The invasive alien plants threatened the balance of ecosystem in conservative area in Ontoloe Island, Flores-Indonesia

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Abstract. Invasive alien plants threaten to biodiversity, particularly in small island with high endemcity values such as Ontoloe Island, a tourist destination area of Riung Seventeen Island in Flores. The study aims to characterized the invasive plants have attacked the conservative area in Ontoloe Island. The method used by combining the line method and the plot method with three observation stations in utilization block and four observation station in protection block. Plot of 1mx1m was used for the observation of ground cover plants and seedling, 5mx5m for the observation in stake level, 10mx10m for the observation in pole level, 20mx20m for the observation in tree level. The data level of the plants obtained then analyzed with Important Value Index (IVI). Result showed that Lamtoro plants (Leucaena leucocephala) is the invasive alien species which has the highest IVI in both of utilization block and protection block in each level of tree, stake, and pole. There are other invasive alien plants such as Tembeleken (Lantana camara) and Bidara (Zizipus mauritiana) dominated in stake level and Alang-alang (Imperata cylindrica) dominated in seedling level. All the native plants in Ontoloe Island will be threatened their existing because of the less control of invasive alien plants. Therefore, needs serious handling by the government in order to keep the balanced of the ecosystems in Ontoloe Island to be maintained especially to not deviated from management objectives area of Komodo Dragons conservation (Varanus komodoensis Ouwens, 1912).

1. Introduction
Biodiversity in an ecosystem is threatened by global climates change [1] and the existing of invasive alien plants (Invasive Alien Species=IAS) [2,3,4]. The effect posed by the IAS in an ecosystem run continuously and at last will change the structure and composition of native vegetation until the degradation and the lost of a habitat [5]. Therefore, it is important to know the peril of plants which became the invasive plants in an area [6].

IAS by International Union for Conservation of Nature (IUCN) institution defined as the species spread by human intentionally or unintentionally in past distribution, which its spread threatened the biodiversity [7]. According to The Invasive Species Advisory Committee (ISAC) defined IAS as the types that introduction in another ecosystem and caused the economic loss or environmental damaged or dangerous to human health [8].
The report about IAS in Indonesia, published by Invasive Species Specialist Group (ISSG) [9]. The alien species plants in Indonesia based on references and herbarium, there are 1936 species in 187 family with 339 species or 17% species as weeds. Highest record on weeds founded in Poaceae family (57 species), followed by Asteraceae (53 species), and Cyperaceae (35 species) [6]. All the alien plants were bush, tree, herbs and grass or water plants and ferns [10].

Invasive alien plants and exotic plants have been in invaded some area include in small island [11,12]. Small island with least in diversity but strong endemcity biodiversity due to geographies isolation [13,14] very vulnerable of IAS [15]. Ontoloe Island in destination area of Riung Seventeen Island has the highest biodiversity values with its ecosystem. The existing of the native flora and fauna in Ontoloe Island making it as conservation area [16].

Ontoloe Island cannot be avoided from IAS, therefore, as the conservation area, it is important to review the characteristic of invasive plants, how far has it invade the Ontoloe Island especially to not deviated from management objectives area of Komodo Dragons conservation.

2. Method and Material

2.1 The Location of Research

The research was conducted in Ontoloe Island in Riung 17 Islands Marine Park in February 2017. Administratively it was located to administrative village Nangamese sub-district Riung Ngada regency. Geographically it was located to 08°- 09° S and 121°45' - 121°50'E [17]. There were 7 research sites, 3 sites for Utilization block (U1, U2, U3), and 4 sites for Protection block (P1, P2, P3, and P4 (Fig. 1).

![Fig. 1. The 3 Research Sites in Utilization block (U) and in 4 research sites in Protection block (P) in Ontoloe Island, Flores](image-url)

2.2 Research Design

The method used in this research is the combination of line method and plot method with 3 observation station in utilization block and 4 observation stations in protection block, space distance
was 100m. In each location, there were 3 replications with the distance reached 50m. Plot of 1mx1m was used for the observation of ground cover plants and seedling. 5mx5m for the observation in stake level, 10mx10m for the observation in pole level, 20mx20m for the observation in tree level, the data obtained by the types, individual number, stem diameter for tree level and pole level [18]. The criteria of big tree with minimum diameter 20m, pole criteria are the early tree with diameter 10-19cm, the stake criteria are the part of the tree with the diameter 1.5m, and seedling with the diameter less than 1.5m [18,19]. The types of the plants that were observed was bush, trees, herbs, and grass. Types of alien plants founded than matched based on data of alien species on web Global Invasive Species Database [20].

2.3 Vegetation Analysis
The observation data of vegetation were analyzed by IVI to specify the percentage and the effect gave by a plant to its communities, then the formulation comes as follows [21]:

Relative Density (RDen) = \( \frac{\text{Density of a kind}}{\text{Density of all kinds}} \times 100\% \)

Relative Frequency (RF) = \( \frac{\text{Frequency of a kind}}{\text{Frequency of all kinds}} \times 100\% \)

Relative Domination (RDom) = \( \frac{\text{Domination of a kind}}{\text{Domination of all kinds}} \times 100\% \)

Importance Value Index = RDen + RF + RDom

3. Results
Based on the current observations, there were 13 invasive species with 7 families dominated by Poaceae and Asteraceae family of 3 species and 2 types of fabaceae family. The results showed that in the utilization block, especially the M1 section, there was no identification of invasive foreign species.

Level of tree and pole level found only 1 (one) type (Figure 2a and 2b) ie L. leucocephala with INP respectively 300% (M2, M3 and L2, L3, L4).

![Figure 2a. Highest INP Tree Levels on Utilization Blocks and Protection Blocks](image)

![Figure 2b. Highest INP Level Pole on Utilization blocks and Protection blocks](image)
The stake level was found to be 7 species in 6 families with the highest INP in the utilization block of *L. camara* type INP 46.31% (M2), *L. leucocephala* INP 47.99% (M3), where as in protected block type *Z. mauritiana* INP 106.76% (L1), *L. camara* INP 76.81% (L2), *L. leucocephala* INP 96.32% (L3) and 148.89% (L4). The INP level on the block utilization and protection blocks is shown in Figure 3 below.

![Stake Level](image1)

**Figure 3.** INP Level of Stake on Block Utilization and Protection Block

Level of seedlings found 12 species in 6 families with the highest INP in the utilization block type *I. cylindrica* INP 71.76% (M2) and 78.47% (M3), whereas in the protection blocks type *Z. mauritiana* INP 93.75% (L1 ), and *I. cylindrica* INP 50.02% (L2), 55.87% (L3), 83.33% (L4). The INP seedling level on the utilization blocks and protection blocks is shown in Figure 4 below.

![Seedling Level](image2)

**Figure 4.** INP Seedling Level on Block Utilization and Protection Block
4. Discussion

*Leucaena leucocephala* is the species of Fabaceae family from Central America, very dominated and has invasive almost all the Ontoloe Island both in utilization block and protection block. This species is capable in thrives because this species was very adaptive to the dry climate condition with the lower rainfall between 500-3500mm and in soil condition with the lower nutrient [22,23,24]. This species introduces to Riung for the first time in 1990s because of the advantages especially soil conservation, erosion control and the leaves for feed and the branches for firewood [22,25,23,26]. The existing of this species have been the serious treatment for biodiversity in Ontoloe Island because the power of this species in killing the native plants and capable to change the structure and composition of vegetation in Ontoloe Island. The lamtoro tree, if cut, produces large amounts of sprouts of approximately twenty sprouts grown from the truncated stem. Sprouts can grow 30 cm in a month, 80 cm in two months and as high as native trees in a few years. The density of regrowth will be higher than the original tree before it is cut [24].

Other invasive alien plants in Ontoloe Island is *L. camara*. *L. camara* includes in Verbenaceae family and known traditionally as the medicinal plants and also for firewood and mulch [27]. The extract of the leaves shows the antimicrobial, fungicide, insecticide, and nematicide [27,28]. The chemical content of *L. camara* make it not the first choice in alternative treatment because this species considered as weed in whole world [29]. *L. camara* is the useless bush with the branches because the highest level of the tolerance to environmental condition and capable to make impenetrable bush thick in degradation land, savanna, and forest edge [30]. *L. camara* become the serious treatment in an ecosystem because it will dominate other plants in grabs the space, water, and nutrition [31]. *L. camara* is the useless bush with the branches because the highest level of the tolerance to environmental condition and capable to make impenetrable bush thick in degradation land, savanna, and forest edge [30]. *L. camara* become the serious treatment in an ecosystem because it will dominate other plants in grabs the space, water, and nutrition [31]. *L. camara* is the species that will interfere other native plants and will dominate lower plants species and the result is it will decrease the diversity of lower plants species in forest ecosystem [32,33].

*Ziziphus mauritiana* is the species of Rhamnaceae family. *Z. mauritiana* is big bush or small tree with the tall reached 15 m which can be found in tropic and sub tropic area and become invasive in some area [34]. This species has spread widely until Queensland, Australia, and considered as the invasive species level 2 [35]. This plant comes from India, Southeast Asia, Iran and some area in Africa [36]. This plant can live till the tall reached 1500 m with the range of extreme temperature 50ºC and down until 7ºC but intolerance with frost and categorized as the strongest species which can stand and survive of salinity and dryness and puddles [37]. This species is useless or cause economic loss, social and environmental effects. According to the researcher from Australia, *Z. mauritiana* is capable to growth in any soil variety between any vegetation species in wide habitat and cannot survive well in others canopy tress [38]. The dissemination of this plants damaged the ecosystem not only kill the species of native plants but also damaged the movement of wildlife [35].

The species of *Imperata cylindrica* dominated in seedling level and lower plants both in utilization and protection block in Ontoloe Island. *I. cylindrica* comes from Asia, generally lived in tropic and sub tropic area with annual rainfall 75-500mm. *I. cylindrica* considered as one of the ten bad weeds in the world. The increase of the *I. cylindrica* has involved the ecology because this species has the power in killing other plants and resistant to the fire [39]. The changes of nutrient cycle caused by exotic plants will harm seedling in forest regeneration [40] because *I. cylindrica* can allocated the carbon of soil, and growth rapidly after the wildfire. Large rhizome of *I. cylindrica* not only results in fast regeneration of leaves, but also produce the exudate allelopathic root which can inhibit the germination and other plants growing [41]. Figure 2 shows the species of invasive alien plants in Ontoloe Island based on IVI.
The existence of foreign plants such as *L. leucocephala*, *L. camara*, *Z. mauritiana*, and *I. cylindrica*, have been dispersed in blocks of use and protection blocks will eliminate some types of native flora on Ontoloe Island ecologically valuable for the survival of the Komodo Dragons, in terms of shelter and rest, as well as foraging places. Protective blocks intended for habitat building activities, population coaching primarily of Komodo Dragons (*Varanus komodoensis*) ancient animals and rehabilitation of the area will be greatly disrupted by the presence of these invasive species. Similarly, utilization blocks in areas intended for the utilization of natural resources and ecosystems in the form of environmental services in the form of phenomena and natural beauty, especially for the development of tourism and recreation will diminish its natural beauty due to the presence of invasive species.

5. Conclusion
There were 13 species of invasive alien plants with 7 families dominated by Poaceae and Asteraceae 3 species and Fabaceae family with 2 species. Invasive alien species will reduce the level of biodiversity in Ontoloe Island and has impact in habitat change and degradation area. Therefore, needed a serious handling to the invasive alien species so, this plant cannot change the function of this area as the conservative area of Komodo Dragons.

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