# 琉球弧の奄美群島におけるユリ科ウケユリの自生地

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# Yoshiyuki Maeda[1], Junko Miyamoto[1], Kemurio Ozaki[2], Mitsuru Moriguchi[3] and Ai Kakishita[4] : **Natural distribution of *Lilium alexandrae* (Liliaceae) in Amami Islands of Ryukyu Archipelago, Japan**

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The genus *Lilium* L. includes seventy species and these are distributed throughout the northern hemisphere. Twelve wild species of the genus were found in the Japanese Islands (Hatusima 1971, 2004 ; Satake 1982). Alexandra lily was introduced to Europe in the 19 th century, and named *L. ukeyuri* Veitch, *L. alexandrae* hort. ex Wallace and *L. japonicum* Thunb. var. *alexandrae* Baker at the same time in 1893 (Shimizu 1987). Large quantities of bulbs were collected in the natural habitat and exported during the 19 th and 20 th centuries and used to breed floricultural races (Makino 1932 ; Shimizu 1987). Recently, molecular phylogenetic studies of the genus *Lilium* have been reported (Nishikawa et al. 1999 ; Hayashi and Kawano 2000 ; Vinnersteen and Bremer 2001 ; Wikstorum et al. 2001 ; Ronsted et al. 2005). The species is one of the Japanese endemic wild lilies.

*Lilium alexandrae* was regarded a type IA ( CR ; Critically Endangered ) of the red-data plants by the Japanese Ministry of Environment ( Kagoshima-ken Kankyoseikatsu-bu Kankyohogo-ka 2003) and became as a natural monument of Kagoshima Prefecture in 2007. The environment of two growing sites of the species was studied in Amami-o-shima Island by Hayashi (1983). A few localities were listed by Hatusima ( 1986 ) and by the Kagoshima-ken Kankyoseikatsu-bu Kankyohogo-ka (2003) and reported that *L. alexandrae* grew in Amami-o-shima, Ukejima and Yorojima Islands. The recent state of the whole natural habitat, however, was unknown. Basic information of the number of plants remaining in nature and of the environmental situation are necessary to consider the future conservation plan of this species. In this research, we counted numbers of living lilies and described the forest structure of their growing position. The aim of our survey was to clarify the present growing state of the wild Alexandra lily at its natural habitat in Japan.

## Materials and methods

The field survey was carried out in the Amami-o-shima, Kakeromajima, Yorojima, Ukejima and Tokunoshima Islands, from March 2007 to July 2008. We made field investigations around the habitats and tried to find new growing locations. When we found the species, accurate latitudes, longitudes and altitudes were recorded using a portable global positioning system (GPS) receiver and geographical maps. The slope direction, gradient, width (X m) and vertical length ( Z m ) of the cliff-face were measured. Samples of the boulders were collected and identified. The positions, X-coordinate (cm) and Z-coordinate (cm) on the face of a cliff, of all individuals of the lilies was recorded by ascending and descending the vertical rocky cliff surfaces. The individual lilies were categorized into four types : adults with stem carrying over five leaves and flowers or fruits, adults with stem carrying over five leaves and neither flowers nor fruit,

sprouts with less than four leaves and no stem and dead stems. Maps of growing positions of four categories were drawn by using their positional data of X- and Z-coordinates.

A linear transect was set on a face of cliff and the vegetation survey was carried out. Species name of all trees, their growing positions, tree-heights (H cm) and diameters at 1.5 m high above the ground (DBH cm), of the main trees of the tree layer were recorded. Dry specimens of branches of these trees were stored at the Faculty of Science, Kagoshima University, Japan. The sectional view of growing positions was drawn using on-site sketches and digital photographs.

## Results and discussion

Figure 1 shows a geographical map of the Amami Islands and their position in the Japanese Islands. The hatched regions show the area of our field survey. Eighteen sites were studied in Amami-o-shima, Kakeromajima, Ukejima and Tokunoshima Islands. Table 1 shows the dates of counting lilies, localities, island names, direc-


Fig. 1. A map of the Amami Islands and their position in the Japanese Islands. Hatched area shows the research area studied in the present survey.

Table 1. The research sites

| Site No. | Date | Localities in Kagoshima Pref. Japan | Island name | Direction | Gradient | X (m) | Z (m) |
|---|---|---|---|---|---|---|---|
| 1 | Jun. 2007 | Yamato Village, Oshima County | Amami-o-shima | N | 50° | 10 | 10 |
| 2 | Jun. 2007 | Yamato Village, Oshima County | Amami-o-shima | N | 75° | 13 | 17 |
| 3 | Jul. 2007 | Yamato Village, Oshima County | Amami-o-shima | NNW | 74° | 15 | 20 |
| 4 | Jun. 2007 | Amami City | Amami-o-shima | SEE | 77° | 15 | 24 |
| 5 | Jul. 2007 | Yamato Village, Oshima County | Amami-o-shima | N | 85° | 6 | 5+ |
| 6 | May. 2007 | Setouchi Town, Oshima County | Amami-o-shima | NNW | 89° | 10 | 11+ |
| 7 | Aug. 2007 | Setouchi Town, Oshima County | Amami-o-shima | NNW | 80° | 6 | 11 |
| 8 | Jun. 2008 | Setouchi Town, Oshima County | Amami-o-shima | NNW | 90° | 15 | 10 |
| 9 | Jun. 2008 | Setouchi Town, Oshima County | Amami-o-shima | N | 68° | 10 | 4 |
| 10 | Jul. 2007 | Setouchi Town, Oshima County | Kakeromajima | N | 95° | 9 | 9 |
| 11 | Jun. 2008 | Setouchi Town, Oshima County | Kakeromajima | NW | 85° | 15 | 20 |
| 12 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | SWW | 93° | 12 | 7 |
| 13 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | N | 100° | 8 | 7 |
| 14 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | N | 84° | 25 | 10 |
| 15 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | W | 60° | 7 | 7 |
| 16 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | W | 83° | 11 | 5 |
| 17 | Jul. 2007 | Setouchi Town, Oshima County | Ukejima | W | 73° | 11 | 11 |
| 18 | May 2008 | Tokunoshima Town, Oshima County | Tokunoshima | N | 89° | 10 | 5+ |

An abbreviation ' + ' of the column Z means that the whole cliff length was longer than the studied ranges. X : width of a cliff surface. Z : vertical length of a cliff surface.

tions, maximum gradients and sizes of cliffs. The range of latitudes, longitudes and altitudes of all sites was approximately 27° 50′ −28° 20′ N, 128° 55′ −129° 25′ E and 174−595 m, respectively. Unfortunately, we are unable to place accurate GPS -data in the public domain, except to the government office, to protect the remaining plants from picking for sale on the black market. The direction of cliffs tended to be more northerly, though it often varied from southeast by east via north to west. The range of the maximum gradients of cliffs was 50−100° and the average was 80.5°. The width (X m) of studied cliff-surfaces was from 6 m to 25 m. The range of the vertical length (Z m) from the top of studied cliffs was 4 m to 24 m.

Three hundreds and seventy four lilies were found in eighteen research sites (Table 2). Forty-four percent of the living plants had one or two flowers or very young fruits. Sixteen solitary sprouts carrying less than four leaves without stem were included in the living plants of the Sites 1, 2, 4 and 14. There were dry yellow stems in the Sites 15, 16 and 17. The number of dead stems should be included in the number of the whole plants because living bulbs remained underground. As a result, 308 living plants and 66 dead stems were found in our field survey from June 2007 to June 2008.

Figure 2 shows graphs of percentages of four categories of *L. alexandrae* at each vertical Z-coordinate (m) of each research site. The four categories were adult plants with flowers or young fruits (white bars), adult plants with neither flower nor fruit (gray bars), sprouts (black bars) and dead stems (striped bars) at the vertical position on each cliff. All adult plants were growing within 10 m of the top of cliffs at fifteen sites : 1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18. The lilies grew on the middle of the cliff, i.e. between approximately 4 m and 14 m from the top in Site 2, 4−16 m in Site 3, and 15−20 m in Site 4.

Table 3 is a tree list on the linear transects of all sites. *Castanopsis sieboldii* (Makino) Hatus. ex T. Yamaz. et Mashiba (No.7 in Table 3) appeared in 14 sites and *Ternstroemia gymnanthera* (Wight et Arn.) Bedd. (No. 43) was found

Table 2. Numbers of plants of *Lilium alexandrae* at eighteen research sites

| Site No. | Adult with flower | Adult without flower | Sprout | Dead stem | Total |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 5 | 0 | 7 |
| 2 | 9 | 4 | 1 | 0 | 14 |
| 3 | 31 | 13 | 0 | 0 | 44 |
| 4 | 12 | 49 | 1 | 0 | 62 |
| 5 | 5 | 0 | 0 | 0 | 5 |
| 6 | 15 | 0 | 0 | 0 | 15 |
| 7 | 7 | 4 | 0 | 0 | 11 |
| 8 | 0 | 5 | 0 | 0 | 5 |
| 9 | 0 | 2 | 0 | 0 | 2 |
| 10 | 5 | 0 | 0 | 0 | 5 |
| 11 | 11 | 0 | 0 | 0 | 11 |
| 12 | 0 | 2 | 0 | 0 | 2 |
| 13 | 30 | 3 | 0 | 0 | 33 |
| 14 | 5 | 14 | 9 | 0 | 28 |
| 15 | 0 | 2 | 0 | 2 | 4 |
| 16 | 2 | 3 | 0 | 50 | 55 |
| 17 | 1 | 9 | 0 | 14 | 24 |
| 18 | 3 | 44 | 0 | 0 | 47 |
| Total | 137 | 155 | 16 | 66 | 374 |

Each site number is the same in Table 1.

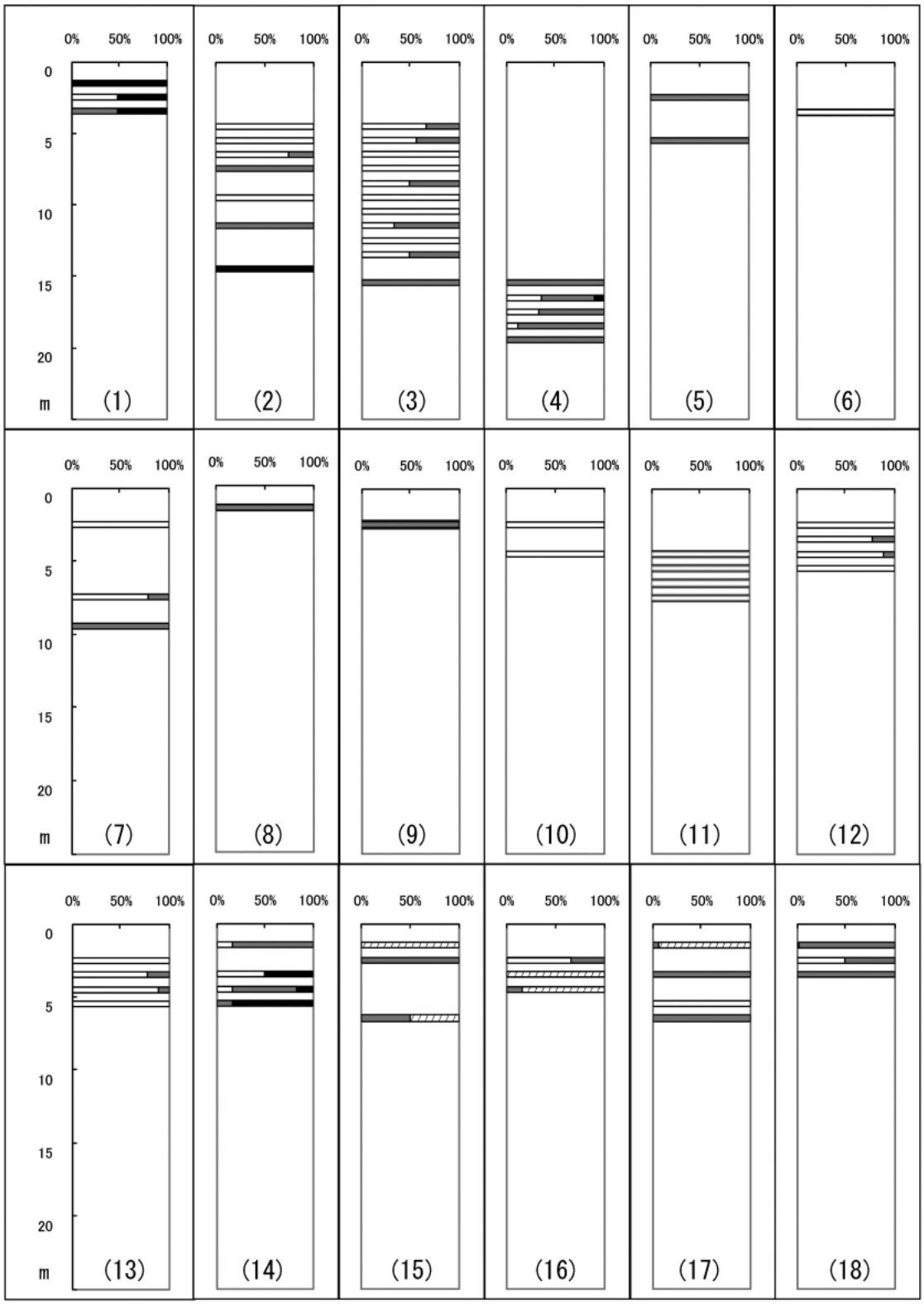


Fig. 2. Growing positions of plants of *Lilium alexandrae*. (1)−(18) : Sites No. 1−18. White, gray, solid black and striped regions show percentages of adult plants with flowers or young fruits, adult plants without flowers, sprouts and dead stems, respectively. The site number is the same in Table 1.

Table 3. Trees in research sites

| Trees | | Site No. | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sp. No. | Species name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 | *Abelia chinensis* var. *ionandra* | | | | | | ■ | | | | | | | | | | | | |
| 2 | *Ardisia crenata* | | | | | | | | | | | | | ■ | ■ | | | | |
| 3 | *A. quinquegona* | | | | | | | | | | | | ■ | | ■ | | | | |
| 4 | *A. sieboldii* | | | | | | | ■ | | | | | | | | | | | ■ |
| 5 | *Callicarpa japonica* | | | | ■ | | | | | | | | | | | | | | |
| 6 | *Camellia japonica* | | | | | | | ■ | ■ | | | | | | | | | | ■ |
| 7 | *Castanopsis sieboldii* | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| 8 | *Cinnamomum doederleinii* | | ■ | | | | | | | | | | | | | | | | |
| 9 | *Cleyera japonica* | ■ | | | | | | | | | | | | | | | | | |
| 10 | *Cycas revoluta* | | | | | | | | | ■ | ■ | ■ | | | | | | | |
| 11 | *Daphniphyllum macropodum* | | | | | | | | | | ■ | | | | | | | | |
| 12 | *D. teijsmannii* | | | | | | | | | | | | | | ■ | ■ | | | ■ |
| 13 | *Dendropanax trifidus* | ■ | | | | | | ■ | | | | | | | | | ■ | | |
| 14 | *Distylium racemosum* | | | | | | | | | | | | | | | ■ | | | |
| 15 | *Elaeocarpus japonicus* | ■ | ■ | ■ | | | | ■ | | | | | | | ■ | | | | |
| 16 | *Eurya japonica* | | | ■ | | | | | | ■ | | | | | | | | | ■ |
| 17 | *Ficus thunbergii* | | | ■ | | | | | | | | | | | | | | | |
| 18 | *Fraxinus floribunda* | | | | | | | | | | ■ | | | | | | | | |
| 19 | *Gardenia jasminoides* | | | | | | | | | | | | | | | ■ | | ■ | |
| 20 | *Illicium anisatum* | | ■ | | | | | | | | | | | | | | | | |
| 21 | *Itea oldhamii* | ■ | | | | | | | | | | | | | | | | | |
| 22 | *Lithocarpus edulis* | | | | | | | | | | ■ | | | | ■ | | | ■ | |
| 23 | *Machilus thunbergii* | | | | | | | | | | | | | | | | ■ | | |
| 24 | *Meliosma rigida* | | | | | | | | | | | | | ■ | | | | | |
| 25 | *Michelia compressa* | | | | | | | | | | | | | | | | ■ | | |
| 26 | *Myrica rubra* | ■ | | | | | | | | | | | | | | | | | |
| 27 | *Myrsine seguinii* | ■ | ■ | ■ | ■ | | | | | | | | | | ■ | ■ | | ■ | |
| 28 | *Neolitsea aciculata* | ■ | | ■ | | | | | | | | | | | | | | | |
| 29 | *Pinus luchuensis* | | | | | ■ | | | | | | ■ | | | ■ | | | | |
| 30 | *Podocarpus macrophyllus* | | | | ■ | ■ | | | | ■ | | | | | | | | | |
| 31 | *Psychotria manillensis* | | | | | | | | | | | | ■ | | ■ | | | | |
| 32 | *Quercus glauca* var. *amamiana* | | | ■ | | | | | | | | | ■ | | ■ | ■ | | ■ | |
| 33 | *Rhaphiolepis indica* var. *umbellata* | | | | | | ■ | ■ | | | ■ | | | | ■ | | | ■ | |
| 34 | *Rhododendron scabrum* | | ■ | | ■ | | ■ | | | ■ | | ■ | | | ■ | | | ■ | |
| 35 | *R. tashiroi* | ■ | | ■ | ■ | | ■ | | | | | ■ | | | | | | | ■ |
| 36 | *Rhus succedanea* | | | | | | | | | | | | ■ | ■ | | | | ■ | |
| 37 | *Sapium japonicum* | | ■ | ■ | | | | | | | | | | | | | | | |
| 38 | *Sarcandra glabra* | | | | | | | | | | | | | | ■ | | | | |
| 39 | *Schefflera octophylla* | | | | | | | | | | | | | | ■ | | | | |
| 40 | *Schima wallichii* | | | ■ | ■ | | | | | | | | | | | | | | |
| 41 | *Styrax japonicus* | | | | | | | | ■ | | | | | ■ | | | ■ | | |
| 42 | *Syzygium buxifolium* | ■ | ■ | | | | | ■ | | | | | | | | | | | |
| 43 | *Ternstroemia gymnanthera* | | ■ | | | | | | ■ | ■ | ■ | ■ | | | ■ | | | ■ | ■ |
| 44 | *Trochodendron aralioides* | | ■ | | | | | | | | | | | | | | | | |
| 45 | *Vaccinium wrightii* | | ■ | ■ | | ■ | | | | ■ | | | | | ■ | | | | |

Numbers 1 to 18 at the top of the table are the site numbers. Solid black squares indicate that the species in the left column was found at the site number at the top.

in 8 sites. *Myrsine seguinii* H. Lév. (No.27) and *Rhododendron scabrum* G. Don (No. 34) were growing in 7 sites. An evergreen fern, *Pyrrosia lingua* (Thunb.) Farw. and grasses, *Miscanthus sinensis* Andersson or *M. condensatus* Hack. were always found around the lily on the cliff surface.

Vertical sectional images of all sites were drawn (Fig. 3). Species numbers of each tree in Fig. 3 are shown in Table 3. Heights (H cm) and diameters at approximately 1.5 m high (DBH cm) of the main canopy trees are listed in Table 4. Small alphabetical letters in Fig. 3 are the tree-ID in Table 4. These vegetations were regarded as the secondary forest of evergreen broad-leaved trees that was common in the back-country and low mountains of the Amami-o-shima (Okuda 1989 ; Tagawa et al. 1989).

Details of each site are as follows. Sites 1 to 9 were located in Yamato Village, Amami City and Setouchi Town on Amami-o-shima Island. At Site 1 (Figs. 2 (1), 3 (1)), a boulder approximately 10 m wide and 10 m high faced to the north. The cliff surface was covered with trees growing from the both sides and the bottom of the boulder. One adult lily was flowering near the top of the cliff where there was a small gap in the tree layer. Three sprouts appeared on soil

Table 4. Heights and diameter at 1.5 m high of canopy trees in research sites

| SiteNo. | TreeID | H(cm) | DBH(cm) |
|---|---|---|---|
| 1 | a | 250.0 | 4.0 |
| | b | 300.0 | 7.5 |
| | c | 400.0 | 9.6 |
| | d | 400.0 | 9.2 |
| | e | 400.0 | 6.2 |
| | f | 300.0 | 3.0 |
| | g | 350.0 | 2.0 |
| | h | 450.0 | 12.1 |
| | i | 600.0 | 8.8 |
| 2 | a | 180.0 | 3.5 |
| | b | 190.0 | 3.5 |
| | c | 195.0 | 4.0 |
| | d | 580.0 | 10.0 |
| | e | 680.0 | 6.0 |
| | f | 360.0 | 3.0 |
| 3 | a | 160.0 | 3.5 |
| | b | 150.0 | 3.8 |
| | c | 110.0 | 2.0 |
| | d | 70.0 | 1.9 |
| | e | 1330.0 | 14.0 |
| | f | 1360.0 | 9.0 |
| | g | 530.0 | 8.0 |
| | h | 1390.0 | 12.5 |
| 4 | a | 510.0 | 24.3 |
| 5 | a | 200.0 | 30.0 |
| | b | 200.0 | 20.0 |
| | c | 300.0 | 20.0 |
| 6 | a | 200.0 | 10.0 |
| 7 | a | 150.0 | – |
| | b | 200.0 | – |
| | c | 250.0 | – |
| | d | 300.0 | – |
| | e | 350.0 | – |
| | f | 400.0 | – |
| | g | 300.0 | – |
| 8 | a | 810.0 | 20.0 |
| | b | 980.0 | 20.0 |
| 10 | a | 180.0 | 15.0 |
| | b | 180.0 | 10.0 |
| | c | 400.0 | – |
| | d | 400.0 | – |
| 11 | a | 200.0 | 12.0 |
| | b | 250.0 | 30.0 |
| | c | 200.0 | 20.0 |
| | d | 200.0 | 10.0 |
| 12 | a | 1220.0 | 28.9 |
| | b | 1320.0 | 30.5 |
| 13 | a | 425.0 | 18.0 |
| | b | 940.0 | 12.5 |
| | c | 690.0 | 8.1 |
| | d | 815.0 | 16.5 |
| 14 | a | 360.0 | 8.0 |
| | b | 275.0 | 4.0 |
| | c | 790.0 | 23.6 |
| | d | 850.0 | 20.0 |
| | e | 460.0 | 6.0 |
| 15 | a | 230.0 | 2.0 |
| | b | 300.0 | 2.0 |
| | c | 515.0 | 4.5 |
| | d | 1235.0 | 14.8 |
| 16 | a | 430.0 | 14.0 |
| | b | 350.0 | 8.0 |
| | c | 530.0 | 4.1 |
| | d | 820.0 | 19.5 |
| | e | 520.0 | 3.0 |
| 17 | a | 315.0 | 4.0 |
| | b | 590.0 | 13.7 |
| | c | 370.0 | 7.7 |
| 18 | a | 200.0 | 3.0 |
| | b | 200.0 | 3.0 |
| | c | 300.0 | 6.0 |
| | d | 300.0 | 10.0 |
| | e | 250.0 | 3.0 |
| | f | 200.0 | 6.0 |
| | g | 200.0 | 3.0 |
| | h | 200.0 | 3.0 |
| | i | 200.0 | 2.0 |

Each site number is the same in Table 1. Alphabets of the tree ID are shown in Fig. 3. H : tree heights. DBH : diameters at 1.5 m high.

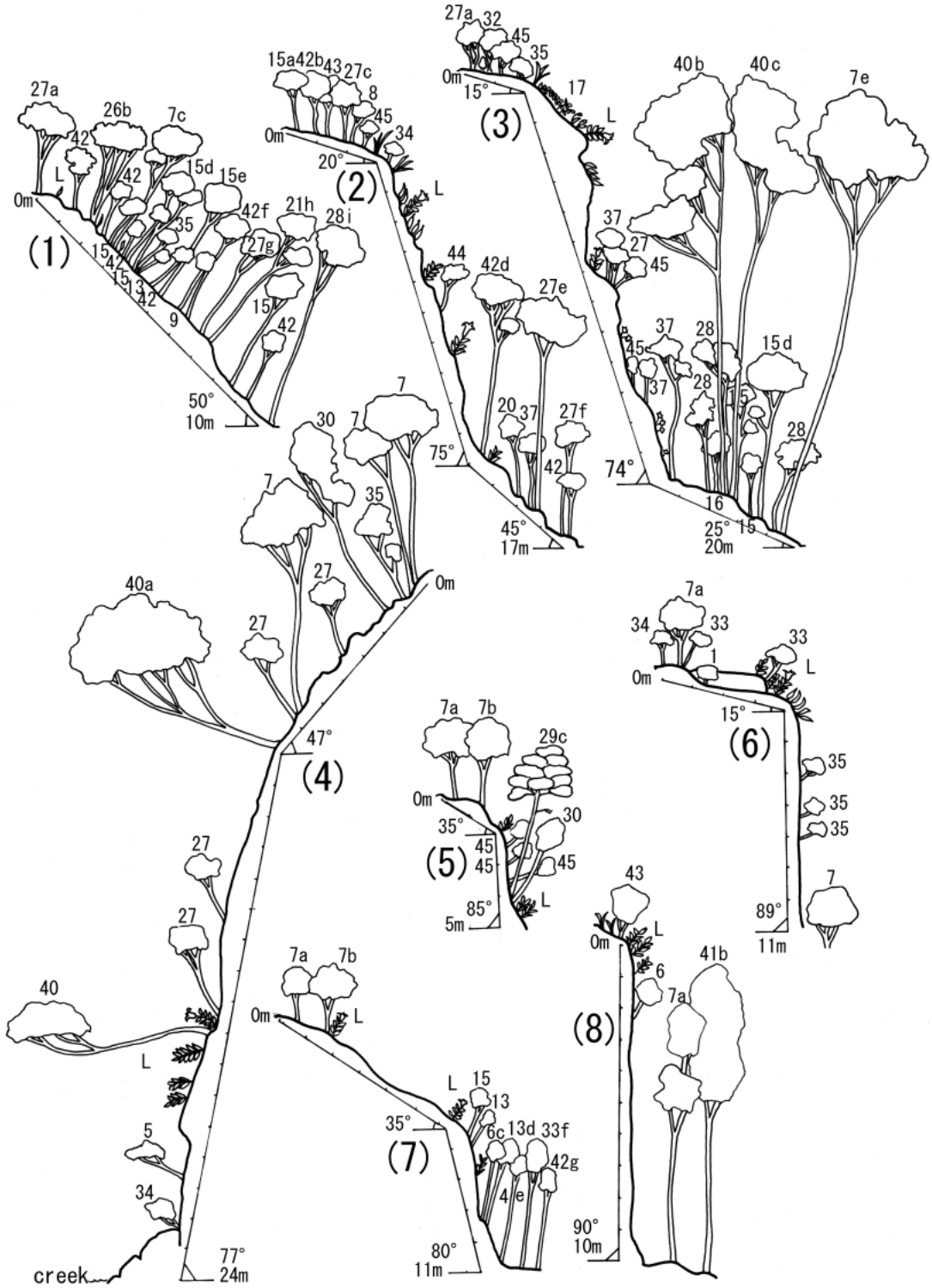


Fig. 3. Vertical sectional drawings of cliff surfaces and forests beside the growing position of *Lilium alexandrae*. (1)–(18):Sites No. 1–18. Numbers of each tree are the species number in Table 3. Alphabets of trees are the tree ID of table 4. L : *L. alexandrae*. The site number is the same in Table 1.

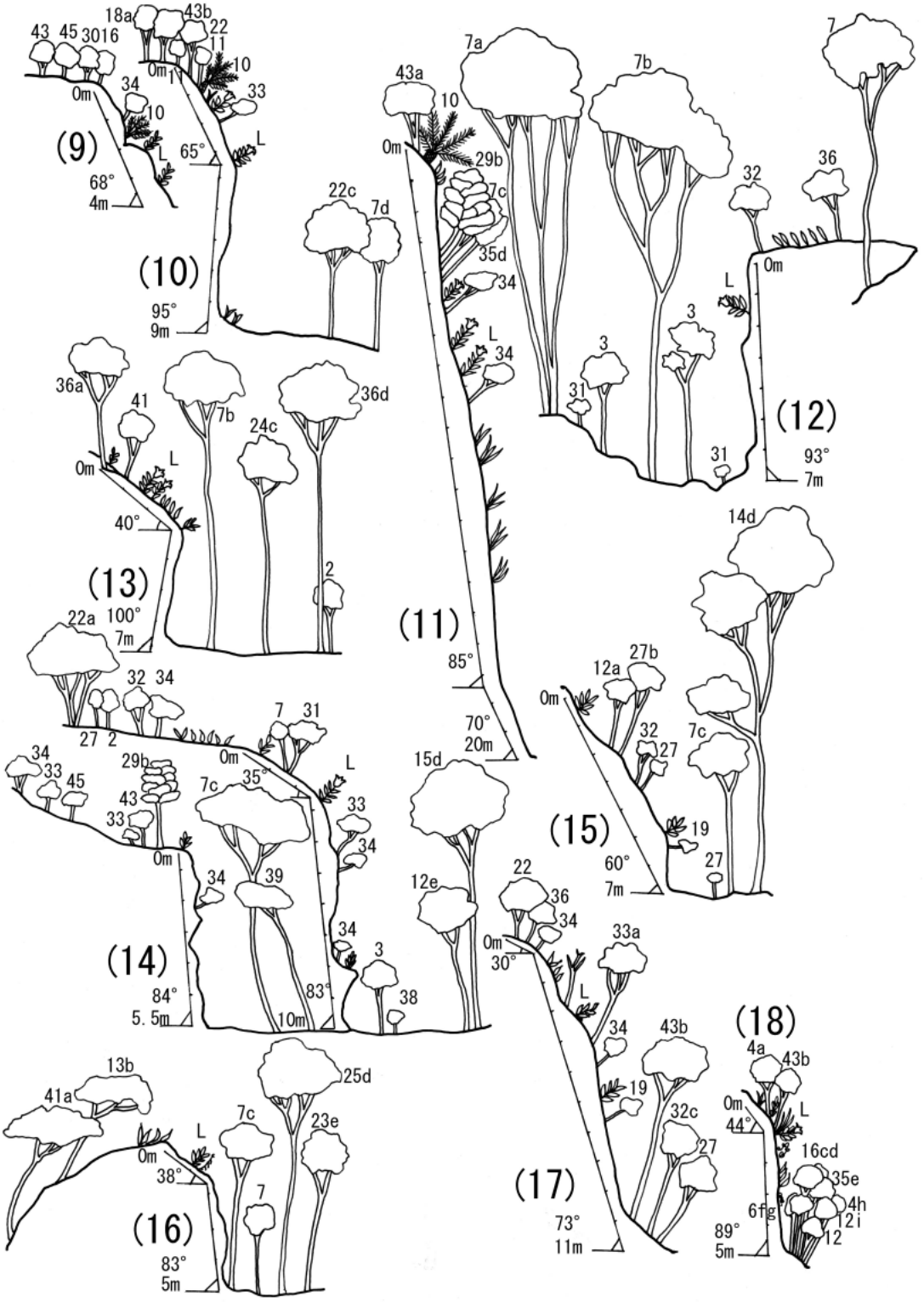


Fig. 3. Continued.

ground just beside the boulder, and two grew on a ledge covered with a *Myrsine seguinii*. These sprouts seemed to be stressed because of shadowing by the trees. In Site 2 (Figs. 2(2), 3(2)), a boulder faced to the north. The middle part of the cliff (Z : 3–13 m from the top) was not covered with trees and held adult lilies and *Pyrrosia lingua*. The top of the boulder, (Z : 0–3 m), was covered with thick woody shrubs of 1–2 m height. On Site 3 (Figs. 2(3), 3(3)), a boulder mainly faced to north. The direction of a cliff holding lilies was north northwest. The top of the boulder was covered with low trees and shrubs, and the middle part (Z : 4–13 m) held the lilies, *Pyrrosia lingua* and a woody vine of *Ficus thunbergii* Maxim. Site 4 (Figs. 2(4), 3(4)) was on the largest boulder among the present research sites beside a narrow valley of a river. The direction of a cliff was southeast by east. The lilies grew on a ledge at the bottom part of the cliff, from 5 m to 10 m above the water level of the river. We found sixty-one adult lilies and twenty percent of them had young fruits. In Site 5 (Figs. 2(5), 3(5)) and Site 6 (Figs. 2(6), 3(6)), only upper open parts of huge cliffs were studied because their bottoms were overhung and covered with thick forests. The abbreviations, ' 5+ ' and ' 11+ ', in Table 1 mean more than five meters and more than eleven meters in the Sites 5, 6 and 18. The upper part of the cliff at Site 5 faced to the north and held five blooming lilies. The cliff of Site 6 held fifteen adults with flowers. In Site 7 (Figs. 2(7), 3(7)), the cliff faced north northwest and seven flowering ones and four adults without flowers were found. Sites 8 and 9 (Figs. 2(8), (9), 3(8), (9)) were very near in position to each other. Seven lilies were growing on the boulders of the sites with *Selaginella involvens* (Sw.) Spring and *Pyrrosia lingua*.

Sites 10 and 11 (Figs. 2(10), (11), 3(10), (11)) were distribution points in Kakeromajima Island. In Site 10, a boulder held five lilies on its north-faced ledge. The width of the bottom of the cliff was 9 m. The face between 2 m and 6 m from the top was covered with only mosses. Eleven lilies were found on upper part of a boulder, that was 15 m wide and 20 m long, in Site 11.

Sites 12 to 17 were on Ukejima Island. Around Site 12 (Figs. 2(12), 3(12)), there were at least twelve boulders in a horizontal quadrate (23 m × 12 m). Seven *Castanopsis siiboldi*, two *Quercus glauca* Thunb. ex Murray var. *amamiana* (Hatus.) Hatus. ex H. Ohba, one *Lithocarpus edulis* (Makino) Nakai, one *Elaeocarpus japonicus* Siebold et Zucc., one *Ardisia sieboldii* Miq. and one *Cycas revoluta* Bedd. were growing in the center area of the quadrate. *Pyrrosia* and *Miscanthus* were found on rocky surfaces. Site 12 was at a western cliff of the western-side boulder in the quadrate. The cliff was 7 m high and its gradient was 93°. There were lilies on a redge at 5 m high. In Site 13 (Figs. 2(13), 3(13)), the direction of a cliff was north. Its gradient was 40° on the upper part, and 100° on the bottom part. Lilies grew on the upper part, approximately 1–4 m from the top. We found thirty-three adult lilies and ninety-one percent of them bloomed. Site 14 was next to Site 13 and had two ridges (Figs. 2(14), 3(14)). The cliff gradient of the ridges was 83° and 84°, and the direction was north. There were shrubs of *Rhododendron scabrum*, *Rhaphiolepis indica* (L.) Lindl. ex Ker var. *umbellata* (Thunb. ex Murray) H. Ohashi, etc., *Miscanthus* and *Pyrrosia* at the top and on ledges. The lilies grew on the upper parts. We found nineteen adults lilies and nine sprouts. The direction of a cliff of Site 15 (Figs. 2(15), 3(15)), was west and the gradient was 60°. *Castanopsis siiboldii* dominated in the forest surrounding this site. Only two living plants and two dead stems were found at the bottom part of the cliff surface. In Site 16 (Figs. 2(16), 3(16)), a boulder was divided into three parts horizontally. The lilies were attached to the upper part of the two. The direction was west and the gradient was 83° and 38°. Five living individuals remained on the boulder, and at least fifty dead stems stood on the top. In Site 17 (Figs. 2(17), 3(17)), the cliff faced to the west and its gradient was 73°. Ten adults and fourteen dead stems were found on ledges (Z : 3–6 m from the top). These dead stems had been fresh in March 2007. We estimated that twenty-four plants had been growing just before our survey on July.

Site 18 (Figs. 2(18), 3(18)) located in Tokunoshima Island. A boulder was 10 m wide and more than 5 m high, and its direction was the north. Forty-seven lilies were growing near the

top of the cliff. *Selaginella involvens*, *Pyrrosia lingua*, *Psychotria serpens* L., *Hedera rhombea* (Miq.) Bean, *Hoya carnosa* (L. f.) R. Br., *Swertia tashiroi* (Maxim.) Makino, *Miscanthus sinensis* were found near the lilies.

Hatusima (1986) reported that *L. alexandrae* grew in Amami-o-shima and Yorojima Islands. Its distribution was Amami-o-shima, Ukejima and Yorojima Islands in the Kagoshima Red Data Book by Kagoshima Prefectural Government (2003). We could find living plants of *L. alexandrae* in Amami-o-shima, Ukejima, Kakeromajima and Tokunoshima Islands, but could not find in Yorojima Island in 2007 and 2008.

Hayashi (1983) mentioned that the gross morphology of *L. alexandrae* on Mt. Togura-yama in the southern Amami-o-shima Island was influenced by brightness. Concretely, lilies had erect stems, spiral phyllotaxis, flower buds, and maximum leaves with 14.2 and 34.8 $cm^2$ while the relative light intensity of their growing position was over 30.1 %. When the relative light intensity was 2.5 to 11.6 %, lilies had slanting or creeping stems, alternate phyllotaxis, and maximum leaves with 30.1 and 46.8 $cm^2$. He reported that lilies having over 21 leaves per individual were fertile size classes. All blooming lilies were growing on the top to the middle parts of boulders in our research sites except Site 4. Their growing position was not covered with any tree layer. The direction of the cliffs did not face to the south. The cold wind blows to the northwestern side of the boulders in winter. This species seemed to grow well in a bright forest gap that was not exposed all day to the direct rays of the sun and to pass the cold season as bulbs underground. The lilies without flowers included both erect and slanting stem-types. Creeping stem-type was not found in our survey. Sprouts with no-stem were found in Sites 1, 2, 4 and 14. A blooming plant in Site 2 had only 16 leaves. This leaf number was less than the fertile size classes of Hayashi's category.

The boulders of Sites 1 to 3 were on the chert of Naon-Complex of the Chichibu-Belt. Pieces of rock sampled at Site 3 were identified as a typical chert and a chert including quartz. A boulder at Site 4 laid basically on sandstone and mudstone of the Naze-Unit of a sedimentary complex, called the Shimanto-Belt (Takeuchi 1993). Rocks of Site 4 were a mudstone and a slate. All boulders of Sites 6 to 17 were on chert, and one sample taken from Site 13 was a siliceous mudstone. A rock sample of Site 18 was identified as the sandstone including mudstone. The soil depth was very low on the ledge of boulders and seemed be well-drained through small cracks in the rocks. The correct soil in which to cultivate Oriental lilies in a pot includes light soil to allow drainage of water (Matthews 1989 ; Miyamoto 2006). The growing position of the lilies on each cliff might be limited by soil conditions.

This study reconfirms that *L. alexandrae* is only distributed in very restricted habitat of limited islands of the middle Ryukyu Archipelago. Its habitats seemed to be limited because of natural environmental conditions, such as light, temperature, wind flow, soil and water-drain. Its distribution in each island, however, might have been influenced by recent human activities. This species faces pressures, such as environmental changes of growing places, being eaten by wild boars and stray goats and picking by humans. Further continuous observation of these natural habitats will be necessary for conservation of this endangered endemic species.

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**References**

Hatusima, S. 1971. *Lilium*. Ryukyu shokubutsu shi, p. 784. Okinawa Seibutsu Kyoiku Kenkyu Kai, Naha. (in Japanese)

Hatusima, S. 1986. *Lilium alexandrae* Hort. ex Wall. Kagoshimaken shokubutsu mokuroku, p. 219. Kagoshima Shokubutsu Doukou Kai, Kagoshima. (in Japanese)

Hatusima, S. 2004. Liliaceae. Flora of Kyushu. A list of ferns and flowering plants from Kyushu including the Amami Islands, pp. 276–284.

The Kagoshima University Museum, Kagoshima. (in Japanese)

Hayashi, K. 1983. Native lilies in Japan. III. The natural habitats of *Lilium alexandrae* in Amami o-shima. J. Phytogeogr. Taxon. **31** : 111–119.

Hayashi, K. and Kawano, S. 2000. Molecular systematics of *Lilium* and allied genera (Liliaceae) : phylogenetic relationships among *Lilium* and related genera based on the *rbcL* and *matK* gene sequence data. Pl. Sp. Biol. **15** : 73–93.

Kagoshima-ken Kankyoseikatsu-bu Kankyohogoka (ed.). 2003. Ukeyuri. Kagoshima red data book, plants, pp. 437－438. Kagoshima-ken Kankyo-gijutsu Kyokai, Kagoshima. (in Japanese)

Makino, T. 1932. Ukeyuri. J. Jpn. Bot. **8** : 4. (in Japanese)

Matthews, V. 1989. Cultivation. Matthews, V. (ed.). Lilies, pp. 43–49. Collingridge Books, London.

Miyamoto, J. 2006. Yuri. Fukui, K., Mukai, Y. and Taniguchi, K. (eds.). Chromosome. Shokubutsu senshokutai kenkyu no houhou, pp. 226–227. Yokendo, Tokyo. (in Japanese)

Nishikawa, T., Okazaki, K., Uchino, T., Arakawa, K. and Nagamine, T. 1999. A molecular phylogeny of *Lilium* in the international transcribed spacer region of nuclear ribosomal DNA. J. Mol. Evol. **49** : 238–249.

Okuda, S. 1989. Vegetation von Amami-Ohshima. Miyawaki, A. (ed.). Vegetation of Japan, vol. 10, Okinawa and Ogasawara, pp. 501–504. Shibundo, Tokyo. (in Japanese)

Ronsted, N., Law, S., Thornton, H., Fay, M. F. and Chase, M. W. 2005. Molecular phylogenetic evidence for the monophyly of *Fritillaria* and *Lilium* (Liliaceae ; Liliales) and the infrageneric classification of *Fritillaria*. Mol. Phylogen. Evol. **35** : 509–527.

Satake, Y. 1982. *Lilium*. Satake, Y., Ohwi, J., Kitamura, S., Watari, S. and Tominari, T. (eds.). Wild flowers of Japan, herbaceous plants I, pp. 39–42, pls. 32–35. Heibonsha, Tokyo. (in Japanese)

Shimizu, M. 1987. Ukeyuri *Lilium alexandrae* hort. Wallace (1893) to tamotoyuri *L. nobilissimum* Makino (1914). Shimizu, M. (ed.). The lilies of Japan, species and hybrids, pp. 60–64. Seibundoshinkosha, Tokyo. (in Japanese)

Tagawa, H., Kawakubo, N., Suzuki, E. and Koyama, T. 1989. Vegetation of Amami-o-shima. Tagawa, H. (ed.). Amami-o-shima chosa houkoku, pp.75–105. Japanese Environmental Agency, Tokyo. (in Japanese)

Takeuchi, M. 1993. Geology of the Yuwan district. 164 pp. Geological Survey of Japan, Tokyo.

Vinnersteen, A. and Bremer, K. 2001. Age and biogeography of major clades in Liliales. Am. J. Bot. **88** : 1695–1703.

Wikstorum, N., Savolainen, V. and Chase, M.W. 2001. Evolution of the angiosperms : calibrating the family tree. Proc. R. Soc. Lond., Ser. B **268** : 2211–2220.

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**前田芳之[1]・宮本旬子[1]・尾崎煙雄[2]・盛口　満[3]・垣下　愛[4]：琉球弧の奄美群島におけるユリ科ウケユリの自生地**

ユリ科ウケユリは琉球列島固有植物で，絶滅が危惧されているが，近年の自生地の現状が不明であった。本研究は，鹿児島県の奄美大島，加計呂麻島，与路島，請島，徳之島においてウケユリの自生地を探索し，現存個体数とその生育環境を調査したものである。2007 年 3 月から 2008 年 7 月に対象地域をほぼ網羅的に踏査した結果，奄美大島 9 箇所，加計呂麻島 2 箇所，請島 6 箇所，徳之島 1 箇所の計 18 箇所において，374 個体の生育を確認した。このうち 292 個体は茎に 5 枚以上の葉をつけた大株で，その中の 137 個体は花または若い果実をつけていた。さらに，実生の可能性がある小型の１６個体と，枯れた茎をつけた 66 個体を確認した。生育場所は北緯 27° 50′ から 28° 20′，東経 128° 55′ から 129° 25′，標高 174 m から 595 m の範囲内に点在する露岩のほぼ垂直な壁面であった。ウケユリは林冠の被覆が無く日当りがよい岩壁の中部や上部に多く生育していた。露岩の周辺はスダジイなどを優占種とする常緑広葉樹の二次林であった。

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