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WATER PLANT SURVEY IN BOGOR, WEST JAVA, INDONESIA

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Abstract
A comparative survey of aquatic plants of eight ponds in and around Bogor, West Java, Indonesia, was preliminarily done to document the present status of aquatic flora in the locality. A total of 12 taxa were recorded, and most frequently encountered taxa were *Eichhornia crassipes* and *Salvinia molesta*. Number of taxa per pond ranged from one to eight and mean number was 4.9. Results of some water measurements and DCA application are also reported.

Introduction
According to the draft checklist of Indonesian freshwater aquatic herbs compiled by Giesen (1991), there exist 623 aquatic plant species in Indonesia. Most of these species (over 80%) are emergent, and the plants with a free-floating life-form comprise 4%, suspended plants 2%, rooted submerged plants 10% and rooted-with-floating-leaves comprise 1% of all aquatic plant species. Up to present, much data is available on taxonomy and distribution of aquatic plants in Indonesia (Giesen (1991) and the literature cited therein), but quite a few describe the ecology of aquatic plants in Indonesia (Cary *et al.*, 1991).

Reportedly there exist ca. 160 small ponds/reservoirs in and around Bogor, West Java, Indonesia. Some of the significant functions of these water bodies are among others for domestic use, fishery, irrigation, industry, recreation and flood control, and not less important are their roles in recharging the underground water supply and as habitat for rich variety of aquatic lives (Nontji and Hartoto, 1989). Comparative studies of aquatic flora between stagnant water bodies have long been attracting many investigators (Hutchinson, 1975), and the correlation between species occurrence and environmental variables have been examined in many geographical regions (cf. Kunii, 1991). Nevertheless, no comparative studies of the aquatic flora in the locality have ever been done. From the viewpoint of conservation of biodiversity, it is inevitable to know the present status of aquatic flora in the locality. We therefore carried out the observation on the floral composition and water chemistry of some ponds/reservoirs in and around Bogor when we stayed at the Research and Development Center for Limnology-LIPI, Bogor, as JICA experts.

Site and Methods
We visited eight ponds/reservoirs in and around Bogor from 2 March 1993 to 15 March 1993 (Fig. 1). The name and location of each pond determined by GPS (Sony IPS-360) is as follows; Rawakalong (6°23'46"S, 106°52'12"E), Cikaret (6°28'03"S, 106°50'11"E), Ciriu (6°28'11"S, 106°51'37"E), Bojongsari (6°23'15"S, 106°45'13"E),

Jampang (6°28'00"S, 106°43'33"E), Situ Burung (6°32'50"S, 106°44'09"E), Telaga Warna (6°41'50"S, 107°00'17"E), Cigudeg (6°33'15"S, 106°32'14"E). Each pond was surveyed from a boat or by wading, and presence or absence of all species of submerged, floating-leaved and free-floating macrophytes was recorded. Water depth, Secchi disc transparency, pH, water temperature, dissolved oxygen content and electric conductivity were measured in the field, and alkalinity was analysed in the laboratory of Limnology-LIPI using surface water samples. From the species presence/absence data, species and site ordinations were done by using Detrended Correspondence Analysis (DCA) (Hill, 1979). Data of the taxa that occurred only once was omitted from the analytical procedure.

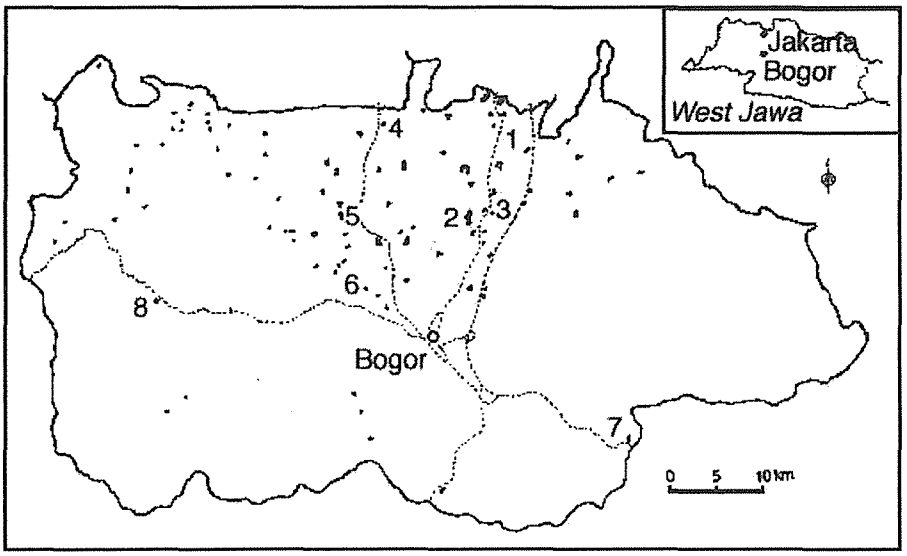

Fig. 1. Map showing study sites.

Results and Discussion

Table 1 shows the result of water measurements. Transparency value exceeded over 1 m only in Cikaret and mean of other six ponds was 77 cm. Minimum value of 30 cm was recorded at Bojongsari, the largest water body in the district of Sawangan (Nontji and Hartoto, 1989). Electric conductivity ranged from 44 to 88 μS/cm except for the high value recorded at Rawakalcng, into which waste water from the surrounding factories was discharged. In Rawakalong, anoxic conditions were found even at the surface because of the dense growth of *Eichhornia crassipes*.

A total of 12 taxa were recorded from the ponds visited (Table 2). Of the 12 taxa recorded, only two taxa were submerged (*Hydrilla verticillata* and *Najas graminea*). The most frequently encountered plants were free-floating *Eichhornia crassipes* and *Salvinia molesta* (6 out of 8 ponds), and *Lemna* sp., *Limnocharis flava* and *Najas graminea* occurred only once. Number of taxa per pond ranged from one to eight and mean number was calculated to be 4.9. This value is almost the same as that reported by Kunii (1991); 4.1 species per pond in and around Matsue, Shimane Prefecture, Japan.

Table 1. Some environmental variables of eight ponds around Bogor, West Java, Indonesia.

Pond name	Depth (m)	Transparency (cm)	Conductivity (μS/cm)	pH	Alkalinity (mg/l)	D.O. (mg/l)
Rawakalong	1.15	60	296	6.4	–	0.0
Cikaret	4.0	130	88	6.8	24.3	5.7
Ciriu	3.3	94	87	8.5	31.1	8.6
Bojongsari	4.2	30	59	6.6	13.9	5.1
Jampang	4.9	95	44	7.2	13.6	9.0
Situ Burung	4.3	52	56	7.5	–	5.1
Telaga Warna	–	–	69	8.8	31.2	9.2
Cigudeg	–	–	55	7.5	28.2	2.4

Table 2 Presence/absence of 12 taxa of aquatic macrophytes found in eight ponds in and around Bogor, West Java, Indonesia. Marks show relative abundance of each taxon.

Plant name	Rawakalong	Cikaret	Ciriu	Bojongsari	Jampang	Situ Burung	Telaga Warna	Cigudeg	Occurrence
Eichhornia crassipes	###	#	#	#	#			#	6
Salvina molesta		###	##	#	##	###		#	6
Nelumbo nucifera		#	#	#	#	#			5
Ipomoea aquatica	#	#	#		#			#	5
Nymphaea sp.		#	#		#			#	4
Hydrilla verticillata		##	###		#		##		4
Ludwigia sp.			#					#	2
Utircularia sp.					#	#			2
Sagittaria sp.			#	#					2
Lemna sp.	#								1
Limnocharis flava	#								1
Najas graminea		#							1
No. of taxa found	4	7	8	4	7	3	1	5	

Figs. 2 and 3 show the result of species and site ordination of DCA, respectively. Along the first axis of DCA (Fig. 2), plants can be divided into three groups; *Eichhornia crassipes* on the right hand and *Utricularia* sp. and *Hydrilla verticillata* on the left and other six plants in the middle of the axis. It must be noted that DCA should be applied for the large number of data sets and a DCA axis can be interpreted as a theoretical environmental variable that maximally separates species response curves along its length. After accumulating data and analysing more environmental variables, linear correlations between the first axis of DCA and environmental variable are to be computed for each species to clarify relationships between species occurrence and environmental variables.

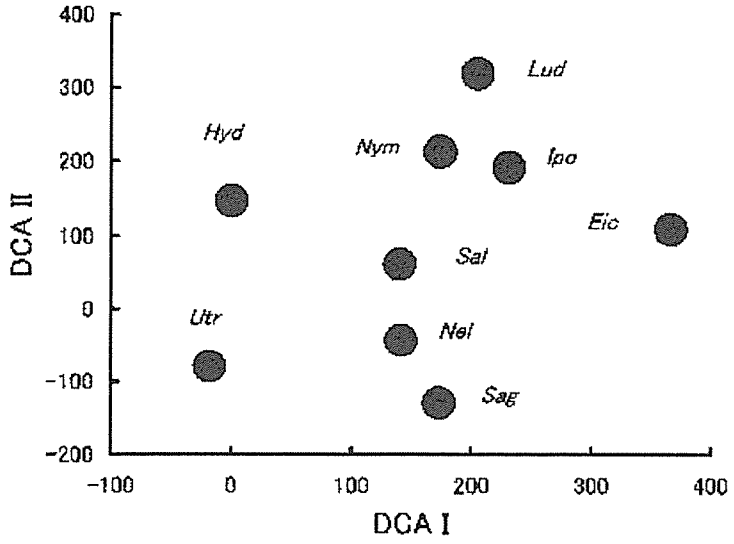

Fig. 2. DCA ordination of nine aquatic plants encountered more than twice.

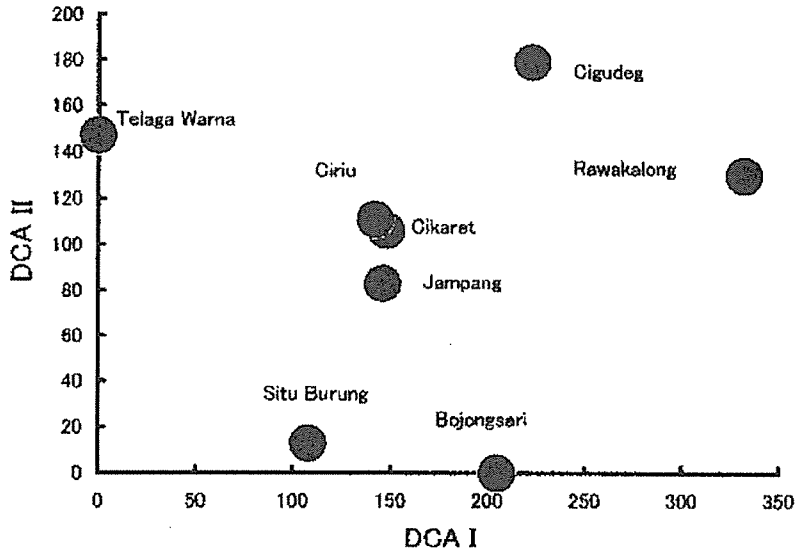

Fig. 3. DCA ordination of eight ponds/reservoirs.

The present results are only preliminary and the numbers of visited ponds are quite few. However, the results presented here are thought to be valuable, since very little studies have been done so far on the ecology of aquatic vegetation in the locality. The main contribution of the present study is to provide a first step toward the assessment of aquatic flora and water quality of the ponds and reservoirs in a tropical region. To confirm the present results, more extensive survey should be further promoted.

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