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Effects of Environmental and Nutritional Factors to the Density of Larvae Anopheles Spp. in Coastal Endemic Bulukumba, Indonesia

Hasanuddin Ishak[1*], Besse Irna Tawaddud[2] and Ridwan Amiruddin[1]

[1]Department of Environmental Health, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

[2]Environmental Health Academy of Muhammadiyah, Makassar, Indonesia

***Corresponding author**

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Environmental Factor, Nutrition, Density of Anopheles Larvae, Coastal Bulukumba

A B S T R A C T

Bulukumba coastal area could be potentially support a breeding site larvae of Anopheles spp. This research aimed to analyze the degree of the direct and indirect of the environment and nutrition factors on the larva density of Anopheles spp. along the coastal area of Bulukumba. The research used the ecological study. The environment samples comprised 50 points of the breedingsite that were chosen based on certain criteria. The data collection was conducted using the in-situ mesurement and the laboratory test. Data were analyzed using path analysis regression (the coefficient β and $\alpha=p\leq 0{,}05$) and SPSS. Research result indicated that the greatest total effects (direct and indirect effects) of the environment and nutrition factors on the larva density of Anopheles spp. was the vegetation covered channel to the larva density of Anopheles spp. ,the value of 0,454 (45,4%) while the rest 54,6 % was explained by other factors outside the model. The conclusion of this study that there is a direct and indirect influence of environmental factors and nutrients to the density of larvae of Anopheles spp. at Bulukumba coast. Environmental modifications can be applied to the vegetation cover to control an abundance of Anopheles larvae by using a Grass Carp Fish.

Introduction

In 2010 in Indonesia, the number of malaria cases were 229 819 cases and second ranks in the ASEAN after Myanmar (WHO, 2012). South Sulawesi Province currently has the status of endemicity with the data recorded in 2011 API of 0.38 ‰ and the highest case was rediscovered in Bulukumba and Selayar (Health Department, 2012; Ministry of Health, 2011).

Bulukumba the tropics with some coastal areas. Tropics is the ideal zone for diseases transmitted through mosquito vectors (Gouagna, 2012). Although each type of species of Anopheles spp. has the characteristics of breeding habitats different for each geographic zone, the coastal state has the potential to be a good habitat for larvae of Anopheles spp.

Coast of environmental conditions have distinctive characteristics. Changes in physical factors (temperature, light, water, and waves), chemical factors (levels of chloride and organic pollution), and biological factors (vegetation water, food, and natural enemies) can cause changes in the breeding habits of the mosquito larvae (Liu et al., 2012). Need a basic understanding of the ecology of Anopheles spp mosquito larvae. in planning and implementing interventions as an effective vector control strategies (Mereta et al., 2013). Understanding of space and time distribution of the resources available for food mosquito larvae in natural habitats could clarify the relationship between the availability of food for mosquito development. However, the quantity and quality of available food source for the larvae are often neglected in the study larval growth.

Khan research (2013) stated that an environmentally friendly approach to vector control should be explored. Research Gilbreath (2013) showed that there are still relatively few studies that examine the actual partition of larval competition for food sources. Then, Imbahalle Research (2011) stated that the larvae control can be achieved through environmental management and environmental manipulation in reducing human contact with the pathogen vectors. This study aims to analyze the influence of the direct and indirect environmental and nutritional factors on the density larvae of Anopheles spp. in Bulukumba coast, Indonesia

Methods

Research Design

This type of study is an observational study with ecological studies, and use a map to describe the distribution of Malaria.

Location and Time Research

The study was conducted in April-June 2014 in the Bulukumba coast i.e., District of Gantarang Ujung Bulu, Ujung Leo, Bonto Bahari, and Bonto Tiro. Site selection was based on the presence of reported cases of malaria incidence in coastal areas Bulukumba health centre. In addition, the geographical conditions Bulukumba coastal areas have environmental characteristics that may support the existence of breeding sites of Anopheles spp larvae, as seen in the following map.

Population and Sample

The population in this study were all habitats of Anopheles larvae in the Coastal Zone of Bulukumba. Samples from this study were all Anopheles larvae positive habitats that meet the inclusion and exclusion criteria that were 50 points of breeding sites by purposive sampling technique.

Data analysis

The influence of environmental and nutrients factors to the larvae of Anopheles denisity analyzed using path analysis with SPSS regression to obtain the coefficients ß and significant if $p < 0.05$. The data collection for temperature and pH using a pH - thermometer Hanna *HI* 8424, using a stick measuring depth, salinity using a refractometer Atago, vegetation cover using transect quadrant (1x1 m), and total coliform using Wagtech Potaflex® Microbiological Water Quality Laboratory, and the density of larvae of Anopheles spp . using the WHO standard dipper.

Path analysis is done by the following procedure: path analysis model development should be based on causal relationships that have a strong theoretical justification and established a causal relationship expressed in equation form made prior to path analysis (Suwarno, 2007). The next step after the model is determined to test the assumption base on path analysis on the relationship between the variables in the path analysis should be linear and adiftif, only recursive models that can be considered minimal endogenous variables in the scale measuring interval, the last step in the pathway analysis is to determine the interpretation of the analysis results pathways and identify the significant influence that the effect is stronger pathways by comparing the magnitude of the standardized path coefficients. Beta coefficient is a direct effect, while the indirect effect is done by multiplying the beta coefficients of the variables passed. The net effect is calculated by summing the direct effect and indirect effect.

Results and Discussion

Sample characteristics

In table 1, it can be seen that the type of breeding site the most in the study area was a swamp with the highest density of larvae capture 191/10, while the lowest marsh, lagoon, pond, and river banks with the lowest capture of larval as seen in the following table 1.

In table 2, shows the 50 points obtained breeding site habitat temperatures ranged from 26 to 38.5°C with an average of 31.8 °C, the depth of breeding sites ranged from 4.5 to 70 cm with an average of 21,2 cm, pH breeding sites ranged from 7.24 to 9.8 with an average of 8.13, and a salinity range of 0-2 g / l with an average of 0.4 g / l, vegetation cover breeding site ranged from 10.42 to 87% with an average of 37.5%, total coliform microorganisms in breeding site ranged from 983-16250 g / 100 ml with an average of 3305.4 g / 100 ml and the density of larvae of Anopheles spp. ranged from 0.1 to 19.1 with an average of 3.19.

Direct and Indirect Influence of Environmental Factors and Density Nutrition against larvae of Anopheles spp. Table 3 described the total effect (direct and indirect influence)

temperature, depth, pH, and salinity on the abundance of the vegetation, respectively for 10.9%, 17.7%, 31.45%, and 39.9 %.

Whereas the total effect of environmental factors and vegetation on microbial abundance (total coli), respectively for 28.2%, -33.6%, 23%, - 32.3%, and 26.5% respectively while the total effect individual and environmental factors of each nutrient to the density of Anopheles larvae, respectively for 10.6%, -19.5%, 10.7% 42.1%, 45.4%, and 14.1% while (Figure 1) describes the magnitude of the direct effect of each variable.

Temperature is one of the abiotic environmental factors that contribute to the proliferation of larvae. The higher the temperature, the lower the solubility of oxygen at extreme temperatures Anopheles larvae cannot breed well even to experience death. Suwarno research (2007) states that there is a positive correlation between water temperature and density of larvae and early an.Pharoensis. Gambiae in Ejersa. 's. Gambiae S.L. tolerant of relatively high water temperatures. Environmental factors such as the depth effect on the density of larvae of Anopheles spp. Water depth affects the average larval mortality An. gambie when forced to dive to avoid predators or find food.

Environmental factors such as pH affects the density of larvae of Anopheles spp. This study is in line with Salem’s research (2013) which states that the pH up to 7.61 is a risk factor for high larval density on the breeding and research from Sukowati (2009) which states that the breeding habitats of Anopheles spp. the characteristics of the average normal pH between 7.2-7.6. Environmental factors such as salinity affect the density of larvae of Anopheles spp. Research Harijanto (2010) stated that the Anopheles sundaicus grows optimally at their salinity brackish water and 12-18% do not thrive on salt content 40% and above. However, in North Sumatra were also found sundaicus Anopheles breeding in fresh water. Jude Research (2012) which states that the larvae of Anopheles spp. collected from brackish with salinity ranging from 2-6 ppt. Research Salem (2013) also stated salinity up to 0.1 g / l is a protective factor against high density of larvae and research Ernamaiyanti (2010) stated that the water salinity 0 ‰ less good for the life of Anopheles larvae. and research Sukowati (2009) states that the breeding habitats of Anopheles spp. with 3.0 to 3.5 per mil salinity characteristics.

Nutrition larvae of Anopheles spp. such as microorganisms and vegetation (aquatic plants) affect the density of larvae of Anopheles spp. Numerous studies have documented a positive correlation between larval density and amount of plant cover. Aquatic plants provide a food source for mosquitoes in the form of plant detritus and also encourage other mosquito food production such as bacteria, algae, and protozoa. Research Oliver (2013) states that malnutrition in early larvae. Arabiensis implications for the developmental stages ofadult mosquitoes. Effect of dietary (food) can limit the life of the anopheles larvae and number density. Anopheles Gambie in Africa like freshwater pond or pool of water that is less vegetation. Anopheles stephensi in India like a large pond or swamp marsh vegetation.

Several types of aquatic plants is an indicator for a particular mosquito species such as moss chicken stomach (*Heteromorpha,* sp) and moss silk (*Enteromorpha,* sp). The larvae of Anopheles spp. growing under conditions of nutrient stress suffered when becoming adult mosquitoes require a blood meal before starting more oogenesis. In addition, the effect of different larval nutritional regime on uninfected mosquitoes or infected with the malaria parasite Plasmodium Nigeriensis Yoelii which will slightly contribute to the transmission of malaria (Takken et al., 2013). Larval dispersal uneven surface tends breeding sites, but tend to rely on aquatic plants because the larvae are protected from adverse changes in the aquatic flora and are often microscopic plankton as larvae food being around plants (Santjaka, 2013).

Larval habitats with naturally available supply and / or allochthonous Destritus providing sufficient supplies for larval food source. Environmental factors such as rainfall, solar radiation, air temperature, water temperature, salinity and algae have a significant effect on larval density (Saputri, 2012). This study is in line with research Rejmankova (2013) which states that the density of larvae is controlled by the interaction between abiotic (hydrology, temperature, light / shade, pH, salinity, nutrient availability) with biotic (predators). The types of nutrients larvae of Anopheles spp. the group of microbes and vegetation. Limitations of this study include: Samples of breeding sites is strongly influenced by the weather and season, Examination of microorganisms limited for total coli, and the distance breeding breeding site with other sites still too close because of the time efficiency.

Table.1 Characteristics of Breeding Site types base on Larva *Anopheles spp.* Density in Bulukumba Coastal areas

No.	*Breeding SiteType*	Density of *Anopheles spp.* Larvae		Number	
		Highest	Lowest	n	%
1.	Marsh	19,1	0,1	28	56
2.	Lagoon	9,3	0,1	5	10
3.	Pond	8,8	0,1	15	30
4.	River bank	0,1	0,1	1	2
5.	Canal	0,5	0,5	1	2
		Total		50	100

Source : Primary data, 2014

Table.2 Characteristics of *Breeding Site* Larva Anopheles spp. Base on environmental and nutritional factors in Bulukumba Coastal areas

No.	Variable	Min.	Maks.	Average	SD	n
1.	Temperature (°C)	26	38,5	31,8	±2.94	50
	Depth (cm)	4,5	70	22,02	±14.5	50
3.	pH	7,24	9,8	8,13	±0,60	50
4.	Salinity (g/l)	0	2	0,4	±0,48	50
5.	Vegetations	10,42	87	37,4	±19.6	50
6.	Microorganism	983	16.250	3310,4	±3112.9	50
7	Larva Density	0,1	19,1	3,07	±3.9	50

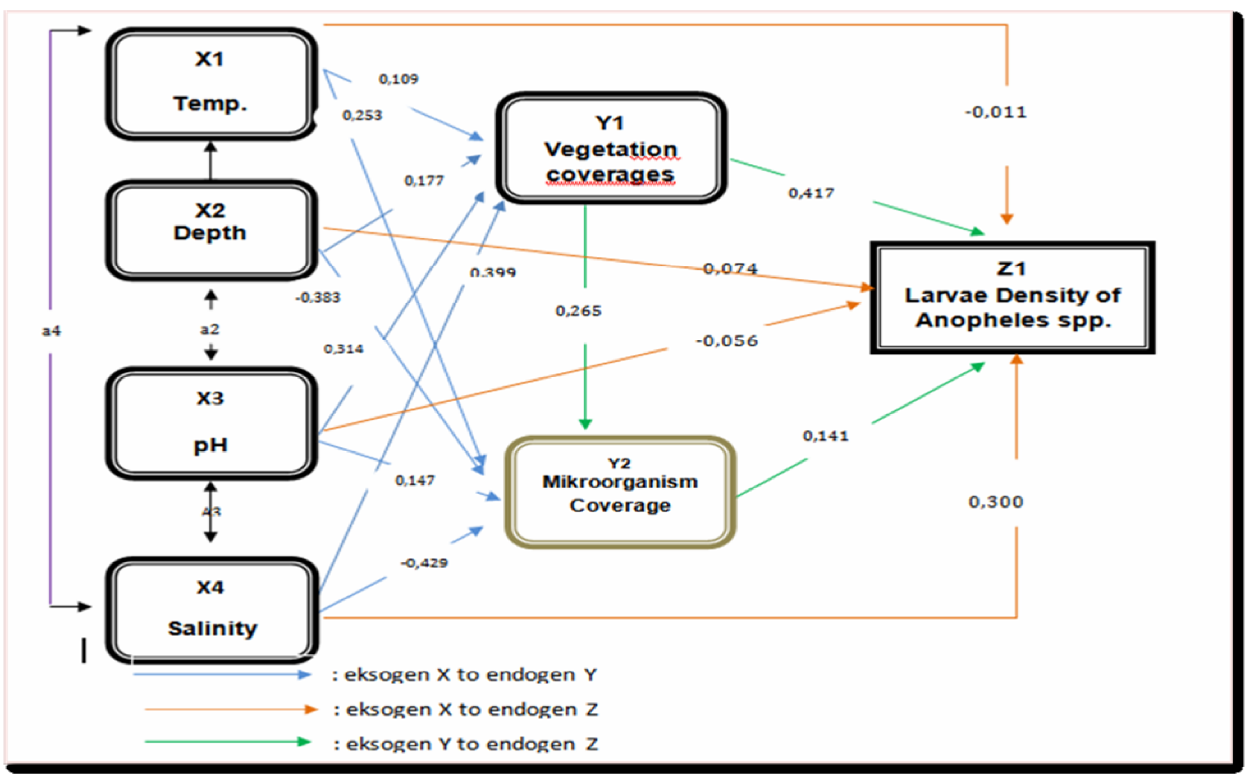
Source : Primary data, 2014

Table.3 Path Analysis Matriks relate to environmental and nutritional factors to Larva Density of *Anopheles spp.*

Model	Variables	Indirect Effect	Direct Effect	Total
X1-Y1	Temp.–Vegetation	0,029	0,109	0,109
X1-Y2	Temp – Microba	0,117	0,253	0,282
X1-Z1	Temp – Density	-	-0,011	0,106
X2-Y1	Depth – Vegetation	0,047	0,177	0,177
X2-Y2	Depth – Microba	-0,121	-0,383	-0,336
X2-Z1	Depth – Density	-	-0,074	-0,195
X3-Y1	pH – Vegetation	0,083	0,314	0,314
X3-Y2	pH – Microba	0,163	0,147	0,230
X3-Z1	pH – Density	-	-0,056	0,107
X4-Y1	Salinity – Vegetation	0,106	0,399	0,399
X4-Y2	Salinity - Microba	0,121	-0,429	-0,323
X4-Z1	Salinity - Density	-	0,300	0,421
Y1-Y2	Vegetation – Microba	0,037	0,265	0,265
Y1-Z1	Vegetation – Density	-	0,417	0,454
Y2-Z1	Microba –Density	0,029	0,141	0,141

Source : Primary data, 2014

Figure.2 *Path Analysis* Model of environmental and nutritional factors effect to the Larvae *Anopheles spp.* density



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