

The estimation of dynamical distribution of domesticated Burgo chicken population in Bengkulu coastal area, Indonesia

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Abstract. *Putranto HD, Hasibuan GP, Yumiati Y, Setianto J, Brata B, Kurniati N, Hakiki FF. 2017. The estimation of dynamical distribution of domesticated Burgo chicken population in Bengkulu coastal area, Indonesia. Biodiversitas 18: 458-464.* As one of the endemic bird species, which inhabits on the west coast of Sumatra and southern Sumatra region, such as Bengkulu Province, Jambi Province and South Sumatra Province, Burgo chicken is recognized as a pet and a socio-economic symbol status for fanciers. The study aimed to monitor the dynamical distribution of male Burgo population domesticated by fanciers in three regencies and a city located in the coastal area of Bengkulu Province. The locations were determined by a purposive sampling method. By using the software in the form of online questionnaire program, enumerators conducted a field survey for four weeks in July-August 2016 by a purposive sampling in three regencies and a city, i.e. Bengkulu City, Seluma District, Bengkulu Utara District and Bengkulu Tengah District. The data obtained in the field were connected and stored in the system provided on a page and could be accessed on a limited basis. Furthermore, the population data were summarized and analyzed by using a Variance-Mean Ratio (VMR) formula to determine the distribution pattern of domesticated male Burgo chicken. The results showed that in the year of 2016 the highest population of male Burgo chicken (53.29% population) was found in Bengkulu Utara District as many as 89 individuals, while the lowest population (1.19% or 2 individuals) was found in Seluma District. Furthermore, it was also known that the distribution of domesticated male Burgo population in the coastal area of Bengkulu Province could be classified as negative binomial distribution or over-dispersed (VMR>1.0). The results of estimation of the dynamical distribution pattern of male Burgo chicken population in the year of 2016 in the coastal areas of Bengkulu Province was similar to the distribution pattern of mixed sex Burgo chicken population in Bengkulu Province in the year of 2009 which was categorized as negative binomial distribution.

Keywords: Burgo, coastal, distribution, dynamic, population

INTRODUCTION

Based on the most recent studies conducted by the conservation experts, the number of fauna species and its population now is ranked as the biggest number of other species in the history (Ceballos et al. 2010). Of those numbers, the bird is one of the species which its population apparently increase significantly each year. However, there is now any opposite trend regarding its population, which massively plummet due to the negative human activities including the destruction of native habitat, pollutant products and uncontrolled exploitation of natural resources. Furthermore, Ceballos et al. (2010) have reported that around 134 of bird species in the world has been noted as endangered species. Of these reasons, the conservation program prior to protecting the fauna species must be conducted and being intensively improved. On the other hand, the utilization of endemic fauna species, which is

widely developed its function will become interested studies to the conservation experts, which it means in line with the goal of the conservation program (Ruetz III et al. 2005). According to Ajayi (2010) who reported that the utilization of endemic fauna species, which has been further developed its function, showing in well-developed progress in both tropical and sub-tropical regions. As an example, in Nigeria almost 80% of total 120 million of domesticated birds derived from the species of endemic chicken.

Indonesia, known as megadiverse country, is habitat for many floras and fauna species. One of them is an endemic bird species, which can be further developed and domesticated. One of the success developments of endemic chicken is Burgo chicken in Bengkulu province (Putranto et al. 2016a, 20016b, 2015, 2012a, 2012b, 2010). Burgo is one of the subspecies from local endemic chicken, which is the same as other local chicken such as Bekisar, Nunukan,

Pelung, Cemani, and Kokok Balenggek. Those endemic chickens are part of the natural plasma resources of Indonesia as well as part of the world fauna treasures. Many types of research has being studied Burgo in decades in terms of its population density based on mixed sex parameter (Putranto et al. 2010), the profiles of reproductive hormone of mature Burgo female and the effect of supplemented-micro nutrition toward its reproductive system (Putranto et al. 2012a), as well as the genetic mapping of ayam Burgo compared to its male parental, Hutan Merah (*Gallus gallus* or *Gallus bankiva*) (Putranto et al. 2012b).

Burgo chicken is one of an endemic fauna in Sumatra island especially Bengkulu province. Burgo can be found in forests in Bengkulu province and also around South Sumatra and Jambi province. Naturally, Burgo lives in *in situ* habitat but recently this species has been widely domesticated in Bengkulu province. The domestication area of this species is located at suburb areas using management system namely semi-intensive domestication. This system has been developed due to there is no established system to domesticate Burgo intensively, yet. Another factor limits the management system of Burgo domestication is the natural-wild behavior (Putranto et al. 2016a, 2016b, 2012b, 2010; Setianto et al. 2016; Setianto 2010, 2009), which lead to the strenuous efforts in domestication program of this species.

Based on the study in mixed sex Burgo chicken population, it has been reported that the population of Burgo from 2004 to 2009 is up to 1,291 individual species (Putranto et al. 2015, 2012a, 2012b, 2010). Those numbers have been dominated by male Burgo around 696 or 62.09% of Burgo's total population, while the rest number is female Burgo around 595 or 53,08%. It indicated that Burgo male has been preferred by fanciers than Burgo female. Furthermore, it is reported that the major population of domesticated Burgo has been recorded in Bengkulu province especially in Rejang Lebong District with the average number reached 128,67 individuals per year from 2004 to 2009.

Based on morphological performances, male Burgo possesses the unique characters, which mesmerize the fanciers to retain it (Putranto et al. 2016a, 2016b, 2012a, 2012b, 2010). This chicken has a specific mark in its ears i.e., the round white wide shape and black beak. Generally, the appearance of male Burgo is bigger than its parental, Hutan Merah, with the height ranging from 10 to 15 cm,

leg length between 5 and 7 cm and total weight gained from 800 to 1250 gr/individuals. Based on economical value, the price of male Burgo is expensive. This happens not only due to its attractive performances but also the common belief from the fanciers that retain this chicken will rise the level of social status and self-esteem in the society (Putranto et al. 2012b).

Generally, coastal region which is defined as the meeting area of ocean and land is the pleasant habitat of many flora and fauna species and has many natural resources, which are benefits to human life (Bonodikun et al. 2015; Pinto 2015; Indarti and Wardana 2013; Fauzi et al. 2009; and Gustiani 2005). Based on the definition of coastal area, this study was conducted in the coastal region in Bengkulu province. The districts in Bengkulu i.e., Bengkulu Utara, Bengkulu Tengah, Bengkulu City and Seluma have a coastal region which directly adjacent to the shoreline of Indian Ocean.

The objective of this study was to estimate the dynamical distribution of domesticated male Burgo population in the coastal region of Bengkulu province. According to Kwatrina et al. (2013) and Kuswanda dan Mukhtar (2010), the dynamic population can be used as a reference in ecology field which of importance to design the management scheme in the conservation region. It was supported by Kwatrina et al. (2013) who reported the immense importance of the availability of data and information in the population of species.

MATERIALS AND METHODS

Study sites

This study was conducted for four weeks starting from July to August 2016. Totally four research sites consisted of 3 districts and a city located in the coastal province of Bengkulu, Indonesia i.e. Bengkulu Utara District, Bengkulu Tengah District, Bengkulu City and Seluma District were selected as study sites. These locations are coastal regions, which directly adjacent to the Indian Ocean in the West part of Sumatera island as shown in Figure 1.

Bengkulu province comprised of 10 districts and city located in diverse altitude (BPPS Bengkulu Province in 2015) with a total area of about 19.919,33 km² (Table 1). Of these four locations, Bengkulu Utara District is the largest area (32%) of the total area of the Bengkulu province.

Table 1. The total area of the district and research sites in Bengkulu, Indonesia

Characteristics	Location of study (km ²)				Total area of Bengkulu province (km ²)
	BC	BTD	BUD	SD	
Total area (km ²)	144,52	1.223,94	4.424,60	2.400,44	19.919,33
Percentage (%)	11,39	7,23	32,76	7,23	100

Note: BC = Bengkulu City, BTD = Bengkulu Tengah District, BUD = Bengkulu Utara District, SD = Seluma District. (Source: BPS Bengkulu Province in 2015)

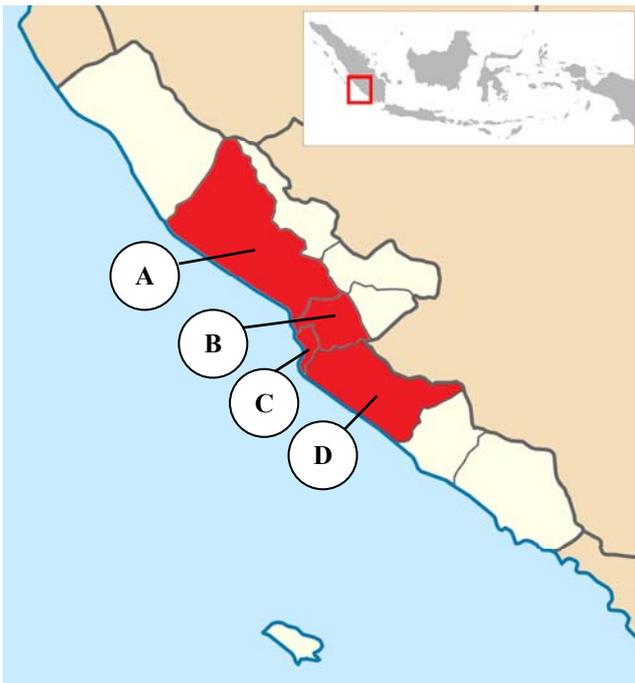


Figure 1. The coastal province of Bengkulu, Indonesia as location of the research. A. Bengkulu Utara District, B. Bengkulu Tengah District, C. Bengkulu City, D. Seluma District

Geographically, the location of the study i.e. three districts and a city are located at a latitude with coordinates between $2^{\circ}16'-3^{\circ}31'$ south and $101^{\circ}01'-103^{\circ}41'$ east. The topography of the tree districts and city are divided into two groups: (i) coastal areas with an altitude of 100 meters above sea level, there are along the coast and includes lowland classification, and (ii) the area with an altitude of 100-500 meters above sea level, located at the foothills of Bukit Barisan. Bengkulu City as selected location for research on the population of domesticated male Burgo is geographically at a latitude with coordinates between $102^{\circ}14'42''-102^{\circ}22'45''$ east and $3^{\circ}43'49''-4^{\circ}01'00''$ south. This city consists of eight sub-districts, which seven of them possesses coastal ecosystems and nearly adjacent to marine waters (Fauzi et al. 2009).

Research methods

The location of the research was determined by purposive sampling. This study was then conducted by survey methods including interview and census. The preliminary survey has been done in each district and city to select villages as random samples. The first responder was determined by purposive sampling followed by subsequent responders, which were selected by snowball sampling method (Putranto et al. 2016a, 2016b, 2010). A total of 36 of fanciers retaining male Burgo were selected as responders with nine responders from Bengkulu City, 19 responders from Bengkulu Utara District, two responders from Seluma District and six responders from Bengkulu Tengah District.

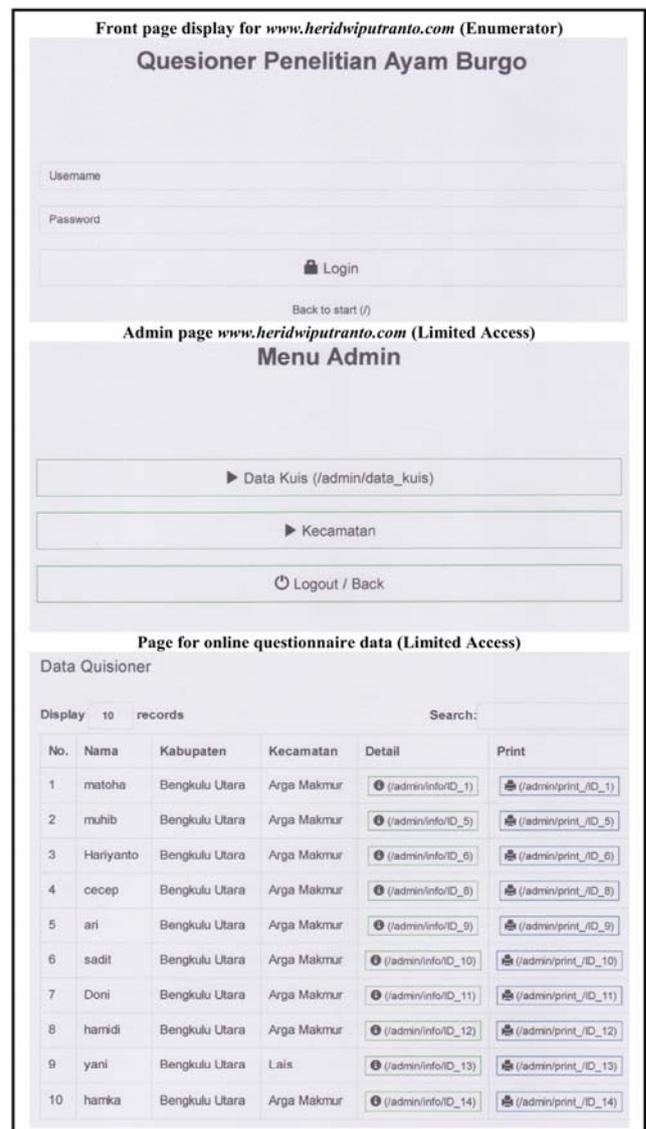


Figure 2. The profile of digital software for filling online questionnaire. (Source: www.heridwiputranto.com).

Detailed research work

In this population study, the researchers developed a census system by utilizing the digital technology including the software programs for filling the online questionnaire. This software has been designed in term of a collaborative platform with technical assistance from the collaborative partner, PT. Methamou Amba Persada. Enumerator did the field research by doing a census and searching the responders to fill the online questionnaire installed in android system belongs to an enumerator. The online questionnaire could be accessed by enumerator using the username and specific password prior to further data analysis (Figure 2).

Enumerator then inputs the primary data including responder's identities, the number of retained male Burgo, the number of natality and mortality of male Burgo, the migration level of male Burgo and male Burgo's picture as documentation. This data was categorized as real-time and

automatically will be saved in the new provided–online page (www.heridwiputranto.com), which could be accessed in limit basis.

Before conducting census activity of male Burgo, enumerator has been intensively trained prior to professionally applying for the online questionnaire program and solving the problem regarding with Internet connection in the sampling area. Furthermore, enumerator has been provided with manual equipment such as written questionnaires, stationery, and camera in case of slow Internet connection occur. The tangible-obtained data in terms of quantitative data and pictures was then uploaded directly in the provided page via online. If technical errors happened, enumerator inputted data manually which was then uploaded via online later.

This method was modified from research conducted by Putranto et al. (2010) based on Shaffer theory related with migration concepts. The collected data, which was only focussed in male Burgo, was also modified from research conducted by Putranto et al. (2010). Another reason regarding with male Burgo selection was the fancier's preference, easy to domesticate and to have high economical values (Putranto et al. 2016a, 2016b, 2015, 2012a, 2012b).

Data analysis

The obtained data was then analyzed its population distribution using Soegianto (1994) equation as follows:

$$VMR = \delta^2 / \mu$$

Where:

VMR = Variance-Mean Ratio

δ^2 = sample variance

μ = sample average

VMR = 1.0 interpreted as poisson distribution (random distribution population), VMR < 1.0 interpreted as binomial distribution or under-dispersed (homogeneity distribution population), and VMR > 1.0 interpreted as negative binomial distribution or over-dispersed (cluster distribution population).

RESULTS AND DISCUSSION

According to Ruetz et al. (2005), the main aim of conducting a study in ecological population is to further understand the spatiotemporal pattern from the fluctuated population of species in the certain habitat. Furthermore, the synchronized dynamic of animal population in a large-scale become one of high research of interest. In addition, Ceballos et al. (2010) reported that animal species and its population is of importance to support the human life.

Prior to reducing the declining trend of mammals population including bird, Kuswanda and Mukhtar (2010) suggested that local government should further develop the conservation programs supported by innovative approaches from experts. Up to now, most conservation programs had no comprehensive and clear management regarding

endemic species in Bengkulu (Susatya 2003). Moreover, the biological characteristics and ecological attributes lead to the strenuous effort in preserving the population level of endemic species of Burgo in Bengkulu.

According to Rahmasari (2011) and Gustiani (2005), the coastal region possesses the highest productivity in the world based on its biological prospect. Furthermore, it has potential natural resources which can be divided into three main clusters i.e. renewable resources, non-renewable resources, and environmental services. In addition, it has an ecosystem with the highest natural productivity.

The population study in certain species by census activity and application of digital technology such as filling the online questionnaire is the technical approach, which is firstly published in scientific journal. Interestingly, researchers can further develop the real-time data utilized in this study for many scientific purposes.

The analysis data of male Burgo study collected from the coastal region of Bengkulu was presented in Table 2. It can be seen that 167 male Burgo have been domesticated by fanciers in 3 districts and a city in the coastal region of Bengkulu. Almost 95% of male Burgo population was adults which were assumed having an expensive economical value, while the rest population (5%) was clustered as Day Old Chick or DOC. Of the distribution region, more than 50% of male Burgo's population has been found in Bengkulu Utara District and the rest was from Seluma District (1%).

From the analysis of population density of male Burgo in the coastal region of Bengkulu, it shows that the total average of its population density was 0.0204 individuals/km² (Table 2). Interestingly, the highest population density was obtained in Bengkulu City (0.0387 individuals/km²) followed by Bengkulu Utara District and Bengkulu Tengah District which reached to 0.0201 individuals/km² and 0.0163 individuals/km². Meanwhile, the population density of male Burgo in Seluma District was the lowest one (0.0008 individuals/km²).

Table 2. Data analysis of population, density, and distribution of male Burgo in Bengkulu Province, Indonesia in 2016

Location	Male Burgo	Population (individual)	Population density (ind./km ²)	Population distribution
Bengkulu City	DOC	9	0.0387	2.337
	Adult*	47		
	Total	56		
Bengkulu Tengah District	DOC	0	0.0163	0.758
	Adult*	20		
	Total	20		
Bengkulu Utara District	DOC	0	0.0201	8.233
	Adult*	89		
	Total	89		
Seluma District	DOC	0	0.0008	1.913
	Adult*	2		
	Total	0		
Averages			0.0204	3.3098

Note: DOC= Day Old Chick, * = male adult

Table 3. Total population of mixed sex Burgo chickens in Bengkulu Province, Indonesia in 2009

Burgo chicken	Study sites					Total population	Percentage (%)
	Leb	RL	KP	BT	BU		
Male Burgo	31	64	21	36	37	189	62.58
Female Burgo	7	34	4	51	17	113	37.42
Total (individuals)	38	98	25	87	54	302	100
Percentages (%)	12.58	32.45	8.28	28.81	17.88		

Note: Leb = Lebong District, RL = Rejang Lebong District, KP = Kepahiang District, BT = Bengkulu Tengah District, BU = Bengkulu Utara District. (Source: Putranto et al. 2010).

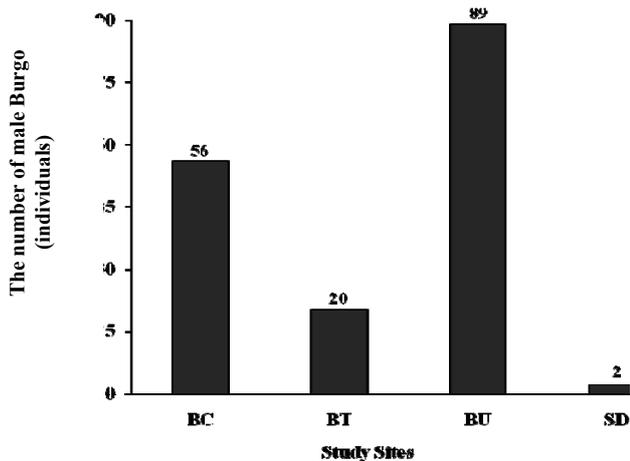


Figure 3. The composition of male Burgo's population in 4 coastal region of Bengkulu in 2016. Note: BC = Bengkulu City, BT = Bengkulu Tengah District, BU = Bengkulu Utara District, SD = Seluma District.

Based on the population distribution (*Variance-Mean Ratio*) analysis using modified equation from Soegianto (1994), the total population distribution of male Burgo in the coastal region of Bengkulu reached 3.3098 (Table 2). The population of male Burgo was highest distributed in Bengkulu Utara District followed by Bengkulu City and Seluma District which were 2.337 and 1.913. The lowest population distribution of male Burgo was achieved in Bengkulu Tengah District which was equal to 0.758 ($\delta^2/\mu \leq 1$).

The indigenous chicken species living in endemic habitat will represent the existence of high resources which is valuable to the further development of animal husbandry science (Ajayi 2010). It happens due to the extensive genetic diversity of chicken will give many benefits especially in large scale maintenance purposes. The main advantages of these, for example, are chicken will easily adapt to the diverse environmental condition and its potential benefit for producing the variety of food products as well as an ecological function for supporting human life. This is supported by Pathak and Nath (2013) who reported that endemic chicken managed using the semi-intensive and non-intensive management has produced eggs which could supply the national demand in India up to 11% of total eggs production. Generally, the non-intensive method in endemic chicken management was applied for saving

purposes, inexpensive source of animal protein and additional household income (Yousfi et al. 2013). The same reasons were recorded from responders in the coastal region of Bengkulu during the interview and answering the online questionnaire. This is in agreement with the previous researches (Putranto et al. 2016a, 2016b, 2015, 2012a, 2012b, 2010), which mentioned that retaining Burgo chicken was addressed to saving purposes because of its high economical value. Retaining male Burgo will also raise the level of social status in the society because there is an assumption that only a rich person having male Burgo as a pet.

The population number of male Burgo discovered in the coastal region of Bengkulu in 2016 was 167 individuals, which means fewer than that number population in 2009 (189 individuals) (Table 3). In 2009, the percentage of male Burgo population reached 62.58% of total Burgo's population, while the population of female Burgo was around 37% (Putranto et al. 2010).

Based on population data shown in Tables 2 and 3, it can be seen that there was population dynamic of male Burgo in Bengkulu Province. These dynamics was performed in the fluctuated population number. Specifically, population number of male Burgo decreased from 189 birds in 2009 to 167 birds in 2016. According to Kwatrina et al. (2013), an animal which biologically able to reproduce continuously (*iteroparous*) until the subsequent generation (filial) will possess an overlapped population number. Based on that theory, the population of Burgo chicken is expected to have the model of this population dynamics. In detail, the population growth of male Burgo is being expected to continuously increase in accordance with the model of exponential population growth during a certain time, so that the number of the population become double. In this study, however; the population dynamics of male Burgo in the coastal region of Bengkulu showed in contrary with this expected model. Regardless of how the population size of male Burgo obtained in this study, it can be stated that this population size has not exceeded the number of minimal population which can be eternal (*minimum viable population*) (Susatya 2003). It is known that the small population size can lead to the various factors triggering the acceleration of the extinction of flora and fauna species. However, the population size data in this study can not also be said to be sufficient if it is used as main data in the further conservation programs. There is need an advanced study to those purposes.

Figure 3 represents the composition of male Burgo’s population in 4 coastal regions of Bengkulu. To be specific, the highest population of male Burgo was found in Bengkulu Utara District (89 individuals), while the lowest one was in Seluma District. It might happen due to most the Rejang ethnic group lives in Bengkulu Utara District compared to other three districts. This is in accordance with Yumiati (2012) who reported that the majority of Burgo fanciers in Bengkulu Province came from Rejang ethnic group that inhabit in Rejang Lebong District, Lebong District, Kepahiang District and Bengkulu Utara District.

Based on the result of population density of male Burgo in the coastal region of Bengkulu, it showed that the average of this population density was 0.0204 individuals/km² (Table 2). This average was smaller than the previous research conducted by Putranto et al. (2010) which was 0.125 individuals/km² in Bengkulu Province in 2009. Furthermore, census data from the mixed-sex Burgo chicken in Bengkulu Province reached the highest one with 0.202 individuals/km² in 2009. Generally, this happens due to various factors. One of them was there is no intensive-development of male Burgo breeding as seed sources (Putranto et al. 2010). Most male Burgo seed was obtained by capturing directly from *in situ* habitat in the forest (Setianto et al. 2016). Commonly, the small population size causes the population of flora and fauna become in endangered warning (Susatya 2003), which extremely lead to the extinction of local resources spontaneously. Moreover, if the population size exceeds the certain population threshold due to the habitat quality is fragmented and destructed, it will lead to the fast extinction rate. It can be concluded that small population size will be

extinct faster than the large population size. In this study, it can be assumed that *Alle effect* might effect on the declined population. According to Ceballos et.al (2010), Alle effect will decrease the growth rate when the population density is low resulted in the strenuous interaction in each individual.

Based on the population structures, there were two groups of domesticated male Burgo in this study i.e., DOC and adult male. These groups were clustered based on age group. In detail, more than 5% the population of domesticated male Burgo was categorized as DOC and the rest percentage (95%) or equal to 158 individuals was the adult male (Table 2). According to Kwatrina et al. (2013), this population structure based on age group showed the low success of reproduction program in male Burgo management.

Generally, the population distribution of domesticated male Burgo was categorized as negative binomial distribution or over-dispersed (cluster distribution population) ($\delta^2/\mu > 1$) (Table 2 and Figure 4). This is based on VMR analysis, which resulted in the average number of 3.3098 except for Bengkulu Tengah District was binomial distribution or under-dispersed (homogeneity distribution population (VMR < 1 (0.758)). The population distribution is the movement of individuals into or out of the population (Ruetz III et al. 2005). Furthermore, the population distribution is of importance to spread plants, animal or human geographically from one place to another new place prior to the inhabitation. This population distribution happens due to the stimulation of various factors such as finding food, climate effects, carried by the water/wind, mating habits, and other physical factors.

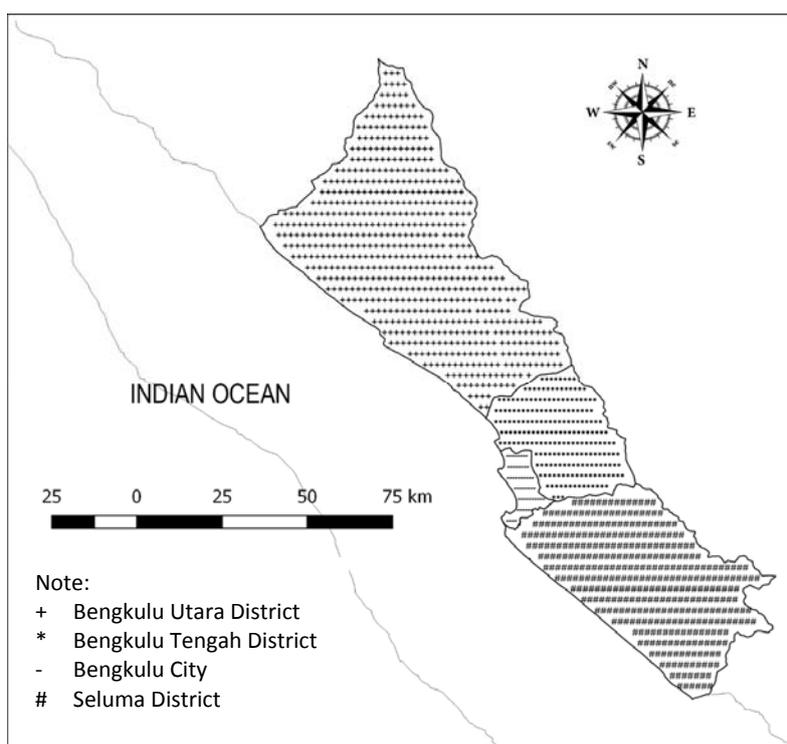


Figure 4. The population distribution and population density of male Burgo in coastal region of Bengkulu, Indonesia in 2016

The information of population density was not enough for comprehensively picturing the condition of population in the certain habitat. Two population can have the same density but it can be different in the spatial population distribution. The population density in the region depends on the pattern of population distribution. The changing in the type of habitat can influence the changing in the distribution pattern. As a result, there is any distinct distribution pattern among species in the same habitat (Ruetz III et al. 2005).

The results of this population study, it can be concluded that the pattern of population distribution dynamics of male Burgo in the coastal region of Bengkulu in 2016 was estimated having the similar distribution pattern to the mixed-sex Burgo population in Bengkulu Province in 2009 which were categorized as negative binomial distribution or over-dispersed.

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