Penelitian Budidaya Kerang Mutiara di Indonesia (2011-2021): Sebuah Kajian Bibliometrik

(*Research of Pearl Oyster Culture in Indonesia (2011-2021): A Bibliometric Analysis*)

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Abstract

Pearl oyster is one type of mollusc that has great potential to be developed in several regions in Indonesia, such as West Papua, Maluku, Bali, and West Nusa Tenggara (NTB). The development of the marine and fisheries industry, including the pearl industry, is quite rapid, encouraging Indonesian scientists to conduct research and development related to the cultivation of the pearl oyster. To map the trend of pearl oyster research in Indonesia and the potential for further research, this paper explores research that has been carried out for ten years (2011-2021) based on the Google Scholar database through a bibliometric analysis, followed by visualization using the VOSviewer software. It was found that during the period, pearl oyster researchers were divided into 32 clusters and Cokrowati (4 documents) was the most dominating researcher in studying pearl oyster cultivation, followed by Ginting and Mukhlis (3 docs). The type of pearl oyster that has been most studied related to farming is pearl oyster (Pinctada maxima) and the penguin wing oyster shell (Pteria penguin). This study provides opportunities to develop research on both species.

Keywords: Bibliometric analysis, culture, Google Scholar, Pearl oyster, Pinctada maxima, Pteria penguin

Abstrak

Kerang mutiara adalah salah satu jenis moluska (kekerangan) yang berpotensi besar untuk dikembangkan di beberapa wilayah di Indonesia, seperti Papua Barat, Maluku, Bali, dan Nusa Tenggara Barat (NTB). Perkembangan industri di kelautan dan perikanan termasuk industri mutiara yang cukup pesat, mendorong ilmuwan Indonesia untuk melakukan penelitian dan pengembangan terkait budidaya kerang tersebut. Untuk memetakan trend penelitian kerang mutiara di Indonesia dan potensi penelitian lanjutannya, tulisan ini mengeksplorasi penelitian yang telah dilakukan selama sepuluh tahun (2011-2021) berdasarkan database Google Scholar melalui sebuah analisa bibliometrik, yang dilanjutkan dengn visualisasi dengan software VOSviewer. Didapatkan bahwa dalam periode tersebut, peneliti kerang mutiara terbagi dalam 32 klaster dan Cokrowati (4 dokumen) adalah peneliti yang paling mendominasi dalam mengkaji budidaya kerang mutiara, diikuti oleh Ginting dan Mukhlis (3 dokumen). Jenis kerang yang paling banyak diteliti terkait budidayanya adalah tiram mutiara, (*Pinctada maxima*) dan kerang tiram sayap penguin (*Pteria penguin*). Hasil penelitian ini memberikan peluang peneliti untuk mengembangkan penelitian pada kedua species tersebut.

Kata kunci: Kajian bibliometrik, Google Scholar, Pearl oyster, Pinctada maxima, Pteria penguin

INTRODUCTION

Pearl oysters are marine commodities that have economic value and have prospects for future business development. Pearl products from mollusc in the *Pteriidae* family are increasingly in demand and the price continues to increase (Nur et al., 2020). In 2018, Indonesia managed to export pearls of up to USD40.7 million, the majority of the export destinations (94%) were Japan. Indonesian pearl oyster farming has existed since 1918, developed by the private sector but seed production volume is still the main problem faced by the farmers today (Wardana et al., 2014). The species that have been widely cultivated in Buton, Southeast Sulawesi since 1936 generally come from white-lipped pearl oysters (*Pinctada maxima*) and mabe oyster or the penguin wing pearl oyster (*Pteria penguin*) (Mushaffa et al., 2018).

There are several pearl oyster producing areas in Buton including Palabusa Village which produces mabè pearl oysters (Mushaffa et al., 2018). Meanwhile, the area that is the centre of pearl production in Indonesia is Nusa Tenggara Barat (NTB) waters with southern sea pearls of the *Pinctada Maxima* species. Then, there are also waters in Lampung, Nusa Tenggara Timur (NTT), Bali, North Sulawesi, Southeast Sulawesi, Central Sulawesi, Gorontalo, Maluku, North Maluku and West Papua. Since 2005, Indonesia has dominated the supply of South Sea pearls in the international market, reaching 43 percent (Ambari, 2018)

There are five types of seashells (oysters) that are known to produce pearls, namely silver-lipped pearl oyster or white-lipped pearl oyster (*Pinctada maxima*), the penguin wing pearl oyster (*Pteria penguin*), black lip pearl oyster (*P. margaritifera*), Japanese pearl oyster (*P. fucata*), and triangle sail mussel (*Hyriopsis cumingii*) *P. maxima*, *P. margaritifera,* and *P. penguin* are the most common oysters farmed in Indonesia since the year 2000 (Winanto, 2004; Sujoko, 2010). Pearl oyster farming and the related sectors in Indonesia mostly use wild oyster seeds. If not managed well, the national industry will not sustain because the wild harvesting can potentially destroy the oyster population (Manez et al. 2010; Awaluddin et al., 2013). The Indonesian government continues to strive to become a supplier of pearl needs in the world market. Of the four types of pearls sought by pearl hunters, Indonesia is currently listed as the main supplier of one type of pearl, namely south sea pearls. However, the availability of this type of pearl is currently under threat of decline, because the number continues to shrink (Ambari, 2018).

Indonesia is one of the export-quality pearl seed producing countries that is well known in the international market with pearl quality being ranked third after Australia and Myanmar (Wardana et al., 2014). The right solution to control the number of catches in nature is to conduct a breeding program for pearl oyster commodities. Overcoming various kinds of problems in the pearl production business, currently the pearl production business has been carried out in an integrated manner by companies with large capital, from seed (spat), hatchery or hatchery to post-harvest since the past decade. To support the government's program in advancing pearl oyster farming, a number of Indonesian scientists have conducted various research topics spread across various regions. The purpose of this study was to map the trend of research topics related to pearl oyster farming, conducted by Indonesian researchers in some farming centres during the period between 2011 and 2021, through a bibliometric analysis using VOSviewer software. The mapping will benefit other researchers who want to collaborate on research or find interesting topics to be developed further related to pearl oyster farming.

MATERIALS AND METHOD

This study utilized a bibliometric analysis by using the Google Scholar database, which is free and open access. The metadata data was collected in January 2022. Originally, by using keywords in searching metadata (in *Bahasa*) kerang mutiara "DAN" budidaya, the number of collected documents was 1380, containing mixed types of papers (in *Bahasa*). Then, through the limitation of published year between 2011 and 2021, the number of articles reduced to 1110, with the number of relevant articles beong 507. Forty-three papers were selected and the metadata was saved into *.csv* and *ris* for further data analysis through VOSviewer version 1.6.7.

Fifty-seven most recent and relevant research papers (*.ris*) were selected among 1030 collections and they were submitted through the VOSviewer. Microsoft excel and VOSviewer (van Eck and Waltman, 2018) were used to visualize raw data into tables, graphs, and maps.

RESULTS AND DISCUSSION

Figure 1 depicts the distribution of a total 507 research articles on pearl oyster cultivation in Indonesia published by Indonesian scientists between 2011 and 2021. The number of articles increased tripled from 26 in 2011 to 77 in 2018 and decreased from 77 in 2018 to only 46 papers in 2021. The results showed that the number of research papers produced by Indonesian researchers in Indonesia fluctuated. This is because, in recent years, the Indonesian government has encouraged researchers to publish their research in foreign publishers rather than in domestic publishers.

Research on pearl oyster culture (2011-2021) was dominated by Cokrowati (4 docs) as the top authors and followed by Ginting and Mukhlis (3 docs) as indicated in Fig. 2. The fields of study conducted by the top ten authors were scattered, ranging from the biology, the cultured systems, the feed technology to the farming environment.
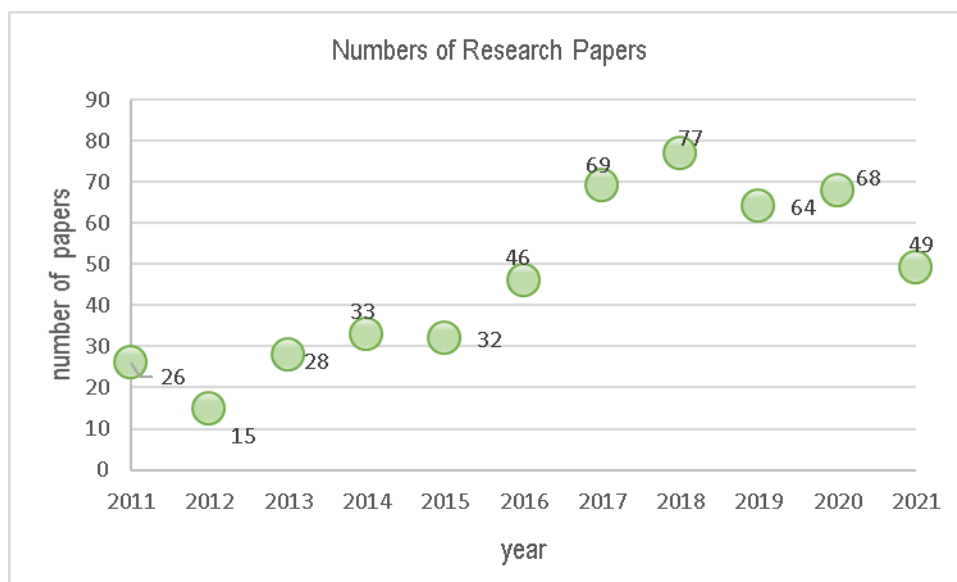
Figure 1. The number of research articles (2011-2021) collected from the Google Scholar database
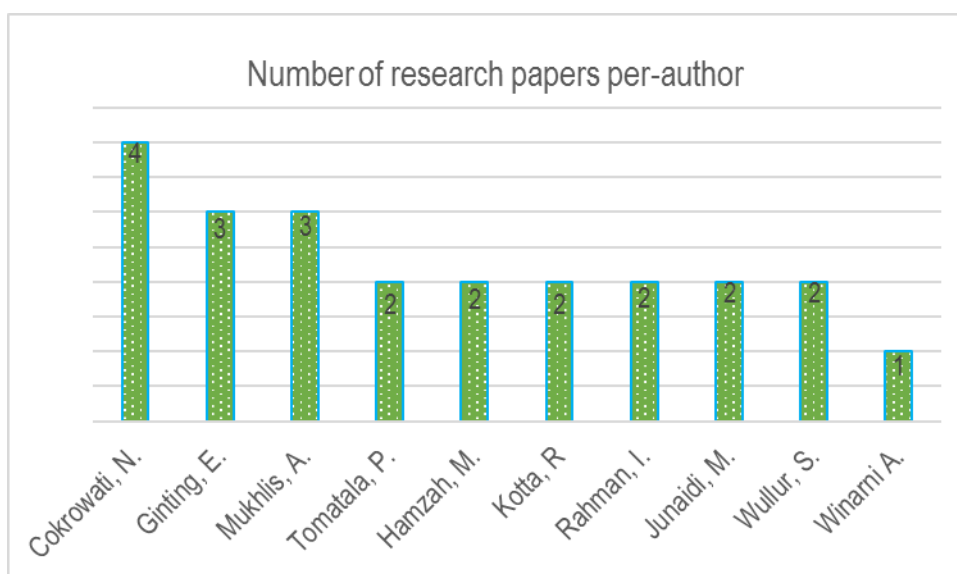

Figure 2. Ten top authors of pearl oyster culture (2011-2021) collected from the Google Scholar database

Among those 507 papers (Fig.1) from the Google Scholar database, 43 papers related to the most relevant topics to pearl oyster culture in Indonesia were selected and were visualized the research trends on the topics assisted with VOSviewer version 1.6.7 software. This effort is useful for finding the novelty of the research in this domain. Figure 3. indicated the whole picture of research on pearl oyster culture (2011-2021). Of the total 116 items selected by the software, it produced 31 clusters, indicated with different colours of bullets (Fig. 3). The authors focused on different topics, i.e. identification of site location of the oyster farming (Junaidi et al., 2018), observing pearl shell spat with different densities (Oktaviani et al., 2018), and introducing an integrated cultured system in floating cages (Junaidi et al., 2021).
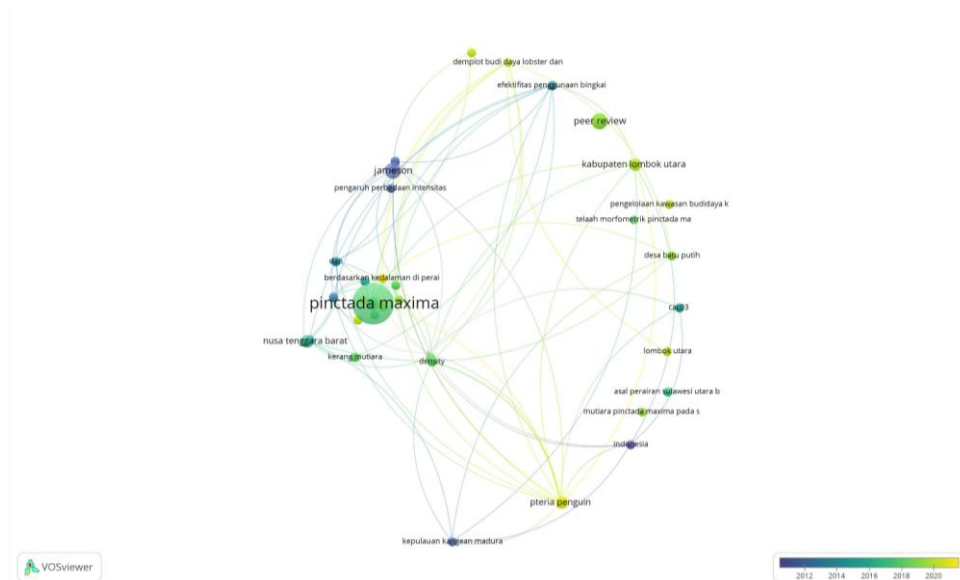
Figure 3. The network visualization map of research on pearl oyster culture

Figure 4. *Pinctada maxima* and *Pteria penguin* are two species of the pearl oysters culture research
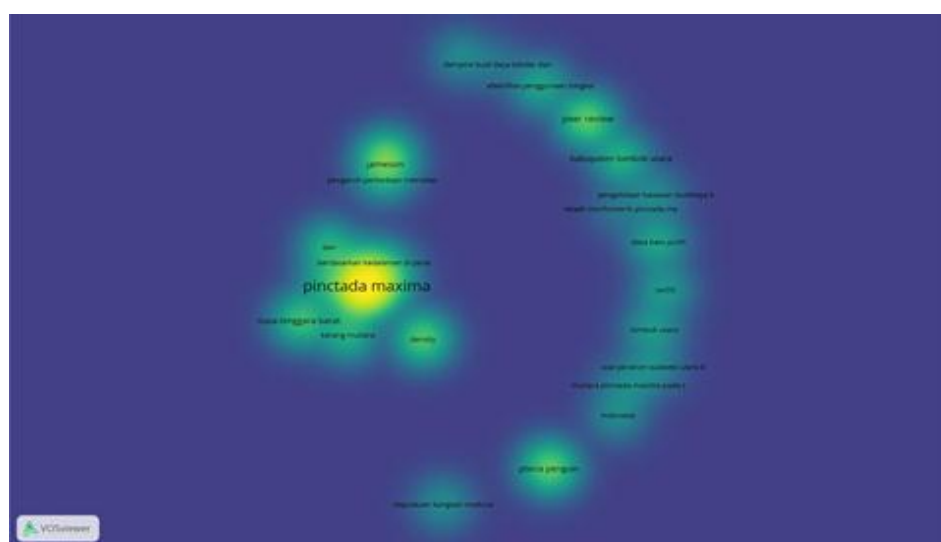

Figure 5. Density visualisation of research topic related to pearl oyster culture

Figures 4 and 5 indicated that *Pinctada maxima* and *Pteria penguin* were the two most observed species of pearl oysters. The first species (*P. maxima*) was studied for a long time and the guideline of the farming technique was documented in Winanto (2004), Sujoko (2010), and Ningsih (2017), to name but a few.

Even though it was not clear enough to identify the related focus of the study on the map (Fig. 4 & 5), some suggestions were made by the researchers from their different findings. Mukhlis et al. (2019) suggested assistantships for superior quality pearl shells and operational capital loans for the farmers considering the long enough enlargement period so that farming activities can be sustainable. It is necessary to provide technical assistance during the operational period to ensure a high level of seed production (Wullur et al., 2019).

Junaidi et al. (2019) suggested an integrated pear oyster culture system, because the production of floating net cages will no longer rely on one commodity, but one net cage unit can produce more than one commodity, one net cage can produce two commodities at once, namely lobster (*Panulirus homarus*) and pearl oysters (*P. maxima*).

The knowledge of bacteria present in living cultures is important for designing nutritional strategies for oyster culture. A molecular approach by Wullur et al., (2019) found seven isolates colonies possess high similarity to five bacteria species i.e. *Pseudomonas pachastrellae*, *Vibrio alginolyticus*, *Bacillus filamentosus*, *Bacillus cereus* and *Idiomarina fontislapidosi* belonging to four different genera, i.e. *Bacillus*, *Staphylococcus*, *Vibrio*, and *Alteromonas*. The authors further suggested that EM treatment is suspected to involve bacterial species in the process of diet decomposition and subsequently became a food source or decomposed organic material as nutrition for the oyster larvae.

Whereas, the penguin wing pearl oyster (*Pteria penguin*), has just recently attracted researchers to develop their studies. *P. penguin* is the producer of half-pearl pearls (Gervis and Sims, 1992; Nur et al., 2020). Generally farmed by the community either in groups or individually to produce semi-round pearl seeds or commonly called mabe and handicrafts made from shells that have been coated with a core in the form of protrusions (blisters) with varied shapes (Haws, et al., 2006; Teitelbaum, et al., 2008; Chand, et al., 2011; Firmansyah et al., 2019; Nur et al., 2020).

P. penguin is a type of oyster that can form semi-round pearl grains which are widely farmed in Palabusa Village, Baubau City, and Southeast Sulawesi Province. The carrying capacity of Palabusa waters for the development of pearl mabe pearl farming is 847 units. Further research needs to be carried out, especially regarding social and economic aspects as well as other water quality parameters that affect the determination of the suitability of the farming areas such as environmental pollution, waves and tides (Hartina et al., 2021).

The ibliographic data in this study was further mapped to create co-authorship, keywords co-occurrence, citation, bibliographic coupling, or co-citation map. Fifty-seven files from RIS format (*.ris*) were used to map the authorships. With the minimum number of authors per document being one (1), it provided 73 names. For each of the 73 authors, the total strength of co-authorship links with other authors was calculated. The authors with the greatest total length strength were selected. The map of authorships produced 32 clusters (Figure 6) and was created with all items were selected even some of them are not connected to each other. The most recent studies in 2021 were conducted by Cokrowati, Hamsiah, Baso, Dermawan, and Nuning (indicated with yellow bullets in Figure 6).

In this study, the metadata (*.ris*) then was further limited by the specific keyword pear oyster or *kerang mutiara* (in Bahasa) and some locations were selected, it will break the previous map shown in Figure 3. The research of pearl oyster in Indonesia, from the past to the latest year's coverage 7 locations, including Kapontoripulau Bay, Kangean Island (kepulauan Madura), West Nusa Tenggara (Nusa Tenggara Barat), Sekotong, Sekotong Bay (Teluk Sekotong), North Maluku (Maluku Utara), South Ternate Sea (Perairan Ternate Selatan) (Figure 7).
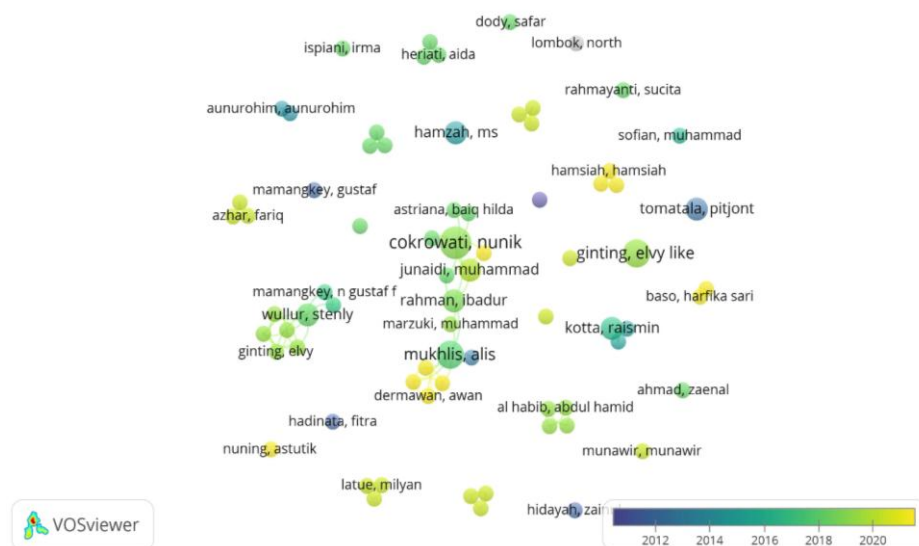
Figure 6. Overlay visualization of top researchers in pearl oyster culture in Indonesia

Figure 7. Research location on pearl oyster (*Pinctada maxima*) culture

CONCLUSION

This present study provided some interesting findings. First, even though the Google Scholar database has limited authority for free accesses, the database determined the number of published papers (*in Bahasa*) in pearl oyster culture (2011-2021) by Indonesian researchers fluctuated, with the peak in 2018 (77 papers). Second, VOSviewer analysis indicated that the research was dominated by Cokrowati as the top author, followed by Ginting and Mukhlis. Third, the two most oyster species subjected to the research were silver-lipped pearl oyster (*Pinctada maxima*) and penguin wing pearl oyster (*Pteria penguin*). Fourth, upcoming researchers were provided different options of research locations, including South Ternate seawater and Teluk Siung Sekotong for developing further research. In addition, this study suggested fields of research of *Pinctada maxima* were broadened than that of *Pteria penguin* and the opportunity to conduct collaborative research on both species is still widely open.

REFERENCES

Awaluddin, M., Indriati, S. Y., Mukhlis, A. (2013). Tingkat penetasan telur dan kelangsungan hidup larva kerang mutiara (*Pinctada maxima*) pada salinitas yang berbeda. *Jurnal Kelautan*, 6(2):142-149. https://doi.org/10.21107/jk.v6i2.788

Ambari, M. (2018). Bertahan Demi Status Produsen mutiara laut selatan terbesar di dunia. Mongabay: Situs Berita Lingkungan. Retrieved from https://www.mongabay.co.id/2018/09/24/bertahan-demi-status-produsen-mutiara-laut-selatan-terbesar-di-dunia/.

Chand, A., Naidu, S., Simos, T, Southgate, P. C. (2011). Pearl industry value chain review 2011: Tonga. Australian Centre for International Agriculture Research. Australia. 17pp.

Firmansah, F., Muskita, W. H., Indrayani I. (2019). Effect of culture duration on layer thickness and pearl quality of winged pearl oyster *Pteria penguin* (Bivalvia: Pteriidae) in Palabusa waters, Buton Strait, Southeast Sulawesi. *AACL Bioflux,* 13(2):451-458. Retrieved from http://www.bioflux.com.ro/docs/2020.451-458.pdf

Gervis, M. H., Sims, N. A. (1992) The Biology and Culture of Pearl Oyster (Bivalvia: Pteriidae). International Center for Living Aquatic Resources Management and Review, Manila, Philippines. 56 pp.

Hartina, I., Kasnir, M. Hamsiah, H. (2021). Analisis kesesuaian dan daya dukung lokasi budidaya kerang mutiara mabè (*Pteria penguin*) di Perairan Palabusa Kota Baubau. *Journal of Indonesian Tropical Fisheries,* 4(2):180-197. https://doi.org/10.33096/joint-fish.v4i2.99

Haws, M. C., Ellis, S. C., Ellis, E. P. (2006). Producing Half-Pear (Mabe). Western Indian Ocean Marine Science Association, University of Dar es Salaam, University of Hawaii, Hilo and the Coastal Resources Center, University of Rhode Island, 16pp + vi.

Junaidi, M., Nurliah, Marzuki, M, Cokrowati, N, Rahman, I. (2018). Identifikasi Lokasi Perairan Untuk Pengembangan Budidaya Laut di Kabupaten Lombok Utara. *Jurnal Biologi Tropis*, 18(1): 57-69.

Junaidi, M., Cokrowati, N., Diniarti, N. (2021). Peningkataan Produktivitas Keramba Jaring Apung dengan Budidaya Kerang Mutiara Sistem Terintegrasi di Kabupaten Lombok Utara. *Jurnal Pengabdian Magister Pendidikan IPA*, 4 (2):124-13. https://doi.org/10.29303/jpmpi.v4i2.696

Manez, K. S. (2010). Java's forgotten pearls: the history and disappearance of pearl fishing in the Segara Anakan lagoon, South Java, Indonesia. *Journal of Historical Geography*, 36:367-376. https://doi.org/10.1016/j.jhg.2010.03.004

Mukhlis, A., Marzuki, M., Rahman, I. (2019) Introduksi Metoda Penanggulangan Parasit Pada Benih Kerang Mutiara Pinctada maxima di Dusun Siung, Desa Batu Putih, Kabupaten Lombok Barat. Prosiding PEPADU LPPM UNRAM, 1:325-332. e-ISSN: 2715-5811. Retrieved from https://jurnal.lppm.unram.ac.id/index.php/prosidingpepadu/article/viewFile/50/50

Mushaffa W. O., Hamzah, M., Nur, I. (2018). Pertumbuhan cangkang kerang mutiara *Pteria penguin* yang diimplantasi yang dibudidayakan dengan metode gantung di Perairan Palabusa Selat Buton. *Jurnal Sains dan Inovasi Perikanan*, 2(2):55-59. http://dx.doi.org/10.33772/jsipi.v2i2.7574

Ningsih, (2017). Rekayasa Teknik Pembenihan Tiram Mutiara (Pinctada maxima, Jameson) di Laboratorium: Laporan Tahunan BBL Lampung. DKP, Dirjen Perikanan Budidaya, BBL Lampung: 72-81.

Nur, I., Mushaffa, W. O., Hamzah, M. (2020). Effect of number of nuclei and nucleus position on shell growth and mabe pearl coating in *Pteria penguin* cultured in coastal waters of Southeast Sulawesi, Indonesia. *Journal of Shellfish Research*, 39(2):1–7. https://doi.org/10.2983/035.039.0216

Oktaviani, T., Cokrowati, N., Astriana, B. H. (2018). Tingkat kelangsungan hidup spat kerang mutiara (pinctada maxima) dengan kepadatan yang berbeda di balai perikanan budidaya laut (BPBL) Lombok. *Jurnal Kelautan*, 11(1):47-55. http://doi.org/10.21107/jk.v11i1.3136

Sujoko, A. (2010). Membenihkan Kerang Mutiara. Insan Madani. Yogyakarta. 89 pp.

Teitelbaum, A., Southgate, P. C., Beer, A., Ngaluafe, P. F., Finau, M. (2008). Support for Tongan half- pearl industry. *SPC fisheries newsletter*, 125: 40-44.

van Eck, N. I. Waltman, L. (2018). VOSviewer manual.

Wardana, I. K., Sudewi, Supii, A. I., Sembiring, S. B. M. (2014). Seleksi benih tiram mutiara (*Pinctada maxima*) dari hasil pemijahan induk alam dengan karakter nacre putih. *Jurnal Research Aquaculture,* 9(1):1-13. http://dx.doi.org/10.15578/jra.9.1.2014.1-13

Winanto, T. (2004). Memproduksi Benih Tiram Mutiara. P.T. Penebar Swadaya, Jakarta. Seri Agribisnis. 95p.

Wullur, S., Napitupulu, H., Ginting, E.L., Mamangkey, N.G.F., Louisianawantania, L., Smolak, R., Ogello, E. (2020). Molecular identification of bacteria isolated from culture medium of the gold-lipped pearl oyster *Pinctada maxima* larvae. *Biodiversitas*, (11):5291-5297. https://doi.org/10.13057/biodiv/d211133