Notes on seed set ratio variation and reproductive plant size in *Euryale ferox* (Nymphaeaceae)

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オニバス（スイレン科）の
結実と繁殖サイズに関するノート

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抄録：オニバスの野外集団において個体サイズと結実はについて調査を行った。1回のみの調査なので一般的傾向が得られたかどうかは疑問だが、大形個体では開花・結実がみられたのに対して、大部分の小形個体は花をつけていなかった。また、1果実内の稔実率（推定値）は、胚珠数にかかわらず大きな変動幅を示した。

Abstract: Some ecological traits such as plant size distribution and seed set of a *Euryale ferox* population was observed and described. Because of only one time field survey, the results below may not have good reliability. Large-sized plants produced flowers but most of small-sized plants had no flowers. Variation of seed set was larger independent of estimated ovule number in a fruit.

Key Words: *Euryale ferox*; seed set ratio; plant size distribution

*Euryale ferox* Salisbury is a large annual water plant, which is distributed in Eastern Asia from Northern India to Japan (Kadono, 1994b). In Japan, it grows in wetland of lowland, especially in eutrophic ponds, but has recently decreased by over-eutrophication and reclamation of the habitats (Kadono, 1994a) and is now listed in the endangered plants (Environment Agency of Japan, 2000).

It has large round-shaped floating leaves and produces both chasmogamous and cleistogamous flowers (Okada & Otaya 1930; Kadono & Schneider, 1987). There were some works on reproductive biology of the species such as Okada & Otaya (1930) and Kadono & Schneider (1987), but the basic information such as seed set and plant size distribution in a population is still lacking. For the conservation of the species, this study aimed at accumulating ecological information in a field population.
Materials and Methods

The field study was done on August 18, 1998 at the Ima-gawa River (34°36'40"N, 135°32'30"E) which flows through the border of Higashi-sumiyoshi-ku and Hirano-ku in the southern part of Osaka City, central Japan. In early 1900's, the river with 9 km flow started from a pond and finished into the Oh-kawa River. This river had no current in 1970's after its irrigation role had been lost when surrounding area had been developed as residential area from agricultural land. In 1984, the river was reborn as urban water amenity space, and the current has recovered with the treated waste water which flows only in the day time from 9:00 am to 5:00 pm by electric pump. *Euryale ferox* happened to grow densely here in 1998 (Fig. 1) but after that only sporadic occurrence was observed until 2002.

Leaf diameter of all the leaves was measured in randomly selected 23 plants. Each leaf area was estimated by the assumption that the shape of all leaves was complete circle. Total leaf area of a plant, which has a few leaves, was calculated by summing up them. Plants with flower buds, flowers, and/or fruits, were recorded as reproductive, while ones without such reproductive organs as sterile.

Apart from 23 plants above, 33 fruits were randomly collected from the population and seed number in a fruit was counted respectively. The degree of seed development, such as large or small size, was checked, and seed set ratio was calculated by the assumption that developing larger seeds would become mature and that undeveloped ones would abort. Some fruits were too young to check and 21 fruits were available for seed set ratio estimation.

Results and Discussion

Estimated total leaf area of the individual plants had significant correlation with diameter of the largest leaf in each plant (Fig. 2, r²=0.779). From this result, diameter of the largest leaf was regarded as a good indicator of total leaf area.

The distribution pattern of total leaf area estimated as above was L-shaped (Fig. 3). Total leaf area is usually a good indicator of plant size, then I hereafter use the estimated total leaf area as the plant size of *Euryale ferox*. A few small-sized plants (leaf area < 9,000 cm²) produced flowers and all large-sized plants (leaf area > 18,000 cm²) had flowers and/or fruits. It is probable that the transition to the reproductive stage is regulated by plant size in this species. This may suggest that it is important for reproduction to exceed some

Fig. 1. A view of study site (July 22, 1998).
minimum size. If so, rapid growth must be particularly important in such a habitat as this field, where water surface for leaf expansion is limited.

Ovule number in a fruit, estimated by summing up developing and undeveloped seed number, varied from 23 to 105, confirming its large variation in the previous report (Kadono & Schneider, 1987) and many fruits had small number of ovules (Fig. 4).

Seed set ratio in a fruit varied from 25.0 % to 92.9 %, and no relation with estimated ovule number (Fig. 5). Large variation of seed set ratio was not probably caused by pollen limitation, because chasmogamous flowers already finished self-pollination before flower opening (Wakita, 1959; Kadono & Schneider, 1987). Kadono & Schneider (1987) reported that chasmogamous flowers yielded small number of seeds per fruit than cleistogamous ones. In this study, there is no
information whether the fruits were developed from chasmogamous or cleistogamous flowers. Detailed study of fertilization and seed development in both cleistogamous and chasmogamous flowers is important.

As *Euryale ferox* is annual, it is interesting that most of the observed plants were small-sized and still in sterile condition (Fig. 3). I have no information, however, whether these sterile plants would flower or die without flowering later in the season. The study of population structure focusing on plant size distribution and seed set variation through the growing season is necessary.

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**Literature Cited**


