per piece to the Philippines from 1984 to 2018 CITES database.

Years	Australia	Bahamas	Malaysia	New Caledonia	Nicaragua	Palau	Philippines	Spain	United States of America
1984-1988	500	-	-	-	-	-	-	-	-
1989-1993	15,000	-	-	-	-	-	360	-	6,000
1994-1998		22,000	-	-	-	-	-	475	30
1999-2003	-	-	-	40	-	-	-	-	-
2004-2008	-	-	-	-	15,000	-	-	-	17,362
2009-2013	-	-	-	-	-	3	-	-	2
2014-2018	-	20,000	200	-	-	-	-	-	-