ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research, volume 394
3rd International Conference on Innovative Research Across Disciplines (ICIRAD 2019)

Mapping and Distribution of Useful Plant Species in Bukit Kangin Forest, Pegringsingan Village, Karangasem, Bali

Nyoman Wijana[1], I Gusti Agung Nyoman Setiawan[2]
[1,2]Biology, Fisheries and Maritime Department
Ganesha University of Education
Singaraja-Bali, Indonesia
[1]wijana_1960@yahoo.com [2]gustiagungsetiawan@gmail.com

***Abstract*— The objectives of this research were to produce a distribution map and to know the distribution patterns of useful plant species in the original nature in Bali Aga Tenganan Pegringsingan village. This research belongs to explorative and descriptive research. The locations and population of this research took place at Bukit Kangin forest, Tenganan Pegringsingan Village, Karangasem Regency included the vegetation that grows in it. The research sample was all plant species covered by a total square of 65 square. Data were taken systematically by sampling then processed and analyzed descriptively and ecologically statistics. From the results of the research, it can be concluded: (1) A map of the distribution of useful plant species has been produced; (2) The pattern of distribution of useful plant species is divided into three patterns namely clustering patterns with 34 species (74%), random patterns with 11 species (24%), and regular patterns with 1 species (2%).**

Keywords—distribution of species; mapping; tenganan pegringsingan; useful plants.

I. INTRODUCTION

Bali has several traditional forests functioned as tourism and conservation forests. The tourism forests in Bali are Alas Kedaton, Sangeh, and Monkey Forest; meanwhile the conservation forests are Tenganan Pegringsingan forest, Taro Village Forest in Gianyar, Lemukih forest in Buleleng and Penglipuran forest in Bangli. Those tourism and conservation forests have their own special attractions because they are managed by the village based on local wisdom. Therefore, the sustainability of those forests remains well-maintained.

The results of the studies that have been done, such as [1, 2, 3, 4, 5, 6], in Monkey Forest, Penglipuran Village, Alas Kedaton and in Bali Aga and Bali Majapahit Villages, also in Tenganan Pegringsingan Village. The objects of the study included the rare plants with their mapping and distribution; the plants symbolizing the human body in Bali Aga and Bali Majapahit Villages, as well as the conservation of the plants in Tenganan Pegringsingan Village. The results of the studies done by reference [7, 8] about rare plants showed that it has been established a map of rare plant species distribution in Monkey Forest, Penglipuran and Alas Kedaton. The result of the second year study showed that the conservation pattern was based on the local wisdom oriented to awig-awig, myth, religious, tenget (eeriness), tonya (magical creatures), and community awareness. From this result, it can be used as a reference to do the mapping of useful plants in the forest of Bali Aga Tenganan Pegringsingan Village.

The utilization of the plant species in Tenganan Pegringsingan does not contribute to the damage of the village forests. The forests remain sustainable, even though socio systemically those plants are used by the community. Reference [9] stated that plants can generally be used for clothing, food, housing, medicine, household, and religious purposes. The plants in Bali Aga Tenganan Pegringsingan Village do not useful in terms of economic value only, but also in terms of culture, social and religious. In order to find out more about the usefulness of the plant species in Tenganan Pegringsingan forest, it is a necessary to explore it, so the plant species mapping and their distribution in their natural origin, biodiversity, bio conservation, can be known in depth. The objectives of this study are (1) producing a map of the useful plant species distribution in Bali Aga Tenganan Pegringsingan village forests, and (2) finding out the useful plant species distribution pattern in their original nature in Bali Aga Tenganan Pegrinsingan Village.

II. MATERIAL AND METHODS

This research was an explorative and descriptive research. It took place at the Bukit Kangin forest of Tenganan Pegringsingan Village, Karangasem regency. The populations of this research were the entire area of the Bukit Kangin forest and all of its vegetation. The mapping sample was the entire area of the Bukit Kangin forest and the distribution pattern sample was all the plants covered by 65 squares sized 20x20m2, 10x10m2, and 1x1m2. The research instruments regarding the mapping were GPS (Global Positioning System), compass, Hilling, pegs, and nails. The instruments for vegetation sampling were strings of raffia, pegs, Hag meter, Environmental thermometer, Soil tester, Anemometer, Hygrometer, Lux meter, and Pita meter. The mapping method was conducted by a simple measurement technique referring to [10, 11] on a simple mapping and

boundary note. Related to the steps on the useful plant species distribution pattern, it was done by placing the plots (squares) as many as 65 square on the forest ground with the distance between one square to another was 10 meters. Furthermore, recording and documenting the observation results were carried out. The data were analyzed descriptively and ecologically statistic [12, 13, 14, 15, 16].

III. WORK STEPS

The work steps in this study included the work steps of mapping the distribution of useful plants and ecosystem/vegetation studies are:

A. *Mapping Aspects*

Mapping the distribution of useful plant species was taken after the process of measuring the research location. The location measurement was used for the data calculation, processing and correction to determine the position (coordinate) of every measured point in the mapping area. The applied mapping method was simple measuring technical according to reference [10] on the map and boundary layout simple mapping notes. The steps of simple mapping work are described as follow:

1. Piling temporary points by determining the measurement points (peg). How to set the point can be seen in Figure 1.

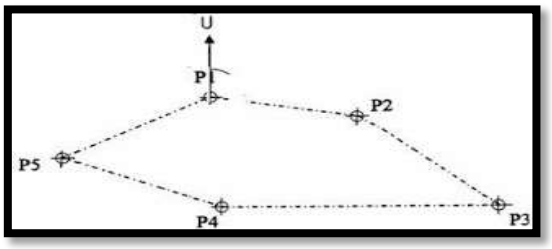

Fig 1. *Peg Measurement Point (source: [10], [11])*

The points that had been made on the research location must be easily found, these points were marked with wood (stakes) sized 15 x 15 cm2 which were planted on the ground. Then those stakes were numbered and nailed on the top. The distance of the peg was adjusted to the research location.

2. Direct measurement of the distance between the pegs with a length measuring tool completed with lines and numbers in a meter. The tool was placed horizontally so that the distance could be measured correctly.
3. Calculating the difference of land surface height between the pegs and healing.
4. Performing simple definitive measurements with sliding system polygon compass method according to reference [11].
   a. Angular or azimuth measurement on each peg that had been placed on the location points to form a closed polygon.
   b. Calculate the compass polygon point coordinates by identifying the starting and ending points and then determining the geographical azimuth.

The mapping distribution of useful plant species was taken by using an explorative method with species data collection using GPS to determine the plant's location as presented in the distribution map of useful plant species.

B. *Vegetation Aspect*

The data collection of useful plant species was carried out in two stages, they were preparation stage and implementation stage

Preparation Stage

1) Research Location Observation is observing the location, its layout and the plant species in Bukit Kangin Forest of Tenganan Pegringsingan Village.
2) Research Permit from Tenganan Pegringsingan Official.
3) Preparing the research schedule with the source person.
4) Preparing the Tools and Materials as presented in Table 1.

TABLE I. THE LIST OF TOOLS AND MATERIALS

No.	Name	Category	Function
1	GPS(Global Positioning System)	Tool	Navigation system displaying plant position and time information
2	Compass	Tool	Measuring angles of azimuth (coordinate) of each measured point in the mapping area
3	Environmental Thermometer	Tool	Temperature gauge
4	Soil tester	Tool	Measuring pH and the soil organic materials
5	Anemometer	Tool	Measuring the wind speed
6	Hygrometer	Tool	Humidity gauge
7	Lux meter	Tool	Measuring light intensity
8	Meter tape	Tool	Measuring the length and distance between squares
9	Wooden peg	Tool	As the point piles and to install the transect line
10	Raffia rope	Tool	As transect line
11	Altimeter	Tool	Measuring the place height
12	Electric Scale	Tool	Weighing soil samples
13	Blast Furnace	Tool	High-temperature soil samples furnace
14	Digital Camera	Tool	Documenting the research
15	Plastic Bag	Material	To store the soil samples
16	Label Paper	Material	Labeling on the plants and soil samples
17	Marker	Material	Stationary
19	Data Recording Sheet	Material	To record the observation results

IV. IMPLEMENTATION STAGE

The implementation stage in collecting data on Bukit Kangin Forest, Tenganan Pegringsingan Village was following steps below:

1. Dividing the forest area into two zones.
2. Spreading the transect line as a compass line.
3. Laying the squares on the compass line alternately.
4. The interval between one square and the others was 10 meters each.
5. Collecting data of plant species was carried out on tree habitus plant species with a square size of 20 x 20 m, sapling with a size of 10 x 10 m, and seedling with a size of 1 x 1 m, with a total of 65 squares. (See Figure 2.)

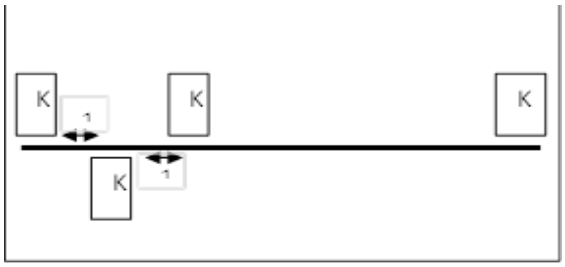

Fig 2. *Square placing on the research field due to data collection of useful plant species K1-K65 = Square 1-65*

6. Recording the number of each plant species on each sample point and systemically measure the stem diameter. In order to make the work on the field easier, the data obtained were recorded in a book that had been prepared with a work table that contained the local name of the plants, scientific name, number of specific individuals and the stem circumference.
7. Measuring the research supporting parameters such as temperature, humidity, location height, light intensity, soil organic material, soil moisture, and pH.
8. Documenting every plant species found.
9. Sampling plant species in the research field and collecting plant samples into the plastic bags which had been labeled as herbarium supplies.
10. Conducting laboratory observation by identifying the plant species through a literature study.

V. RESULT AND DISCUSSION

A. The Research Results

Based on the analysis there were 46 useful plant species found in Bukit Kangin Forest. The data are presented in Table 2.

TABLE II. USEFUL PLANT SPECIES COMPOSITION IN BUKIT KANGIN FOREST OF TENGANAN PEGRINGSINGAN VILLAGE. (TOTAL AREA: 32.565 M2)

No	Species Code	Local Name	Scientific Name	Family	Number Of Individual
1	BS	Alang-alang	*Imperata cylindrica* (L.) P.Beauv.	Poaceae	7
2	BI	Alpukat	*Persea Americana* Mill.	Lauraceae	1
3	BJ	Asem	*Tamarindus indica* L.	Fabaceae	2
4	S	Ata	*Lygodium circinatum* (Burm.) Sw.	Lygodiaceae	79
5	AF	Badung	*Garcinia dulcis* (Roxb.) Kurz	Clusiaceae	5
6	Y	*Tiing Tali*	*Gigantochloa apus* Kurz	Poaceae	76
7	R	Bayur	*Pterospermum celebicum* Miq.	Malvaceae	188
8	L	Belalu	*Hopea celebica* Burck	Dipterocarpaceae	20
9	V	Belalu Bali	*Hopea* sp.	Dipterocarpaceae	1
10	BU	Belimbing Wuluh	*Averrhoa bilimbi* L.	Oxalidaceae	4
11	AP	Beringin	*Ficus benjamina* L.	Moraceae	4
12	F	Cempaka Putih	*Michelia alba* DC.	Magnoliaceae	21
13	N	Dauh	*Dracontomelon mangiferum* Bl.	Anacardiaceae	1
14	B	Durian	*Durio zibethinus* Murr.	Bombacaceae	34
15	A	Enau	*Arenga pinnata* Merr.	Arecaceae	1.091
16	AS	Gamongan	*Zingiber aromaticum* Valeton	Zingiberaceae	32
17	U	Gegirang	*Leea* sp.	Leeaceae	27
18	AM	Ilak	*Amomum* sp.	Zingiberaceae	25
19	AV	Jambu Biji	*Psidium guajava* L.	Myrtaceae	1
20	AX	Jangar Ulam	*Syzygium polyanthum* Miq.	Myrtaceae	1
21	AC	Jeruk Bali	*Citrus maxima* (Burm.) Merr.	Rutaceae	3
22	AI	Jeruk Lemo	*Citrus amblycarpa* Ochse	Rutaceae	3
23	BR	Juwet	*Syzygium cumini* (L.) Skeels	Myrtaceae	1
24	AZ	Kayu Manis	*Sauropus androgynus* (L.) Merr.	Euphorbiaceae	10
25	AA	Kelapa	*Cocos nucifera* L.	Arecaceae	37

No	Species Code	Local Name	Scientific Name	Family	Number Of Individual
26	H	Kemiri	*Aleurites moluccanus* Willd.	Euphorbiaceae	30
27	I	Kepundung	*Baccaurea racemosa* Mull.Arg.	Phyllanthaceae	21
28	AT	Kerasi	*Lantana camara* L.	Verbenaceae	14
29	AL	Kutat	*Planchonia valida* Blume	Lechytidaceae	38
30	AW	Majegau	*Dysoxylum densiflorum* Miq.	Meliaceae	3
31	M	Mangga	*Mangifera indica* L.	Anacardiaceae	38
32	AD	Manggis	*Garcinia mangostana* L.	Clusiaceae	4
33	BY	Nanas	*Ananas comosus* (L.) Merr.	Bromeliaceae	7
34	G	Nangka	*Artocarpus heterophyllus* Lam.	Moraceae	46
35	C	Pakel	*Mangifera odorata* Griff.	Anacardiaceae	59
36	BB	Pandan Duri	*Pandanus tectorius* B.C. Stone	Pandanaceae	3
37	E	Pangi	*Pangium edule* Reinw.	Achariaceae	5
38	P	Pinang	*Areca catechu* L.	Clusiaceae	11
39	O	Pisang	*Musa paradisiaca* L.	Musaceae	72
40	AG	Pule	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	145
41	AO	Pulet	*Urena lobata* L.	Malvaceae	11
42	BH	Rambutan	*Nephelium lappaceum* L.	Sapindaceae	3
43	AR	Salak	*Salacca zalacca* (Gaertn.) Voss	Aecaceae	1
44	BK	Sukun	*Artocarpus altilis* (Parkinson) Fosberg	Moraceae	7
45	BL	Tabia Bun	*Piper retrofractum* Vahl	Piperaceae	3
46	AK	Talas	*Colocasia esculenta* (L.) Schott	Araceae	54
Total			**46**	**31**	**2.249**

Based on the Table 2 above, there were 31 families of plants which consisted of 46 useful plant species with 2.249 total individual species. The highest individual number was from the Arecaceae family and the lowest was Lauraceae family. The plant species found were mostly enau (48,51%), bayur (8,35%), Pule (6,44%) and Ata (3,51%).

Based on the whole data of the plant species in Bukit Kangin in total 77 species, 46 (60%) of them were useful plant species to the local community, meanwhile the other 31 (40%) were plants that were not utilized by the community according to the Bali Aga Tenganan Pegringsingan socio-cultural. Thus, it can be understood that most of the plants (60%) were utilized and 40% of them were not traditionally used by the local community.

Based on their usefulness, those plant species were utilized for the housing, medicine, food, clothing, industrial and religious (Hindu) purposes. One plant species were used for one to four types of usefulness. The utilization of those plant species in Bukit Kangin Forest is presented in Table 3.

TABLE III. THE PLANTS UTILIZATION BY THE COMMUNITY OF TENGANAN PEGRINGSINGAN VILLAGE BASED ON BALI AGA SOCIO CULTURAL

No	Number of Utilization Types	Allotment of Plant Utilization	Number of Species	Percentage (%)	Total of Percentation (%)
1	1 Utilization Type	Housing	3	6,5	41,4
2		Medicine	6	13,1	
3		Religious Ceremony	10	21,8	
4	2 Utilization Types	Food and Medicine	3	6,5	43,3
5		Food and Housing	2	4,3	
6		Food and Religious Ceremony	6	13,1	
7		Housing and Medicine	2	4,3	
8		Housing and Religious Ceremenony	2	4,3	
9		Medicine and Religious Ceremony	4	8,7	
10		Religious Ceremony and Industrial	1	2,2	
11	3 Utilization Types	Clothing, Food, and Housing	1	2,2	10,9
12		Clothing, Religious Ceremony, and Industrial	1	2,2	
13		Food, Housing and Religious Ceremony	2	4,3	
14		Housing, Medicine and Religious Ceremony	1	2,2	
15		Food, Housing, Medicine, and Religious Ceremony	2	4,3	4,3
Total			46	100	100

From the Table 3, it can be seen that there were 41,4% of plant species used for one utilization type, 43,3% for two utilization types, 10,9% for three utilization types and 4,3% of them were for four utilization types. Therefore, it can be stated that the local community utilized the plants from one to four utilization types based on the socio-cultural of Bali Aga Tenganan Pegringsingan Village.

Based on the data presented in Table 2, the mapping of plant distribution was conducted. The mapping of these useful plant species which were utilized by the community of Bali Aga Tenganan Pegringsingan is presented in the form of their distribution map in the Bukit Kangin forest. This plant species distribution map is completed with their actual coordinate positions in Universal Transverse Mercator (UTM). The data of these useful plant species distributions are presented on the map as shown in Figure 3.

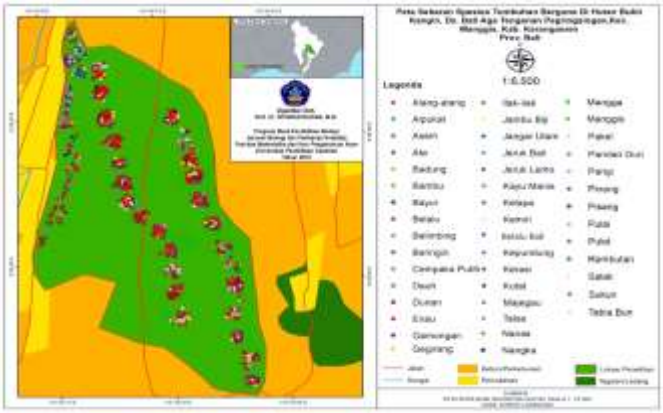

Fig 3. *The Map of the Useful Plant Species Distributions in Bukit Kangin Forest*

Based on the figure 3, it can be seen that the map shows the distribution of 46 useful plant species in the area of Bukit Kangin forest. Moreover, enau (palm) was the dominant species because it grew the most in Bukit Kangin Forest. The Bukit Kangin forest was also called Bukit Jaka or Bet Jaka (palm hill) by the local people. Based on the number of plant species in the Bukit Kangin forest, they were divided into three zones as presented in Table 4.

TABLE IV. THE RECAPITULATION OF THE NUMBER OF USEFUL PLANT SPECIES AND INDIVIDUALS

Zone	Number Plant Species	Number of Individuals
I	27	968
II	34	687
III	31	596

Based on Table 4, it shows that Zone II was the study area with the highest species number in total 34 plant species, Zone III in total 31 plant species, and Zone I in total 27 plant species. Based on the number of their individuals it can be seen that Zone I was the study area with the highest number of individuals which was 968 individuals. Meanwhile, there were 687 individuals in Zone II and 596 individuals in Zone III.

From the individual species number of a particular plant species, the analysis went further using the Poison analysis method. Therefore, the distribution pattern of each species can be calculated. The results of the 46 plant species distribution pattern are presented in Table 5.

TABLE V. THE USEFUL PLANT SPECIES DISTRIBUTION PATTERN IN BUKIT KANGIN FOREST OF TENGANAN PEGRINGSINGAN VILLAGE

No.	Local Name	Scientific Name	Type of Distribution Pattern
1	Alpukat	*Persea americana* Mill.	Random
2	Alang-alang	*Imperata cylindrica* (L.) P.Beauv.	Cluster
3	Asem	*Tamarindus indica* L.	Cluster
4	Ata	*Lygodium circinatum* (Burm.) Sw.	Cluster
5	Badung	*Garcinia dulcis* (Roxb.) Kurz	Cluster
6	*Tiing Tali*	*Gigantochloa apus* Kurz	Cluster
7	Bayur	*Pterospermum celebicum* Miq.	Cluster
8	Belalu	*Hopea celebica* Burck	Random
9	Belalu Bali	*Hopea* sp.	Random
10	Belimbing Wuluh	*Averrhoa bilimbi* L.	Cluster
11	Beringin	*Ficus benjamina* L.	Random
12	Cempaka Putih	*Michelia alba* DC.	Cluster
13	Dauh	*Dracontomelon mangiferum* Bl.	Random
14	Durian	*Durio zibethinus* Murr.	Cluster
15	Enau	*Arenga pinnata* Merr.	Regular
16	Gamongan	*Zingiber aromaticum* Valeton	Cluster
17	Gegirang	*Leea* sp.	Cluster
18	Ilak	*Amomum* sp.	Cluster
19	Jambu Biji	*Psidium guajava* L.	Random
20	Jangar Ulam	*Syzygium polyanthum* Miq.	Random
21	Jeruk Bali	*Citrus maxima* (Burm.) Merr.	Random
22	Jeruk Lemo	*Citrus amblycarpa* Ochse	Random
23	Juwet	*Syzygium cumini* (L.) Skeels	Random
24	Kayu Manis	*Sauropus androgynus* (L.) Merr.	Cluster
25	Kelapa	*Cocos nucifera* L.	Cluster
26	Kemiri	*Aleurites moluccanus* Willd.	Cluster
27	Kepundung	*Baccaurea racemosa* Mull.Arg.	Cluster
28	Kerasi	*Lantana camara* L.	Cluster

No.	Local Name	Scientific Name	Type of Distribution Pattern
29	Kutat	*Planchonia valida* Blume	Cluster
30	Majegau	*Dysoxylum densiflorum* Miq.	Cluster
31	Mangga	*Mangifera indica* L.	Cluster
32	Manggis	*Garcinia mangostana* L.	Cluster
33	Nanas	*Ananas comosus* (L.) Merr.	Cluster
34	Nangka	*Artocarpus heterophyllus* Lam.	Cluster
35	Pakel	*Mangifera odorata* Griff.	Cluster
36	Pandan Duri	*Pandanus tectorius* B.C. Stone	Cluster
37	Pangi	*Pangium edule* Reinw.	Cluster
38	Pinang	*Areca catechu* L.	Cluster
39	Pisang	*Musa paradisiaca* L.	Cluster
40	Pule	*Alstonia scholaris* (L.) R.Br.	Cluster
41	Pulet	*Urena lobata* L.	Cluster
42	Rambutan	*Nephelium lappaceum* L.	Cluster
43	Salak	*Syzygium cumini* (L.) Skeels	Random
44	Sukun	*Artocarpus altilis* (Parkinson) Fosberg	Cluster
45	Tabia Bun	*Piper retrofractum* Vahl	Cluster
46	Talas	*Colocasia esculenta* (L.) Schott	Cluster

Based on Table 5, it can be seen that the useful plant species in the Bukit Kangin forest had 3 types of distribution patterns. The plants which had a regular type of distribution pattern were only 1 species or 2% of the plant species. The plant species that belongs to the category of regular distribution pattern was Enau (Arenga pinnata Merr.).

There were 11 useful plant species (24%) which had a random distribution pattern. The plant species that belong to random distribution pattern were Alpukat (Persea americana Mill.), Belalu (Hopea celebica Burck), Belalu Bali (Hopeasp.), Beringin (Ficus benjamina L.), Dauh (Dracontomelon mangiferum Bl.), Jambu Biji (Psidium guajava L.), Jangar Ulam (Syzygium polyanthum Miq.), Jeruk Bali (Citrus maxima (Burm.) Merr.), Jeruk Lemo (Citrus amblycarpa Ochse), Juwet (Syzygium cumini (L.) Skeels), and Salak (Syzygium cumini (L.) Skeels). Meanwhile, there were 34 useful plant species (74%) which had clustering distribution patterns, they were Alang-alang (Imperata cylindrica (L.) P.Beauv.), Asem (Tamarindus indica L.). Ata (Lygodium circinatum (Burm.) Sw.), Badung (Garcinia dulcis (Roxb.) Kurz), Tiing Tali (Gigantochloa apus Kurz), Bayur (Pterospermum celebicum Miq.), Belimbing Wuluh (Averrhoa bilimbi L.), Cempaka Putih (Michelia alba DC.), Durian (Durio zibethinus Murr.), Gamongan (Zingiber aromaticum Valeton), Gegirang (Leea sp.), Ilak (Amomum sp.), Kayu Manis (Sauropus androgynus (L.) Merr.), Kelapa (Cocos nucifera L.), Kemiri (Aleurites moluccanus Willd.), Kepundung (Baccaurea racemosa Mull.Arg.), Kerasi (Lantana camara L.), Kutat (Planchonia valida Blume), Majegau (Dysoxylum densiflorum Miq.), Mangga (Mangifera indica L.), Manggis (Garcinia mangostana L.), Nanas (Ananas comosus (L.) Merr.), Nangka (Artocarpus heterophyllus Lam.), Pakel (Mangifera odorata Griff.), Pandan Duri (Pandanus tectorius B.C. Stone), Pangi (Pangium edule Reinw.), Pinang (Areca catechu L.), Pisang (Musa paradisiaca L.), Pule (Alstonia scholaris (L.) R.Br.), Pulet (Urena lobata L.), Rambutan (Nephelium lappaceum L.), Sukun (Artocarpus altilis (Parkinson) Fosberg), Tabia Bun (Piper retrofractum Vahl) and Talas (Colocasia esculenta (L.) Schott).

Based on the data above, it can be understood that the highest distribution pattern of the useful plant species in Bukit Kangin Forest was cluster distribution patterns (74%), then random distribution pattern (24%), and the lowest was regular distribution pattern (2%).

B. Discussion

From the results of this study, there were 46 plant species of 26 plant families in the Bukit Kangin forest that were utilized by the people of Tenganan Pegringsingan Village. Those plants were used by the community for clothing, housing, ceremony, traditional medicine, and industrial purposes. Based on the 46 plant species recorded, the dominant plants were Enau (Arenga pinata), Bayur (Plerospermum celebicum) and Pulai (Alstonia scholaris).

Enau (Arenga pinata) were mostly found in Zone I which the altitude was 233-303 meters above sea level and pH 5 on average. According to reference [21] the palm can grow in various soil conditions, whether it is clayey soil, calcareous or sandy soil. However, the palm cannot grow well in an excessive pH soil. According to reference [17] Enau (Arenga pinata) can grow well at an altitude 0-1.400 meter above sea level.

Bayur (Pterospermum celebicum) grew in the area of Bukit Kangin Forest. They were mostly found in Zone 3 which altitude was 118-190 meters above sea level and the soil pH was 5-7. According to reference [18] Bayur (Pterospermum celebicum) has broad tolerance for soil moisture. However, its young plant has semi moisture soil tolerance where young bayur plant needs low light intensity and before weaning it needs high light intensity. Therefore, Bayur (Pterospermum celebicum) found in the Bukit Kangin forest were mostly mature plants due to the area has a low light intensity that is 20-40 Lux.

Pulai (Alstonia scholaris) in Bukit Kangin forest were mostly found in Zone 3 which altitude 118-190 meter above sea level with the humidity was 71% and soil pH between 6-7. This is in line with the statement from reference [19] which said that Pulai (Alstonia scholaris) will optimally grow in the area with humidity between 70%-90% and soil pH between 6-8.

The useful plants in Indonesia based on their utilization can be classified into several types of use, such as clothing materials, foods, housing and household appliances, medicine, cosmetics, rigging and plaiting, as well as for social and religious activities [20]. The people who live in Tenganan Pegringsingan village use the forest products for clothing, food, shelter, medicine, industrial and religious purposes

Based on the interview with Mrs. Komang Handayani (Private interview, 2019) the plants were mostly used in religious ceremonies. There were various plant species used by the people of Tenganan Pegringsingan village in religious ceremonies such as Bambu Tali (Gigantochloa accer), Enau (Arenga pinata Merr.), Gegirang (Leea angulata), Kelapa (Cocos nucifera L.), Pinang (Areca catechu L.), and Pisang (Musa paradisiaca).

The results of distribution mapping of the plant species are in line with the results of the study conducted by reference [7] about rare plants in some tourism forests in Bali as shown in Figure 4.

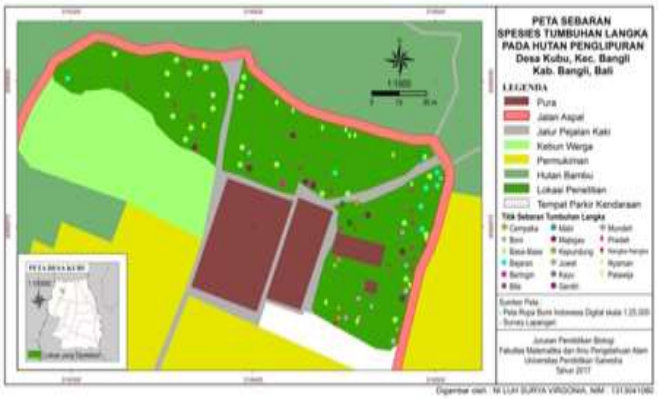

Fig 4.*The Map of Rare Plant Species Distribution in Tourism Forests in Bali. A. Penglipuran Tourism Forest. B Monkey Forest. C. Alas Kedaton.*

Based on the study results in the Bukit Kangin forest of Tenganan Pegringsingan village, there were 46 useful plant species found. The plant species distribution patterns found were 3 different patterns; they are regular, random and cluster distribution patterns. These distribution patterns were affected by biotic factors. It is due to conservation/cultivation or accidentally other living things throw fruits or seeds which help the process of these plant species distributions become wider [6].

The useful plant species generally had cluster distribution patterns because each plant species spread both its fruits and seeds influenced by the gravity. Therefore, the seeds tend to grow and mature in the areas close to the source plants, so that these species tend to grow clusters in several areas according to the presence of their source plants. Besides, the environmental factors also affect plant species life success. The species which has specific environmental growth requirements will only be able to grow in a certain area, so the species cluster distribution pattern is formed [5, 7, 12, 16].

VI. CONCLUSION

From the results of the study, it can be concluded: (1) A map of useful plant species in Bukit Kangin forest of Tenganan Pegringsingan village, Karangasem-Bali has been produced; (2) There were three distribution patterns of the useful plant species, they are cluster pattern with 34 species (74%), random pattern with 11 species (24%) and regular pattern with 1 species (2%). Based on the result of the study, it can be recommended (1) It is necessary to conduct a further study of the useful plants in Bukit Kauh and Bukit Kelod forests; (2) From the mapping results of the useful plant species, it can be developed further a creative tourist destination other than the existing tourist attractions.

REFERENCES

[1] N. Wijana, “The measurement of rare plant learning media using backward chaining integrated with context Input-Process-Product Evaluation Model based on mobile technology,” IJACSA (International Journal of Advance Computer Science and Application), vol. 9, 2018.

[2] N. Wijana,”The formation of mini illustrated dictionary of rare plant in the village forest of Penglipuran, Bangli, Bali,” 2018.

[3] N. Wijana, "Rare plant preservation throught Village Forest Policy in Bali", Advances in Social Science, Education and Humaties research, volume 134. 2nd International Conference on Across reaserch (ICIRAD, 2017), 2017.

[4] N. Wijana, "Plant species mapping and diversity in the village of Penglipuran, Bangli, Bali, Indonesia and use in the learning media," 2017.

[5] N. Wijana, "Pengelolaan lingkungan hidup: aspek kearifan lokal, ergonomi, ergologi dan regulasi,"Yogyakarta, Plantaxia, 2016.

[6] N. Wijana, "Keanekaragaman spesies tumbuhan, manfaat dan upaya pelestarian oleh masyarakat Desa Adat Tenganan Pegringsingan, Karangasem,"Jurnal Wahana Matematika dan Sains, vol. 5, Oct 2008.

[7] N. Wijana and I.G.A.N, Setiawan, "Pemetaan pencaran spesies tumbuhan langka pada hutan wisata di Provinsi Bali," Stranas Tahap I. Laporan Penelitian, 2017.

[8] N. Wijana and I.G.A.N. Setiawan, "Distribusi dan komparasi spesies tumbuhan simbol tubuh (Tri Angga) masyarakat Bali Agedan Bali Majapahit pada Trimandala di Provinsi Bali," 2018.

[9] K. Heyne, "Tumbuhan berguna Indonesia I-IV. Badan Litbang Kehutanan," Jakarta, Yayasan Sarana Wana Jaya. Terjemahan dari: de Nuttige Planten van Indonesia, 1987.

[10] R.P. Soenaryanto, "Catatan pemetaan sederhana peta dan tata batas," Bogor, Pusat Pendidikan dan Latihan Kehutanan, 1976.

[11] E. Teten, Darjo, and S. Usep, "Polygon kompas," Kadipaten, Pelatihan Pengukuran Terrestris Angkatan IV Balai Latihan Kehutanan, 1999.

[12] M.G. Barbour, J. H. Burk, W. D. Pits, "Terrestrial plant ecology," Inc. California, The Benjamin/cummings, California, Publishing Company, 1987.

[13] Mueller-Dombois and Ellenberg, "Aims and methods of vegetation ecology," Sanfransisco , W. H. Freeman and Company,1974.

[14] G.W Cox, "Laboratory manual of general ecology," USA, WM. C. Brown Company Publisher, 1976.

[15] J.A. Ludwig and J.F. Reynolds, "Statistical Ecology," New York, Jhon Willey and Sons, 1988.

[16] N. Wijana, "Metode analisis vegetasi," Yogyakarta, Plantaxia, 2014.

[17] B. Adjie, "Koleksi tanaman Upacara Adat Bali Kebun Raya Bali," Bali, UPT Balai Konservasi Tumbuhan Kebun Raya Eka Karya, 2002.

[18] S. Hidayat, "Pola sebaran dan asosiasi bayur (Pterospermum Javanicum Jungh.) di kawasan Taman Nasional Gunung Rinjani". Jurnal Pendidikan Hutan dan Konservasi Alam, vol. 11,2014.

[19] H. Setiono, "Struktur populasi Alstonia scholaris (L) R.Br di kawasan Air Terjun Bajuin Tanah Laut," Makalah disajikan dalam Seminar Nasional XII Pendidikan Biologi FKIP UNI, Jakarta FKIP UNI, 2015.

[20] N. Hasanah, "Potensi tumbuhan berguna di Cagar Alam Yanlappa, Bogor-Jawa Barat," Skripsi, Bogor,Institut Pertanian Bogor, 2011.

[21] F.A. Fatah, A.H Nawai, R. Anwar, and N. Othman, "Socioeconomic study of Arenga Pinnata smallholders in Malaysia," Look East Policy, 2015.