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Abstract. Hernowo JB. 2017. Population analysis of Bali Mynah (Leucopsar rothschildi Stresemann 1912) released in 2007 in Bali Barat National Park, Indonesia. Trop Drylands 1: 83-89. The population of Bali Mynah (Leucopsar rothschildi) has been released in the year 2007 in Bali Barat National Park should be monitored. Monitoring of the Bali Mynah (BM) population development was done in June 2008, June 2009 and October 2009. Monitoring method employed was direct observation focused on rations feeding site and surrounding areas at Tanjung Gelap (Menjangan Resort). The individual number that was released in June 2008 was 20 individuals, and that in June 2009 and October 2010 was, respectively, 20 individuals and 22 individuals. The Bali Mynah survival is approximately 77.27-110.53% in two respective years. The bird natality rate is 10.53%. The sex ratio is about 1:1 and birds age structure are 95.24% adult and 4.76% sub adult. The over-all population of Bali Mynah (BM) at Tanjung Gelap is in good condition. The important factors that support Bali Mynah survival in the wild habitat is through managed nest box, food rations, and BM safety

Keywords: Analysis, population, Bali Mynah, Bali Barat National Park

INTRODUCTION

Bali Mynah (Leucopsar rothschildi) is categorized as critically endangered species (Kurniasih 1997; IUCN 2011) and CITES categories it as Appendix I (can not be directly sold from the wild) and the Republic of Indonesia has declared it as a protected species. The natural bird distribution is only in an insufficient area in northwest Bali Island, and currently, the distribution of the bird is concentrated just in Bali Barat National Park (BBNP). Also, Bali Mynah (BM) is a songbird, which attracts many people for cage bird, making the Bali Mynah a highly prioritized bird to be conserved (Alikodra 1987; Hartojo & Suwelo 1987). Since 1986, the population is declining rapidly due to illegal hunting, lack of security and surveillance, lack of legal sanctions and low public awareness. Nowadays the population of this wild bird is at a very alarming situation, likely lead to extinction if the population is not adequately managed.

BBNP authority has released the Bali Mynah several times to its wild natural habitat. In the year 1998, there were only six birds in the wild, and 12 more individuals have been released into the wild. The Bali Mynah census in 2000 counted just 12 individuals. In the year 2007, 72 individuals were released by Tegal Bunder Bali Mynah Breeding Centre and Asosiasi Pelestari Curik Bali (APCB). The population development of Bali Mynah after its release in the year 2007 should be analyzed and monitored because until now no report related to released BM in Bali Barat National Park, Indonesia is available. Analysis and monitoring of the bird is a priority for conservation effort of Bali Mynah. The goal of this paper is to study (i) the dynamics of Bali Mynah population after its release in 2007, (ii) the habitat conditions that support Bali Mynah population, and (iii) management effort that has been done for Bali Mynah.

MATERIALS AND METHODS

The study site

Bali Barat National Park (BBNP) is located in the northwest of Bali Island, Indonesia (8°05’-20”-8°15’-25” S; 114°25’-00”-114°56’-30”E), covering an area of about 19,003 ha. The National Park is bordered by the Bali Sea to the north and by the Bali Strait to the west. The south, the Park is bordered by the Indian Ocean and to the east with Bali road from Gilimanuk to Singaraja (Balai Taman Nasional Bali Barat 2009). The geological situation of BBNP is described as various parts, mostly Plio-Pleistocene deposits. Most of the area in the Park has undulating topography, small part of wavy and the mountainous regions are located at Mount Prapat Agung (c.310 m asl), Mount Banyuwedang (c. 430 m asl), Mount Klatakan (c. 698 m asl) and Mount Sangiang (the highest, c. 1002 m asl). The climate of the Park is categorized as a tropical climate, typically with less precipitation (climatic types of C, D, and E; Schmith-Ferguson criteria). Average rainfall at observed areas having a climatic I type C approximately 1559 mm.year⁻¹, regions having climatic type D about 1064 mm/year and areas having climatic type E nearly 972 mm/year. The humidity is around 85% and an average temperature of 33 °C.

The rivers flowing in BBNP are Labuan Lalang River, Teluk Terima River, Trenggulun River, Bajra-Klatakan
River, Melaya River, and Sangiang Gede River. The Park has six vegetation types: mangrove, beach forest, monsoon forest, low land tropical forest, evergreen forest, and savannah.

Field observation

Monitoring of released Bali Mynah was carried out in October 2009, focused on central release area at Tanjung Gelap (Menjangan Resort) closed to monsoon forest of the Menjangan. The BM population observations were done by counting the individual number of the bird at around 200 m x 1000 m as single plot observation (BM only distributed at the sample plot). The counting was done by a team consisted of 3 group observer placed at center feeding stations, areas that have nest box and area without facilities such nest box or feeding stations. The BM counting was started at 6.00 AM until 17.00 PM. Observed variables of the birds counting were the number of individuals with a colored ring or not, number of pair, and the frequencies of visited feeding stations and the bird's activities. Monitoring of the local distribution of Bali Mynah was conducted by recording daily movement. Individual number, sex ratio, age structure and population growth were analyzed. The released individuals were marked by using a colored ring.

The habitat of Bali Mynah was observed by studying food provided in the feeding station, the frequency of visit to the feeding station, response to artificial nest holes, and the number of artificial nest holes created in the field. Population data in December 2007, June 2008, and June 2009 were used as a comparison to this study.

Data analysis

The released BM population was analyzed for percentage of increased population every year started from 2007 until 2009.

\[
nt = \frac{n(t + 1) - n(t)}{n(t)} \times 100\%
\]

- \(nt\) = natality
- \(n(t)\) = natality at certain years
- \(n(t+1)\) = natality at the beginning

Percentage of age structure of adult bird

\[
= \frac{\text{Number adult bird} \times 100\%}{\text{Total bird}}
\]

Percentage of age structure of sub-adult bird

\[
= \frac{\text{Number sub adult bird} \times 100\%}{\text{Total bird}}
\]

RESULTS AND DISCUSSION

Bali Mynah population (number, sex ratio, age structure)

Based on observation at Tanjung Gelap, the BM population recorded as the individual number was 17-21 birds outside of the released cage. Two individual birds were not marked using a colored ring. Those unmarked birds were juvenile and adult birds. There were ten individual birds in the released cage, but one juvenile has been produced from last breeding season of 2009 (Table 1). That condition indicated that the BM released population has increased in number.

![Figure 1. Map of research location in Tanjung Gelap, Bali Barat National Park, Indonesia](image)
The sex ratio of BM released at Tanjung Gelap was around 1:1, which is not significantly different with the previous observation. The age structure was approximately 95.24% adult and 4.76% sub adult. The suitable ratio of the BM sex ratio is essential to support developing BM released population.

Thirty-two individuals of BM were released at Tanjung Gelap in 2007, 23 of them have been released in the wild, and nine individuals were kept at the cage. From 23 individuals released in the wild, one individual was found dead (Nana, personal communication, 2009). The bird monitoring held in June 2008 recorded 19 individuals, but later on only 17 individual was observed in June 2009, 3 of which came from Brumbun released center (Table 2).

Based on monitoring in June 2008, The released BM have good adaptation, from 22 birds that were released in 2007 in the wild, 19 birds (86.3%) are still alive and breed resulted in 1 additional individual from the original population. The bird population has natality of approximately 4.54%. All birds at release cage (9 individual) are still alive in good condition. In general, BM population at Tanjung Gelap is in excellent condition. Meanwhile, population monitoring in June 2009 recorded only 17 individual birds, and three individual birds migrated to Tanjung Gelap from Brumbun population released in 2009. The BM populations that are still existing in the wild is approximately 77.27%, and immigration rate is around 13.64%. There are still nine individuals present at the cage.

Based on the monitoring, the BM released population outside of released cage at Tanjung Gelap was recorded 22 individuals bird, consisting of 20 adults (19 birds with mark + 1 bird without marked) + 1 sub adult bird unmarked and one sub-adult bird result from breeding time in 2009. The percentage of BM exists in the wild is 110.53%. The BM has been released in 2007 resulted three individuals, one individual produced from birth in 2008 now becomes an adult, and two individuals resulted from birth in 2009. The natality rate in 2009 at Tanjung Gelap was 10.53%.

**Population development of Bali Mynah at Tanjung Gelap**

The population growth of Bali Mynah resulted from birds released in 2007 at Tanjung Gelap Bali Barat National Park from the bird monitoring in the year 2007, 2008 and 2009 was recorded in Table 3.

In general, BM population development at Tanjung Gelap is in better condition (because the BM population increased from 2007 to 2009). This fact was indicated by the number of the individual bird still alive in the wild in 2007 to 2009 with a percentage of 77.27-110.53%. Information on the development of BM is obtained from the natality rate. The natality rate of the bird is significant with three individuals in 2 years, so the development was approximately 10.53% (Figure 1).

**Figure 2.** BM with colored ring mark and without colored ring mark (A), BM responds to feeding ration (B)

**Figure 3.** Bali Mynah development curve at Tanjung Gelap, Bali Barat National Park, Indonesia, from 2007-2009
Table 1. Observation results of Bali Mynah population released in the year 2007 outside of release cage, Tanjung Gelap, Bali Barat National Park, Indonesia

<table>
<thead>
<tr>
<th>Time of Observation</th>
<th>Individual number of Bali Mynah at feeding site</th>
<th>Individual number of Bali Mynah outside of feeding site</th>
<th>Total individual</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marked</td>
<td>Not marked</td>
<td>Marked</td>
<td>Not marked</td>
</tr>
<tr>
<td>January 4/10/2009</td>
<td>10</td>
<td>2*</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>5/10/2009</td>
<td>14</td>
<td>1*</td>
<td>5</td>
<td>1**</td>
</tr>
<tr>
<td>June 6/10/2009</td>
<td>14</td>
<td>2*</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Population development of Bali Mynah population after its release in 2007 at Tanjung Gelap Bali Barat National Park, Indonesia based on monitoring in the year 2008 and 2009

<table>
<thead>
<tr>
<th>Monitoring time</th>
<th>Number of birds have been observed</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>After released in December 2007</td>
<td>32 (23+9)</td>
<td>(23 birds have been released in the wild, and nine birds were kept at cage, one individual was found dead in wild</td>
</tr>
<tr>
<td>June 2008</td>
<td>19</td>
<td>nine birds were kept in the cage</td>
</tr>
<tr>
<td>June 2009</td>
<td>17 + 3*</td>
<td>* the birds were off of the bird released in 2009 at Brumbun. 9 birds were kept at the cage</td>
</tr>
<tr>
<td>October 2009</td>
<td>20 + 1*</td>
<td>(1 adult birds was unmarked, + 1 sub adult bird was unmarked) and 1* sub adult bird was kept at the cage breeding resulted from the released bird. !) birds were present At the cage.</td>
</tr>
</tbody>
</table>

Table 3. Population development of Bali Mynah after its release in 2007 at Tanjung Gelap, Bali Barat National Park, Indonesia

<table>
<thead>
<tr>
<th>Monitoring time</th>
<th>Individual number of Bali Mynah Outside of the released cage</th>
<th>At the released cage</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2007</td>
<td>23*</td>
<td>9</td>
<td>*1 individual dead</td>
</tr>
<tr>
<td>June 2008</td>
<td>20*</td>
<td>9</td>
<td>*1 sub adult bird</td>
</tr>
<tr>
<td>June 2009</td>
<td>20*</td>
<td>9</td>
<td>* 3 individual from Brumbun</td>
</tr>
<tr>
<td>October 2009</td>
<td>22</td>
<td>9 + 1*</td>
<td>* 1 sub adult from breeding 2009</td>
</tr>
</tbody>
</table>

Development of groups and pairs

Based on observation of the BM individuals that came to feeding site and at monsoon forest, we found that the released BM visited those places in group or pair and rarely in solitary. The group consisted of 3-5 individuals bird in each group, while individuals or single birds also visited feeding site was young /sub adults birds. Formation of groups by the released BM indicated that bird was adjusting to the natural behavior. In natural condition, BM lives with forming of a group as their strategy for life. These activities suggested that the bird has been adapted to the natural condition.

Three pairs of the released BM have been observed, two pairs of them have actively used tree nest hole breeder. Those pairs of birds consisted of unmarked bird pairing with marked bird (right feet with the color blue and left feet with red blue) and a pair of bird (red marked at right feet-white marked at left feet) with bird marked (white right feet-the blue, red left feet). Another pair is unmarked on right feet-green marked left feet with bird marked red blue at right feet and unmarked on left feet. Pairs of the bird with red marked at right feet and white marked at left feet are pairing with bird marked white right feet-blue red left feet and unmarked on right feet-green marked left feet with bird marked red blue at right feet and unmarked left feet. Those all pairs birds have actively used tree nest hole breeder. These two pairs of birds have indicated that the birds have been adapted to the wild condition and will breed at rainy season (December 2009) next future month hopefully.
Movement and local distribution

In general, the movement of the BM after its released in 2007 is not far from feeding site, approximately 100-150 m away. The movement and local distribution are influenced by food given (ration) and distribution of man-made tree nest hole breeder. In one case, it was found that one unmarked individual bird was observed moved at approximately 350 m away from the release cage. This condition indicated that BM released was trying to move more than usual. Also, it provides information that the bird gradually moves more to wider areas.

There is any case with bird movement, the BM birds after released in 2009 at Brumbun has united with BM released bird at Tanjung Gelap (3 km away), and it formed pairs. This bird has a red color ring marked at right feet-white color ring marked at left feet with bird marked white ring marked at right feet-green and red ring marked at left feet. The movement of the bird has been observed only around their tree nest hole breeder at position (08° 08' 33.3'' S and 114° 33' 05.3'' E).

Local distribution of BM released at Tanjung Gelap was influenced by the daily movement of the bird. The daily movement is influenced by daily feeding. Rations food provided to BM released caused daily the bird do not move far away from the feeding site. Beside the rations food at the feeding site, frequencies of rations feeding also influenced the daily movement of BM. The BM released population makes more distribution over all areas, the feeding site ration does not only in one place but spread out in several sites. Those management efforts will impact the bird’s movement. If the feeding site is not concentrated in one place, the bird also will distribute following availability of feeding site. Automatically, the bird will spread more over in the habitat. Besides the feeding site, the availability of nest box will also influence the local distribution of BM released.

Habitat of Bali Mynah

Bali Mynah after released 2007 at Tanjung Gelap used habitat types concentrated at monsoon forest. The habitat condition is harsh at dry season (7-8 month), where most of the vegetation is experiencing leaf falling, mainly shrubs such as kirinyuh (Eupatorium odoratum), krasi (Lantana camara), pole and sapling of kayu pahit (Strychnos lucida), putihan (Alangium chinense), kapasan (Simplocos javanica). But trees still green conditions are pilang (Acacia leucophloea) and tekik (Albizia lebekkoides).

An example that pairs of BM have been marked at right feet red color-left feet is white pairing with marked bird white color at right feet-blue, red color at left feet searching for food at morning and afternoon in the ground, open area under dry shrub BM closed to their nest box. This couple of BM has been observed slept at a dry and dense branch of the pole. The position of their sleeping site is approximately 2-2.5 m above the ground. These activities/behaviors showed that BM does not depend on feeding ration, implying that they have adapted to the natural condition.

At noon, the BM is sheltering at shrubs area, the area with a dense leaf or at trees with luxuriant foliage. During daytime, the temperature at BNP is about 32-34 °C, which is too hot for BM. Thus the bird will look for sheltering places.

Tree nest hole breeder

The availability of tree nest hole breeder is one of important habitat component for BM living. Bali Mynah is one of the birds that use the type of their nest with tree nest hole breeder. However, BM is not able to make a hole on their own so that the bird will use nest hole from other birds such as woodpeckers. At natural conditions, tree nest hole breeder is limited in number.
Man-made tree hole breeder nests (nest boxes) at Tanjung Gelap were put in the tree of 10 nest boxes, 8 of the nests were at pilang tree (Acacia leucophloea), 1 of the nests was at Suren (Toona sureni) and one at the other tree. Two of nest boxes have been actively used in geographical position of 08° 08’ 35.9” S, 114° 33’ 09.7” E and 08° 08’ 33.3” S, 114° 33’ 05.3” E.

Pair of unmarked with the marked bird, bleu right feet-blue red left feet has been found at natural tree nest hole breeder at pilang tree with a distance of approximately 150-200 m away from feeding site. One of the nest boxes at Suren tree has been occupied by the honey bee. This is one of nest box disturbance for BM. Ten of nest boxes have been put in the tree to meet the nest box need for 22 individuals of BM bird. In reality, several of the boxes have not been used yet. These facts should have attracted attentions of the managers to evaluate. The availability of natural nest for BM is insufficient, so man-made tree nest hole breeder is highly required, and it is sufficiently available.

The nest hole breeder is one of the critical vital factors for a successful living of BM. 10 nest boxes have been available, at a distance between 20-50 m from one to each. The nest boxes should be evaluated for their effectiveness. If the boxes are not used, they should be removed to more strategic places. The distance between nest boxes should be more than the past if the birds do not depend on food rations. The number of nest box should be available and suitable for the number of BM. The natural tree nest hole breeder for BM should be monitored.

Rations food

The ration food is one of the efforts to manage BM after its released in 2007. Rations are given to BM in two times of feeding, i.e., at 08.00 AM and 14.00 PM. The rations consist of fruits and hongkong larvae (Tenebrio molitor). Foot ration is still needed for the living of BM after released in the year 2007. The frequencies of BM coming to rations feeding site is one criterion of their adaptation effort to get food. The more frequent the bird is coming to the feeding site means the lower the BM adaptation effort for searching food. In general, the BM is more frequent coming to rations feeding site in around every 0.5-1 hour. This indicates that BM is very dependent on rations food. The adaptation effort of the bird to natural food is very low. Only the pairs of birds have been marked at right feet is red color-at left feet white color with bird marked white color at right feet-blue color at the red left does not search food at rations feeding site. This indicates that these pairs do not depend on food rations as they can get food from natural habitat on their own. The significant proportion of food ration is not of natural in origin. To enable their adaptation to natural food take place faster, the BM should be given mixed food with natural food. It is difficult to find natural food in dry season at monsoon forest such fruits of Lantana. Therefore, it should be searched for in other places.

Birds safety

The BM released safety at Tanjung Gelap is in quite a good condition. Although none of the birds has been stolen, preventive actions are still needed to be taken into account. The price of BM at marked is always high (1 pair is valued at 12-15 million IDR). This high price of BM is a threat for development of BM released population. If the bird's safety from poaching can be guaranteed, possibly the BM population will grow up more prospectively. Other factors that support the BM released are the food rations that are more distributed, and the number of nest boxes added, and consequently, the BM safety is more guaranteed.

Bird released

The BM released is needed since the existing population was very small or sharply decreased until a critical condition. The Bali Mynah released is a historical monument for restocking and restoring very small population in the wild habitat in Indonesia. The future release activities should comply with comprehensive studies about the habitat and the disturbance. If the BM is going to be released anymore at Tanjung Gelap, it should be postponed until the former population gets into a stable condition, or the safety of BM population from poaching is guaranteed.

Discussion

The population of the Bali Mynah after its released in 2007 at Tanjung Gelap is in a good and satisfactory condition, with survival rate from December 2007 to October 2009 was 77.27% to 110.53%. The natality of the population in two years was 10.53%. The bird sex ratio was approximately 1:1 and the age structure was 95.24% adult and 4.76% sub adult. The general condition of BM released population at Tanjung Gelap was good. Three pairs of the BM have been monitored. In general, BM released program in 2007 is quite satisfactory. The BM released in Nusa Penida in July 2006 was 62 individuals, composed of 45 adult birds and 17 juveniles, but in 2013 about 25 ± 2 individuals were observed (Rianty and Aunurochim 2013). The BM individual number in Nusa Penida is an indicator that the bird had the ability to adapt into the new habitat, even though the individual number declined.

The BM habitat at Tanjung Gelap is mostly monsoon forest. The habitat is very harsh during the dry season (7-8 month). Noerdjito et al. (2011) stated that trees used for BM roosting and resting were pilang (Acacia leucophloea) and Walikukun (Scoutenia ovata) in Bali Barat National Park. BM in Nusa Penida used vegetation around 29 species from scrubs and trees. Also the bird in Ped village used nest box for nesting, and the natural nest is Anacar tree and randu (Ceiba petandra) (Rianty and Aunurochim 2013; Ginandra et al. 2009). During observation at Tanjung Gelap, the BM released movements do not far, approximately 100-150 m away from feeding site rations. The released BM is seemed to be dependent on feeding site rations. Most of BM is still depending much on food rations, so the food rations are essential factors to be managed with natural food. The availability of food is a constraint for release process to get the bird become wild.
Besides the food, availability of nest box is one of the important factors to support the living of the BM. The local distribution of BM released has been influenced by food rations and availability of nest boxes. The natural tree nest hole breeder is limited, management of the nest boxes is, therefore, need be done properly.

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