The Occurrence of Harmful Jellyfish Outbreaks and Human Stung Reported at Recreational Beaches in Special Region of Yogyakarta, Indonesia

H A Mulyadi* 1,3 and O R Sianturi 2

1 Research Center for Deep Sea, Jln. Y. Syaranamual, Poka, Ambon, Indonesia.
2 Research Center for Oceanography, Pasir Putih Raya 1, Ancol Timur, Jakarta, Indonesia.

*Corresponding author: hans83_lipi@yahoo.com

Abstract. Harmful jellyfish outbreaks have occurred annually in Southern Java. The occurrence could be seen at recreational beaches such as Baron Beach, Kukup Beach, Parangtritis Beach, and Glagah Beach. Although outbreaks happen every year, there are few studies. This research investigates the occurrence of harmful jellyfish and the number of visitors stung at recreational beaches in the Yogyakarta Special Region based on interview approaches and literature review. The outbreaks of harmful jellyfish, identified as Physalia cf physalis, occurred during June-August every year at recreational beaches in the Special Region of Yogyakarta. In this year, the outbreaks of harmful jellyfish Physalia cf physalis started in late June. Total 913 people were reported stung during 19 June -12 July. Visitors stung by harmful jellyfish at Parangtritis beach and Kukup beach account for 89.92% and 6.46%, respectively. Visitors stung increased during the weekend (except on Kukup Beach). The first-aid treatment was made by the local rescue team, namely Satuan Perlindungan Masyarakat (Satlinmas), using hot water, vinegar, and topical analgesic as a painkiller. Sometimes, they use traditional medicine from Jinking (Mictyris sp, which is abundant in the coastal area) to reduce the pain. This study’s information is a critical baseline study for the biology and ecology of harmful jellyfish in the future.

1. Introduction
Jellyfish Physalia physalis belongs to the class Hydrozoa, phylum Cnidaria. Jellyfish are divided into five classes, i.e., Anthozoa (sea anemones and corals), Cubozoa (box jellyfish), Hydrozoa (hydroids, Physalia physalis), Scyphozoa (true jellyfish), and Staurozoa (Stauromedusae/stalked jellyfish) [1][2]. Jellyfish with bell-shaped bodies are called umbrellas, with varying sizes and numbers of tentacles from a few millimeters up to 40 meters in length. The tentacles possess specialized epidermal cells, called cnidocytes, the main part of the envenomation (stung) process. Upon contact with human skin, it can deliver hundreds to thousands of potent venom into the skin. The results may vary, depending on
its species, skin sensitivity, and venom amount. It can range from itchy skin, mild pain to life-threatening [1,3,4].

Harmful jellyfish refers to the medusae of class Scyphozoa and class Cubozoa which can cause harm or negative impact to humans, ecosystems, and socio-economic [5]. Jellyfish outbreaks have been reported on the Northeast Atlantic and Mediterranean Sea from schyopozomedusans *Pelagia noctiluca* [6,7]. The outbreak is indicated as causative agents in a significant fish kill on aquaculture [8]. The jellyfish outbreak impacts on recreation beach along the Mediterranean Sea was documented as a health hazard and threats to visitors [9].

This phenomenon also happens in Indonesia, but the information is limited from the media due to a lack of research. This paper discusses the occurrence of jellyfish outbreaks in the Special Region of Yogyakarta, human stung at recreational beaches, first aid, and traditional medicine for jellyfish stung. This paper gives initial systematic information and outlook on the impact of jellyfish stung to socio-economic in the Special Region of Yogyakarta, specifically. But this information becomes the basis for understanding the impact of jellyfish stung in Indonesia, generally. Thus, a proper and effective mitigation plan could be set up in the future.

2. **Materials and Method**

This paper applies systematic review based on limited information from several published articles, online news, and personal interviews with the local rescue team coordinator, namely Satuan Perlindungan Masyarakat (Satlinmas), in each region. This review paper searches for answers to jellyfish outbreaks on the Southern Java Sea by looking at its impact on recreational beaches. The number of visitors stung by jellyfish is obtained by interviewing the local rescue team coordinator in each region (beach). The data was calculated and shown by their location and age to show the impact of the outbreaks on humans and tourism.

![Figure 1. Map of Recreational Beaches of Glagah Beach, Parangtritis Beach, Kukup Beach, and Baron Beach (Google map, 2020).](image)

3. **The occurrence of harmful jellyfish outbreaks and visitors stung at recreational beaches.**

The harmful jellyfish reported outbreaks and stranded at the several pots of recreational beaches in Yogyakarta were identified as *Physalia cf. physalis*. The local people have the specific names “Rawe”
or “Impes” based on morphological features. Rawe it refers to tentacles length which the size up to 2 metres and Impes because the quickly broken pneumatophore after stranded on the beach (Figure 2).

![Figure 2. Stranded harmful jellyfish Physalia cf. physalis at Glagah Beach (left) and Baron Beach (right), late June-early July 2020 (Photo by: Agung Kurnia, Aris Widiatmoko, and Sukamto).](image)

*Physalia cf. physalis* is a species from class hydrozoa, often called ‘jellyfish’ is actually not a true jellyfish. It is a Siphonophore colony that consists of pneumatophore (a boat-like sail), gastrozoid (feeding polyps), dactylozoid (capturing polyps), and gonozoid (reproduction zooid) [10,11]. The pneumatophore can range from 2-25 cm long with tentacles submerged underwater range up to 30 m. The pneumatophore and the tentacles are usually bright bluish, sometimes purplish [4].

The classification of *Physalia physalis* :

- **Kingdom**: Animalia (Haeckel, 1866)
- **Phylum**: Cnidaria (Hatschek, 1888)
- **Class**: Hydrozoa (Owen, 1843)
- **Order**: Siphonophorae (Eschscholtz, 1829)
- **Family**: Physaliidae (Brandt, 1835)
- **Genus**: Physalia (Lamarck, 1801)
- **Species**: *P. physalis* (Linnaeus,1758)

The jellyfish of *Physalia cf. physalis* outbreaks in the Southern Java Sea from Cilacap to Sendang Biru Bay, Malang, occurred annually in June-August. This phenomenon might be related to the strong wind and ocean current during the southeast monsoon [5,12]. After closing due to covid-19 regulation, several recreational beaches were re-opened in late June 2020. At the moment, it was Eid Mubarak holiday and after quarantine for months, lots of people go to the beach with their family for swimming, enjoying sunrise or sunset, or playing with their kids. Unexpectedly, many visitors reported being stung by jellyfish in several recreational beaches in Yogyakarta. Total 913 visitors were reported stung by jellyfish during 19 June-12 July 2020. Detail of visitors stung in each location shown in Figure 3.
| Date          | Location                        | Number of victims | Fatality                      | Species             | References           |
|---------------|---------------------------------|-------------------|-------------------------------|---------------------|----------------------|
| June 5, 2008  | Mlandingan, Situbondo, East Java| 1                 | 19-year-old man die           | Physalia utriculus  | Radar Banyuwangi, 2008 |
| July 4, 2008  | Banyuputih, Situbondo, East Java| 1                 | 10-year-old boy die           | Physalia utriculus  | Radar Banyuwangi, 2008 |
| October 5, 2008 | Bembang beach, Jebus, Bangka Belitung | 1 | 4-year-old boy die | Chrysaora quinquecirrha | Bangka Pos, 2008 |
| July 19, 2009 | Parangtritis and Samas beach, Yogyakarta | tens | Severe pain, unconscious | Physalia utriculus  | Waskita, 2009 |
| September 22, 2009 | Parangtritis beach, Yogyakarta | hundreds | Severe pain, unconscious | Physalia utriculus  | Heru, 2009 |
| September 22, 2009 | Widrapayung beach, Cilacap, Central Java | tens | Severe cold, choke | Physalia utriculus  | Republika, 2009 |
| September 23, 2009 | Glagah Indah and Trisik beach, Yogyakarta | tens | Asphyxia, unconscious | Chrysaora quinquecirrha | Kuntadi, 2009 |
| September 26, 2009 | Kukup beach, Yogyakarta | 64 | - | Unknown | Wulan, 2009 |
| October 2, 2009 | Pangandaran beach, Ciamis, West Java | 1 | Almost unconscious | Unknown | Pikiran Rakyat, 2009 |
| August 17, 2014 | Krakal beach, Yogyakarta | >10 | Asphyxia, cramp, severe pain, nausea, shivering | Physalia sp | Maryanto, 2014 |
| July 20, 2015 | Balekambang beach, East Java | 10 | Itchy and burnt on skin, severe pain | Unknown | Memo-x, 2017 |
| August 21, 2016 | Parangtritis beach, Yogyakarta | 5 | Asphyxia, Itchy and burnt on skin, Severe pain | Unknown | Viva, 2018 |
| August 13, 2017 | Sepanjang beach, Yogyakarta | 20 | Asphyxia, stomachache, Itchy and burnt on skin | Unknown | Widuri, 2017 |
| 2017 | Balekambang beach, East Java | 10 | Itchy and burnt on skin, severe pain | Unknown | Malangpost, 2017 |
| June - July, 2018 | Southern beaches, Yogyakarta | 92 | Asphyxia, Itchy and burnt on skin, Severe pain | Physalia sp | Hasanadin, 2018 |
| June 20, 2018 | Souther beaches, Central Java | 10 | Itchy and burnt on skin, severe pain | Unknown | TribatraNews, 2018 |
| 2018 | Balekambang beach, East Java | 13 | Itchy and burnt on skin, severe pain | Unknown | Nana, 2018 |
| June 2019 | Parangtritis beach, Yogyakarta | 139 | Itchy and burnt on skin, severe pain, unconscious | Unknown | Dinisari, 2019 |
| June - July, 2020 | Kukup, Glagah, Parangtritis and Baron beach, Yogyakarta | 913 | Itchy and burnt on skin, severe pain | Physalia physalis | Present study |
Figure 3 shows that the number of visitors stung by harmful jellyfish *Physalia cf physalis* in recreational beaches fluctuated. Parangtritis beach, as the most popular beach and the closest to Yogyakarta city, becomes the beach with the most cases of a jellyfish sting, accounting for 89.92% from total victims followed by Kukup Beach (6.46%). The number of victims increased during the weekend (4/7/2020, 5/7/2020, and 12/7/2020) except on Kukup beach. This pattern may be related to the high number of visitors coming to the recreational beaches during weekends and it could increase the probability of visitors being stung by jellyfish. Furthermore, many visitors may not be aware to avoid activities such as swimming or snorkeling during the outbreaks. Ghermandi et al (2015) reported that most visitors at Mediterranian Sea main purposes are sunbathing and resting, which are safe activities during outbreaks of jellyfish [9].

*Physalia* looks so colorful with their elongated blue tentacles, white pneumatophore with a pink top, and white or brown of the beach. This shape and color attract people, especially kids, to touch and play with it. To make matters worse, the nematocysts are still active after being stranded on the beach/dead. This could be the main reason children (0-10 years old) and teenagers (11-20 years old) become the main victims of jellyfish stung (Figure 4).

The occurrence of harmful jellyfish outbreaks and the human stung by jellyfish have been reported worldwide, e.g., Southeastern Brazil [13], Langkawi Island, Malaysia [14], and from Okinawa and Amami, Japan [15]. However, several plans were suggested and applied as mitigation actions to reduce the damage caused by jellyfish stung. To avoid fatality, Giordano et al. [16] told the sting of Physalia should be treated more aggressively from the onset to prevent further consequences, both direct and indirect. Self-awareness from swimmers in the jellyfish area was also emphasized to wear protective clothes while swimming in the jellyfish area.
Figure 4. Distribution of age visitors stung by harmful jellyfish at Kukup and Glagah Beach during late June-12 July 2020 (except Baron Beach and Parangtritis Beach, age visitors' data was not available).

Broader mitigation plans were also suggested by Giordano et al. [16]. It should be made known to everyone, especially the lifeguards, rescue personnel, health workers, and hospital staff, that jellyfish could cause an injury. This suggestion has already been applied in France, where “Physatox” works as a multidisciplinary monitoring and alert system. Its participation consists of healthcare (Poison centers, coast guards, coastal emergency units), scientific and governmental, and territorial organizations (local and national authorities) [16,17].

In Indonesia, harmful jellyfish outbreaks are less published in scientific papers due to a lack of research [1,5]. This phenomenon could be traced mostly from online news and summarized in Table 1. While the oceanographic conditions in the South Java Sea were highly influenced by the monsoon systems, by mid-June, the south-east monsoon strengthened associated with intensive wind forcing [18]. Upwelling occurred during June-October, affected by wind and South Equatorial Current (SEC) [19]. SEC becomes the dominance phase during the Eastern Monsoon with a velocity of nearly 0.150 m/s [20]. The mean value of temperature is about 28°C and its mean salinity around 33.75 psu [21]. Reviewing the location reported, where most of the data are in Java Island, more cases were not recorded. It is important to have comprehensive data about the stung cases in Indonesia, as it will become the basis of understanding the magnitude of the jellyfish stung phenomenon.

4. First Aid and traditional medicine
Physalia stung cases are not always coming from the swimmers but also come from beach go-ers who got stung by stranded Physalia. Even after days left, Physalia still can sting if touched. Physalia sting is quite painful and severe, acute pain, skin necrosis, sometimes causing significant symptoms like nausea/vomiting, headache, fainting, and cardio-respiratory syndromes [2,17].

First aid was made by a local rescue team, namely Satuan Perlindungan Masyarakat (Satlinmas) by cleaning up the sand from the skin and rinse the skin with vinegar to remove any residual stingers or bits of tentacle left on the skin and then immerse in hot water. Wilcox et al. (2017) studied the capability of vinegar as a potent inhibitor of cnidae discharge and the importance of cnidae-inactivating rinse solutions as a first and primary step in jellyfish envenomation first aid [22]. If the symptom of venom still happened, they will use topical pain killer betamethason valerate 0.1% cream (Figure 5). Betamethasone Valerate Cream 0.1% contains a typical corticosteroid, constituting
a class of primarily synthetic steroids used as anti-inflammatory skin conditions [15]. Sometimes, they are using traditional medicine from *Jink ink* (*Mictyris sp.*, which is abundant in the coastal area) to reduce the pain.

![Figure 5. First aid by rescue team Satlinmas Parangtritis and Kukup Beach, 2020 (Photo by: Agung Kurnia and Sukamto)](image)

There was some fatality reported due to the sting of *Physalia* in the world [23–25]. One case involved a scuba diver who was found pulseless only 3 minutes after he called for help. Other cases involve a man and a woman who are out of the water with jellyfish’s tentacles still on their body [2]. While in Indonesia, Mujiono (2010) reported three little boys died because of the jellyfish’ sting. An older brother and younger brother play on the beach when suddenly they get stung on the feet, and soon they are unconscious. The younger brother died during the evacuation to the hospital, the older brother survived. The other two fatalities also died during the hospital evacuation after they got stung while swimming on the beach [1]. From these cases, limited time, proper first aid, and prompt health assistance become very important, as they could be the determinant of life and death.

5. Conclusion
The outbreaks of harmful jellyfish caused by *Physalia cf physalis* occurred during June-August every year and stung visitors unaware of the threat from stranded *Physalia*. The number of people who got stung in a short time (less than a month) showed the magnitude of threat created by Physalia in Yogyakarta, specifically and jellyfish outbreak in Indonesia, generally. Even though the outbreak and stung cases happen every year, no mitigation plans were made, and no evacuation systems were prepared. Mitigation plan, including forecast and quick medical response, becomes paramount to reducing the impact of the Jellyfish outbreak.

References
[1] Mujiono N 2019 Jellyfish Sting: Sebuah studi Kasus Indonesia.[Jellyfish Sting : An Indonesian Case Report] *J. Ilm. Perikan. dan Kelaut*. 21
[2] Tibballs J 2006 Australian venomous jellyfish, envenomation syndromes, toxins and therapy *Toxicon* 48 830–59
[3] Mariscal R N 1974 Nematocysts Coelenterate biology: reviews and new perspectives (New
York: Academic Press) pp 129–78

[4] Cegolon L, Heymann W C, Lange J H and Mastrangelo G 2013 Jellyfish stings and their management: A review Mar. Drugs 11 523–50

[5] Tan A, Hwai S, Teh C, Peng C, Nilamani N and Yasin Z 2019 Harmful Jellyfish Country Report in Western Pacific

[6] Licandro P, Conway D V P, Yahia M N D, De Puelles M L F, Gasparini S, Hecq J H, Tranter P and Kirby R R 2010 A blooming jellyfish in the northeast Atlantic and Mediterranean Biol. Lett. 6 688–91

[7] Yahia M, Batistić M, Lučić D, Puelles M, Licandro P, Malej A, Molinero J C, Siokou-Frangou I, Zervoudaki S, Prieto L, Goy J and Yahia-Kéfi O D 2010 Are the outbreaks of Pelagia noctiluca (Forsskål,1775) more frequent in the Mediterranean basin? undefined

[8] Fleming N, Harrod C and Houghton J 2013 Identifying potentially harmful jellyfish blooms using shoreline surveys Aquac. Environ. Interact. 4 263–72

[9] Ghermandi A, Galil B, Gowdy J and Nunes P A L D 2015 Jellyfish outbreak impacts on recreation in the Mediterranean Sea: Welfare estimates from a socioeconomic pilot survey in Israel Ecosyst. Serv. 11 140–7

[10] Linné C von 1758 Caroli Linnaei...Systema naturae per regna tria naturae :secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. (Holmiae : Impensis Direct. Laurentii Salvii,)

[11] Munro C, Vue Z, Behringer R R and Dunn C W 2019 Morphology and development of the Portuguese man of war, Physalia physalis Sci. Rep. 9 1–12

[12] Araya J F, Aliaga J A and Araya M E 2016 On the distribution of Physalia physalis (Hydrozoa: Physaliidae) in Chile Mar. Biodivers. 46 731–5

[13] Shemer A, Sakka N and Tamarkin D 2014 Betamethasone valerate foam: a look at the clinical data Clin. Investig. (Lond). 4 259–67

[14] Suan M A M, Tan W L, Soelar S A, Cheng H P and Osman M 2016 Jellyfish stings on Langkawi Island, Malaysia. undefined

[15] Hifumi T, Fukuchi Y, Otani N, Kondo Y, Kitamoto T, Kobayashi K, Nakaya N and Tomioka J 2020 Clinical characteristics of jellyfish stings in Japan Acute Med. Surg. 7 e469

[16] Giordano A R, Vito L and Sardella P J 2005 Complication of a Portuguese man-of-war envenomation to the foot: A case report J. Foot Ankle Surg.

[17] Labadie M, Aldabe B, Ong N, Joncquiert-Latarjet A, Groult V, Poulard A, Coudreuse M, Cordier L, Rolland P, Chanseau P and De Haro L 2012 Portuguese man-of-war (Physalia physalis) envenomation on the Aquitaine Coast of France: An emerging health risk Clin. Toxicol. 50 567–70

[18] Sprintall J, Chong J, Syamsudin F, Morawitz W, Hautala S, Bray N and Wijffels S 1999 Dynamics of the South Java Current in the Indo-Australian Basin Geophys. Res. Lett. 26 2493–6

[19] Raden Bima Yoga B H S and Gentio Harsono. 2014 Upwelling and Downwelling Berdasarkan Variabilitas Suhu Permukaan Laut dan Klorofil-a Perairan Selatan Jawa J. Oceanogr. 3 57–66

[20] Utamy R M, Purba N P, Pranowo W S and Suherman H The Pattern of South Equatorial Current and Primary Productivity in South Java Seas

[21] Purba N P, Pranowo W S, Faizal I and Adiwira H 2018 Temperature-Salinity stratification in the Eastern Indian Ocean using argo float IOP Conference Series: Earth and Environmental Science vol 162 (Institute of Physics Publishing) p 12010

[22] Wilcox C, Headlam J, Doyle T and Yanagihara A 2017 Assessing the Efficacy of First-Aid Measures in Physalia sp. Envenomation, Using Solution- and Blood Agarose-Based Models Toxins (Basel). 9 149

[23] Burnett J W, Gean C J, Calton G J and Warnick J E 1985 The effect of verapamil on the cardiotoxic activity of Portuguese man-o’war (Physalia physalis) and sea nettle (Chrysaora quinquecirrha) venoms Toxicon 23 681–9
[24] Stein M R, Marraccini J V., Rothschild N E and Burnett J W 1989 Fatal portuguese man-o’-war (Physalia physalis) envenomation Ann. Emerg. Med. 18 312–5
[25] Burnett J W and Gable W D 1989 A fatal jellyfish envenomation by the Portuguese man-o’war Toxicon 27 823–4