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Souvenirs, Shells, and the Illegal Wildlife Trade

Vincent Nijman[1]

Abstract. Shells are often seen as portable souvenirs, and both domestic and international tourists bring shells home. While part of this activity concerns individual tourists collecting a small number of shells on the beach, another part concerns large-scale commercial trade. Each year the Indonesian beach resort of Pangandaran is visited by several million tourists, most from within Indonesia. Here, I focus on the commercial trade in large-sized shells for decorative purposes and, using an anthropological approach, gain insight into the trade in marine mollusk shells of the area. A number of the large-shelled species are rare and over-exploited, and receive different levels of protection. By comparing three pairs of similar species, in which one species is legally protected (i.e., on Indonesia's protected species list) and the other is not, I attempt to gauge how rarity and protection affects trade. Protected species were as openly displayed as non-protected species, and more shops offered the protected than the unprotected species. The Indonesian shell trade involves a complex and organized network of collectors, transporters, middlemen, and sellers. Traders indicated that they purchased shells from middlemen, who obtained them from eastern Indonesia; no shells were collected in the Pangandaran area. The main buyers of these large shells are domestic Indonesian tourists. Pangandaran is a trade hub for shells to meet the demands of an urban consumer market in Java. While protected, there is no social stigma in buying these shells, nor do traders that display them run the risk of prosecution, indicating a lack of support for protective and regulatory measures.

Keywords: CITES, conservation, Indonesia, natural resource use, wildlife trade

Introduction

There is a considerable domestic and global international trade in marine mollusk shells. As indicated by Gössling et al. (2004), shells have been used for currency, jewelry, ornaments, tools, horns, games, medicine, and as magical or religious symbols (Dias et al. 2011; Gibbons and Remaneva 2011). When traded, these shells are usually sold for either decorative or utilitarian purposes, with some species being traded for both. Shells are a particularly important item in the tourism industry, where they are often traded as portable souvenirs. While individual tourists may pick up small amounts of shells on the beach or water's edge, in many seaside resorts, there is a whole industry dependent on the trade in seashells for decorative purposes (Floren 2003; Salamanca and Pajaro 1996). In reference to live-collected shells, Duncan and Ghys (2019) noted that since specimens are ultimately intended for a collection or for display, the best quality examples are those that are specifically collected, either by the collectors themselves or by professionals for subsequent sale. In order to acquire the best and most pristine shells, and in large enough volumes, collectors do not rely on washed up (dead) specimens but actively collect shells when still alive in a professional and highly organized manner. This includes, for instance, the deployment of baited cages lowered to ~40 m to obtain chambered nautilus (*Nautilus pompilius*) or the use of scuba gear to collect large quantities of horned helmet (*Cassis cornuta*) (Dolorosa et al. 2013; Duncan and Ghys 2019; Dunstan et al. 2010). Shells are often traded over large geographic areas and the species sold at particular markets, e.g., a beach resort, and may be derived from the surrounding seas , obtained from other parts of the country, or may have been imported

[1] Oxford Wildlife Trade Research Group, Department of Social Sciences, Oxford Brookes University, Gipsy Lane, OX3 0BP, Oxford, UK (vnijman@brookes.ac.uk)

from abroad (Dias et al. 2011; Gössling et al. 2004; John et al. 2012).

Shells are sold in a number of forms: whole and unworked, as jewelry, lampshades, or other ornaments, or as inlays (using the nacre or mother-of-pearl found on the inside of shells). The shape of some shells allows them to be used as ashtrays, soap holders, and food dishes, whereas many small shells can be worked into elaborate displays. The international ornamental shell trade, which principally includes shells exploited for their decorative or rareness value, is global and it concerns considerable volumes of shells being traded. In the late 1980s, Wells (1989) reported that there were an estimated 1000 shell dealers in the United States alone, and similar numbers would have been present in Europe, East Asia, and other regions. Since then, clear shifts have occurred in that a significant proportion of the ornamental shell trade now occurs over the Internet, and just about every species and every shell item can be ordered from anywhere.

While perhaps most of the trade in marine mollusks is legal, there are numerous reports of protected species being traded at a commercial scale (Deines 2018; Dias et al. 2011; Floren 2003; Gibbons and Remaneva 2011; Gössling et al. 2004; Nijman et al. 2015). This illegal trade often includes extensive, complex, and highly organized networks, with collectors, middlemen, processors, and vendors colluding, and some of the trade involving large-scale import and export of marine mollusk shells (John et al. 2012; Nijman et al. 2015), thus meeting the definition of organized crime. In some places, such as Bali, Indonesia, protected species are openly offered for sale and few distinctions are made between legally protected and unprotected species (Nijman and Lee 2016), whereas in other places, such as Tamil Nadu, India, protected species are treated differently than non-protected species and have higher asking prices (John et al. 2012). Governance (strong or weak), regulations, and enforcement of regulations vary across countries or regions and even between communities, as do cultural norms regarding the illegal wildlife trade. Better understanding of why and when individual actors participate in this trade—what social and cultural forces and norms drive rule-breaking, collection of protected species, subsistence uses, and market activities (such as valuing of rarity or connection to identity)—is critical for sustainable management and improved governance (Blair et al. 2017).

In this paper, I present data on the use and selection of marine mollusk shells in the popular beach resort community of Pangandaran on the south coast of the Indonesian island of Java. Data was collected on the availability of specific mollusk shells, those who were selling them, how they displayed these shells, and who was buying them. I focus on three legally protected species and three similar-sized species that are not protected to explore if illegality and rule-breaking displays itself in this trade. The observations were made over two decades, allowing me to build up rapport with traders and government officials, and to have in-depth discussions with traders, consumers, fishermen, and government officials about all aspect of the trade, including sensitive topics. The result is a unique overview, as well as a narrative of the trade in large mollusk shells in Pangandaran.

Methods

Study Area

The tourist resort of Pangandaran (7°41′ S, 108°39′ E) is situated on a small, narrow (200 m at its narrowest) isthmus leading to a larger 5 km^2 forested nature reserve. The nature reserve is essentially a small, rotund island firmly anchored in the Indian Ocean that is connected to the mainland by a narrow, two-kilometer long strip of land (Whitten et al. 1996; Figure 1A). The

reserve was established in 1934 and, for many years, the isthmus was characterized by small hotels and homestays (*losmen* or *wisma* in Bahasa Indonesia). Since 1985, Pangandaran is home to a National Kite Festival and, in the 1980s and 1990s, the western beaches gained a reputation as a surfing destination.

On July 17, 2006, after a 7.7 magnitude earthquake in the Indian Ocean some 200 km off Pangandaran, the area was hit by a tsunami that killed approximately 600 people (Fritz et al. 2007; Reese et al. 2007). The five- to six-meter-high waves destroyed many single-story bamboo, timber, and traditional brick structures. Many of the wooden or bamboo cafes, shops, and homestays along the waterfront and up to 20 or 30 m inland were destroyed. Better-built hotels and houses that were further inland, while damaged, could be repaired. The tsunami resulted in a major rebuild of Pangandaran with a focus on mass tourism. Pre-tsunami Pangandaran was characterized by small hotels and hostels catering to individual tourists and smaller parties, whereas now it is dominated by high-rise three- and four-star hotels catering for large groups and organized tours. The new hotels were initially erected predominantly on the western beachfront, but now they are a feature throughout the peninsula.

Alongside the infrastructural changes in Pangandaran, tourist numbers have changed (Figure 1B). Tourism has increased slowly but consistently from less than 100,000 visitors in the 1970s to around one million in the 1990s and early 2000s. A significant drop was seen in 2006, coinciding with the tsunami and its aftermath. After 2006, Pangandaran recovered and the number of tourists has increased year on year. In 2018, 4.2 million tourists visited the peninsula (Figure 1B). Up until the 1990s, about two to three percent of the tourists, i.e., ~25,000 visitors, were mainly Western foreigners, but that dropped to less than one percent in the last two decades, with fewer Western and more Asian tourists visiting. Declared by the Indonesian government as one of the country's "National Tourism Sites [*Andalan Wisata Nasional*]," the Pangandaran District has a population of just over 50,000 people. Over 90% of the people of Java are Muslim and, in recent years, Pangandaran has branded itself as an Islam-friendly tourist destination, often contrasting itself with Hindu Bali (Triandara 2017). The West Javan government has included Pangandaran on its list of Muslim-permissible tourist destinations (*Wisata Halal*).

Research that has been published on Pangandaran prior to the tsunami focused on the vegetation of the nature reserve (e.g., Sumardja and Kartawinata 1977), its wildlife, and, in particular, the population of the endemic ebony langurs (*Trachypithecus auratus*; e.g., Kool 1993) and, briefly, on a coelacanth (*Latimeria menadoensis*) that had allegedly been caught in the Bay of Pangandaran in 1995 (Erdmann and Caldwell 2000; McCabe and Wright 2000). Not surprisingly, post-tsunami research focused heavily on the disaster and its aftermath (e.g., Fritz et al. 2007; Lavigne et al. 2007; Reese et al. 2007) and, to a lesser extent, wildlife and fisheries (Nurhayati and Purnomo 2014; Tsuji et al. 2013). Research on tourism and development is limited (but see Wilkinson and Pratiwi 1995), and reports on wildlife trade in Pangandaran are few (e.g., Hilterman and Goverse 2005; Nijman et al. 2015). Recently, the first study on marine mollusks in the waters around Pangandaran was published (Sahidin et al. 2018).

Data Collection and Observations

Over the last 22 years, I have made 11 visits to Pangandaran (1995, twice in 1997, 1999, 2004, twice in 2012, 2013, 2015, 2016, 2018). This allowed me to observe the trade of marine products over a long time period. Because of tourism, the area is open to outsiders. As such, I had no problem collecting key data on the exploitation of marine mollusks. I used a social anthro-

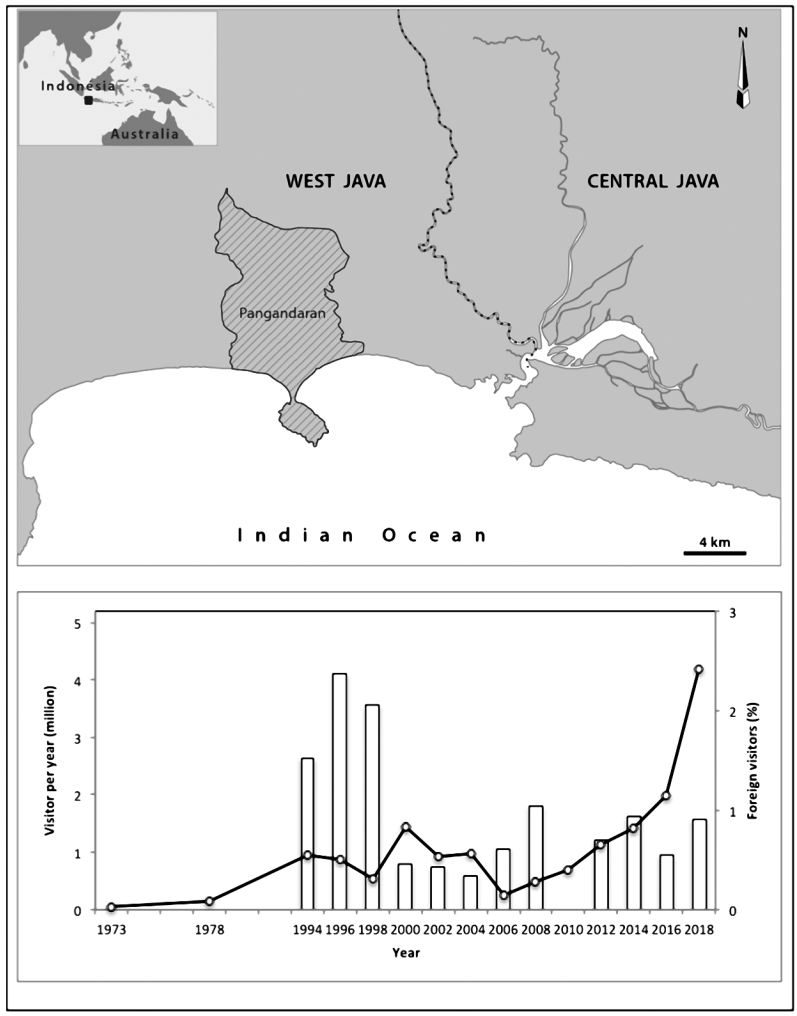

Figure 1. (A) Map of the study area. (B): Number of tourists visiting Pangandaran between 1973 and 2018 (solid line) and the proportion of them being from outside Indonesia (bars), showing a steady increase in numbers over time and a consistent majority presence of domestic tourists.

pological approach in data collection, observing the trade as it happened without intervention. Nekaris et al. (2010) and Robinson et al. (2011), amongst others, have advocated following an ethnographic approach in collecting wildlife trade (and poaching) data. As a discipline, social anthropology has long been concerned with human-environment relationships and is well positioned to make contributions to both social and ecological dimensions of biodiversity conservation; it allows various aspects of trade to be examined through an ethnographic lens, contextualizing each dataset in conjunction with research conducted in a more formal manner (Robinson et al. 2011).

During my visits to Pangandaran, each day was planned in advance, ensuring as many shops were visited as was possible and, at the same time, allowing enough time to collect quantitative data on the shell trade (species, volumes, prices) and qualitative data on the traders, customers, and

their interactions. As most of the time I was the only, or one of a few, Western tourists, traders and tourists were generally keen to talk to me or for me to observe their business. Establishing a good rapport was quick and easy. This was greatly aided by me speaking their language, as even in a tourist hotspot like Pangandaran, few Indonesian people speak English or other Western languages. During and immediately after conversations, I took detailed notes; I added personal impressions and interpretations at a later stage (often in the evening in a restaurant or hotel room). Photos were taken sparsely and as unobtrusively as possible. Over the years, traders and government officials recognized me from previous trips; this aided the data collection as rapport was quickly re-established and information was exchanged freely. My long-term connections in Pangandaran and repeat visits to the same traders allowed me to triangulate the results across multiple informants to validate and confirm findings (Bernard 2017).

Each visit lasted between two and four days, similar to that of many tourists to Pangandaran, totaling 32 days. During the visits in the 1990s and early 2000s, the mornings were spent primarily collecting data on the eagles and primates in the adjacent nature reserve and the shops and stalls were visited during the afternoon. These shops were mostly concentrated in the southernmost part of the village, close to the nature reserve, and the entire area could be surveyed in the course of an afternoon. Data collection in this period was qualitative.

In the 2000s, post-tsunami, surveys were more extensive and more systematic, and were conducted as much as possible during weekends or public holidays when more shops were open. I was mostly interested in the trade of shells of larger species of mollusk (and indeed other wildlife), many of which are protected. A study by Simard et al. (2019) in the Tigak Islands of Papua New Guinea indicated that artisan shell-based handicraft producers often see these larger species as the most important ones in sustaining their business and livelihood. For the purpose of the present study, I focus on six species, in three pairs of similar size and shape, whereby one species is formally protected under Indonesian law and the other is not (Noerjito and Maryanti 2001). These pairs are: chambered nautilus (*Nautilus pompilius* [protected]) and crusty nautilus (*Allonautilus scrobiculatus* [unprotected]); Triton's trumpet (*Charonia tritonis* [protected]) and false trumpet (*Syrinx aruanus* [unprotected]); and horned helmet (*Cassis cornuta* [protected]) and ramose murex (*Chicoreus ramosus* [unprotected]). I attempted to visit all shops that potentially could sell these large marine mollusk shells. Compared to the 1990s and early 2000s, post-tsunami, the total number of shops increased, and those selling marine products became spread out over a larger area than before. Hence, it would typically take me a full day or sometimes a day and a half to check all shops, observe the trade in the various parts of Pangandaran, and collect the necessary data. Subsequent days were spent revisiting shops, checking ones that may have been closed on the first day, and collecting additional data on the wildlife trade. At no point did I purchase marine mollusks or any other wildlife product.

Prices of unworked whole shells, collected between 2012 and 2018, are based on "first quotes" and would have decreased with bargaining or with bulk purchase of multiple shells. One vendor indicated that the first quotes as presented here could go down some 20% when negotiating the final price, and often vendors would give unsolicited second quotes some 10–15% below the first quote. Prices were quoted in Indonesian Rupiah (Rp) but are here presented in US dollar (USD); the exchange rate ranged from ~9,900 (January 2013) or ~13,300 (January 2018) Rp to

the USD and, for conversion, I used a rate of 12,000 Rp to the dollar.

Results

General Observations of the Seashell Trade

Over the weekends, between 200 and 300 stalls and shops selling marine shells and products made out of these shells were open (during the week, half the shops are typically closed). The trade was open and there was no need to resort to undercover techniques or to hide from the traders that I was interested in marine mollusks. Even during the most recent survey, my eleventh visit, I had the impression that the traders saw me as merely someone with a somewhat higher interest in marine mollusks and other wildlife than other Western tourists. Even with weekend visitor numbers in excess of 10,000 per day, for most of the time, I was the only, or one of very few, non-Asian people in Pangandaran. As indicated above, Pangandaran caters mainly for the domestic tourism trade and, indeed, all the traders were Indonesian (mostly from Pangandaran itself) and the clientele was almost exclusively Indonesian. In the tourist market on the northern end of the peninsula (*Pasar Wisata*, at the junction between Jl Bulak Laut and Jl Baru), several wholesalers were present, and they exported their wares to countries like Saudi Arabia and Malaysia.

The most popular items containing shells were mirror or picture frames with shell inlays, strip fly curtains to hang in door openings, small wall cabinets decorated with whole shells and shell pieces, and shell chandeliers. Most of the shells used for these were small and only a small proportion of these shells were from protected species, such as bear paw clam (*Hippopus hippopus*) or China clam (*H. porcellanus*). Unworked shells of bear paw clam and China clam were offered in the hundreds, whereas the equally protected commercial top shell *Trochus niloticus* were offered in the thousands. The main use of these three smaller protected shells was as collectables for tourists to take home as portable souvenirs.

Large shells were offered mostly as whole, unworked specimens; a small number may have been included in mosaics or other handicrafts but, by and large, they were traded as if the customer could have collected the shells themselves on Pangandaran's beaches. Perhaps unbeknownst to most of the customers, but not the traders, none of these large shells can be found in Pangandaran. Instead they are exported from other parts of Indonesia. According to the traders, some come from other parts of Java, most from the east or along the north coast. Some derive from Bali or Lombok, east of Java, and some were said to originate from Sulawesi. Crusty nautilus and false trumpet must have been collected in eastern Indonesia, 1000s of km from Pangandaran (current knowledge of these species suggests they are confined to these eastern regions, although increased research may reveal their presence in western Indonesia [see Santhanam 2018; Ward and Saunders 1997]). There is no evidence to suggest that shells are brought in from neighboring countries, such as the Philippines, Malaysia, Papua New Guinea, or East Timor. Species not native to Pangandaran, and perhaps including species that do occur in Pangandaran, were brought into the village by traveling salesmen. They were either bought in bulk by one or a few local traders and then redistributed to smaller traders and souvenir shop owners, or they were purchased directly from salesmen.

Manufacturing of Shell Craftworks, Selling and Buying

The marine mollusk shell trade is found in three distinct parts of Pangadaran: the tourist market on the northern end of the peninsula, along the entire West Beach Road (Jl Pantai Barat and Jl Pamugaran), and at the southern end of the East Beach Road

(Jl Pantai Timur). The tourism market has a number of shops selling relatively large numbers of shells, curios, and shell handicrafts, with some of the shops functioning as wholesalers. There are also a number of workshops that manufacture handicrafts (hangers, picture frames, curtains, etc.), either to be sold in the adjacent shops, other shops in Pangandaran, or that are intended for the international market. Along the west and east beaches, there are many small shops selling marine mollusk shells; some of them make their own handicrafts, others clearly purchased them from the workshops in the tourism market, and many sell a combination of both.

The laborers in the workshops are mainly women or family members of owners of adjacent shops, who are both men and women. In the other parts of Pangandaran, it is mainly women, many of them in their late teens or twenties, who tend shops and sell products. In these same areas, there are some shops that are owned by fishermen's families, with the men spending time at sea and women (and children) taking care of the shop.

In terms of customers, and the buyers of marine mollusks, it is difficult to make any generalizations on the basis of my observations and discussions. Men, women, single individuals, and families all seem to be equally interested in the shells or the products that contain them. The only constant is that they all, or at least the vast majority of them, are Indonesian, and often from the larger cities in Java (Bandung, Jakarta, Surabaya). Traders confirmed these observations and assertions.

Focus on Protected vs. Non-protected Species

The most numerous of the six species of large marine mollusk was the horned helmet, which was sold in 31 different shops and of which almost 400 individual shells were recorded. The second most common species was chambered nautilus with almost 200 individual shells in 23 shops. Both species are protected under Indonesian law and should not have been traded. The average price for these shells was ~US$14 and ~US$15, respectively. Ramose murex, a non-protected species priced at ~US$16, was traded in substantial numbers and was recorded in 17 shops. Shells of Triton's trumpet (a protected species) and false trumpet (an unprotected species) were traded in equal numbers and were offered for sale in an equal number of shops (Table 1). Prices were ~US$40 and ~US$45, respectively. The least commonly recorded species was the non-protected crusty nautilus, of which only four specimens were recorded in one shop in 2016; they were priced at US$20. While the various species are priced differently, prices were dependent on the size and the quality of the shell and not on whether or not the species was legally protected. There did not appear to be a change in prices over the most recent six years for the three species for which sufficient data was available (protected chambered nautilus and horned helmet, and non-protected false trumpet). Prices did differ somewhat between years but, over the six-year period and for the three species combined, no clear change (increase or decrease) was observed (Figure 2).

[Insert Figure 2 about here]

[Table 1 about here]

The number of shops offering the six large marine mollusk shells was substantial, but individual shops mostly displayed only small numbers of these large shells (often of just two or three species). The exceptions were some of the shops in the tourism market, which displayed larger quantities. The number of shops displaying shells of legally protected species was similar, or even larger, to the ones that only displayed those of unprotected species. Traders simply do not appear to differentiate between protected and unprotected species; prices and prominence of display is dependent on the size and the quality of

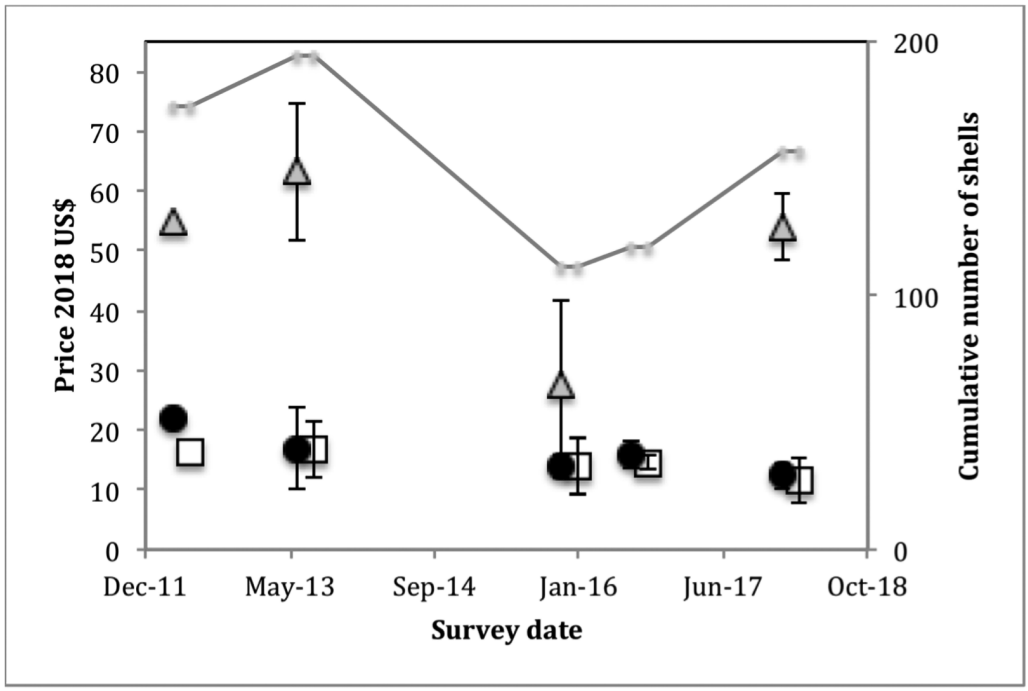

Figure 2. Prices (corrected for inflation and converted to 2018 US$ prices) of marine mollusk shells for sale at Pangandaran. Mean prices (±1 standard deviation) are given for two protected species (chambered nautilus [black circles]; horned helmet [open squares]) and one unprotected species (false trumpet [grey triangles]). The continuous line indicates the total number of these three species offered for sale.

Table 1. Trade in large marine shells at Pangandaran beach resort, Java, Indonesia, based on five visits between 2012 and 2018. Presented are the total numbers of shells for sale, number of shops where the species was offered for sale, and maximum number of shells on offer per shop. Species in bold are protected.

Species name (English)	Species name (Latin)	Total (maximum per shop)	Shops
Chambered nautilus	*Nautilus pompilius*	194 (10)	23
Crusty nautilus	*Allonautilus scrobiculatus*	4 (2)	1
Horned helmet	*Cassis cornuta*	387 (21)	31
Ramose murex	*Chicoreus ramosus*	158 (14)	17
Triton's trumpet	*Charonia tritonis*	78 (8)	9
False trumpet	*Syrinx aruanus*	89 (11)	10

the shell. Trade is open, with shops displaying protected and unprotected shells in full view (Figure 3).

Neither traders nor customers expressed the presence of a social stigma related to either buying or selling protected mollusk shells. This is different from the purchase of hard liquor (*arak*), for instance, which I have experienced in Java over the same period. Here, due to social stigma attached to trade in spirits, sellers do not display their products openly; when making a purchase, bottles are put in plastic bags, buyers do not carry the bottles out openly, and sellers are reluctant to discuss this directly. I never observed something even remotely similar to this in the protected mollusk shell trade.

With respect to the marine mollusk shells, government officials (fisheries, forestry, and police) in Pangandaran also

Figure 3. Marine mollusk shells for sale in Pangandaran, West Java, Indonesia. From top left, (1) baskets with small shells inlays, horned helmet *Cassis cornuta*, chambered nautilus (*Nautilus pompilius*; both with brown striping and without); (2) protected hawksbill turtle (*Eretmochelys imbricate*) and chambered nautilus, in the display cabinets in the background; (3) shop selling numerous shell curios and handicrafts, as well as unworked shells; (4) horned helmet and ramose murex (*Chicoreus ramosus*) in the background, seashell fly doorscreens, and handicrafts; and (5) view of Pangadaran market.

did not attach any negativity to the sale of protected wildlife. Several times it was pointed out to me that numbers were small, the animals were dead already, and it would be a waste to throw the shells away. Once, when discussing this with an officer from the fisheries department, I pointed out that chambered nautilus shells are obtained by using baited cages and that the high-quality shells we see displayed were unlikely to be picked up empty from the beach. This comment was politely dismissed. The two offices of the forestry department, the police station and the office of the department of fisheries, are situated in and amongst the traders and exporters,

allowing officials to observe the trade in legally protected marine mollusk shells and indeed other protected wildlife (such as stuffed marine turtles or dried seahorses) at close hand and on a daily basis. I did not obtain any information of officials actively participating in the illegal wildlife trade or that traders had to pay bribes to keep trading, but it is evident that the officials were tacitly complicit.

Discussion

Calls for ethnobiologists to focus their research on topics related to biocultural conservation have increased during the last two decades (Davidson-Hunt et al. 2012; Gavin et al. 2015), which has been referred to as Ethnobiology 5 (Wolverton 2013; Wyndham 2009). The result has been an increase in applied research that seeks to address environmental management, conservation biology, and applied ecology (Lepofsky 2009; Lertzman 2009; see summary in Wyndham 2009). One advantage of field research in ethnobiology is that researchers are situated deeply into local cultures but also maintain understanding of local environments (Hunn 2014). The research presented here takes advantage of the cross-cultural bridge that ethnobiology provides between local peoples and environmental conservation.

Observing traders, law enforcement agents, residents, and outside consumers over a prolonged period provided insights into the trade of marine mollusk shells in Pangandaran. Long-term connections with traders, officials, and local villagers through repeat visits offer a means to confirm the findings through triangulation of the results across multiple informants. Protected marine mollusk species were as openly displayed as non-protected species and, in fact, more shops offered the protected than the unprotected species. This trade is not local—the shells are collected mainly in eastern Indonesia and the consumers are visitors from other part of Java—showing that Pangandaran is a hub for the domestic trade in protected and unprotected marine mollusk shells. This is similar to the curio shell trade in Tamil Nadu, India, where traders sourced their shells from other parts of India (sometimes hundreds of kilometers away), and even imported them from Sri Lanka, the Maldives, China, the Philippines, Tanzania, and South Africa (John et al. 2012; Patterson and Ayyakannu 1992). While protected, in Pangandaran, there is no social stigma related to buying these shells and traders who openly display them do not run the risk of prosecution, suggesting a lack of support for these protective and regulatory measures. Pangandaran is not unique in this. As noted by Gössling et al. (2004) the increase in tourist numbers in tropical countries and the demand for souvenirs have developed simultaneously with the widespread availability of scuba, outboard motors, and cheap underwater lights to local fishermen. This has increased the harvest pressure on marine species, particularly large mollusks. Since there is no captive farming of the main species sold, the trade in marine mollusk shells is based on sustained harvest from wild populations (Dias et al. 2011). The exception in Indonesia could be the collection of commercial topshell (Arifin et al. 1998; Barhunuddin 1997; Lee and Amos 1997) but there are uncertainties about the legality and regulation of this trade (Nijman 2019).

Similar to Indonesia, shell collecting activities and the trade in ornamental shells are substantial in Zanzibar, with 13 tons of shells being exported by tourists (four tons were collected by the tourists themselves on the beaches and in the ocean and nine tons were bought in tourism shops) (Gössling et al. 2004). While the curio trade and shell collecting activities may account for less than one-third of Zanzibar's shell exports, in terms of job and income generation, it is estimated that curio trade creates 120 jobs and contributes roughly 4% of the tourism component within the Zanzibar economy (Gössling et al. 2004). In India, Shyam et al. (2017) estimated that there

were roughly 50 active shell handicraft traders selling some 11,000 tons of shells annually, generating revenue of US$13.9 million. Exports accounted for a significant proportion of this amount. Deines (2018) reports from southern India that one shell processing facility was able to process between 30 and 100 tons a month; in the region, some 30,000 to 40,000 people are directly or indirectly employed in the shell trade industry. Compared to Zanzibar and southern India, the trade in Pangandaran is less commercial and of a smaller scale.

As discussed by Gössling et al. (2004), more needs to be done to understand the ecological effects of the removal of shells from marine ecosystems. The process of collecting shells is far from benign, as it may disturb sandy areas, coral rocks may be turned over, and corals may be broken. The fact that the majority of the species commonly commercialized occur in shallow water habitats is particularly problematic, as these areas are easy to harvest, making them vulnerable to over-exploitation (Dias et al. 2011). Unfortunately, little is known about the biology of the rarer and often cryptic and nocturnal species of mollusk, but, from some of the better-studied ones, it is clear that they have important roles to play. Bivalves, such as giant clams (*Tridacna gigas*), are important filterers of seawater and gastropods, such as false trumpet, are either grazers of algae on rocks, predators of invertebrates, or scavengers. Triton's trumpet feeds extensively on the crown-of-thorns starfish (*Acanthaster planci*), which is a consumer of living scleractinian corals, and healthy trumpet populations may mean healthy corals. Horned helmet feed on sea urchins, which in turn feed on algae, soft limestone rocks, and corals, thus increasing the health of the latter. Even empty gastropod shells have an important role to play. Not only do they function as homes for hermit crabs (important algae feeders) but empty shells are also a hard substrate onto which many sessile benthic organisms, such as corals and sponges, settle. In areas where marine mollusks are harvested, the perceptions held by fishermen and artisans creating shell-based handicrafts often have a good understanding and long-term perspective on whether or not species have declined in abundance. Utilizing these views may be one avenue to direct resource management, and linking the benefits of conservation for the purpose of sustaining economically important resources such as marine mollusks may be well received (Simard et al. 2019).

With respect to the large marine mollusks offered for sale in Pangandaran, these ecological processes and the effects of the removal of large numbers of mollusks are not affecting the local ecosystems as many, and perhaps most, of the shells are not collected in this part of Indonesia (cf. Sahidin et al. 2018). Of all the species traded in Pangandaran, it is especially the larger ones that have both ecological and economic significance. It is important to note, however, that most of the economic benefits of the shell trade are concentrated in the hands of a few, perhaps first and foremost the middlemen that come into Pangandaran and the large-scale traders concentrated in the tourism market. Nijman et al. (2016) noted that the monetary earnings for individual shop owners selling protected marine mollusk shells in Pangandaran was relatively small. In 2013, the average value of marine mollusk shells on display in 33 shops was ~US$150, and this average was skewed by a few shops in the tourism market that had relatively large numbers on offer. In the absence of data on turnover and purchasing costs, it is difficult to gauge what income can be derived from the sale of shells. To put the average monetary value of shells on display in context, this is one-and-a-half times the 2013 government-recommended minimum monthly wage for the province of West Java, which stood at just below 100 USD. Better regulating the trade in marine mollusk shells, including the proper enforcement of

the non-sale of protected species, is unlikely to have a negative impact on the livelihood of the vast majority of small-scale sellers in Pangandaran. Thus far, the enforcement of protected species laws when it concerns marine mollusks is concentrated in harbors and targets exporters (Nijman 2018; Nijman and Nekaris 2017). The trade in marine mollusks in Pangandaran is part of a larger, Indonesia-wide network, with collectors, middlemen, and sellers allowing these species to crisscross the county. With several legally protected species being traded in large volumes, it is clear that this forms part of organized crime activities, as it embeds complex operations, using high-volume transportation, often over large distances, and the participation of different actors in the supply chain.

Conclusion

Research presented here revealed extensive trade networks with regards to sourcing of large marine mollusk shells, but many details are lacking. At present, it is unclear precisely where shells are from and to what extent the trade in shells impacts the different species of marine mollusks and, importantly, their surrounding environments. Research is imperative in areas distant from the places where the shells are sold to provide a more comprehensive understanding of these dynamics and for better management of marine mollusks. There are several other avenues for further research, based on this long-term research in Pangandaran, that relate to other areas where marine mollusks are traded (Nijman and Lee 2016; Nijman et al. 2015). These include: (a) quantifying the importance of shells for local livelihood; (b) investigating the sourcing of shells and the impact shell collecting has on the environment; and (c) expanding the research to include other beach resorts. Focusing on just the largest marine mollusk shells will lead to an incomplete picture with respect to the importance of the shell trade in the local economy. Consideration of smaller shells, while focusing on handicrafts and curios containing shells, is worthwhile to provide a broader assessment of the economic importance of shells within the lives of local peoples. Finally, it is worth asking to what degree the situation in Pangandaran is typical or representative for other beach resorts in Indonesia (including other parts of Java, but also Sumatra, Bali, Lombok, and eastern Indonesia), and, indeed, other parts of Southeast Asia. If it is, and following on from avenue b above, what are the source areas of the shells that are sold in these other beach resorts?

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