

**SAGO PALM BIODIVERSITY IN SERAM ISLAND  
MALUKU PROVINCE, INDONESIA**

**BIODIVERSITAS TUMBUHAN SAGU  
DI PULAU SERAM, PROVINSI MALUKU, INDONESIA**

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Accepted May, 11<sup>th</sup> 2018/ Approved December, 9<sup>th</sup> 2018

**ABSTRACT**

The number of sago palm species in Maluku Province becomes the current issue of biodiversity. The research aimed to clarify the species of sago palm in the Seram island, Maluku province. The research was conducted from March to November 2009 in three sample regions i.e. Luhu of Seram Bagian Barat (SBB) district, Sawai of Maluku Tengah (MT) district, and Werinama of Seram Bagian Timur (SBT) district. Genetic analysis was done at the laboratory of plant biology Inter Center University (ICU) Bogor Agricultural University. Variety of palm sago was analyzed using index of similarity analysis for group similarity and Shannon-Wiener ( $H'$ ) index for biodiversity of species. Further, the genetic analysis used isozyme method showed that group of sago in Seram Island shared group similarity included index value ranging from 60.66–80.92%. Based on the result of Shannon-Wiener ( $H'$ ) index, all growth phases of sago palm group in Seram Island generally indicated a very low  $H'$  value ranging from 0.61 – 0.90. Clearly, the genetic analysis illustrated there were only two kinds of sago species in Seram Island i.e. *Metroxylon rumphii* Mart. and *M. sagus* Rottb. The first species consists of three varieties i.e. 1) *Microcanthum* Becc., 2) *Sylvestre* Becc., and 3) *Rotang* Becc. Sago species of *M. sagu* Rottb. has solely one variety *Molat* Becc. Here, variety of *Microcanthum* is divided by two kinds of variety i.e. Tuni and Makanaro.

*Key words* : Biodiversity, *Metroxylon*, species, genetic, Seram island

**ABSTRAK**

Jumlah spesies tumbuhan sagu di provinsi Maluku masih mengalami perdebatan dalam bidang biodiversitas. Penelitian ini bertujuan untuk melakukan klarifikasi spesies sagu yang tumbuh dan berkembang di pulau Seram, provinsi Maluku. Penelitian berlangsung pada bulan Maret–November 2009. Pengamatan dilakukan pada 3 wilayah sampel yaitu: Luhu Kab. Seram Bagian Barat (SBB), Sawai Kab. Maluku Tengah (MT), dan Werinama Kab. Seram Bagian Timur (SBT). Analisis genetik dikerjakan di laboratorium Biologi Tumbuhan Pusat Antar Universitas (PAU) IPB

Bogor. Keanekaragaman kelompok sago dianalisis dengan menggunakan analisis kemiripan kelompok. Keanekaragaman spesies dianalisis menggunakan Indeks Keanekaragaman Shannon-Wiener ( $H'$ ). Analisis genetik menggunakan metode isozim. Hasil analisis menunjukkan bahwa kelompok sago di Pulau Seram memiliki kemiripan kelompok yang termasuk dalam kategori tinggi dengan nilai indeks berkisar antara 60,66 – 80,92 %. Hasil analisis indeks keanekaragaman spesies menurut indeks Shannon-Wiener ( $H'$ ) pada semua fase pertumbuhan menunjukkan bahwa indeks keanekaragaman spesies vegetasi dalam kelompok sago di Pulau Seram secara umum termasuk dalam kategori sangat rendah dengan nilai  $H'$  berkisar antara 0,61 – 0,90. Hasil analisis genetik menunjukkan bahwa di Pulau Seram Maluku hanya terdapat dua spesies sago, yaitu *Metroxylon rumphii* Mart. dan *M. sagu* Rottb. Spesies yang pertama terdiri dari tiga varietas, yaitu: 1) *Microcanthum* Becc., 2) *Sylvestre* Becc., dan 3) *Rotang* Becc. Sedangkan spesies *M. sagu* Rottb. hanya memiliki satu varietas yakni *Molat* Becc. Varietas *Microcanthum* terbagi atas dua subvarietas, yaitu Tuni dan Makanaro.

Kata kunci : Biodiversitas, *Metroxylon*, spesies, genetik, pulau Seram

## INTRODUCTION

Biodiversity calls for all the living species on the earth including not only flora, fauna, fungi and microorganism, but all the genetic materials that these living species and ecology system variety bring on their living place as well. Kartono (2008) described biodiversity has three levels, i.e. a). Biodiversity of genetic, referring to genetic information existed individually, b). Biodiversity of species, explaining the amount of living species in a certain place, and c). Biodiversity of ecosystem, illustrating the habitat variety, biological community, and ecology processes existed in some specific ecosystems.

Related to the biodiversity of sago palm, according to Beccari (1918) in Flach (1997), genus of *Metroxylon* has two groups. The first one is the sago palm having row scales of fruit peel as many as 18 which then grouped in *Eumetroxylon*. Another one sets up for the number of row scales of fruit peel ranging from 24-29 categorized into *Coelococcus*. *Eumetroxylon* has two species i.e. *Metroxylon sagu* Rottb. and *Metroxylon rumphii* Mart while *Coelococcus* consists of seven species i.e. *M. squarosum* Becc., *M. warburgii* Heim., *M. upoluense* Becc., *M. vitiense* Benth et Hook, *M. amicarum* Becc.,

*M. salomonense* Becc., and *M. bougainvillense* Becc.

According to Heyne (1950) in Notohadiprawiro & Louhenapessy (1993) he defined that sago palm is the genuine sago included in genus of *Metroxylon*. This genuine sago is then categorized into two main groups based on the existence of thorn in the leaf stem. The first group defined as thorny palm covers *M. rumphii* Mart, as the main species in this group, *M. Longispinum* Mart., *M. Microcanthum* Mart., and *M. Sylvestre* Mart. Standing on another species which doesn't have thorn is *M. sagu* Rottb and is the one with various forms.

McClatchey *et al.* (2006) conducted a botanical description on sago palm genus of *Metroxylon* and divided it into six species i.e. 1) *M. amicarum* (H.Wendland) Beccari, 2) *M. Paulcoxii* McClatchey, 3) *M. sagu* Rottboell, 4) *M. salomonense* (Warburg) Beccari, 5) *M. vitiense* (H. Wendland) H. Wendland ex Benth & Hooker f., and 6) *M. warburgii* (Heim) Beccari. The spreading region of this various sago palms covers South East Asia, Melanesia, and some islands in Micronesia and Polynesia. Based on the spreading of sago palm map illustrated by Mc Clatchey, it is clear that Indonesia, PNG, and part of islands in South Phillipine has

solely one species of sago palm: *M. sagu* Rottb.

According to the book written by Louhenapessy (2006); Bintoro (2008); and Rostiwati *et al.* (2008), it found that Maluku island has five kinds of sago palm i.e. 1) *Metroxylon rumphii* Mart. (Tuni), 2) *M. sagu* Rottb. (Molat), 3) *M. Sylvestre* Mart. (Ihur), 4) *M. Longispinum* Mart. (Makanaro), and 5) *M. Microcanthum* Mart. (Duri Rotan). Various perspectives given by some scholars above depicted some pros and cons toward the number of sago palm. That issue encourages another study considering necessary to clarify the exact number of sago palm species cultivation in Maluku province particularly in Seram island.

**MATERIAL AND METHOD**

**Place and Time of The Research**

The research was conducted in Seram island known as the biggest island in Maluku province with ±18.000 km<sup>2</sup>. The research was also conducted for 9 months started from March to November 2009. The observation was conducted into three sample regions: 1) Luhu of Seram Bagian

Barat (SBB) District, 2) Sawai of Maluku Tengah (MT) District, dan 3) Werinama of Seram Bagian Timur (SBT) District. Genetic analysis was analyzed in the plant biology laboratory of Inter Center University (ICU) Bogor Agricultural University.

**Material and Method of The Research**

In this study, the sago palm was located in vegetation exposure where several various of plants grow up together in uncertain class or group. The sago palm group is equalized to sample region, so each of sample region was assumed as a group.

The observation activity was conducted in a square equipment. The size of the square equipment was suitable with the phase of vegetation sprouting. For seedling, the observations was done on the square equipment of 2 m x 2 m, phase of clum (sapling) measured for 5 m x 5 m, pole of 10 m x 10 m, and tree of 20 m x 20 m. Vegetation observation of study biodiversity was conducted through some stages as described in Figure 1. The observed variables were: a) Plantation species, b) The number of each species, c) The density of each sample unit, and d) coverage.

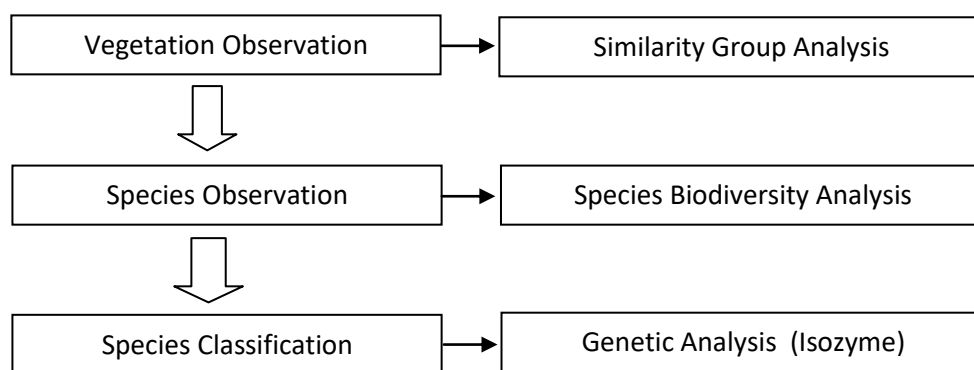


Figure 1. Study Stage of Sago Palm Biodiversity

**Biodiversity of Group**

To explain biodiversity of group of sago palm in Seram island, Maluku province, analysis of group similarity was used where

as one sample region was assumed as sago group as well. The analysis of group similarity was conducted through index of

similarity (IS) (Smith 1980 *in* Setiadi *et al.* 1989), given as :

$$IS = \frac{2w}{(a + b)} \times 100\%$$

where :

- IS : Index of Similarity
- a : Number of important value of the first stand
- b : Number of important value of the second stand
- w : the smallest number for each observed stand

The similarity level between sago groups divided into some criteria i.e. very high index of similarity (IS > 75 %), high index of similarity (50 % < IS < 75 %), low index of similarity (25 % < IS < 50 %), and very low index of similarity (IS < 25 %) (Krebs, 1999).

**Biodiversity of Species**

This analysis aimed to explain biodiversity of species for each sago group in sample regions. The number of index of biodiversity of species (Shannon-Wiener H') was set up as below (Ludwig dan Reynolds, 1988) :

$$H' = -\sum[(n.i/N)\log(n.i/N)]$$

where :

- H' : Index of Biodiversity
- n.i : important value of each kind
- N : total number of important value

Theoretically, index of biodiversity of Shannon (H') ranged from 0-7. If the value of H' ≤ 1, then it could be concluded that biodiversity of the species was very low. If the value was 1 < H' ≤ 2, it was said that the

index of biodiversity was low, if the value was 2 < H' ≤ 3 then index of biodiversity was included as medium, and if the value was 3 < H' ≤ 4 then index of biodiversity was assumed high, and if the value of H' > 4 then the index of biodiversity was categorized as very high (Soegianto, 1994).

**Biodiversity of Genetic**

The genetic analysis aimed to classify the sago palm species as there was tendency different point of view related to the number of sago palm species existed in Seram island Maluku province particularly and in Indonesia generally. The particular analysis to explain these difference point of view was conducted through a method of tapioca flour gel electrophoresis or named as isozyme analysis (Hartana, 2003). The method utilized some enzymes i.e. 1) Aspartat Amino Transferase (AAT), 2) Phosphatase Acid (ACP), 3) Peroxide (PER), and 4) Esterase (EST).

**RESULT AND DISCUSSION**

The result was used to clarify sago palm species in Seram island, Maluku province. The species clarification was according to two identified point of views, this research result and sago experts and clarification described by Beccari (1918) *in* Flach (1997). The division of clarification of sago palm species in Seram island was illustrated as follow in Table 1.

Table 1. Species of sago palm in Seram island, Maluku

No	Name of area	Name of species in general*	Name of species according to Beccari (1918) <i>in</i> Flach (1997)		
			Species	Variety	Subvar.
1.	Tuni sagu	<i>M. rumphii</i> Mart.	<i>M. rumphii</i> Mart.	Micracanthum Becc.	Tuni
2.	Makanaro sagu	<i>M. longispinum</i> Mart.	<i>M. rumphii</i> Mart.	Micracanthum Becc.	Makanaro
3.	Ihur sagu	<i>M. sylvestre</i> Mart.	<i>M. rumphii</i> Mart.	Sylvestre Becc.	-
4.	Durirotan sagu	<i>M. micracanthum</i> Mart.	<i>M. rumphii</i> Mart.	Rotang Becc.	-
5.	Molat sagu	<i>M. sagu</i> Rottb.	<i>M. sagu</i> Rottb.	Molat Becc.	-

Sources : \* Haryanto and Pangloli (1992); Louhenapessy (2006); Bintoro (2008); Rostiwati *et al.* (2008).

Luhu-SBB area I, Sawai-MT sample area II and Werinama-SBT as sample area III showed that the sago palm groups in Seram island shared the index of similarity included as high category ranged from 60.66–80.92%. (average 65.76 %) (Table 2). Based on the cultivation phase, it showed that the highest similarity of the group of sago obtained on the weaning phase reaching 74.33% and the lowest similarity of group respectively showed on pole phase for 58.69%, seedling phase for 62.41%, and tree phase for 67.61%. The similarity index of group among

sample regions in all phases of sago growth showed a high category of sago species index of similarity in Seram island, Maluku province with index of 65.76%. The number showed that there is a natural similarity of sago group in Seram island. The high value of similarity index was caused by the formation of cluster which grows massively through longitudinal rhizome growth in all sample areas or regions. Thus, the longitudinal rhizome formed a new individual own cluster.

Table 2. Index of similarity of sago group in Seram island, Maluku province

No.	Cultivation Phase	Index of Group Similarity (%)			
		I x II	I x III	II x III	Mean
1.	Tree	60.95	60.95	80.92	67.61
2.	Pole	57.14	57.52	61.42	58.69
3.	Sapihan	74.91	71.60	76.47	74.33
4.	Seedling	65.92	60.66	60.66	62.41
	Mean	64.73	62.68	69.87	65.76

Note: Data was gathered from the data mean of Luhu Western Seram sample area I, Sawai Central Maluku sample area II, and Werinama Eastern Seram sample area III, 2009.

A high value of IS in Seram island lies on the similarity of either growth environment or habitat. This condition will be placed by homogen individual creature also from the same species, as that creature has naturally developed adaptation mechanism and tolerance toward its own habitat. The similarity of vegetation group of sago in Seram island, Maluku province is propelled also by the society cultivating activity and growing sago palm sporadically over thousand years ago. It is in line to Loveless (1983) in Setiadi (2005) stated that other factors determining the existence of botany species or community is not only caused as a part of the influence of physics and chemistry factor, but also both animals and human take a big contribution to the growth of vegetation itself.

### Biodiversity of Species Level

The index analysis of species biodiversity according to Shannon ( $H'$ ) index to all the phases of sago growth in sample regions depicted the fact that index of species biodiversity was included as very low index given as  $H'$  ranging from 0.61 – 0.90, except for seedling phase in sample first region of Luhu-Western Seram with  $H'$  value 1.18 (Table 3).

Generally, index of species biodiversity in Seram island, Maluku province is included as very low category. It means that sago palm groups spread in every sample regions does not share any different on the index of species biodiversity. This phenomenon provides a clue that the group of sago palm cultivated naturally in Seram island, Maluku province reached both climax and stable group. Barbour *et al.* (1987) made the point that species biodiversity is the important

species giving an important information related to the activity of one specific group. He also explained that the wider the sample area, the more species will be located. Thus, the high value of species index biodiversity will then be higher. Low index value of species biodiversity generally met climax group units. In addition, a very stable group, widespread regional and homogen, has lower index value of species biodiversity as

well compared to mozaic forest form. Sometimes, the value index is regionally affected by fire, wind, flood, infection, and human intervention periodically. Usually, after the disturbance is over, the increase on the species biodiversity reached a point where the group also has a climax. Then, the appearance of climax will tend the decrease of biodiversity index.

Table 3. Index of species biodiversity in sago palm group in Seram island, Maluku province

No.	Growth Phase	Index of Shannon (H')			Mean
		Sample I area Luhu-WS	Sampel II area Sawai-CM	Sample III area Werinama-ES	
1.	Tree	0.61	0.61	0.65	0.62
2.	Pole	0.64	0.68	0.89	0.74
3.	Weaning	0.75	0.71	0.90	0.79
4.	Seedling	1.18	0.92	0.95	1.02
	Mean	0.79	0.73	0.85	0.79

Note: Data described was taken from mean data of sampel I area of Luhu Western Seram, sample II area of Sawai Central Maluku, and sample III area of Werinama Eastern Seram, 2009.

The result of the analysis depicted on Table 3 is considered relevant to argument of Barbour *et al.* (1987) stated that there is a low index of species biodiversity in all sample areas and growth phase. He also argues that the species biodiversity is included in relatively similar category. It showed that the environment of habitat in sample regions are relatively homogenous and it means some intrusions will not drastically cause significant detriment.

**Biodiversity of Genetic Level**

The result of enzyme analysis or enzyme isolation showed some interpretation obtained from three dye enzymes out of four. They were enzyme of AAT, ACP, and PER. On the other hand, the dye process used enzyme of Esterase (EST) resulted imperfect dye process. The three kinds of dye enzyme resulted good interpretation can be described as follow in Figure 2.

Figure 2 clearly illustrated the trend of isozyme bands from five analyzed sago species and it showed only two bands isozyme trends. Species *M. rumphii* Mart., *M. sylvestre* Mart., *M. longispinum* Mart., and *M. micrtocanthum* Mart. form isozyme band trends into one specific group, while *M. sagu* Rottb. separately forms its own bands trend. Four sago species forming the first isozyme bands trend was clearly the sago species with thorn. The second isozyme band trend was *M. sagu* Rottb. which stands for the non-thorn sago species. It concluded that there were only two kinds of sago species cultivating and growing in Seram Island, Maluku Province from knowingly five kinds of sago species after all. These both two species by Beccari (1918) in Flach (1997) are catagorized into species of *Metroxylon rumphii* Mart. for the thorny one and *Metroxylon sagu* Rottb. for those non-thorn sago species. It is also showed that the

research is in line to Beccari (1918) in Flach (1997).

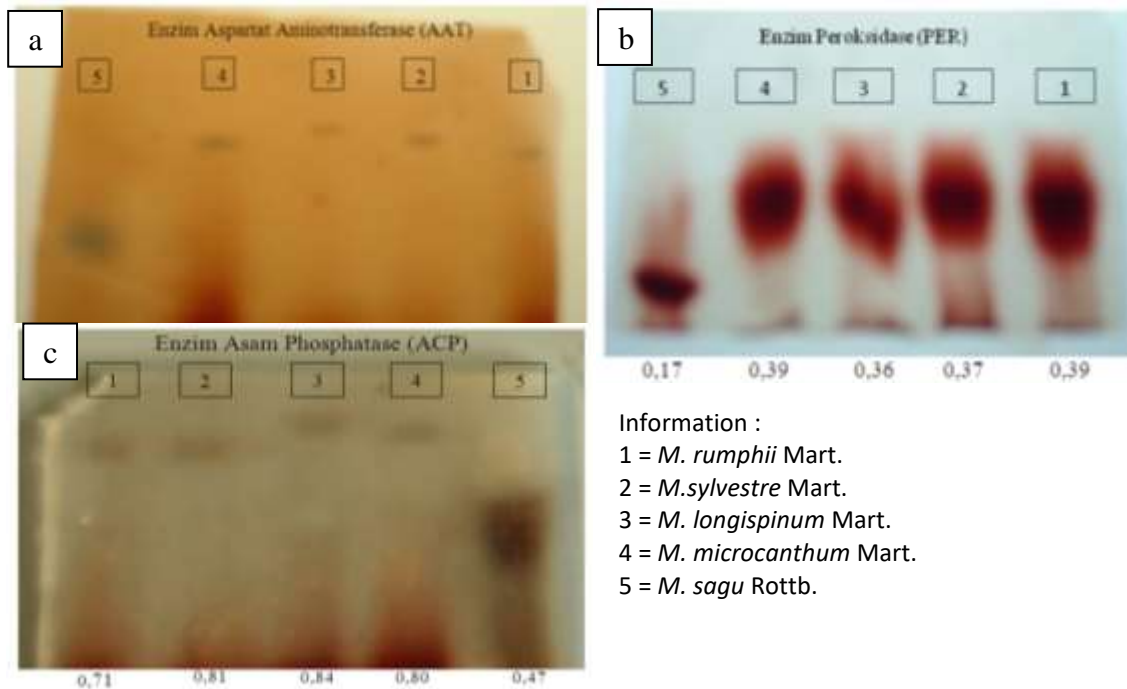


Figure 2. Zimogram of isozyme (a) Aspartat Aminotransferase (AAT), (b) Asam Phosphatase (ACP), and (c) Peroksidase (PER)

Based on Sarkar (1970) in Flach (1997), he stated that there were 16 chromosomes found in sago palm ( $2n = 32$ ). The number was supported by the research of Verhaar (1976) in Flach (1997) who found out that non-thorn sago species (*M. sagu* Rottb.) has chromosomes as many as 13 ( $2n = 26$ ). Thus, it can be concluded that thorn sago species *M. rumphii* Mart has 16 chromosomes and another species *M. sagu* Rottb. has clearly 13 chromosomes.

As it is explained previously, from all five sago species spread all over the world, two of them, *M. rumphii* Mart. and *M. sagu* Rottb., were cultivated and grown in Seram Island, Maluku Province. Then Beccari (1918) in Flach (1997) grouped these two species into four varieties. *M. rumphii* Mart. consisted of three varieties i.e. 1) *Microcanthum* Becc., 2) *Sylvestre* Becc., and 3) *Rotang* Becc. The another one sago species *M. sagu* Rottb. solely has one variety i.e. *Molat* Becc. Further, division of variety

*Microcanthum* was divided into two subvarieties i.e. Tuni and Makanaro. The result of genetic analysis using isozyme reinforce more argument of Beccari statement that the classification system in sago species was named after biological species terminology.

Based on the recent research above, there is a scientific correction about the amount of sago species located in Seram Island, Maluku Province, Indonesia. It can be explored also from the research that according to *Botanica Sistemática* issued by FAO (2007), the sago species *M. longispinum* Mart., *M. microcanthum* Mart, and *M. sylvestre* Mart had not existed from the eight sago species classification spread all over the world. Additionally, there are only two kinds of sago species i.e. *M. rumphii* Mart. and *M. elatum* Mart. made by Martius (1838) in FAO (2007). The total numbers of sago species according to Beccari (1918) in Flach (1997) and other marked experts are

illustrated below in Figure 3. Particular case took place in Molat variety from *M. sagu* Rottb. species as mentioned previously by Beccari (1918) in Flach (1997). It was still in line to the result of sago genetic research conducted in PNG by Kjaer *et al.* (2004) using AFLP methods that taxonomically *M. sagu* species merely consisted of one single

species. Further, he also explained that morphology distribution pattern geographically unreflected genetic variety pattern. It means there was morphological differences in *M. sagu* Rottb. species and the morphological similarity in all areas of PNG unaffected the genetic difference.

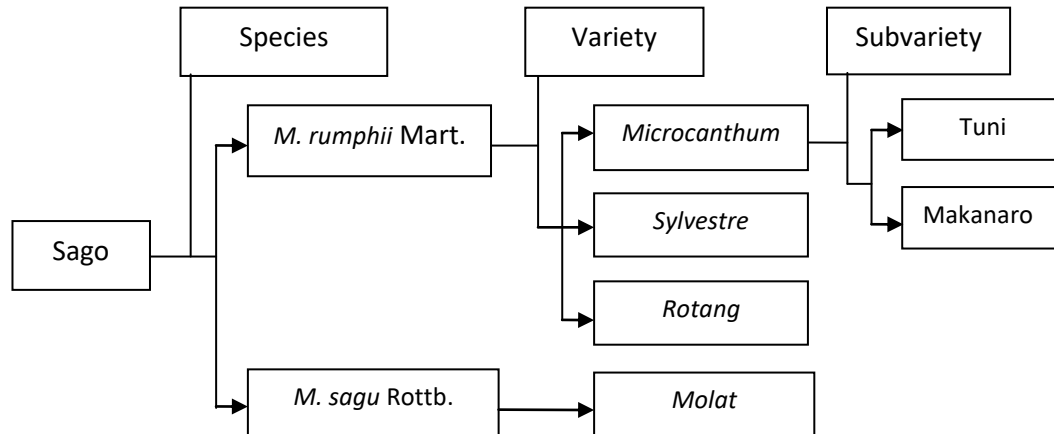


Figure 3. The Numbers of Sago Species in Seram Island, Maluku Province According to Beccari (1918) in Flach (1997).

### CONCLUSION

Based on the classification in biology species, sago palm cultivating and growing in Seram Island, Maluku Province consisted of two species i.e. 1) *Metroxylon rumphii* Mart., and 2) *Metroxylon sagu* Rottb. Species *M. rumphii* Mart. consisted of three varieties i.e. 1) *Microcanthum* Becc., 2) *Sylvestre* Becc., and 3) Variety of *Rotang* Becc. Species of *M. sagu* Rottb. only has the variety *Molat*. *Microcanthum* has two subvarieties i.e. Tuni and Makanaro. The genetic analysis was considered important to do using specific marker to strengthen or test the accuracy of clarification test for the existed species whether it is in Seram Island in Maluku Province or other regions as well.

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