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Studi populasi dan distribusi *Austruca annulipes* (kepiting biola berkaki cincin) di mangrove Muara Kali Ijo, Kebumen, Jawa Tengah, Indonesia

Population and distribution study of *Austruca annulipes* (ring-legged fiddler crab) in Ijo River Estuary mangrove, Kebumen, Central Java, Indonesia

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Abstrak. *Fadilah RN, Yulia IT, Alfitra ZS, Armadhan WS, Widyaningtyas R, Rahmayani D, Permatasari DP, Igustita, Kusuma D, Prambudi SA, Berlin GE, Triyanto A, Yap CK, Setyawan AD. 2023. Studi populasi dan distribusi* Austruca annulipes *(kepiting biola berkaki cincin) di Mangrove Muara Kali Ijo, Kebumen, Jawa Tengah, Indonesia. Pros Sem Nas Masy Biodiv Indon 9: 178-185.* Ekosistem mangrove merupakan ekosistem yang memiliki peran yang sangat penting, terutama dalam jasa lingkungan yang disediakannya. Salah satu fauna khas ekosistem mangrove adalah *Austruca annulipes* (H. Milne-Edwards, 1837). Penelitian ini bertujuan untuk mengetahui kepadatan populasi dan pola sebaran *A. annulipes* di kawasan mangrove Muara Sungai Ijo, Ayah, Kebumen, Indonesia. Lokasi penelitian digunakan untuk ekowisata, dan ekosistemnya perlu dievaluasi untuk menjaga kelestariannya. Salah satu cara untuk menjaganya adalah dengan mengidentifikasi spesies krustasea karena memiliki peran penting dalam ekosistem mangrove dan dapat digunakan sebagai bioindikator lingkungan. Pengambilan data dilakukan dengan menggunakan teknik purposive random sampling dengan membuat 22 plot persegi berukuran 10m x 10m. Selanjutnya dilakukan pengambilan data berupa dokumentasi morfologi dan aktivitas *A. annulipes* untuk identifikasi, data abiotik, dan data jumlah individu yang akan dianalisis dengan menggunakan perhitungan indeks kerapatan jenis dan Indeks Morisita. Berdasarkan hasil penelitian diperoleh kepadatan populasi *A. annulipes* sebesar 1,38 individu/m^2 dan nilai Indeks Morisita sebesar 1,53 dengan kategori distribusi mengelompok.

Kata kunci: Bioindikator, ekosistem mangrove, ekowisata, indeks morisita, krustasea

Abstract. *Fadilah RN, Yulia IT, Alfitra ZS, Armadhan WS, Widyaningtyas R, Rahmayani D, Permatasari DP, Igustita, Kusuma D, Prambudi SA, Berlin GE, Triyanto A, Yap CK, Setyawan AD. 2023. Population and distribution study of* Austruca annulipes *(ring-legged fiddler crab) in Ijo River Estuary Mangrove, Kebumen, Central Java, Indonesia. Pros Sem Nas Masy Biodiv Indon 9: 178-185.* The mangrove ecosystem is an ecosystem that has a very important role, especially in the ecosystem services it provides. One of the typical faunas of the mangrove ecosystem is the *Austruca annulipes* (H. Milne-Edwards, 1837). This research aims to determine the population density and distribution pattern of *A. annulipes* in the Ijo River Estuary mangrove, Ayah, Kebumen, Indonesia. The research location was used for ecotourism, and its ecosystem needs to be evaluated to maintain its sustainability. One way to keep it is to identify the crustacean species because they have an essential role in the mangrove ecosystem and can be used as environmental bioindicator.. Data was collected using a purposive random sampling technique by 22 square plots making, measuring 10m x 10m. Furthermore, data were collected to document the morphology and activity of *A. annulipes* for identification, abiotic data; and the number of individuals to be analyzed using species density index and Morisita Index. The research shows that the population density of *A. annulipes* is 1.38 individuals/$m^{2,}$ and the Morisita Index value is 1.53 in clumped distribution category.

Keywords: Bioindicators, crustacean, ecotourism, mangrove ecosystem, morisita index

INTRODUCTION

Indonesia is geographically located between two oceans and continents, namely the Indian and Pacific Oceans and the continents of Asia and Australia. The existence of Indonesia, which is located on the equator, also makes Indonesia an abundance of types of living things, both on land and in water. This is due to Indonesia's geographical location which makes Indonesia affected by sunlight all year round, has a large amount of rainfall, and its archipelago-shaped territory supports this density. This diversity is also caused by Indonesia's unique position, which makes Indonesia have flora and fauna that are characteristic of two continents. The existence of this makes Indonesia often referred to as a mega biodiversity country (Erfina 2021). The diversity of creatures makes an ecosystem more complex so that it will be more resilient in the face of change than ecosystems with less diversity of living things. The biodiversity makes food webs work and ensures that every living thing in it can carry out its role. Besides that, the diversity of living things can also be used as an indicator of the health of an ecosystem (Simanjuntak 2020). Reasons like that make the diversity of living things in Indonesia need to be maintained.

One living creature with a high diversity and plays a major role in Indonesia is mangrove vegetation. Mangroves are a group of dicot plants that grow in brackish areas and are affected by sea tides (Sumar 2021). Mangrove ecosystems have important functions such as carbon absorption, habitat for various living things, preventing abrasion in coastal areas, etc. Extensive mangrove ecosystem areas will have high biodiversity. The uniqueness, uniqueness, and diversity caused by the location of the mangrove ecosystem, which is located between land and sea and is in sub-tropical and tropical areas (Rahman et al. 2021). Living things in the mangrove ecosystem are characterized by their ability to live in flood plain areas and tidal cycles and their tolerance for salinity. According to Melo et al. (2020), the existence of mangrove ecosystems can support aquatic biota's life because they have high carried capacity and productivity values. Within the mangrove ecosystem area, many types of biodiversity exist, such as birds, amphibians, reptiles, mammals, fish, shellfish, gastropods, crabs, plankton-eating bivalves, acacia, umbrella tree, and so on. The biodiversity in mangrove ecosystems can strengthen the function of mangrove ecosystems as natural biofilters (Vincentius 2022). And diversity has a crucial role to maintain the health of the mangrove ecosystem itself.

The presence of crabs in mangrove ecosystems can positively impact soil fertility (Putriningtias et al. 2019). One type of crustacean species that dominates the mangrove area is *Austruca annulipes* (H. Milne-Edwards, 1837). This crab is defined as one of the fiddler crab species that can be found along the coastline. The population density of *A. annulipes* in mangrove areas can be caused by the availability of food and substrates to support its life. *Austruca annulipes* is a species of crab with a black-and-white patterned carapace. In addition, the manus and merus of *A. annulipes* are orange, while the dactylus and polex have white (Saidah et al. 2021). In this case, the carapace size of an adult male *A. annulipes* can reach up to approximately 40 mm.

The Ijo River Estuary mangrove ecosystem area, Kebumen, is located on Ayah-Karang Bolong Argopeni street, Ayah Sub-district, Kebumen District, Central Java, Indonesia. The mangrove area is not far from the Logending Beach area, Kebumen, and has an area of approximately 18 hectares. Within the Ijo River Estuary mangrove area, Kebumen has various types of mangrove plants, with the most dominant type of mangrove being *Rhizophora mucronata* Lam. It is the dominant mangrove species in this area because it can be used to conserve and mitigate disaster threats. Therefore, the existence of research on crabs in mangrove ecosystems can be utilized in improving mangrove ecosystems (Irwansyah et al. 2021). Furthermore, this research was motivated by the absence of research on population density and distribution patterns of *A. annulipes* in Ijo River Estuary mangrove area, Kebumen. Therefore, this study was conducted to determine the population density and distribution pattern of *A. annulipes* in the Ijo River Estuary mangrove area, Kebumen District.

MATERIALS AND METHODS

Study areas

This research was conducted in November 2022, located in the Ijo River Estuary mangrove Area, Kebumen District, Central Java, Indonesia. Locations for taking plots were carried out in two different places, namely Momongan Island and the Kebumen Mangrove Forest.

The two places are separated by the waters of Ijo River at a distance of 2.6 km^2. Ijo River Estuary mangrove Area is located at coordinates -7.719517604134595 LS, 109.39199665396639 BT. The location is known to have a large area of mangrove forest and is actively used for mangrove biodiversity conservation. This creates a mangrove ecosystem that includes crustacean species, especially *A. annulipes*.

Sampling techniques

In the data collection process for this study, 22 plots measuring 10m x 10m were used in several locations using a purposive random sampling technique. This technique applies because the needs and criteria for the plot to be taken are known so that population observations are more targeted (Palinkas et al. 2015). In addition, the plot criteria used as a reference can be adjusted to the substrate conditions and sea tides at the observation site. Sampling observations were made on *A. annulipes* species, including the number of individuals in each plot, activities, behavior, and abiotic factors that affect the ecosystem. Parameters of abiotic factors measured were temperature (water, air, and soil), pH (water and soil), humidity, and water salinity. Observing activity and behavior in species *A. annulipes* is done by observing the movements of each individual with the help of documentation in the form of photographs and taking one individual as the observation sample. The technique of taking individual samples is done with a tool in the form of a clamp. Then, the identification of *A. annulipes* was carried out by observing the morphology of the individual samples. The captured samples were preserved using 70% alcohol. At the end, naming the body parts of the crab is done by studying the literature by books or journals.

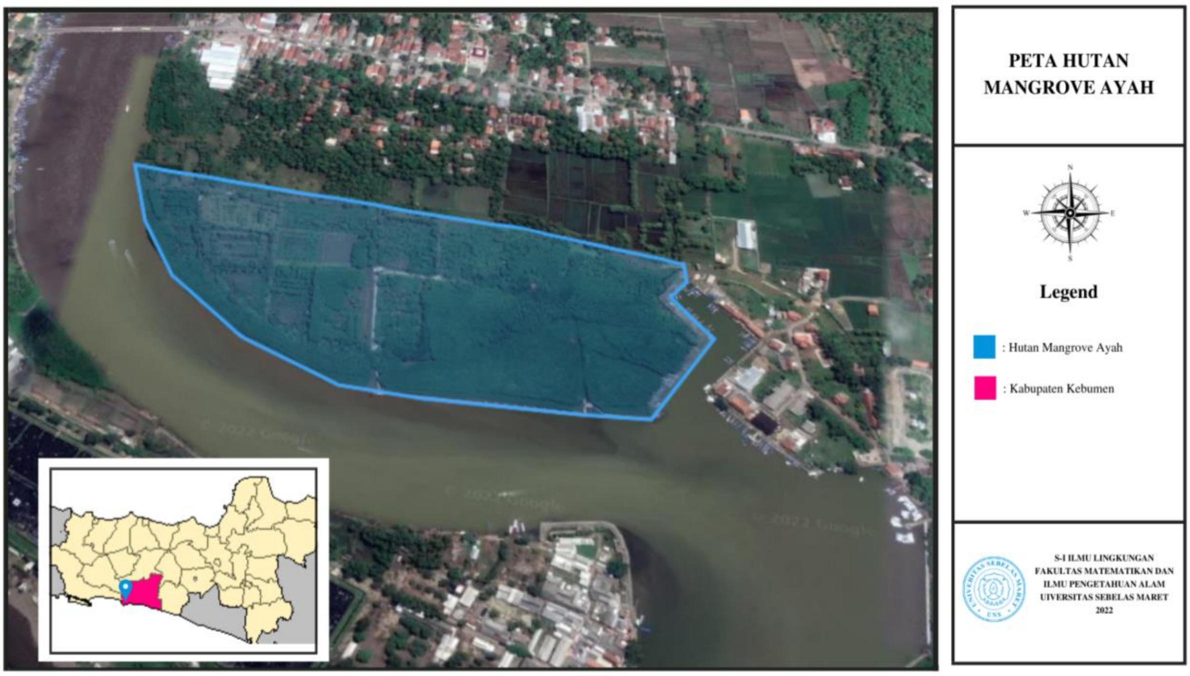

Figure 1. Map of research Momongan Island and Ijo River Estuary mangrove, Kebumen District, Indonesia

Data analysis

This study was analyzed by knowing the population density and distribution pattern of *A. annulipes* species. Population density is defined as the density number of the number of individuals to the total number of individuals present in all plots that have been taken (Jacobs et al. 2019). The following formula can calculate the population density :

$$N = \frac{\Sigma ni}{A}$$

Where:
N : Crab population density (ind/m^2)
∑ni : Total number of individuals for species i (individuals)
A : The total area of the sampled area

Then an analysis of the distribution pattern was carried out using the Morisita Index (Id) formula (Machrizal et al. 2014) as follows:

$$Id = n\,\frac{\sum X^2 - \sum X^2}{(\sum X)^2 - \sum X}$$

Where:
Id : Morisita spread index
N : Number of picking plots
ΣX : Number of individuals in each plot
ΣX^2 : The number of individuals in each plot is squared

After being analyzed, the obtained Morisita index (Id) values are interpreted as follows:
Id = 1, has a random distribution pattern
Id < 1, has a uniform distribution pattern
Id > 1, has a clumped distribution pattern

RESULTS AND DISCUSSION

Ijo River Estuary mangrove profile

Ijo River Estuary mangrove, or what is known as Ijo Mangrove Forest, is an area that is located adjacent to Logending Beach, Ayah Sub-district, Kebumen District, Indonesia. This area has been recognized and decided by the Provincial Government of Central Java to be one of the Essential Ecosystem Areas (KKE) of Central Java Mangrove Wetlands. The designation of the Ijo Mangrove Forest was ratified based on the Decree of the Governor of Central Java Number 552.52/31 of 2020 on 29 June, 2020. This determination is based on the ecosystem services provided by the mangrove forest area, which give important value to ecological, socio-economic, and local and general community culture (Murniasih et al. 2022). Based on the services provided, the mangrove area's manager makes it ecotourism and aims to attract tourists. The existence of ecotourism potential in this mangrove area is related to the economic value that has a good impact on local communities (Pratama and Wibawanto 2019). In addition to economic value, this also impacts ecological value, namely as a habitat for mangrove biodiversity. Mangrove species that have been marked as growing in this forest consist of *Sonneratia caseolaris* (Apple Mangrove), *Avicennia marina* (Mangrove *Api Api*), *Rhizophora apiculata* (Red Mangrove), *Rhizophora mucronata* (Pure Mangrove or Oil Mangrove), *Acanthus ebracteatus* (Jeruju Mangrove), *Acrostichum aureum* (Sea Nail), *Bruguiera gymnorrhiza* (Mangrove Tancang) and *Nypa fruticans* (Mangrove Nipah). Not only the variety of mangroves, but there is also another biodiversity that lives in the mangrove habitat, including birds, molluscs, crustaceans, fish, and others.

Population density and distribution pattern of *A. annulipes*

Austruca annulipes is a species that has a wide distribution in the Indonesian archipelago. With the density of these species, there is a mutually influential correlation between the organic matter content and the substrate. This shows that the higher the value of organic matter content, the higher the population density of *A. annulipes* species in the region (Krisnawati et al. 2018). The density of viable mangrove plants can affect the population density of *A. Annulipes* species. The Ijo River Estuary mangrove forest area, Kebumen District, Central Java, is where *A. annulipes* is found. Different habitat conditions and substrate content cause differences in species composition. The substrate is a very influential environmental factor in supporting the life of *A. annulipes* species. This is because the substrate has benefits as a spawning ground, feeding ground, and nursery ground. This species is active and lives in holes, including entering for shelter when the tide is high and coming out when the tide is low. Substrates that are more shaded by mangrove forests have organic matter (leaf litter, flowers, fruit, roots, twigs) relatively more evenly distributed and more diverse than those that are less shaded. In addition, the role of ocean waves or currents is also important because they act as agents for spreading organic matter or even carriers of organic matter to other places.

Ijo River Estuary mangrove has environmental parameters (Table 2) that match the preferred habitat of *A. annulipes*. The identified habitat characters are intertidal areas, especially around mangrove forests and sandy beaches (Actuti et al. 2019), with soil moisture of 10, neutral soil pH, and soil temperature of 33°C. In addition, the condition of the mangrove plants, which are still proper and well maintained, as well as the soil in the Ijo River Estuary mangrove area at low tide, is in the form of moist and water-saturated mud. The suitability of the parameters and habitat conditions of Ijo River Estuary mangrove resulted in a high population density of the species *A. annulipes*. The microclimatic factor of the Ijo River Estuary mangrove environment is also considered cool so that the substrate conditions become more comfortable for *A. annulipes* and the soil condition in the Ijo River Estuary mangrove area at low tide is in the form of moist and water-saturated mud. The suitability of the parameters and habitat conditions of Ijo River Estuary mangrove resulted in a high population density of the species *A. annulipes*. The microclimatic factor of the Ijo River Estuary mangrove environment is also considered cool so that the substrate conditions become more comfortable for *A. annulipes* and the soil condition in the Ijo River Estuary mangrove area at low tide is in the form of moist and water-saturated mud. The suitability of the parameters and habitat conditions of Ijo River Estuary mangrove resulted in a high population density of the species *A. annulipes*. The microclimatic factor of the Ijo River Estuary mangrove environment is also considered cool so that the substrate conditions become more comfortable for *A. annulipes*.

In Table 1, the population density of *A. annulipes* distribution in Ijo River Estuary mangrove, Kebumen, Central Java, with a total of 22 plots is 1.38 ind/m^2. The population density distribution of *A. annulipes* in Indonesia has also been proven in studies conducted in several locations, such as in the waters of Bahowo Manado, which is the highest species among other species with a total of three observation stations, namely 0.126 ind/m^2 (Michael et al. 2020). Then, in the Pagatan Besar Mangrove ecotourism area, Tanah Laut District, there was an increase in the density of *A. annulipes* caused by the type of substrate and direct exposure to sunlight with species densities at three successive bridges, namely 0.42 ind/m^2, 1.08 ind/m^2, and 8.50 ind/m^2 (Fauzan et al. 2020). The distribution pattern of *A. annulipes* can also be based on the mud substrate as a favorable characteristic of abiotic conditions, as happened on the south coast of Bangkalan District, where *A. annulipes* was found in a sandy clay substrate habitat with a population distribution density of 1.93 ind/m^2 (Nur and Kunjtoro 2021). In addition, there are observation plots where no *A. annulipes* or the holes dug are found because the substrate is too dry, so it does not support the life of *A. annulipes*. According to Septiani et al. (2019), substrates that are not reached by sea tides cause the substrate to dry and harden. This made it difficult for *A. annulipes* to dig and enter the hole. Then, in research in the mangrove ecosystem area of Pasir Village, West Kalimantan, the population density distribution of *A. annulipes* in the four plots was classified as low, namely 0.98 ind/m^2, 0.96 ind/m^2, 0.99 ind/m^2, and 0 ind/m^2. The low population density of the distribution of these species in Pasir Village was reported due to the influence of human activities, such as logging and pedestrian activities. Both of these can reduce the population density of *A. annulipes* because the environment will experience pressure and physical changes caused by humans.

Figure 2. Habitat of *A. annulipes*

Based on the distribution pattern, *A. annulipes* in Ijo River Estuary mangrove tended to be clumped with the results of calculating the Morisita Index obtained, namely 1.53. The distribution pattern closely relates to environmental conditions (Haruna et al. 2022). The distribution pattern is divided into 3, namely clumped, random, and evenly or uniformly (Widiastuti et al. 2015). This clumped distribution pattern occurs when the distance between one location and another is close together. In addition, clumped distribution patterns may indicate that socio-ecologically the existence of food or drink is concentrated in certain locations (Metananda et al. 2016), or it could also be due to avoiding predators. According to Sulistiyowati et al. (2021), this distribution occurs when the food sources needed are spread unevenly. The nature of the clumped distribution pattern can also be caused by several factors, such as the type of substrate, eating habits, environmental conditions, and reproductive activities that support the survival of *A. annulipes*. The more activities this species reproduces, the more clumped distribution patterns are found.

Habitat abiotic factors

In terms of survival, one of the faunas that inhabit mangrove areas such as *A. annulipes*, makes it dependent on various abiotic factors with certain characteristics. A suitable abiotic factor is very helpful in contributing as a role holder in the mangrove ecosystem. In this study, the Ijo River Estuary mangrove area, the environmental parameters used as benchmarks were temperature (°C), acidity (pH), soil moisture, and salinity (Table 2). The results of measurements of water temperature were in the range of 33°C-37.8°C, air temperature in the range of 32°C-36°C, and soil/substrate temperature in the range of 33°C-34°C. Meanwhile, according to Rahayu et al. (2018), in research conducted in the Mangrove Area in Purworejo District, Central Java, the general temperature of *A. annulipes* lives in mangroves in the temperature range of 23°C-32°C. But basically, the range of temperature intervals that can be tolerated for good crab survival is between 12°C-35°C and will experience good growth between the temperature range of 23°C-32°C. (Septiani et al. 2019). The habitat of A. *annulipes* in open mangrove vegetation locations and the time of data collection during the day will affect the temperature measurements at that location to be higher. Due to the discovery of many *A. annulipes*, the temperature range measured at the observation site was still within the tolerance interval for the species to grow and develop. Besides that, soil/substrate conditions with a temperature range of 33°C-34°C and humidity of 10 RH are suitable for the life of *A. annulipes*.

Based on the habitat conditions of *A. annulipes* at the location, it was observed that the soil pH was 7 and the water pH range was 7.7-7.9, which tended to have weak alkaline properties. This weak base is due to the sampling location's different water and humidity content. However, if the pH < 5 and > 9, it will cause conditions detrimental to the life of macrozoobenthos, including crustaceans. Natania et al. (2017) said that the degree of acidity (pH) influences the condition of fertile waters because it impacts the survival of microorganisms. In this case, the research location is in a good pH content and is suitable to be tolerated by the plants that make up the mangrove ecosystem so that the resulting leaf fall can be sufficient for the life of the violin crab (*A. annulipes*) (Sari et al. 2018). Based on the results of observational data, the salinity is obtained, which is in the range of 5-10 ppt. According to Rahayu et al. (2018), the range of salinity to support crab life has oligohaline values (0.5-5 ppt) to mesohaline values (5-18 ppt), so that fiddler crabs including *A. annulipes* can grow and develop properly. Mangrove areas are affected by the presence of freshwater runoff from the mainland and seawater that enters from the direction of the river mouth so that it experiences fluctuations in salinity values (Irwansyah et al. 2021).

Morphology of *A. annulipes*

Different conditions in each region can affect the genetic aspects of an individual, so these genetic differences can potentially cause genetic dispersion between populations. Likewise, differences in the habitat inhabited by the *A. annulipes* population can lead to differences in the phenotype of each individual. Therefore, in the identification process, a phenotypic approach is needed. This is because the level of morphological similarity between *A. annulipes* species is quite high (Baksir et al. 2022). The morphological similarity of *A. annulipes* is due to the authenticity of the description of the variation or the natural conditions that occurred since the previous subspecies. Therefore, the diversity of this species population can be identified by morphological identification. Besides that, the existence of morphology can be information related to the diversity and adaptation of fiddler crabs to the surrounding environment (Suprayogi 2013; Riswandi and Febriyani 2022).

Table 1. Results of population density and distribution pattern of *A. annulipes*

Species	Number of individuals	Number of plots	Total area (m^2)	Population density value (ind/m^2)	Distribution index
A. annulipes	3038	22	2200	1.38	1.53 (clumped)

Table 2. Results of measurement of abiotic factors Ijo River Estuary mangrove area

Abiotic factors	Temperature (°C)			pH		Humidity (RH)	Salinity (ppt)
	Water	Air	Soil	Water	Soil		
	33-37.8	32 -36.7	33-34	7.7-7.9	7	10	5-10

Based on the observations that have been made, *A. annulipes* species of various sizes were found. According to Sawitri et al. (2019), the body size of *A. annulipes* ranges from 25-60 mm, with a trapezoidal carapace shape patterned with white spots and a predominantly black body (Figures 3 and 4). Even so, the carapace color of *A. annulipes* varies, the factor that causes the color difference is exposure to sunlight. In the observation habitat, *A. annulipes* was found to have a fairly bright color, and this is because the area is in open mangrove vegetation. The specific morphological feature of *A. annulipes* is one of its large pincers (Figure 5). The claw is formed by the propodus, which consists of the polex, manus, and dactilus is move fingers. However, the polex is slightly wider than the dactylus (Naderloo et al. 2016). Another part of the physique of *A. annulipes* is the wide and narrow carapace face (rostrum). Narrow rostrums tend to have long eye stalks, while wide rostrums have short eye stalks. Long-eye stalks are found in A. annulipes in open mangrove vegetation habitats and are exposed to the hot sun so that their vision range is wide. Then it can be seen from the bottom that *A. annulipes* has an abdominal morphology located on the ventral part of the body between the middle of the chest cavity bones. The abdomen has a lid, namely an abdominal flap in the form of a plate-like organ as a protective pleopod (gonopod).

Morphology *A. annulipes* between males and females have sexual dimorphism in the form of different claws. In male *A. annulipes* one of the pincers is large, whereas in female *A. annulipes* both pincers are small in size and symmetrical in shape (Murniati and Pratiwi 2015). Then, based on color identification, female *A. annulipes* tend to be darker when compared to male *A. annulipes* (Actuti et al. 2019). Another difference in the morphology of *A. annulipes* lies in the abdomen namely the male abdomen has an elongated triangular shape, while the female abdomen has a wide and rounded abdomen. The wider abdomen in females is used as a container for the eggs. The abdominal width of female *A. annulipes* ranges from 3.5-9.0 mm, while in male *A. annulipes* the width of the abdomen ranges from 3.5-6.0 mm (Hasan et al. 2014).

Behavior *A. annulipes*

The maximum concentration of *A. annulipes* is during high tide especially at night. *A. annulipes* forages by climbing the roots and trunks of mangrove trees. Then, they will stay in the hole to be able to protect themselves from predators. *A. annulipes* eats by moving the claws repeatedly from the substrate to the mouth and then back to the substrate, similar to the movement of a violinist when moving a violin bow (Figure 6) (Sari et al. 2018).

Austruca annulipes acts as a detritus eater, including organic matter, algae, and bacteria found on the sand surface or in silt particles. This species will rise to the surface to scrape pieces off the substrate using its small pincers and then insert it into the mouth. *Austruca annulipes* have a maxilliped in the mouth. The maxilliped works together with a tipped spoon to separate the organic particles eaten. Meanwhile, inorganic material that is not used will be released as lumps. In its habitat, *A. annulipes* makes holes from the surface to the middle of the sediment and provides oxygen input into the holes. Generally, *A. annulipes* likes sandy soil habitat types because it makes it easier to make holes and has a high litter content so that the organic matter produced is abundant. Thus, the substrate is one of the environmental factors that have an important role in meeting the needs for intake or nutrition for *A. annulipes* so that the substrate conditions in Ijo River Estuary mangrove, Kebumen can be said to be following optimal conditions to support the survival of *A. annulipes*.

In animal species, fights between members can occur to defend their territory. Species of *A. annulipes*, especially males, will form a coalition or fight between residents and intruders to fight over an area so it can be used as a place to live and breed. The pincers of *A. annulipes* were used to compare claw performance between crabs. In addition, *A. annulipes* have a reflex to vibrations in the habitat around crabs. The results of the observations in this study also show that *A. annulipes* is very sensitive to vibrations. If there is vibration around the species' habitat, the species will quickly go back into the hole to hide, and then when there is no vibration, the crabs will reappear. According to Actuti et al. (2019), human activities that produce vibrations or noise pollution contradict the description of the preferred habitat for *A. annulipes*, which is a quiet habitat so that if there is a certain movement or vibration, it will cause *A. annulipes* to immediately protect itself by returning to the hole and hiding.

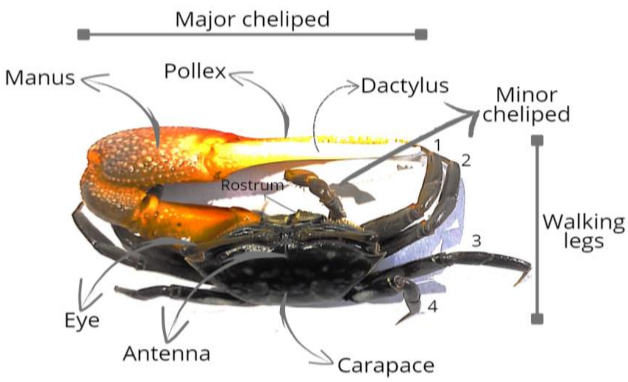

Figure 3. Upper Morphology of *A. annulipes*

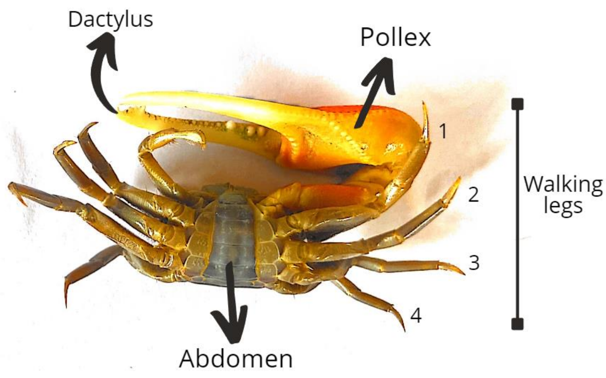

Figure 4. Lower Morphology of *A. Annulipes*

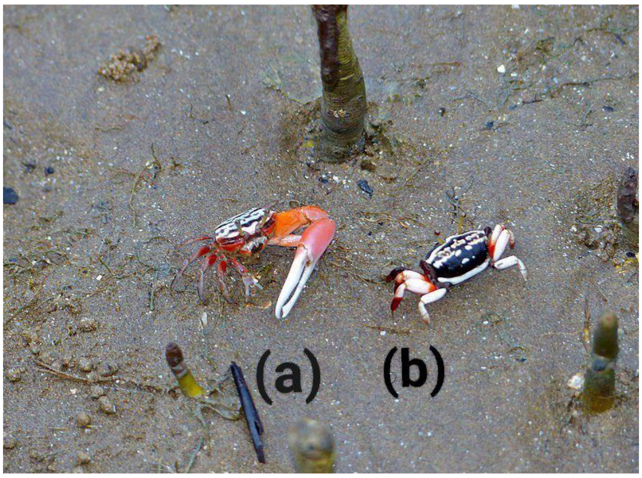

Figure 5. Morphology of *A. annulipes*. A. Male, B. Female (Source: Bernard 2014)

Figure 6. Behavior of *A. annulipes*

In conclusion, based on the research, the population density of *A. annulipes* in the Ijo River Estuary mangrove area, Kebumen, obtained a density index value of 1.38 individuals/m² for a total of 22 observation plots. The existence of *A. annulipes* species in mangrove areas can be influenced by abiotic factors such as soil moisture, pH, temperature, and salinity. Based on the abiotic data obtained, it is known that the abiotic indicators in the Ijo River Estuary mangrove area, Kebumen, are included in optimal conditions to support the survival of *A. annulipes*. In addition, based on the results of calculating the Morisita Index of the distribution pattern of *A. annulipes* in the Ijo River Estuary mangrove area, Kebumen tends to be clumped with a calculation result of 1.53. In this case, the distribution of *A. annulipes* in the Ijo River Estuary mangrove area, Kebumen, is in an intertidal area close to mangrove forest areas and is in a sandy beach area. Therefore, it is hoped that this research can serve as a guideline for future research and a reference in the management and development of the Ijo River Estuary mangrove ecosystem so that the preservation of the mangrove area can be properly maintained.

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