Philippine Journal of Science
150 (6B): 1837-1847, December 2021
ISSN 0031 - 7683
Date Received: 12 Jul 2021

Using Social Media Platforms to Study the Ecology and Exploitation of Mud Lobsters in the Philippines

Frank Paolo Jay B. Albarico[1,2,3]*, **Pinky Jee B. Albarico**[4], **Candelaria C. Peña**[4], **Peithe Ma Salva**[5], and **Cheng-Di Dong**[1,2]

[1]Institute of Aquatic Science and Technology, National Kaohsiung University of Science and Technology, Kaohsiung 81157 Taiwan
[2]Department of Marine Environmental Engineering, National Kaohsiung University of Science and Technology, Kaohsiung 81157 Taiwan
[3]College of Fisheries and Allied Sciences, Northern Negros State College of Science and Technology, Sagay City 6122 Philippines
[4]College of Education, Iloilo State College of Fisheries Barotac Nuevo, Iloilo 5007 Philippines
[5]Department of Tourism Management, National Kaohsiung University of Science and Technology 81157 Taiwan

Mud lobsters are burrowing crustaceans that are widely distributed in the Indo-Pacific region, including the Philippines. However, they are somehow neglected in scientific studies in the country. The increasing risks brought by this pandemic further impede field surveys as mobilization is highly regulated. Hence, the use of social media platforms was explored to study the ecology and exploitation of mud lobsters in the Philippines. This study used content analysis of YouTube videos. Key terms were searched to identify contents such as 'Philippines,' 'mud lobsters,' and local terms like '*bulaso*,' '*uson*,' and '*urong*.' A total of 30 videos were analyzed. Videos were posted from 2015–2021 from at least 10 provinces. Results reinforce the already known wide distribution of mud lobsters in mangrove forests, fishponds, and rice fields beside mangroves. Still, there were notable mud lobster behaviors observed such as 1) surfacing during the rainy season, 2) the timing of which disturbed burrow is repaired, and 3) conspecific repulsion – all of which were not previously documented. Empty burrows were also found inhabited by the terrestrial crab *Cardisoma carnifex*. Mud lobsters were commonly caught using bamboo traps, but some had developed unique fishing techniques such as mound disturbance and the *tali-tali* method. Alarmingly, this study also found the use of toxic chemicals for illegal fishing activity. This study provides evidence on the potential use of social media to study aquatic organisms. Additional knowledge on mud lobster ecology and baseline information on some aspects of its fishery in the Philippines was observed. Social media can be useful for surveillance and ecological studies but could not be used as an alternative method for in-depth biological and taxonomic studies, where actual specimens are necessary.

Keywords: behavior, fishing methods, illegal fishing, Thalassinidae, YouTube videos

*Corresponding Author: albaricofrankpaolojay@gmail.com

INTRODUCTION

Mangrove ecosystems benefit from mud lobsters *Thalassina* Latrielle 1806 through nutrient cycling and regulation of sediment organic geochemistry (Malley 1977; Ng and Kang 1988; Moh *et al*. 2015; Hossain *et al*. 2019a, 2020; Sarker *et al.* 2021). They build complex burrows of up to 2.5 m below ground (Kristensen *et al.* 2017), which in turn creates volcano-like mounds with heights of more than a meter (Malley 1977; Moh *et al.* 2015). Mud lobsters are widely distributed in the Indo-Pacific region (Holthius 1991; Ngoc-Ho and de Saint Laurent 2009; Sakay and Turkay 2012), and populations are concentrated mostly in the Coral Triangle. However, they are less studied in the Philippines because of their cryptic behavior (Bedi and Primavera 2018; Albarico *et al.* 2020) and low economic importance.

The fishery and ecology of mud lobsters are little known in the Philippines. Only two recent studies dealt with mud lobster taxonomy and some aspects of ecology, but both are too focused on small geographical areas of Katungan It Ibajay mangrove forest in Ibajay, Aklan (Bedi and Primavera 2018) and in Suyac Island Mangrove Forest in Sagay City, Negros Occidental (Albarico *et al.* 2020). More importantly, mud lobsters are neither marketed nor exploited in these locations. There are currently four known species of mud lobsters in the Philippines such as *Thalassina anomala* Herbst 1804, *T. squamifera* de Mann 1915, *T. spinosa* Ngoc-Ho and de Saint Laurent 2009, and *T. kelanang* Moh and Chong 2009 (Bedi and Primavera 2018; Albarico *et al.* 2020). However, their exploitation and population status are not documented. Mud lobsters are widely distributed throughout the Philippines inhabiting mangrove forests and brackish water environments. Although mud lobsters are not economically important (Holthius 1991), they are edible (Motoh 1980), hence considered as an alternative food resource for the locals.

Mud lobsters are caught manually and with the use of traps. Fishers either dug out the mounds using their bare hands and shovel or with the commonly used triggered bamboo traps (Holthius 1991; Moh and Chong 2009; Moh *et al.* 2015; Hossain *et al.* 2019b). Hossain and colleagues (2019b) first evaluated the use of different traps to improve exploitation and capture fisheries technologies for mud lobsters. However, mud lobsters outsmart the traps by creating new holes and plugging mud inside the traps (Bedi and Primavera 2018; Hossain *et al.* 2019b). This behavior places a disadvantage on the use of traps and can result in the decline of catch rates. In the Philippines, the use of bamboo traps – although not well-documented – is a common practice especially for catching land crabs *Cardisoma carnifex*. However, its use on mud lobsters yielded only 67% catch rates during the collection of the specimen by Bedi and Primavera (2018). Manual excavation can yield higher catch rates, but it is laborious and time-consuming.

In this pandemic, the use of social media has increased, and numerous posts have been observed on mud lobsters. Interestingly, mud lobsters became known on YouTube through video posts from television (TV) shows and other popular YouTube vlogs. Compared to photos, videos are a more reliable source of information and can be easily verified. With restricted mobilizations due to the COVID-19 pandemic, nationwide ecological studies are limited – especially in an archipelagic country like the Philippines. Hence, this study attempted to use social media platforms to gather information on the exploitation and some aspects of mud lobster ecology in the country. Proper management of our aquatic environment is tough nowadays, and alternative data sources such as social media are relevant. Similarly in the Mediterranean Sea, which is difficult to monitor, Giovos and colleagues (2018) also used social media to assess recreational fishing in the area. The authors noted its importance as an alternative method for field surveys. Likewise, it is cost-effective, which is ideal for large geographical areas. Social media was also found useful to study tourists' preferences for nature-based experiences (Hausmann *et al.* 2018). The use of social media in conservation science has increased (Toivonen 2019) and is commonly used in terrestrial organisms. This paper highlighted the potential use of social media platforms to study the ecology of an aquatic organism. The importance of social media in surveillance of illegal fishing activities is also emphasized with the present observation on unsustainable fishing methods publicized in social media.

MATERIALS AND METHODS

This study was done using content analysis from widely used social media platforms. To identify contents, key terms were searched (Kong *et al.* 2019) such as 'Philippines,' 'mud lobsters,' '*bulaso*' (Filipino term), '*uson*' (Visayan term, also used in Mindanao), and '*urong*' (term used in some parts of Luzon) between March–May 2021. Posts from YouTube channels were used due to their popularity in the Philippines (Shtern *et al.* 2019), and audio-visual and textual information can be easily extracted. Facebook and Twitter were also explored; however, content was mostly shared videos from YouTube, and photographs were not able to provide enough verifiable information. Hence, a total of 30 videos from YouTube (in Filipino, Hiligaynon, and Cebuano) were analyzed. Each video was viewed twice to obtain the necessary detailed environmental information.

Some videos had extensive content, while others were ordinary videos with very few notes, commentaries, and information on the species. A minimum of 13 types of information had been extracted from the videos such as the main content, location, fishing method, gear design, catch rate, price, surrounding environment, cooking method/menu, species identity, sex, size, maturity, and aspects of the behavior of mud lobsters. To avoid misrepresentation and erroneous evaluation, biological data such as species identification, sex, and maturity were not used but were briefly discussed below. The catch rate was determined by dividing the number of catches by the total number of gears deployed. Locations were either identified or taken from the comments section or through direct messages with the content creator. The dialects spoken by the authors were also used to supplement the information to identify the possible location of some videos; nevertheless, the narrowest probable locations were identified. Only observed characteristics and ecological information collected from the videos were included in the results. Some notes and explanations of the authors that were not depicted or observed in the videos and not mentioned in scientific literature were omitted. Due to the difficulty in identifying the authors of the videos, names of YouTube Channels were used except for some of the TV shows where authors/reporters (Soho 2015; Recio 2019)* were indicated. With many restrictions in the use of copyrighted materials such as videos published online as well as for downloading and storage, validity, and verifiability of data might be at stake if the video will be deleted. Hence, a long summary of data is presented to make all of the obtained information open for verification and for future use in the absence of published video references. A map (Figure 1) showing the distribution of mud lobster videos and different fishing methods was generated using MapChart (mapchart.net). Videos without identified provinces were not reflected on the map. Details on YouTube videos were presented in Table 1 to give credits to the content authors. However, those that depicted illegal activities were anonymized. Note that each source of information presented in the Results section was cited as a YouTube channel/author followed by the year of upload. Asterisks (*) were added to citations in the discussion section that referred to videos used in this study to easily distinguish them from scientific literature.

RESULTS

YouTube Videos on Mud Lobsters

The number of videos significantly increased from 2015–2021 based on Pearson's correlation coefficient of 0.86, $p < 0.05$ (Figure 2). A total of 30 videos posted on YouTube between 09 Mar 2015 and 04 May 2021 were distributed in 10 provinces within Luzon and Visayas (Figure 1). These videos were composed of 26 YouTube vlogs, three TV shows, and one very brief informative video. Videos were viewed 19 to over 4 million times. Most viewed videos were from TV shows and some from popular YouTube vloggers. Information collected from the YouTube videos were summarized in Table 1.

Ecology of Mud Lobsters

Mud lobsters were found in different environments such as mono and mixed-mangrove species forest stands, fishponds, and rice fields beside mangrove forests. Mud lobsters were found inhabiting a wide range of habitats surrounded by *Nypa fruticans*, *Avicennia marina*, *Ceriops* sp., *Excoecaria agallocha*, *Rhizophora* spp., *Acrostichum aureum*, *etc.* Substrates were mostly muddy for many zones, but a few mud lobsters were collected from sandy areas (Table 1; K9 Agoy TV 2021, TEAM WATSIK 2021). The size of mud lobsters varied in unexploited areas (*e.g.* Occidental Mindoro, Pollilio Island). In Quezon, mud lobster sizes ranged from 12–30 cm in length. During rainy seasons, mud lobsters were observed to surface from their burrows. After mud lobsters were caught using bamboo traps, fishers just left the burrows open; hence, some were occupied by land crabs *C. carnifex* (*Harabas* 2020b). Mud lobsters dumped piles of mud into bamboo traps, created a new exit hole (around the trap), or came out from other exits (some species construct more than one exit hole) to avoid being trapped (*Asyong* TV 2020; *Harabas* 2020a). In some cases, after the burrows were destroyed, mud lobsters covered the damaged holes with fresh mud after 5–10 min (*Abai* Ariel Tv 2020; Adventurer Rosel 2020a, 2020b).

Fishing Methods

Fishing methods employed to catch mud lobsters varied from one place to another. Bamboo traps were mostly used as observed in 15 videos (15/29 gear users: 52%). Mud lobsters were also caught manually. However, manual fishing was observed to have distinct ways of catching mud lobsters from different localities such as by 1) aiding with a pair of bamboo stakes for digging (1 video: 4%); 2) disturbing the mound and waiting for mud lobsters to cover the entrance – hence, by surfacing made them susceptible to entrapment (3 videos: 10%); and 3) employing territorial aggression – allowing another mud lobster with string knotted to the abdomen (termed as *tali-tali* method) to enter the mound – hence, the resident organism will drive away the trespasser onto the surface, making them susceptible to entrapment (3 videos: 10%). Alarmingly, seven videos (24%) showed the use of chemicals (Cymbush was affirmed by one Vlogger), which was observed mostly in the Bicol Region.

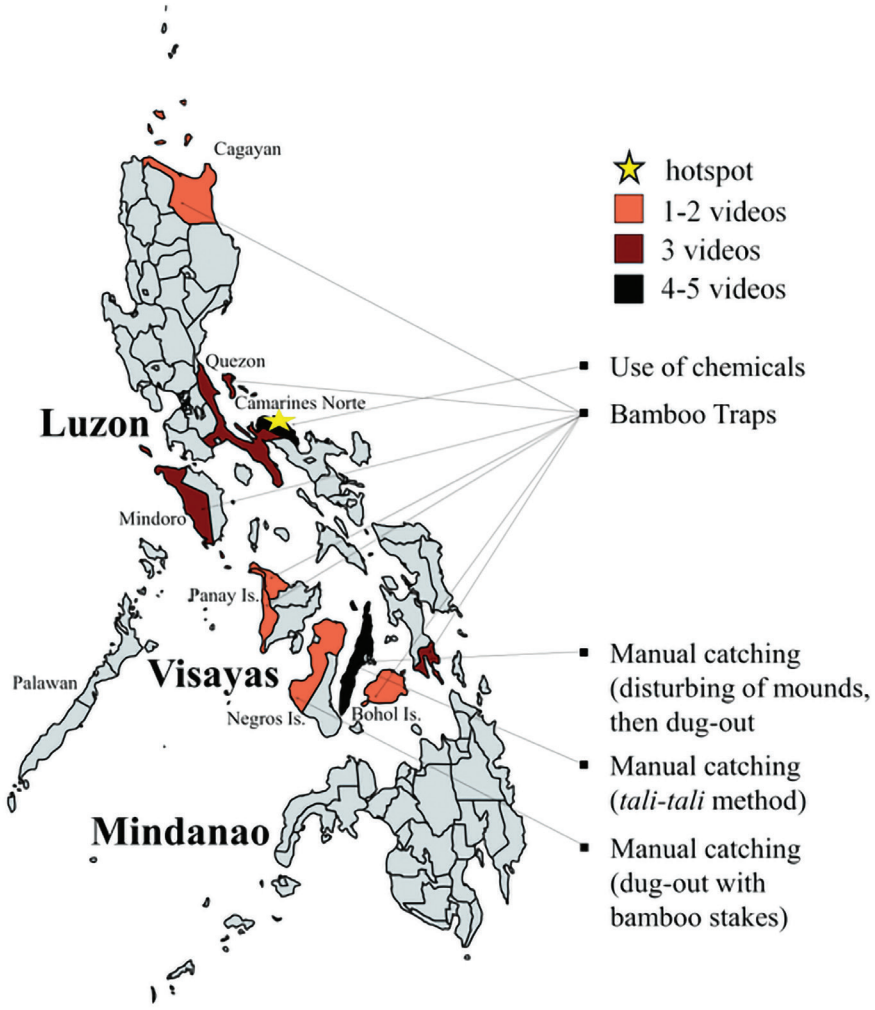

Figure 1. Distribution of YouTube videos and mud lobster fishing methods in the Philippines.

Table 1. Summary of data collected from YouTube videos on mud lobsters in the Philippines.

Date posted	YouTube channel	Video type	Number of views	Location	Environment	Method of catching	Menu	Notes
2015 Mar 09	GMA News, Jessica Soho	TV show	4,268,971	Polillo, Quezon	Mangrove area; *Nypa* assemblage	Bamboo trap (trigger)	Mud lobster curry; *estofado*	Bigger sizes found in some areas in Pollilio Island; price is PHP 25 for 2 pcs.
2017 Sep 05	Agatha Maxine Bedi	Short info-video	971	Ibajay, Aklan	Mangrove area; mixed-species	Bamboo trap (trigger) (Bedi and Primavera 2018)	–	Mentioned the new record of *Thalassina spinosa* in the Philippines
2017 Nov 16	GMA Public Affairs, Kara David	TV show	734,772	Sipalay City, Negros Occidental	Mangrove area; *Nypa* assemblage	Manual excavation aided with 2 bamboo stakes	Mud lobster curry; *uson* omelet	35 yr in mud lobster fishing; mud lobsters surface during rainy seasons
2019 Jul 30	GMA Public Affairs, Ferdinand Recio	TV show	793,121	Polillo, Quezon	Mangrove area; *Nypa* assemblage	Bamboo trap (trigger)	–	(50–67%) catch rate; size range from 12–30 cm (length from tip of the pincer to telson); sexual dimorphism discussed

Date posted	YouTube channel	Video type	Number of views	Location	Environment	Method of catching	Menu	Notes
2019 Aug 27	*Bisaya* Studio	Vlog (catching)	6,201	Cordova, Cebu	Mangrove area; *Avicennia marina* assemblage	*Tali-tali* method	–	–
2019 Oct 6	Simple Life of *Juan*	Vlog (catch and cook)	34,669	Southern Leyte	Mangrove area; *Nypa* assemblage	Bamboo trap (trigger)	Boiled mud lobster	–
2019 Nov 20	*Pulutan* Cooking Ideas	Vlog (catch and cook)	361,447	Antique	Close to *Nypa* assemblage	Bamboo trap (trigger)	–	–
2019 Dec 21	Simple Life of *Juan*	Vlog (catch and cook)	237,139	Southern Leyte	Mangrove area; *Nypa* assemblage	Bamboo trap (trigger)	Boiled mud lobster	90% (29/32) catch rate
2020 Mar 22	*Mindoreniang Lagalag*	Vlog (catch and cook)	8,501	Occidental Mindoro	Close to mangrove area	Bamboo trap (trigger)	Boiled mud lobster	Sexual dimorphism discussed; removed mound and excavate holes to install traps inside the central hole
2020 Apr 30	Simple Life of *Juan*	Vlog (catch and cook)	2,850	Southern Leyte	Mangrove area; *Nypa* assemblage	Bamboo trap (trigger)	Boiled mud lobster	Sexual dimorphism discussed; PHP 20/pc.;
2020 May 26	*Abai* Ariel TV	Vlog (catch and cook)	23,068	Cebu	fishpond area	Manual excavation, mound disturbance method	Mud lobster curry	fish during high tide where mud lobsters surface
2020 Jun 16	*Harabas*	Vlog (catch and cook)	713,346	Occidental Mindoro	Mangrove area; mixed-species assemblage of *Avicennia*, *Rhizophora*, *Ceriops*, *Excoecaria*	Bamboo trap (trigger)	Mud lobster curry	14/25 (56%) catch rate; noted high population density, no market, caught as food by a few; mound volume used as size indicator; one trap was poked by the lobster to escape (bamboo has small holes and was enlarged by the lobster); traps dumped with mud; mentioned that the species is also caught in Coron, Palawan; traps must be installed in the deeper part of the burrow after excavating multiple entrance/exit holes
2020 Jun 23	*KANUTO* TV	Vlog (catching)	2,156	Luzon	Fishpond area; *Nypa* assemblage	Bamboo trap (trigger)	–	38% (3/8) catch rate; some traps were stolen
2020 Jul 08	Adventurer Rosel	Vlog (catching)	205	Cebu	Mangrove area; *Nypa* assemblage	Manual excavation, mound disturbance method	–	Mud lobster cover the disturbed hole after 5–10 min or more; noted that mud lobsters surface during high tide
2020 Aug 13	*Harabas*	Vlog (catch and cook)	295,500	Occidental Mindoro	Mangrove area; mixed-species assemblage of *Avicennia*, *Rhizophora*, *Ceriops*, *Excoecaria*	Bamboo trap (trigger)	–	8 pcs. caught; noted that some abandoned mud lobster mounds were inhabited by land crabs *Cardisoma carnifex*; noted to install the trap at the same direction with the exit hole
*2020 Aug	YouTube User 1	Vlog (catching)	41	Camarines Norte	Mangrove area; *Nypa* assemblage	Use of Cymbush	–	–

Date posted	YouTube channel	Video type	Number of views	Location	Environment	Method of catching	Menu	Notes
*2020 Sep	YouTube User 2	Vlog (catch and cook)	306	Camarines Norte	Riverside	Use of Cymbush	Mud lobster curry	–
* 2020 Oct	YouTube User 3	Vlog (catch and cook)	248	Luzon	Mangrove area; *Nypa* assemblage	Suspected use of chemicals not evident in video, but the organism was weak and without restraint	–	Many catch observed
2020 Oct 18	*Asyong* TV	Vlog (catching)	238	Candijay, Bohol	Fishpond area	Bamboo trap (trigger)	–	Traps were covered with mud by lobster
*2021 Jan	YouTube User 4	Vlog (catch and cook)	214	Camarines Norte	Mangrove area; *Nypa* assemblage	Use of Cymbush	Mud lobster curry	–
*2021 Jan	YouTube User 5	Vlog (catching)	1037	Bicol	fishpond area	Use of Cymbush	–	2 full caps of insecticide/ pail of water were used; 1 tin can per hole; 10–15-min waiting time
2021 Jan 25	K9 *Agoy* TV	Vlog (catching)	28	Visayas-Mindanao	Sandy mangrove area; *Rhizophora* assemblage	*Tali-tali* method	–	–
2021 Jan 26	TEAM *WATSIK*	Vlog (catch and cook)	16,650	Luzon	Sandy mangrove area; mixed-species assemblage of *Ceriops, Lumnitzera*	Bamboo trap (trigger)	–	16% (8/50) catch rate; noted some differences in trap designs; observed a punctured hole at the end of the trap
*2021 Jan	YouTube User 6	Vlog (catching)	627	Camarines Norte		Use of Cymbush	Boiled	–
2021 Feb 13	Alfon Umblas	Vlog (catching)	155	Cagayan Valley	Rice fields close to *Nypa* and *Acrostichum* assemblage	Bamboo trap (trigger) and manual	–	Mound was excavated (approx. 0.5 m); trap submerged in water when installed
2021 Mar 16	Copino Hunt	Vlog (catch and cook)	172	Visayas	Fishpond area	Bamboo trap (trigger)	Boiled	Noted that very few people catch mud lobsters
2021 Mar 20	LanieVin AP	Vlog	52	Polillo, Quezon	Mangrove area	–	–	–
*2021 Apr	YouTube User 7	Vlog (catch and cook)	29	Luzon	Mangrove area; *Nypa* and *Acrostichum* assemblage	Use of Cymbush	Mud lobster curry with squash	Around 30 min waiting period before mud lobsters surface
2021 May 04	FAMARO TV	Vlog (catching)	19	Cordova, Cebu	Mangrove area; *A. marina* assemblage	*Tali-tali* method	*Adobo* with oyster sauce	Mentioned another vlogger about their method
2021 May 04	Adventurer Rosel	Vlog (catch and cook)	20	Cebu	Mangrove area; *Nypa* assemblage	Manual excavation, mound disturbance method	–	–

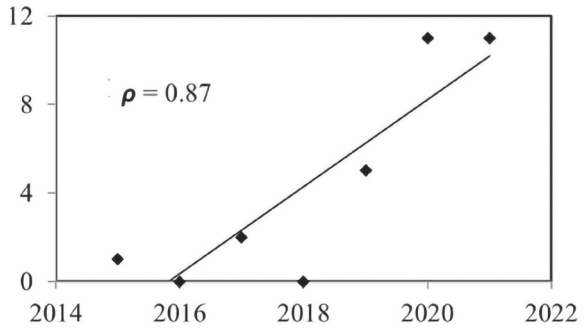

Figure 2. Annual number of mud lobster videos posted on YouTube from 2015–2021.

The operations of each gear varied from minutes to several hours. Widely used bamboo traps were usually deployed overnight or allowed to complete a tidal cycle before harvest. However, these made the traps susceptible to poaching (KANUTOTV 2020). In manual excavation, catching lobsters took time depending on the skill of the fishers. The most efficient gear observed in this study was with the use of chemicals with a waiting time of 10–15 min (YouTube User 5 2021) up to 30 min (YouTube User 7 2021). Mud lobsters then surfaced after several minutes of application with chemicals, depending on the concentrations. Although potency and concentrations were not discussed, the chemical solution used in the video of YouTube User 7 (2021) was paler compared to that of YouTube User 5 (2021). Catch rates vary among provinces ranging from 16–90% for bamboo traps. While there were no data for other fishing methods, the use of chemicals appeared to attain the highest catch rate (approx. 100%; YouTube User 3 2020) and volume. However, this estimate can be overturned due to characteristics of video editing that may employ cuts, fast-forwards, and other alterations. Videos that documented the use of chemicals were viewed 29–1,037 times as of 04 May 2021.

Use as Food

Mud lobsters served as a delicacy in some parts of the country such as Quezon province. These mud lobster delicacies in Quezon were featured in some TV shows (Soho 2015). Mud lobster curry (*ginataan*) was the common menu for the species, while some only boiled them. The economic value of mud lobster is very low, with only two documented markets. In Quezon, two pieces of mud lobsters are sold for PHP 25 (Soho 2015), while the price is a little bit higher in Southern Leyte at PHP 20 per piece (Simple Life of Juan 2020).

DISCUSSION

The use of social media platforms was explored to study the ecology and exploitation of mud lobsters in the Philippines. This method is essential, especially in this pandemic where mobilization is highly restricted. Using social media is a great idea for biodiversity studies and can even give insights into the ecology and the discovery of undocumented species. However, one must have enough knowledge of the ecology of the species to thoroughly observe the relevant information. Videos like those on YouTube are more informative than photos posted on other social media, but careful evaluation must be needed to screen out inaccurate and fraudulent posts (*e.g.* primitive catching methods in freshwater rivers or streams but with the use of marine species) that are viral in YouTube. Likewise, videos in the local dialect can be challenging. In this study, the majority of videos were in Filipino with a few in Cebuano (authors can speak Hiligaynon, Cebuano, and Filipino), making it is easier to curate observations. Some videos have poor resolutions, making it difficult to gather more information. Interestingly, videos can provide morphological details that can be helpful to taxonomists to study the species and their environment. This makes social media an important tool for biodiversity conservation (Toivonen 2019) and wildlife monitoring (Janssen and Sy 2020).

Using some of the high-resolution videos (Bedi 2017; Soho 2015; Recio 2019; TEAM WATSIK 2021)*, species were observed such as *T. anomala*, *T.* cf *kelanang*/ cf *squamifera* (could be either of the two), and *T. spinosa*. Species can actually be hypothesized for videos with high-resolution closed-up shots by observing the first abdominal somite, dorsal aspect of the thorax, rostrum, and the number of denticles found on the dorsolateral and dorsomesial carina of the propodus – following the descriptions of Ngoc-Ho and de Saint Laurent (2009) and Sakai and Türkay (2012). Sex can also be identified, but only very few of the catches were shown ventrally. Little is also known on the gonadal development of mud lobsters, making it difficult to note maturity stages of berried organisms. This information, however, shows that morphological characteristics can be used to pre-identify mud lobsters, yet insufficient where unseen parts (in the videos) like the petasma needs to be examined for proper identification. Hence, biological aspects were not included in the results. Social media can be a good source of information to understand the ecology of aquatic species, but this method could not undermine the importance of first-hand, actual field studies – especially for biological parameters.

In the Philippines, the ecology of mud lobsters is less studied with a century gap from first observations on *T. anomala* in Manila Bay by Pearse (1911), followed

by Bedi and Primavera (2018) on *T. spinosa* in Aklan, and Albarico and colleagues (2020) on *T. kelanang* in Negros Occidental. Aspects of fisheries of mud lobsters in the Philippines are also less known in scientific literature. Results presented in this paper were limited to the genus *Thalassina*, since species-level observations were impossible. Mud lobsters were found to be widely distributed throughout the Philippines. Although videos in this study were concentrated in Luzon and Visayas (Figure 1), previous collections of mud lobsters were from Mindanao: *T. anomala* in Tagum City (Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany, coll: 1988; Davao del Norte) and *T. squamifera* in Zamboanga (Muséum National d'Histoire Naturelle, Paris, France, coll: 1983) (cf Sakai and Türkay 2012). Environmental characteristics observed were consistent with previous studies on mud lobsters such as *T. anomala*, which is mostly found in muddy substrates (Pearse 1911; Moh *et al.* 2015; Bedi and Primavera 2018) similar to *T. spinosa* (Bedi and Primavera 2018), while *T. kelanang* is commonly found in sandy areas (Moh *et al.* 2015; Albarico *et al.* 2020) similar to *T. squamifera* (Moh *et al.* 2015).

Mud lobster behavior in response to environmental and human interactions was observed in this study. Some of these activities were not documented before, such as the surfacing (coming out from the burrow) behavior of mud lobsters during high tide and when there is rain, and the timing after which disturbed burrows were repaired. Dubey and colleagues (2012) noted that more mud lobster burrows were open during rainy days than cloudy days, which may be due to reduced oxygen levels inside the burrow. Although there was no empirical evidence on that conclusion, there is a possibility that mud lobsters came out from their burrows to escape from anoxic environments, which in turn made them easily caught as observed in this study. Another mud lobster behavior taken advantage of by fishers was their tendency to surface and repair their burrows after being disturbed, which also made them easily trapped. Based on the studies of Bedi and Primavera (2018) and Hossain *et al.* (2019), mud lobsters repair their burrows after being disturbed by bamboo traps by plugging in piles of mud into the gear, although Hossain *et al.* (2019) noted that this behavior had no specific period – the exact time when the repair was initiated remained unknown. In this study, the mud lobsters were observed to start the repair 5 min or more after disturbance of the burrow (Adventurer Rosel 2020)*. To escape from being caught, piling of mud into the traps and constructing a new exit hole were also observed (Asyong TV 2020; Harabas 2020a)*, hence outsmarting traps (Bedi and Primavera 2018; Hossain *et al.* 2019b). Mud lobster mounds are ecologically important due to their use as a habitat for other species (Ng and Sivasothi 2001). Harabas (2020a)* noted that after mud lobsters were caught using bamboo traps, fishers just leave the burrow open and some of these were occupied by land crabs *C. carnifex*. Mud lobsters had been known to be nocturnal (Pearse 1911; Dubey *et al.* 2012); however, Albarico and colleagues (2020) observed that *T. kelanang* actively burrow during the day at around 02:00 PM, which suggests interspecific differences. Thus, Ngoc-Ho and de Saint Laurent (2009) suggested for further analysis to understand interspecific behavior, since some of the previous studies reported as *T. anomala* or *T. squamifera* may refer to other species.

Mud lobsters are challenging to catch due to their deep burrows. The most common gear used to catch these species in the Philippines was bamboo traps, as observed in half of the videos. This method is practiced throughout the country, while others are likely to be concentrated in certain areas. Catch rates varied among locations from 16–90%. It was assumed that variability in catch rates was due to the skill in the installment of traps. As Harabas (2020a)* described, traps must be installed in the deeper part of the burrow after excavating multiple entrance/exit holes. These observations were consistent with the mound characteristics of some *T. anomala* – with multiple entrances and one central hole that later bifurcates into several branches (Figure 4g, Hossain *et al.* 2019b). Manual catching of mud lobsters was mostly observed in Cebu and Negros Occidental, while the use of chemicals was seen in Camarines Norte. While manual fishing of mud lobsters varied, the different techniques attempt to exploit a certain mud lobster behavior to reduce fishing effort. Nevertheless, the majority of the gears used were sustainable except with the use of chemical substances (*e.g.* Cymbush, an insecticide used in agriculture), which can cause negative ecological effects. It could kill other biotas, such as those mud lobster mound inhabitants [see Ng and Sivasothi (2001)], and contaminate the area. More importantly, the use of noxious or poisonous substances in fishing is prohibited in the country under Section 94 of Republic Act No. 10654 (2015). This fishing method employed in 24% of the videos is illegal and does not fall to the exemptions specified in Section 94, such as for scientific purposes and for eradication of pests in fish ponds (*e.g.* use of tea seed). Alarmingly, irresponsible posts such as of this type can encourage the use of chemicals in catching mud lobsters in other areas. FAMARO Tv (2021)* even mentioned another popular vlogger, Harabas, and proudly showcased the *tali-tali* method to that vlogger. This is an example of how one YouTube user can influence another and could become a network, although the method of Harabas was not adopted by FAMARO Tv. YouTube videos tend to influence the youth, especially today when social media became the norm as online classes commence. The use of YouTube influencers (also known as vloggers) had even

become a novel marketing strategy to promote a product (Kong *et al.* 2019). The latter authors noted that in the case of vaping, the different methods used in vape can influence the behavior and perception of the youth. This could have a similar effect on the perceptions of viewers and followers, where one could be encouraged to follow a showcased fishing method. Nonetheless, a perception study is necessary to assess the potential impacts of social media posts (*e.g.* videos on illegal fishing activities) in the spread of destructive fishing methods in the country. On average, videos with the use of chemicals in mud lobster fishing had a lower number of views. Still, the number of videos on the latter increased from three in 2020 to seven videos as of May 2021. This finding on the illegal use of chemicals in fishing mud lobsters is vital, highlighting the importance of social media as a tool for surveillance of illegal fishing activities. Social media have been proven to be effective in monitoring the trafficking of terrestrial wildlife species (Sy 2018; Janssen and Sy 2020) in the country. Social media platforms such as, but not limited to, YouTube can be used to effectively monitor hotspots of illegal fishing activities, *e.g.* Camarines Norte, as observed in this study.

The use of one mud lobster tied and released inside the mound to lure and catch another – herein termed as the *tali-tali* method – was never documented. This practice of using conspecifics to aggravate and catch the same species is a unique fishing method that may have not been reported before in aquatic organisms. On the contrary, the use of other animals to fish has long been described with the use of remora (Sclater 1889) and cormorants (Beike 2012). In birds, similar practice in using the same species was done to lure a conspecific (and/or other species) – known as a conspecific attraction (Stamps 1988). However, this behavior observed in mud lobsters where one organism inhabiting the burrow drives away the trespasser is the opposite of conspecific attraction, which is a form of territoriality – henceforth exhibiting conspecific repulsion. Mud lobsters have not been documented inhabiting the same burrow – even with the opposite sex – suggesting a repulsive behavior. Although mud lobsters were thought to use burrows to connect with mates (Dubey *et al.* 2012), neither this concept had been observed in reality due to their deep burrows and cryptic behavior. Mud lobsters are known to be territorial and prefer to live alone in their burrow. The conspecific relationships of these species are rarely explored by researchers. Even their mating behavior, where they probably would interact with conspecifics, is less understood; thus, close observations and mesocosm experiments may be beneficial to understand more of their behavior and interaction.

Since mud lobster burrows reached over a meter (Moh *et al.* 2015), they were less studied and exploited in the Philippines. In this study, mound excavation (a laborious method), trapping (a time-consuming method), and the use of a noxious and poisonous substance (an illegal, environmentally harmful, and convenient method) were documented. This new method of utilizing conspecific repulsion (the *tali-tali* method) and taking advantage of their territorial behavior could be an alternative method for mud lobster fishing while leaving the mound undisturbed (in contrast to digging).

Mud lobsters are gaining popularity with the help of TV shows that provided a platform to showcase the Philippine biodiversity and cuisine. Soho (2015)* was the first to popularize the species in the country by featuring delicacies in Quezon. The video had the highest views with over 4 million. Presently, mud lobster cuisine was dominated by a curry dish (*ginataan*), as seen in the videos. Even though the economic value of mud lobsters was still low, the consumption rate apparently increased with remarks from videos that it was their first time to taste mud lobster. Increasing the demand for alternative food sources can drive economic benefits from mud lobsters. Therefore, there is a need to understand its biology, ecology, and exploitation for sustainable resource utilization. Moreover, this study demonstrated the use of social media as a potential source of information to study the ecology of aquatic species, particularly mud lobsters. It is cost-effective and can be used as an alternative to field surveys (Giovos *et al.* 2018), which is risky in this pandemic.

CONCLUSION

Mud lobsters are very common but somehow neglected in terms of scientific explorations in the Philippines, as shown by the number of published literature. Even in the global setting, studies on mud lobsters are inadequate with many aspects of their biology and fisheries undocumented despite its widespread distribution in the Indo-Pacific region. These findings present additional knowledge on mud lobster ecology and provide baseline information on its fishery in the Philippines. Furthermore, this study proved that aside from field studies, social media can be an additional source of information to study aspects of ecology and the exploitation of aquatic organisms. It can be useful for nationwide ecological surveys and for monitoring, control, and surveillance by local and national agencies. The significance of social media is highlighted with the discovery of undocumented behaviors, unique fishing methods, and detection of illegal fishing activity hotspots. However, social media could not be used as an alternative method for biological and taxonomic studies where actual specimens are necessary. Enough

species background is also necessary to effectively assess video contents, which are different from structured field surveys. Although high-resolution videos provide a clear morphological reference, species identification requires actual specimens especially for mud lobsters, where potential new species are yet to be discovered.

ACKNOWLEDGMENTS

The authors would like to acknowledge the YouTube users that provided information on the locations of mangrove forests depicted in the videos. One anonymous YouTube user that confirmed the identity of the chemical used is highly appreciated.

REFERENCES

ALBARICO FPJB, GACUTAN RQ, BEDI AM. 2020. First record of *Thalassina kelanang* (Crustacea: Decapoda: Thalassinidae) from the Philippines. The Palawan Scientist Journal 12: 61–67.

BEDI AM, PRIMAVERA JH. 2018. New record of *Thalassina spinosa* (Crustacea: Decapoda: Gebiidea: Thalassinidae) from the Philippines. Philipp J Sci 147(3): 357–361.

BEIKE M. 2012. The history of Cormorant fishing in Europe. Vogelwelt 133: 1–21.

DUBEY SK, CHOUDHURY A, CHAND BK, TRIVEDI RK. 2012. Ecobiological study on burrowing mud lobster *Thalassina anomala* (Herbst, 1804) (Decapoda: Thalassinidae) in the intertidal mangrove mudflat of deltaic Sundarbans. Explor Anim Medical Res 2: 70–75.

GIOVOS I, KERAMIDAS I, ANTONIOU C, DEIDUN A, FONT T, KLEITOU P, ... MOUTOPOULOS DK. 2018. Identifying recreational fisheries in the Mediterranean Sea through social media. Fish Manag Ecol 25(4): 287–295.

HAUSMANN A, TOIVONEN T, SLOTOW R, TENKANEN H, MOILANEN A, HEIKINHEIMO V, DI MININ E. 2018. Social media data can be used to understand tourists' preferences for nature-based experiences in protected areas. Conserv Lett 11(1): 1–10.

HOLTHIUS LB. 1991. FAO species catalogue. Vol. 13. Marine lobsters of the world. an annotated and illustrated catalogue of species of interest to fisheries known to date. FAO Fish. Synop 125(13): 1–292.

HOSSAIN MS, BUJANG JS, KAMAL AHM, ZAKARIA MH, MUSLIM AM, NADZRI MI 2019a. Effects of burrowing mud lobsters (*Thalassina anomala* Herbst 1804) on soil macro-and micronutrients in a Malaysian mangrove. Estuar Coast Shelf Sci 228: 106358.

HOSSAIN MS, BUJANG JS, KAMAL AHM, ZAKARIA MH, MUSLIM AM. 2019b. Behavioral response of the mud lobster, *Thalassina anomala* Herbst, 1804 (Decapoda, Gebiidae), to different trapping devices. Crustaceana 92(3): 353–371.

HOSSAIN MS, BUJANG JS, ALAM SMR. 2020. Microclimate and distribution of mangrove soil carbon in mud lobster (*Thalassina anomala* Herbst 1804) mounds. Reg Stud Mar Sci 40: 101540.

JANSSEN J, SY E. 2020. Note on the availability of Philippine Forest Turtle *Siebenrockiella leytensis* in online reptile markets. The Palawan Scientist Journal 12: 68–73.

KRISTENSEN E, CONNOLLY RM, OTERO XL, MARCHAND C, FERREIRA TO, RIVERA-MONROY VH. 2017. Biogeochemical cycles: global approaches and perspectives. In: Mangrove ecosystems: a global biogeographic perspective. Rivera-Monroy VH *et al.* eds. Springer International Publishing AG. p. 163–209.

KONG G, LAVALLEE H, RAMS A, RAMAMURTHI D, KRISHNAN-SARIN S. 2019. Promotion of vape tricks on YouTube: content analysis. J Med Internet Res 21(6): e12709.

MALLEY DF. 1977. Adaptations of decapod crustaceans to life in mangrove swamps. Marine Research in Indonesia 18: 63–72.

MOH HH, CHONG VC. 2009. A new species of *Thalassina* (Crustacea: Decapoda: Thalassinidae) from Malaysia. Raffles Bull Zool 57(2): 465–473.

MOH HH, CHONG VC, SASEKUMAR A. 2015. Distribution and burrow morphology of three sympatric species of *Thalassina* mud lobsters in relation to environmental parameters on a Malayan mangrove shore. J Sea Res 95: 75–83.

MOTOH H. 1980. Field guide for the edible crustacea of the Philippines. Aquaculture Department, Southeast Asian Fisheries Development Center. 96p.

NG PKL, KANG N. 1988. *Thalassina*: the mud lobster. Nature Malaysiana 13(4): 28–31.

NG PKL, SIVASOTHI N eds. 2021. Mud Lobster (*Thalassina anomala*) in A Guide to Mangroves of Singapore. In: Volume 1: The Ecosystem and Plant Diversity and Volume 2: Animal. Diversity Authors:

Lim KKP, Murphy DH, Morgany T, Sivasothi N, Ng PKL, Soong BC, Tan HTW, Tan KS, Tan TK eds. BP Guide to Nature Series published by the Singapore Science Centre, sponsored by British Petroleum. Raffles Museum of Biodiversity Research, The National University of Singapore & The Singapore Science Centre. Retrieved on 30 May 2021 from http://mangrove.nus.edu.sg/guidebooks/text/2064.htm

NGOC-HO N, DE SAINT LAURENT M. 2009. The genus *Thalassina* Latreille, 1806 (Crustacea: Thalassinidea: Thalassinidae). Raffles Bull Zool (Supplement) 20: 121–158.

PEARSE AS. 1911. On the habits of *Thalassina anomala* (Herbst). Philipp J Sci 6(4): 213–217.

SAKAI K, TÜRKAY M. 2012. A review of the species of the genus *Thalassina* (Thalassinidea, Thalassinidae). Crustaceana, 85(11): 1339–1376.

SARKER S, MASUD-UL-ALAM M, HOSSAIN MS, RAHMAN CHOWDHURY S, SHARIFUZZAMAN SM. 2021. A review of bioturbation and sediment organic geochemistry in mangroves. Geol J 56(5): 2439–2450.

SCLATER PL. 1889. Use of the remora in fishing. Nature 39(1004): 295–295.

SHTERN J, HILL S, CHAN D. 2019. Social media influence: performative authenticity and the relational work of audience commodification in the Philippines. Int J Commun 13: 1939–1958.

STAMPS JA. 1988. Conspecific attraction and aggregation in territorial species. Am Nat 131(3): 329–347.

SY EY. 2018. Trading faces: utilisation of Facebook to trade live reptiles in the Philippines. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia. 33p.

TOIVONEN T, HEIKINHEIMO V, FINK C, HAUSMANN A, HIIPPALA T, JÄRV O, TENKANEN H, DI MININ E. 2019. Social media data for conservation science: a methodological overview. Biol Conserv 233: 298–315.