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Artisanal compressor dive fishing

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Artisanal dive fishing, or the practice by an individual fisher or a small group of fishers to catch aquatic animals through moving underwater, is common in fishing communities all throughout the world.[1] There are numerous artisanal dive fishing practices in the Philippines, with the two most common being traditional breath-hold diving (also called *mano-mano* in Bisaya, apnea diving, free diving, or skin diving) and compressor diving. In breath-hold diving, dive fishers hold their breath while keeping their face beneath the water surface. To see underwater, they usually wear simple wooden goggles (Bisaya: antipara) that are small enough to barely cover and keep seawater from touching the eyes. Breath-hold divers typically explore shallow areas at depths of around 3-4 fathoms, equivalent to approximately 5-7 meters.

Surface-supplied diving involves breathing gas underwater, usually compressed air, through a diver's umbilical from the surface.[2 3] A diver's umbilical is a composite hose bundle between the diver and the surface, supplying the diver with breathing gas, communications, and/or other services.[4] Hookah diving and compressor diving, which are basic forms of surface-supplied diving, use an air-line hose attached to a compressor on the surface. Hookah is a diving equipment frequently used in Australasia.[2] The ideal hookah set-up consists of an air compressor, air reserve tank, air hose, air regulator, and a hookah harness or buoyancy control device.[5 6] Compressor diving, on the other hand, is an even more basic form of surface-supplied diving. It is usually practiced in the Philippines, Indonesia, and the Caribbean, for artisanal fishing.[7-10] In the Philippines, the diver wears a diving mask (tempered or half mask) that covers the eyes and nose, along with fins or panyapak (typically homemade). Air is supplied to the diver through plastic hoses connected to an improvised air compressor. Because there is no demand valve or mouthpiece, the diver bites the hose end in his mouth.[7] The compressor pumps air into the hose, allowing the diver to breathe while underwater. To equalize the pressure inside the mask, the diver exhales through their nose, which releases air and balances the pressure inside the mask. This diving method enables divers to explore depths of 7-8 fathoms, equivalent to approximately 13-15 meters, underwater.[7]

Lampirong artisanal dive fishers in Oton, Iloilo utilize an improvised compressor diving technology. Air compressors function by drawing in air and pressurizing it within a container. The pressurized air is then released through an opening in the tank, generating pressure. In the context of compressor diving technology, the equipment is often improvised and utilizes repurposed compressors obtained from outdated machines. In some cases, divers may acquire compressors from local hardware stores (Figure 1). A 45-kg liquified petroleum gas tank is recycled to hold compressed air, allowing a *lampirong* artisanal dive fisher to breathe underwater for up to 45 minutes using this breathing apparatus. Some dive fishers reported staying submerged underwater for up to four hours.[7] This kind of compressor usually draws a mixture of gases from the surrounding environment, consisting of 78% nitrogen, 21% oxygen, and 1% argon, along with carbon dioxide, water vapor, oil, and other gases.[11] Dive fishers also use improvised compressor technology when doing pa'aling, a mass fishing technique practiced in Palawan and performed by up to 25 divers at a time.[12] The origin of the modern-day compressor diving equipment dates back to the 17th century with Edmund Halley's invention of the diving bell used for underwater exploration.[13] By the 1820's, brothers Charles and John Deane invented the standard diving helmet with an attached flexible collar and garment, and successfully performed the first dive using surface-supplied air pumped continuously from the surface.[14 15] The practice of compressor diving, as observed among artisanal dive fishers in Oton, Iloilo, can be traced back to the 1970s. During this period, a group of pangayaw (migrant) seasonal dive fishers from Negros Occidental introduced this diving technique to the area.[7]

Active fishing gears, such as *pa'aling*, purse seines, or trawl nets, are fishing devices that aim to pursue target species.[16 17] *Muro-ami*, another method that uses active fishing

Figure 1 Equipment used in compressor fishing in Oton, Iloilo. A petrol-powered machine (red ring) drives the rotation of the belt (pink arrow), which in turn powers the reciprocating piston (yellow ring). Connected to the piston is an air compressor (green ring) that features a gas line (red arrow). This gas line connects to an air tank (blue ring) consisting of a 45-kg-capacity repurposed liquefied petroleum gas tank. An improvised cylinder (orange arrow) traps and filters the compressed air before releasing it to the hose (white arrow). This hose is utilized by artisanal compressor dive fishers as their breathing apparatus while underwater. (Image source: Ma. Arve B. Bañez, 3 April 2019)

gears, employs a pounding device, such as a rock or bamboo, to drive away the fishes from the corals and into the net.[18] Muro-ami fishing causes a decline in coral reef cover, resulting in the depletion of fish stocks. This depletion, in turn, leads to the unintended catch of unwanted species and reduces the overall production capacity.[19] The utilization of active fishing gear not only contributes to overfishing but also leads to the destruction of marine habitats. In response, the country implemented The Philippine Fisheries Code of 1998 (RA No. 8550), and later, amended by RA No. 10654, which includes a ban on the use of active gears for fishing practices. However, it also allows LGUs to come up with their own implementing rules and regulations, in consultation with the Fisheries and Aquatic Resources Management Council (FARMC).[16 20] In Oton, Iloilo, where several dive fishers harvest *lampirong*, the local government unit has implemented legislation to regulate compressor diving. The ordinances aim to legitimize the use of compressors for *lampirong* harvesting by requiring divers to obtain barangay clearance and permits—such as diving permits, motorized boat owner/operator permits, buyer's permits, and others—and pay their corresponding fees.[21]

Compressor dive fishers harvest commercially viable marine resources, such as Capiz shells (*Placuna placenta*, also called *lampirong* shells, *pios* shells),[22-29] and other tropical marine export commodities, such as pearls, sea cucumbers,[30 31] seahorses,[32] and ornamental fishes,[30 34-36] among others. The Philippine capiz shells and shellcraft manufacturing and export industry have consistently contributed to the local economy of fishing communities and to the country's foreign exchange earnings since the 1920s up to the present day.[7 22 27 28 37 38] Compressor dive fishers now catch an average of 5 kilograms of fish per day, a huge decline from the average quantity 50 kilograms per day in the 1970s and 1980s. The poor catch stems from decades of neglect brought about by overfishing and destruction of marine habitats.[39]

Compressor diving is a type of compressed gas diving, similar to recreational SCUBA (self-contained underwater breathing apparatus), commercial, military, and research diving. The physics of gases under hyperbaric conditions apply to all forms of compressed gas diving, and the physical and physiological responses of humans to high-pressure environments are similar. These well-structured diving activities follow comprehensive guidelines based on scientific studies and experience, and modern equipment is used to ensure safety before exposure to high-pressure environments. However, despite the structured training programs and safety measures related to these activities, the risk of diving diseases, particularly decompression illness (DCI) or "the bends," remains inherent. This condition occurs when nitrogen in the blood forms gas bubbles

during rapid ascent.

Recent studies have shown that a subset of the population with patent foramen ovale (PFO), a hole between the left and right atria of the heart, may have a higher risk of DCI. PFO is present in approximately 25%-30% of the human population. This means that individuals with PFO should take extra precautions when engaging in compressed gas diving activities to minimize their risk of developing DCI.[40]

DCI can manifest in a range of signs and symptoms, from subtle ones such as skin rash and fatigue to severe and debilitating ones like paralysis, or even fatal conditions such as cardiovascular, cerebral, and pulmonary DCI. These signs and symptoms can appear immediately upon surfacing or up to 24 hours after a dive. Joint pains are the most common manifestation of DCI.[41] It is important to note that DCI can occur even when all manageable risk factors and safety measures in diving have been observed.

Divers are also at risk of experiencing barotrauma, which can affect their body air spaces. Although these are mostly mild and non-life threatening, they can still be debilitating, causing symptoms such as hearing loss, sinus pain, bleeding, dental cavity pain, and gassy abdomen. Equipment barotrauma, such as mask barotrauma, is also possible. However, the most fatal form of barotrauma is pulmonary barotrauma, which can result in cerebral arterial gas embolism and tension pneumothorax. This is more likely to occur in divers with underlying medical conditions, such as asthma attacks that restrict the airways at depth and cause overinflation of the lungs, leading to pulmonary injury (although rare). Some rare bubble diseases can cause swelling of certain body parts, usually the extremities, resulting in a condition called lymphedema, where bubbles lodge in the affected lymphatic vessels. While non-life threatening, this can be deforming. Middle ear barotrauma is the most common type of barotrauma, occurring in 30% of novice divers and 10% of experienced divers.

There is also a risk of marine animal injury. This risk can be fatal in cases where the diver is envenomated by certain poisonous jellyfish, such as the Portuguese man-o-war and blue ring octopus. Nitrogen narcosis is another underwater phenomenon that can impair a diver's decision-making abilities, leading to misjudgment, disorientation, and overconfidence, similar to being under the influence of alcohol (known as the "martini effect").[42] Nitrogen narcosis can be relieved by ascending to a shallower depth, but the risk can be fatal if the diver is accidentally entangled underwater. Other risks include loss of gas supply and oxygen toxicity due to unmonitored depth, which can manifest as a seizure. Prolonged exposure to cold water can lead to the development of hypothermia, a potentially life-threatening condition characterized by a drop in body temperature. In severe cases, hypothermia can result in death.

When it comes to the diving equipment, it is important to consider the risks associated with modified compressors. One of these risks is toxic gas inhalation from the exhaust, which can be especially dangerous when gas filtration is not properly applied or not used at all. Even at safe levels at the surface, toxic gas can be fatal if it doubles, triples, or even quadruples in concentration as the pressure increases at greater depths. Therefore, it is crucial to ensure proper filtration when using compressors to minimize the risk of toxic gas exposure during diving activities.

The compressor breathing apparatus is a critical piece of equipment during diving activities, but it can also contribute to the risk of diving accidents. Malfunctions such as a kinked gas supply hose or a sudden loss of air supply can be debilitating or even fatal if the diver does not respond properly. Compressed gas diving uses air, not oxygen, because oxygen under pressure can be toxic as well. It is important to remember that safe diving practices involve not only proper training but also careful equipment maintenance and inspection to minimize these risks.

The use of modified compressors, lack of proper equipment, and inadequate training increase the likelihood of diving-related injuries compared to modern, well-researched, and properly equipped compressed gas diving techniques. The physiological and physical effects of high-pressure environments, including toxic gas inhalation and marine animal injuries, can be debilitating and even fatal. Yet, discouraging compressor dive fishers from choosing safer fishing practices is a difficult task, despite the well-known risks involved.

There is an increased risk of barotrauma and DCI in divers with hypertension, asthma, pulmonary and cardiovascular diseases, and ear infection.[43] [44] Traditional dive fishers, especially those that utilize compressors for fishing, are 16 times more at risk of barotrauma than those who do not use compressors. These fishers make use of substandard compressors that are not specifically designed for diving, e.g., air filters that regulate the amount and quality of air that enters the body are absent.[43] These divers may also lack protective equipment and adequate knowledge and training on diving safety standards in order to safely dive underwater.

Among artisanal dive fishers, the prevalence of DCI is 20 to 94%.[45] In a certain part of Mexico, where sea cucumbers are highly prized, the incidence of at least one DCI event is 84.3% among dive fishers, with a higher occurrence observed among the older population.[46] In Indonesia, the prevalence of DCI among dive fishers is lower at 38.1%.[47] Locally, as in our experience in the Southern Philippines Medical Center (SPMC) Center for Diving, Hyperbaric Medicine, and Difficult Wounds, we have treated 17 patients who incurred dive-related injuries ranging from mild to severe DCI since 2018. Five out of the 17 patients were compressor divers who suffered severe DCI. From these, three patients had a spinal cord injury which resulted in paralysis, while the two others died from complications of DCI. In Oton, Iloilo, there were two reported cases in 2019, as informed by the community, of dive fishers experiencing generalized numbness (Hiligaynon: *balda*)—one with and the other without disorientation (Hiligaynon: *balong*)—after diving. These cases are potentially related to DCI but have not been formally diagnosed.[48] To the best of our knowledge, however, there is no consolidated data on the incidence of DCI and other dive-related injuries among fisherfolk in the Philippines.

In the Philippines, there are 20 hyperbaric facilities dedicated to providing immediate treatment for patients with DCI. Most government hospitals in various provinces are capable of delivering first aid services for diving injuries and accidents. However, there are currently no specialized facilities in the country that focus on its treatment. These injuries are typically managed at the nearest health facility, with only standard first aid treatment available. The Bantay Dagat Task Force is a community-based patrol force composed of fisherfolk volunteers. Its primary responsibility is to prevent illegal fishing activities in coastal waters. The task force was established in accordance with RA 8550, as directed by the FARMC, which extends its influence from the national level down to the barangay level of each city/municipality. The members of the task force are locally selected by the Municipal Agricultural Office, while at the national level, the selection is done by the Department of Agriculture's Bureau of Fisheries and Aquatic Resources.[49] In recent years, the capabilities of the task force have been enhanced to include disaster response and marine resources management.[50] [51] However, they have not been trained to assess and provide preliminary intervention on diving accidents or injuries.

Compressor fishing is dangerous to marine life and the divers. It also contributes to overfishing. Despite the presence of laws and regulations at the local and national levels, compressor fishing remains prevalent, particularly in areas where these laws are not effectively implemented or enforcement is weak.[18] In spite of the health and legal risks involved, compressor dive fishers persist in engaging in this practice due to practical reasons. Compressor fishing not only provides them with food for daily sustenance but also serves as a primary or supplementary source of livelihood. Therefore, in municipalities where compressor fishing is regulated and the local government also benefits from the trade of high commercial value marine organisms, it is crucial to provide fisherfolk with training on basic diving safety knowledge. They should be equipped with the ability to recognize signs and symptoms associated with dive-related accidents and injuries. Additionally, it is essential to ensure the availability of adequate and accessible healthcare services that address the well-being of coastal communities, particularly the dive fishers who are exposed to various risks. By adhering to an ecological public health principle, we can prioritize the well-being of Filipino fishers and the conservation of coastal and marine ecosystems in our pursuit of sustainable development. This approach ensures a harmonious balance between the health and welfare of the fishing communities and the preservation of our valuable natural resources.

Contributors
MABB and JMR conceptualized the article. MABB and JMR wrote the original draft, and performed the subsequent revisions. Both authors have agreed to be accountable for all aspects of this report.

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REFERENCES

1. Food and Agriculture Organization of the United Nations [Internet]. Artisanal Fisheries. Rome: Food and Agriculture Organization; 2015 [cited 2023 Jun 21]. Available from: https://www.fao.org/family-farming/detail/en/c/335263/.

2. Lippmann J. Fatalities involving divers using surface-supplied breathing apparatus in Australia, 1965 to 2019. Diving Hyperb Med. 2021 Mar 31;51(1):53-62.

3. Hackney G. What is Surface Supplied Diving?, and how can CRC help? 2020 Aug 19 [cited 2023 Jun 21]. In: Commercial Rib Charter [Internet]. Hampshire: Commercial Rib Charter Ltd; c2023. Available from: https://bit.ly/44cXqeG.

4. United States Department of Labor [Internet]. Occupational Safety and Health Standards – Commercial Diving Operations. Washington: United States Department of Labor; 2004. Available from: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.402.

5. Thompson J. What Is Hookah Diving? A Complete Overview. [cited 2023 Jun 21]. In: Diving Info [Internet]. La Jolla: Diving Info; c2023. Available from: https://diving-info.com/hookah-diving/#The_Air_Compressor.

6. Keene Engineering [Internet]. Introduction to Hooka Diving. Chatsworth: Keene Engineering; c2019. Available from: https://www.keeneeng.com/pamphlets/introHooka.html.

7. Bañez MAB. Compressor fishing practices among lampirong (Placuna placenta) fishers of a municipality of Panay, Philippines. Phil J Health Res Dev. 2019 Oct; 2(3): 31-38.

8. Duffy H, Dirgantra I, Dirgantra R, Williams N, Benbow S, Fauna & Flaura International. The Compressor Diving Challenge. Environment coastal & offshore. 2020. Available from: https://bit.ly/3Xj7NLH.

9. Steadman D, Tania C, Duffy H, Indra FFI, Dirgantra R, Youvan T. Time to Catch Your Breath: Survey on compressor fishing in Aceh province, Indonesia to inform conservation action. Fauna & Flora International; 2019. Available from: https://bit.ly/3qPFN64.

10. Marschke M, Campbell D, Armitage D. Precarious livelihoods: Examining the intersection of fish work and ecological change in coastal Jamaica. People and Nature. 2019 Nov 28; 2(1): 152-162.

11. Lee YI, Ye BJ. Underwater and hyperbaric medicine as a branch of occupational and environmental medicine. Ann Occup Environ Med. 2013 Dec 19;25(1):39.

12. Republic of the Philippines Department of Agriculture. Regulations govering "Pa-aling" fishing operation in Philippine waters, Fisheries Administrative Order No. 190 Series 1994 (1994 Feb 24).

13. Exploring Our Fluid Earth [Internet]. Diving Technology. Honolulu: Exploring Our Fluid Earth; c2023 [cited 2023 Jun 21]. Available from: https://bit.ly/3NJbNlp.

14. Edubilla.com [Internet]. Standard Diving Suit. Tamilnadu: Edubilla.com; c2019 [cited 2023 Jun 21]. Available from: http://www.edubilla.com/invention/standard-diving-suit/.

15. Oceans Enterprises [Internet]. History of diving. Australia: Oceans Enterprises; [cited 2023 Jun 21]. Available from: http://www.oceans.com.au/oe-histofdive.html.

16. Congress of the Philippines. An act to prevent, deter and eliminate illegal, unreported and unregulated fishing, amending Republic Act No. 8550, otherwise known as "the Philippine Fisheries Code of 1998," and for other purposes, Republic Act No. 10654 (2015 Feb 27).

17. Kumar A. Basic classification of fishing gears- principle, subsidiary and auxiliary gears. A. Von Brandt classification of fishing gear and methods of the world, classification of fishing gear by International Standard Statistical Classification of Fishing Gear (ISSCFG). Available from: https://www.rpcau.ac.in/wp-content/uploads/2020/03/BASIC-CLASSIFICATION-OF-FISHING-GEAR-PRINCIPLE-SUBSIDIARY-AND-AUXILIARY-GEARS.pdf.

18. Tahiluddin AB, Sarri JH. An Overview of Destructive Fishing in the Philippines. Acta Natura et Scientia. 2022; 3(2):116-125.

19. Best Environmental Website of Pakistan. Overfishing and Fish Stock Depletion – Causes, Effects, Solutions. 2021 Jun 15 [cited 2023 Jun 21]. In: Best Environmental Website of Pakistan [Internet]. Available from: https://www.envpk.com/overfishing-and-fish-stock-depletion-causes-effects-solutions/.

20. Congress of the Philippines. An act providing for the development, management and conservation of the fisheries and aquatic resources, integrating all laws pertinent thereto, and for other purposes, Republic Act No. 8550 (1998 Feb 25).

21. Sangguniang Bayan of Oton. Revised Ordinance for the Management, Conservation, Preservation, Development, Culture, Protection, Utilization, and Disposition of Fisheries and Aquatic Resources in the Municipality of Oton, Iloilo (Amending Municipal Ordinance No. 98- 66, "An Ordinance Amending and Integrating All Ordinances Regulating All Fishing/Fishery Laws and the Use of Municipal Waters in the Municipality of Oton, Iloilo.), Municipal Ordinance No. 2002-106 (2002).

22. Talavera F, Faustino L. Industrial Shells of the Philippines. The Philippine Journal of Science. 1931;45(3):339-44.

23. Magsuci H, Conlu A, Moyano-Aypa S. The window-pane oyster (kapis) fishery of Western Visayas. Fish Res J Philipp. 1980;5:74-80.

24. Young A, Serna E. Country report: Philippines. Bivalve culture in Asia and the Pacific: proceedings of a workshop held in Singapore. 1982 Feb 16-19.

25. Rosell NC. Mariculture of kapis, Placuna placenta: a pilot study. Fish Res J Philipp. 1984;9:32-44.

26. Wood E, Wells SM. The Shell Trade: A Case for Sustainable Utilization. In: Kay EA, editor. The Conservation Biology of Molluscs, Proceedings of a Symposium held at the 9th International Malacological Congress. Edinburgh. p41-52.

27. Floren AS. The Philippine shell industry with special focus on Mactan, Cebu. Coastal Resource Management Project of the Department of Environment and Natural Resources. 2003.

28. Laureta LV. Compendium of the economically important seashells in Panay, Philippines. University of the Philippines Press. 2008.

29. del Norte-Campos, Annabelle GC, Burgos LA, Villarta KA. A Ranked Inventory of Commercially-important Mollusks of Panay, West Central Philippines as a Guide to Prioritize Research. The Philippine Journal of Fisheries. 2019;26(2):119-136..

30. Gamboa R, Gomez AL, and Nievales MF. The status of sea cucumber fishery and mariculture in the Philippines. 2004.

31. Akamine J. The status of the sea cucumber fisheries and trade in Japan: past and present. FAO Fisheries Technical Paper. 2005.

32. Stocks AP, Foster SJ, Bat NK, Vincent ACJ. Catch as catch can:

Targeted and indiscriminate small-scale fishing of seahorses in Vietnam. Fisheries Research. 2017;196:27-33.

33. Stacey N, Steenbergen DJ, Clifton J, Acciaioli GL. Understanding social wellbeing and values of small-scale fisheries amongst the Sama-Bajau of Archipelagic Southeast Asia. In: Johnson DS, Acott TG, Stacey N, Urquhart J, editors, Social wellbeing and the values of small-scale fisheries. New York: Springer. 2018. p. 97-123. (MARE Publication Series). Epub 2017 Aug 11.

34. Morris G, Saunders PJ. The Environment in Health and Well-Being. Environmental Science. 2017 Mar 29. Available from: https://bit.ly/3r2shMs.

35. Knudsen M. Poverty and beyond: small-scale fishing in overexploited marine environments. Human ecology. 2016;44(3):341-352.

36. Bacalso RTM, Wolff M, Rosales RM, Armada NB. Effort reallocation of illegal fishing operations: A profitable scenario for Danajon Bank, Central Philippines municipal fisheries. Ecological Modelling. 2016;331:5-16.

37. Sotto F, Cosel R. Some commercial bivalves of Cebu, Philippines. The Philippine Scientist. 1982;19:43-101.

38. Adan RIY. The window-pane (kapis shell) industry. SEAFDEC Asian Aquaculture. 2000;32(4):23-31..

39. Chavez L. Philippine artisanal fishermen cry for help as illegal fishing empties municipal waters. 2021 Aug 25 [cited 2023 Jun 21]. In: Rappler.com [Internet]. Pasig: Rappler Inc. c2023. Available from: https://www.rappler.com/environment/artisanal-fishermen-philippines-cry-help-illegal-fishing-empties-municipal-waters/.

40. American Heart Association [Internet]. Patent Foramen Ovale (PFO). Dallas: American Heart Association; c2023 [cited 2023 Jun 22]. Available from: https://www.heart.org/en/health-topics/congenital-heart-defects/about-congenital-heart-defects/patent-foramen-ovale-pfo.

41. Vann RD, Butler FK, Mitchell SJ, Moon RE. Decompression illness. Lancet. 2011 Jan 8;377(9760):153-64.

42. Kirkland PJ, Mathew D, Modi P, et al. Nitrogen Narcosis In Diving. [Updated 2022 Aug 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470304/.

43. Astari AM, Fatimah F, Andarini S. The effect of medical history and compressor on barotrauma. J Public Health Res. 2021 Apr 14;10(2):2163.

44. Eichhorn L, Leyk D. Diving medicine in clinical practice. Dtsch Arztebl Int. 2015 Feb 27;112(9):147-57; quiz 158.

45. Muindi KK. Knowledge, perception and practices of diving fishermen in relation to decompression sickness: a cross sectional survey of the diving fisherment of Vanga, Kwale County, Kenya [dissertation]. Nairobi: University of Nairobi; 2020.

46. Huchim-Lara O, Chin W, Salas S, Rivera-Canul N, Cordero-Romero S, Tec J, et al. Decompression sickness among diving fishermen in Mexico: observational retrospective analysis of DCS in three sea cucumber fishing seasons. Undersea Hyperb Med. 2017 Mar-Apr;44(2):149-156.

47. Syamila AI, Suwandi T, Wibowo A. Decompression illness among fishermen divers in tanjung papuma beach, jember regency, indonesia. Indian Journal of Public Health Research and Development. 2017 Oct 1;8(4):84-88.

48. Bañez MAB. Unod kag Panit: The narratives of the development of the artisanal lampirong (Placuna placenta) the fishery of Oton, Iloilo [unpublished dissertation]. Davao: Ateneo de Davao University. 2021 [cited 2023 Jun 22].

49. Maderazo M, SSG Advisors. Supporting the Fisheries Commission's Community Fisheries Watchdog Committees: Legal Review of the Bantay Dagat Program in the Philippines. The USAID/Ghana Sustainable Fisheries Management Project (SFMP). 2016. Availabel from: https://www.crc.uri.edu/download/GH2014_POL051_SSG_508.pdf.

50. Momblan G. Iloilo to boost capabilities of Bantay Dagat TF. 2019 Nov 9 [2023 Jun 21]. In: Philippine News Agency [Internet]. Quezon: Philippine News Agency; c2023. Available from: https://www.pna.gov.ph/articles/1085542.

51. Sornito I. Illegal fishing persists - Defensor. 2023 Jun 5 [cited 2023 Jun 5]. In: Panay News [Internet]. Panay: Panay News Philippines; c2023. Available from: https://www.panaynews.net/illegal-fishing-persists-defensor/.

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