

Reproductive Biology of *Lysichiton camtschaticense* (Araceae) in Japan

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ABSTRACT

A reproductive-biology study of *Lysichiton camtschaticense* Schott was carried out at two sites in central Japan. The flower was shown to be protogynous. According to the stage of anthesis, the flowers changed from female to hermaphrodite condition. Potentially, the species may be pollinated by flies (no reward found), wind or by self-pollination. The seeds are thought to be dispersed by water current or by bears consuming the fruits.

KEY WORDS

bear, *Lysichiton camtschaticense*, pollinator, seed dispersal, self pollination, wind pollination.

INTRODUCTION

A reproductive-biology study of *Lysichiton camtschaticense* Schott was carried out at Nida marsh, Fukushima Prefecture and Oze-gahara moor, Gunma Prefecture, both in central Japan (Tanaka, 1997, 1998a, 1998b). The major results of the study are reported here.

Lysichiton camtschaticense is a deciduous perennial herb growing in swampy habitats where the species form dense populations. The white spathe opens soon after the thaw and comes into flower (Fig. 1). The spathe is boat-shaped and 5–50 cm long. The inflorescence is composed of a spadix (3–20 cm long) which bears 80–800 hermaphroditic flowers (Fig. 2). Each flower consists of four green tepals, four

Table 1. Insect visitors to spadices of *Lysichiton camtschaticense* at Nida marsh and Oze-gahara moor during 10 hours 12 minutes observation on 5842 inflorescence.

	Site:	Nida marsh		Oze-gahara		Total
	Observed in: Observed hours (h:min): No. of spadices:	1989	1990	2003		
<i>Pegomya vera</i> (Anthomyiidae)		15			15	
<i>Dilia robustiseta</i> (Anthomyiidae)		3			3	
<i>Homoneura aulatbeca</i> (Lauxaniidae)		3			3	
Diptera spp.			35	29	64	
Small size Diptera spp.		6	12	8	26	
Ants		2	2		4	
Hymenoptera sp.		1			1	
Small beetle 2 spp.		2			2	
Total		32	49	37	118	

Note: Oze-gahara was sampled twice in 1990 and 2003.



Fig. 1. The community of *Lysichiton camtschatcense* on Oze-Gahara moor.



Fig. 2. Inflorescences of *Lysichiton camtschatcense*.

stamens and a pistil. Flowers are protogynous and change from female to hermaphrodite during anthesis. The oval leaves grow after flowering up to 80 cm long.

RESULTS AND DISCUSSION

Pollination by Insects

During the flowering season, inflorescences of *L. camtschatcense* emit a fragrant scent, but the flowers produce no nectar. During observation at Nida marsh (2,744 inflorescences) and at Oze-gahara moor (3,098 inflorescences), 32 and 86 insects were found respectively visiting the inflorescences (Table 1). Most visitors were Diptera (flies), and at both sites they were observed to lick the perianth (Fig. 3), but not the pollen, except one time. However I could not find any potential reward on the perianth.

Some arctic flowers concentrate solar heat with their bowl-shaped perianth in order to elicit insect visits (Hocking &



Fig. 3. Fly visiting inflorescence of *Lysichiton camtschatcense*.

Sharplin, 1965). If *L. camtschatcense* resorts to the same mechanism, the spathe should open toward the sunny south. However, the direction of opening of 103 inflorescences observed at Nida marsh showed no tendency to face south (Table 2). It appears that pollen is likely to be transferred by flies walking on the spadix-

Table 2. Facing direction of spadices of *Lysichiton camtschatcense* at Nida marsh.

Facing direction	North	East	South	West
No. of spadices	26	27	26	24

ces, although no reward could not be identified.

Wind Pollination

Some pollen was observed to be dispersed from spadices by wind at Oze-gahara moor (Fig. 4), suggesting possible wind pollination. Five glass slides mounted with double-sided sticky tape were placed at the distances of 10 cm, 20 cm and 30 cm from a spadix having many hermaphroditic stage flowers. The slide glasses were exposed for 28 hours and 22 minutes for those facing windward, and 10 hours and 42 minutes for those facing leeward. The numbers of pollen grains trapped on viscid tapes are presented in Table 3 (Tanaka, 1998a). According to



Fig. 4. Pollen deposited on a leaf after short wind dispersal from spadices of *Lysichiton camtschatcense*.



Fig. 5. Flowers of *Lysichiton camtschatcense* in the hermaphrodite stage.

Table 3. Number of pollen grains deposited on the slides per 1 cm² at various distances from a hermaphrodite spadix of *Lysichiton camtschatcense* (June 13–14, 1996 at Oze-gahara moor).

Direction facing	Distance (cm)	Exposed hour (h:min)	No. of pollen grains
windward	10	28:22	496
	20	28:22	226
	30	28:22	241
leeward	10	10:42	100
	30	10:42	69

these results, 26% of the stigmas (0.4 mm in diameter) can be assumed to have caught a pollen grain from a spadix at the distance of 30 cm windward after 24 hours.

Self Pollination

Stigmas of *L. camtschatcense* were observed to be covered by their own pollen at the hermaphrodite stage succeeding the female stage (Fig. 5). The possibility of self-fertilization was examined at Oze-gahara moor by bagging 12 inflorescences in order to exclude insect visitor and wind dispersed pollen. Fruits were set in seven of the bagged spadices, however three of these produced no seeds in any of their fruit (Table 4). More than 100 fruits were checked from each of the seven inflorescences, and considering these seven, the overall percentage of fruit with seeds was 31.3% (48.6% when considering only the



Fig. 6. A multiple fruit of *Lysichiton camtschatcense*.

four inflorescences in which there were seeds). The average number of fruits with seed per inflorescence was 43.6 overall (76.3 when considering only the four inflorescences in which fruit had seed). The average number of seed per inflorescence was 50.4 overall (88.2 when considering only the four inflorescences in which the fruit had seed). These results suggest the potential for self-fertilization.

Seed Dispersion

After flowering, the spadix developed into a club-shaped, green, multiple fruit (Fig. 6). In late summer, the non-scented fruit is mature and its fat perianth tastes like flour (Kanai, 1997). Each mature fruit contains one or two seeds. The brown seed is 4–5 mm in diameter and is encased in a jelly-like clear matter which has no odor or taste.

On rainy days, or the occasion of moor inundation, mature fruit crumble on the

Table 4. Seed production of *Lysichiton camtschatcense* at Oze-gahara moor in bagged inflorescences that set fruit.

Spadix code	1	2	3	4	5	6	7	Total	%
One seed	0	83	0	33	0	84	57	257	26.4
Two seeds	0	42	0	2	0	4	0	48	4.9
Seedless	109	30	117	74	120	135	84	669	68.7
Total	109	155	117	109	120	223	141	974	
Fruit set (%)	0.0	80.6	0.0	32.1	0.0	39.4	40.4	31.3	



Fig. 7. Bear dung and seeds of *Lysichiton camtschatcense* (square sign).

ground or in the water, and the floating seeds are dispersed by water.

During the fruiting season of *L. camtschatcense*, bear dung was seen at Oze-gahara moor with their surfaces covered with many seed coats of *L. camtschatcense*. A few intact seeds were found in a piece of dung (Fig. 7). Ten seeds were collected from the dung and placed on wet Sphagnum moss in a dish to measure germination rate. The surface temperature of the sphagnum was maintained at approximately 30°C during the daytime (10hr) by heating with a light-bulb. Seven of the ten seeds germinated after 23 days from sowing (Tanaka, 1997). Naito & Takehara (1998) reported a similar test where 46% of the seeds germinated. These results strongly suggest the possibility of *L. camtschatcense* seeds being dispersed in bear faeces

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