広島県西条盆地のコウホネ属植物の生育地

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Michiko SHIMODA*: Habitats of the Genus *Nuphar* SM. in the Saijo Basin, Hiroshima Prefecture, Western Japan

下田路子*：広島県西条盆地のコウホネ属植物の生育地

Abstract

Three taxa of *Nuphar* are found in the irrigation ponds in the Saijo Basin, Hiroshima Prefecture: *N. japonicum* var. *japonicum*, *N. japonicum* var. *saijoense* and *N. oguraense* var. *akiense*. To show the habitat conditions of each taxon of *Nuphar*, aquatic vegetation was investigated, and pH and electric conductivity of water were measured in 51 ponds having *Nuphar* populations. All of three taxa were not restricted to any specific communities and occurred in the floating-leaved communities belonging to the alliance *Brasenio-Nymphaeion tetragonae* and the alliance *Trapion japonicae*. Conductivity and pH values of pond water ranged 20-100 μS/cm and 6-7 respectively with a few exceptions in the habitats of *Nuphar*. There were no evident differences between three taxa in plant communities and the values of conductivity and pH. *Nuphar* is regarded as one of the aquatic plants with wide range of habitat conditions in the Saijo Basin.

Key words: aquatic plant communities, irrigation ponds, *Nuphar*, Saijo Basin, water quality.

Three taxa of *Nuphar* SM. occur in the irrigation ponds in the Saijo Basin, Hiroshima Prefecture: *N. japonicum* DC. var. *japonicum*, *N. japonicum* DC. var. *saijoense* SHIMODA and *N. oguraense* MIKI var. *akiense* SHIMODA. The last two are characterized by having red stigmatic disk and they were described as new varieties from the Saijo Basin (SHIMODA, 1991). The author has reported the detailed morphological characteristics of the three taxa and showed a distribution map of *Nuphar* in the Saijo Basin (SHIMODA, 1991). However, the habitat conditions of *Nuphar* have not yet been described.

The aim of this paper is to show the habitat condition of each taxon of *Nuphar*. In this paper, aquatic plant communities where *Nuphar* occurred are described, followed by a report on the values of electric conductivity and pH measured in the ponds where *Nuphar* grew. The relationship between *Nuphar* distribution and water quality is discussed with the results of this study and the previous studies on aquatic plants conducted in the Saijo Basin by SHIMODA (1983, 1985) and SHIMODA and HASHIMOTO (1993).

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Study area

The Saijo Basin is located 30 km to the east of the center of Hiroshima City, at an altitude of around 200 m. It extends 12 km from east to west and 10 km from north to south and surrounded by mountains of 400-600 m above sea level. The basin is covered with lacustrine sediments, Saijo sand and gravel beds, which was formed in the Pleistocene. The hills and the mountains consist of granitic and rhyolitic rocks (Hiroshima Prefecture, 1977).

In the basin, more than 1,100 irrigation ponds were constructed for the irrigation of rice fields (SHIMODA, 1993). The ponds are varied in their sizes, shapes, surroundings and vegetation. The ponds surrounded by forests are hardly polluted

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TABLE 1. List of aquatic plant communities and the number of ponds where each *Nuphar* taxon was confirmed in 1989-1990

Aquatic plant communities	*N. japonicum* v. *japonicum*	*N. japonicum* v. *saijoense*	*N. japonicum* v. *jap.* & v. *saij.*	*N. oguraense* v. *akiense*	Total
Floating-leaved communities*					
All. *Brasenio-Nymphaeion tetragonae*					
Ass. *Nymphaeo-Potametum fryeri*	2	2	1	5	10
Ass. *Brasenio schreberi-Nymphaeetum tetragonae*					
Subass. *typicum*	2	2	0	14	18
Subass. *trapetosum japonicae*	2	0	0	6	8
All. *Trapion japonicae*					
Nuphar-Trapa japonica community	0	1	0	1	2
Ass. *Trapetum japonicae*	1	2	0	6	9
Ponds without floating-leaved species except *Nuphar*	0	0	0	2	2
Emergent community dominated by *Nuphar*	2	0	0	0	2
Total	9	7	1	34	51

* According to SHIMODA (1985).

and the water is usually clear. The ponds bordered by rice fields or settlements are influenced by human activities such as water pollution, removal of vegetation and structural modification of ponds.

Methods

The field research was conducted in June-October of 1989-1990, and 51 ponds were investigated. The locality numbers of three taxa were as follows: nine ponds for *N. japonicum* var. *japonicum*, seven for *N. japonicum* var. *saijoense*, one for *N. japonicum* var. *japonicum* and var. *saijoense*, and 34 for *N. oguraense* var. *akiense*.

Vegetation was studied by the BRAUN-BLANQUET methods (BRAUN-BLANQUET, 1964). Phytosociological classification of aquatic plant communities follows SHIMODA (1985). Species nomenclature follows OHWI and KITAGAWA (1983).

Electric conductivity (calibrated for 25 °C) and pH of surface water were measured by a conductivity meter (Yokogawa Electric Co. SC 82) and by a pH meter (Yokogawa Electric Co. pH 51). The measurement was carried out near the spillway of each pond in the daytime (10:00-16:00).

Results

1. Communities

Table 1 shows the aquatic plant communities of 51 ponds studied and the number of ponds where each taxon was found.

The ponds with the association *Nymphaeo-Potametum fryeri* were all surrounded by pine forests and filled with clear water. The subassociation *typicum* of the association *Brasenio schreberi-Nymphaeetum tetragonae* was found in the ponds surrounded by pine forests same as the former association, while the subassociation *trapetosum japonicae* occurred in the ponds which were partly bordered by rice fields, houses or paved roads. The communities of the alliance *Trapion japonicae* occurred in the ponds bordered by agricultural lands, housing lots or paved roads.

All of three *Nuphar* taxa occurred in the floating-leaved communities of both alliances, sometimes as dominant species, and were not restricted to any specific syntaxa.

N. oguraense var. *akiense* has submerged and floating leaves and occurred as a constituent species of floating-leaved communities. *N. japonicum* var. *japonicum* and var. *saijoense* have submerged and floating leaves and occurred in floating-leaved communities in deeper water. The two varieties of *N. japonicum* produced mainly aerial leaves in shallow water up to about 50 cm such as shallow ponds and the margin of ponds. *N. japonicum* var. *japonicum* dominated and formed emergent communities in two small shallow ponds, but var. *saijoense* never occurred

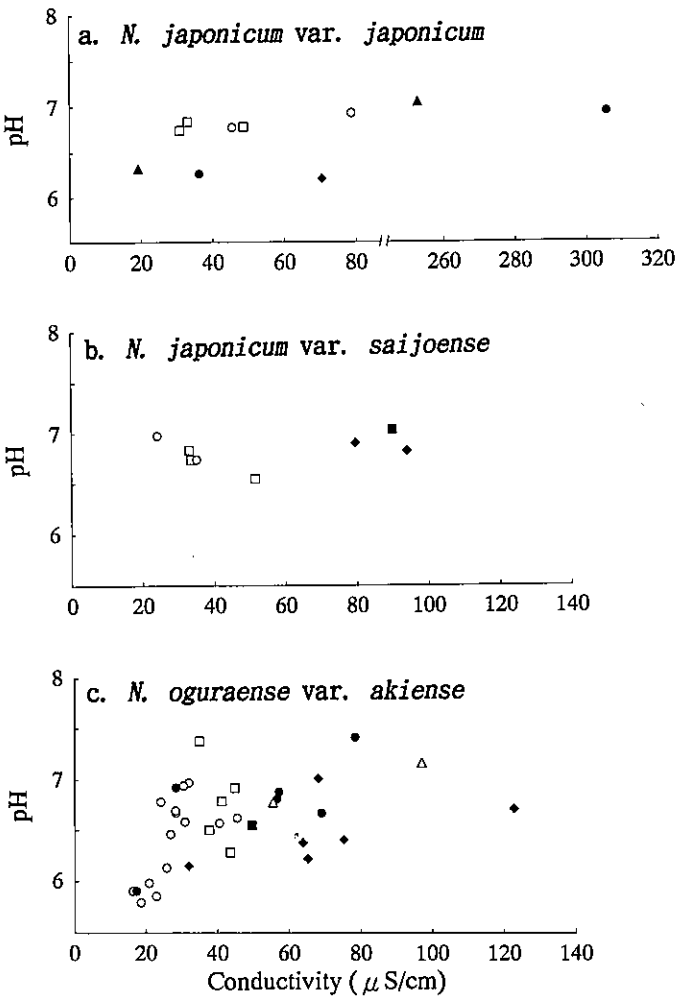

FIG. 1. Relationship between conductivity, pH and distribution of aquatic plant communities in the habitats of (a) *N. japonicum* var. *japonicum*, (b) *N. japonicum* var. *saijoense* and (c) *N. oguraense* var. *akiense*. Community symbols are as follows: □ *Nymphaeo-Potametum fryeri*, ○ *Brasenio schreberi-Nymphaeetum tetragonae typicum*, ● *Brasenio schreberi-Nymphaeetum tetragonae trapetosum japonicae*, ■ *Nuphar-Trapa japonica* community, ◆ *Trapetum japonicae*, △ ponds without floating-leaved species except *Nuphar*, ▲ emergent community dominated by *Nuphar*.

as a dominant species of the emergent community.

Submerged leaves of *Nuphar* were often visible through the pond water. Especially in some shady ponds with transparent water, *Nuphar* populations produced mainly submerged leaves.

2. Water quality

Figure 1 shows the relationship of conductivity and pH in the water of various aquatic plant communities having each taxon of *Nuphar*. The habitats of *N. japonicum* var. *japonicum* had conductivity values in a large range between 19.2 and 306 μS/cm (Fig. 1a). The exceptionally high values of conductivity in two ponds of *N. japonicum* var. *japonicum* (Fig. 1a, 253 μS/cm and 306 μS/cm) were probably because of the effluent from a factory near the ponds. Concentrations of total nitrogen and total phosphorus were also very high, 1.9 mg/l and 0.13 mg/l respectively on 16 August 1991 in the pond with conductivity of 306 μS/cm (HASHIMOTO, personal communication, 14 September 1991). *N. japonicum* var. *saijoense* and *N. oguraense* var. *akiense* occurred in the waters with conductivity of 20-100 μS/cm with a few exceptions (Figs. 1b, c).

The communities of the alliance *Brasenio-Nymphaeion tetragonae* were distributed in the ponds with conductivity <80 μS/cm except one pond with extremely high conductivity of 306 μS/cm. Conductivity ranged wider in the ponds with the association *Brasenio schreberi-Nymphaeetum tetragonae* than in the ponds with the association *Nymphaeo-Potametum fryeri*. The communities of the alliance *Trapion japonicae* occurred in the ponds with conductivity >30 μS/cm.

The two varieties of *N. japonicum* were distributed in the ponds with pH between 6 and 7, and there is no clear relationship between pH and conductivity. The pH values of 26 ponds of *N. oguraense* var. *akiense* varied between 6 and 7, five ponds were < 6 and three ponds were >7. Conductivity values of the five ponds with pH <6 were lower than 30 μS/cm.

There were no evident differences between the three taxa in plant communities and the values of pH and conductivity (Fig. 1).

Discussion

1. Comparison with the reports from various places in Japan

The 51 ponds studied include examples of wide ecological range from the mountainous ponds to the ponds surrounded by rice fields and settlements. Therefore, most types of irrigation ponds in the Saijo Basin are represented in the 51 ponds of *Nuphar* habitats.

Water quality of irrigation ponds have been studied in some places (KADONO 1987; KASUYA *et al.*, 1989; KUNII, 1991; HASHIMOTO, 1992). Compared with these studies, pH values of *Nuphar* habitats in the Saijo Basin are restricted to a narrower range, from weakly acid to neutral waters (Fig. 1). And most of the conductivity values are restricted to a lower range, less than 100 μS/cm (Fig. 1).

There are two reports which mentioned the habitat of *N. japonicum* var. *japonicum* (TAKAGI, 1981; KADONO, 1982). According to TAKAGI (1981), *N. japonicum* var. *japonicum* occurred mostly in the acid water with pH of 5 - 7. According to KADONO (1982), *N. japonicum* var. *japonicum* occurred in the water with pH of 5.9 - 9.0 and conductivity of 26 - 261 μS/cm. Almost all of the pH and conductivity values of ponds of *N. japonicum* var. *japonicum* in the Saijo Basin are within the ranges reported by TAKAGI (1981) and KADONO (1982).

2. Discussion with the reports from the Saijo Basin

Aquatic plant communities in the Saijo Basin were reported by SHIMODA (1985). In her study, the *Brasenio-Nymphaeion tetragonae* was regarded as communities in nutrient-poor water and the *Trapion japonicae* as communities in nutrient-rich water. As shown in Table 1, three taxa of *Nuphar* occurred as constituent species of the communities belonging to both alliances.

SHIMODA (1983) studied the aquatic plant distribution and environmental factors of irrigation ponds in the Saijo Basin, and considered that *N. japonicum* var. *japonicum* and *N. oguraense* var. *akiense*, which were reported as *N. japonicum* and *N. oguraense* respectively by SHIMODA (1983), could grow in wide range of water quality but they could not grow in heavily polluted waters.

SHIMODA and HASHIMOTO (1993) showed the relationship between aquatic plant distribution and concentrations of total nitrogen and total phosphorus in 27 ponds in the Saijo Basin. According to SHIMODA and HASHIMOTO (1993), *N. oguraense* var. *akiense* showed the widest distribution next to *Trapa japonica*. *Nuphar japonicum* var. *saijoense* also showed wide distribution, but *N. japonicum* var. *japonicum* occurred only one pond out of 27 ponds studied by SHIMODA and HASHIMOTO (1993).

From the results of this study on *Nuphar* habitats and the previous studies by SHIMODA (1983, 1985) and SHIMODA and HASHIMOTO (1993), *Nuphar* is regarded as one of the aquatic plants with wide range of habitat conditions in the Saijo Basin. However, *Nuphar* has decreased or disappeared in some ponds by human activities such as water pollution and filling-up of ponds accompanying land development (SHIMODA, 1991, 1993). The habitats of *Nuphar* will continue to decrease and to be threatened with the urbanization of the Saijo Basin.

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摘　要

西条盆地のため池にはコウホネ，サイジョウコウホネ（コウホネの変種），ベニオグラコウホネ（オグラコウホネの変種）の3種類のコウホネ属植物が生育している。

コウホネ属植物の生育環境と群落を明らかにするため，コウホネ類が生育する51個の池において，植生を調査しpHと電気伝導度を測定した。いずれのコウホネ属植物も，ヒツジグサージュンサイ群団とヒシ群団に所属する浮葉植物群落の構成種となっており，特定の植物群落内に生育が限定されることはなかった。またコウホネとサイジョウコウホネは，水が浅い所では挺水した。調査した池水のほとんどは，pH値が6—7，電気伝導度の値が20-100 μS/cmの範囲であり，3種類間に明かな差は認められなかった。

今回の調査結果とこれまでの西条盆地の水草に関する研究報告から，コウホネ属植物は，西条盆地の水草の中では比較的広い生育範囲を持つものと考えられる。しかしながら，水の汚濁や池の埋め立てなどにより，西条盆地のコウホネ類の生育地は減少している。

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○ 日本自然保護協会（編）**生物多様性条約資料集** 日本自然保護協会資料集第33号 1993年8月1日，日本自然保護協会発行。B 5判，196頁。2,500円。

生物の多様性やその保全といったことばは，このところ大へんよく耳にするようになったし，生物学の分野でも現代は多様性の生物学の時代だといわれる。

そんな折，日本自然保護協会は，創立40周年記念国際セミナー「生物の多様性を守る」を，1991年10月26日に開いた。本書の前半は，そのシンポジウムの内容を紹介したものであり，世界のオピニオンリーダーたちが何を考えているかを知る貴重な資料である。後半は資料編で昨年6月，リオデジャネイロで開催された環境と開発に関する国連会議（UNCED）で採択された「生物の多様性に関する条約」，生物の多様性の保全に関わるアジェンダ21の15，16章，NGO条約の16，17章，1992年2月，ベネズエラ・カラカスで開かれた第4回国立公園保護地域会議で発表された生物の多様性保全のための地球戦略，1991年5～6月にノルウェー・オスロで開かれた植物遺伝資源に関するキーストンセンター国際会議第3回総会における最終合意報告書「植物遺伝資源の保全および持続可能な利用に向けての地球規模での先導的試行」（グローバルPGRイニシアチブ）が，それぞれ，全訳あるいは部分訳されて収められている。世界における生物多様性の議論のための客観的資料として重用したい。（清水建美）

○ 正宗厳敬先生追悼文集編集委員会（代表里見信生）（編）**正宗厳敬先生追悼文集** 1993年12月，同編集委員会発行。A 5判，135頁。頒価2,500円＋送料。

植物地理・分類学会の前身，北陸の植物の会の創始者であり，金沢大学理学部植物分類・地理学講座の初代の教授であられた正宗厳敬先生が，平成3年6月18日になくなられた。本書は，北陸の植物の会でも金沢大学でも当初から先生とともに仕事を進めて来られた里見信生氏を中心として，ゆかりの方々の追悼文50篇を収めたもので，先生のありし日の姿が多面的に浮き彫りされている。正宗先生の人となりを知るには貴重な資料である。巻頭には5篇の遺稿がある。入手御希望の方は，里見氏に照会されたい。（清水建美）