Dogtooth Violets of Tokai University Sapporo Campus

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Abstract

A population of dogtooth violets began to emerge in a small woodlot on Tokai University Sapporo Campus in 2001. The emergence was observed a few years after the grass mowing was partially terminated and/or delayed for several weeks to protect spring ephemeral plants and breeding birds. This study is probably one of the few cases in which the precise timing of the initiation of a dogtooth violet population was identified and that suggested grass mowing practices to be responsible for hindering their growth. The oldest plants were believed to be more over years old. The first flowering dates had a significant positive correlation with April temperatures. Future conservation concerns are discussed.

Key words : *Erythronium japonicum*, grass mowing, longevity, conservation concerns

Introduction

The Japanese dogtooth violet *Erythronium japonicum* is a perennial plant found in Japan, including Hokkaido[1]. Its ecological distribution is unique in the way that the dogtooth violets grow on hilly collapse land or partially denuded soil, facing southeast to southwest in northern Japan, while they are often found on northern hills in warmer areas[2]. The plant is much admired as one of spring ephemerals.

A population of the Japanese dogtooth violets began to emerge in the early 2000s on Tokai University Sapporo Campus, after the grass-mowing practice had been gradually reduced in order to care for breeding birds and to protect wild herbs and seedlings so that the natural turn-over of the woods was to be restored.

This paper illustrates how the population of the dogtooth violets has expanded and discusses the future conservation perspectives.

Study area, materials and methods

The study area was a woodlot with an area of about 0.67ha, located on Tokai University Sapporo

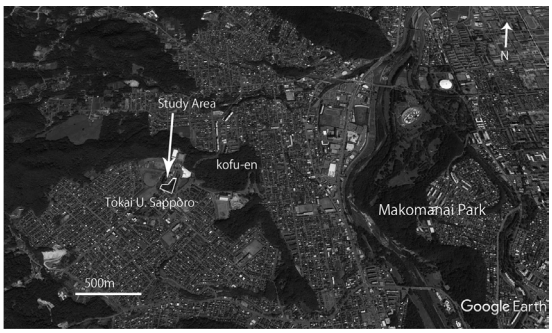


Figure 1 Satellite image of the study area

Campus (42° 59′ 29.1″ N, 141° 19′ 7.6″ E). The altitude was 170m above sea level. The entire woodlot was on a steep hill facing south to south east with a height difference of 10-15m (Figure 1). Dominant tree species were the Japanese white birch *Betula platyphylla* and the water oak *Quercus mongolica var. grosseerrata*. Komayumi *Euonymus alatus*, Kumazasa *Sasa veitchii*, hebacious plants, grasses, forsythia *Forsythia suspensa* and Montana pine *Pinus mugo* were the major consituents of the understory vegetation. The latter two species were the remnant ornamental plants when the woodlot used to be managed as a part of a manicured campus garden.

The dogtooth violets began to emerge in 2001 after the regular grass mowing practice was ceased in most parts and/or delayed later in the season to avoid disturbing breeding birds and negative effects on the understory plants, particularly those that emerged early in the spring and tree seedlings. The routine mowing had been done in late April to early May around the Golden Week holidays and in early- to mid-June just before the University Festival. The mowing of the woodlot was terminated entirely in 2004.

The study was conducted in April in 1998-2001, 2005, 2007, 2009-2010, and 2012-2016 over the 19 years between 1998 and 2016. The first flowering date, defined as the first date when the first flowering buds opened, was recorded for most of the study years.

The numbers of individual dogtooth violets were counted and recorded by walking as slowly and evenly as possible. The individual plants were classified into three age groups: 1) very young (1-2 years of age with the leaf length of less than 2cm), 2) over three years of age but with no flowers yet, and 3) mature (flowering individuals).

The plant species found in the woodlot during the study were compiled into a species list. Temperatures and other meteorological data were obtained from the Sapporo Meteorological Observatory.

Results

The dogtooth violets flowered from mid- to late-April in the study area (Figure 2). The first flowering dates varied from year to year.



Figure 2 Dogtooth violets on Tokai University Sapporo Campus

Figure 3 shows the first flowering dates, the numbers of individual dogtooth violets and age groups in 1998-2001, 2005, 2007, 2009-2010, and 2012-2016. The number of plants increased after 2001, when the emergence of the dogtooth violets was recorded for the first time and seemed to have reached a plateau around 2009, although there were some fluctuations between years. The isolated bunch of several dogtooth violets on the southern hill emerged from exactly the same spot at least for 11 year, while one plant disappeared in 2016.

Since I did not carry out a precise quadrat survey for the species, it was not possible to evaluate their spatial distribution quantitatively. Thus, the illustration in Figure 4 is a rough sketch of how the dogtooth violets had expanded in the study area. Nevertheless, the figure shows that the dogtooth violets tended to expand its distribution upward towards the western edge of the hill. April temperatures which had influence on depth of snow

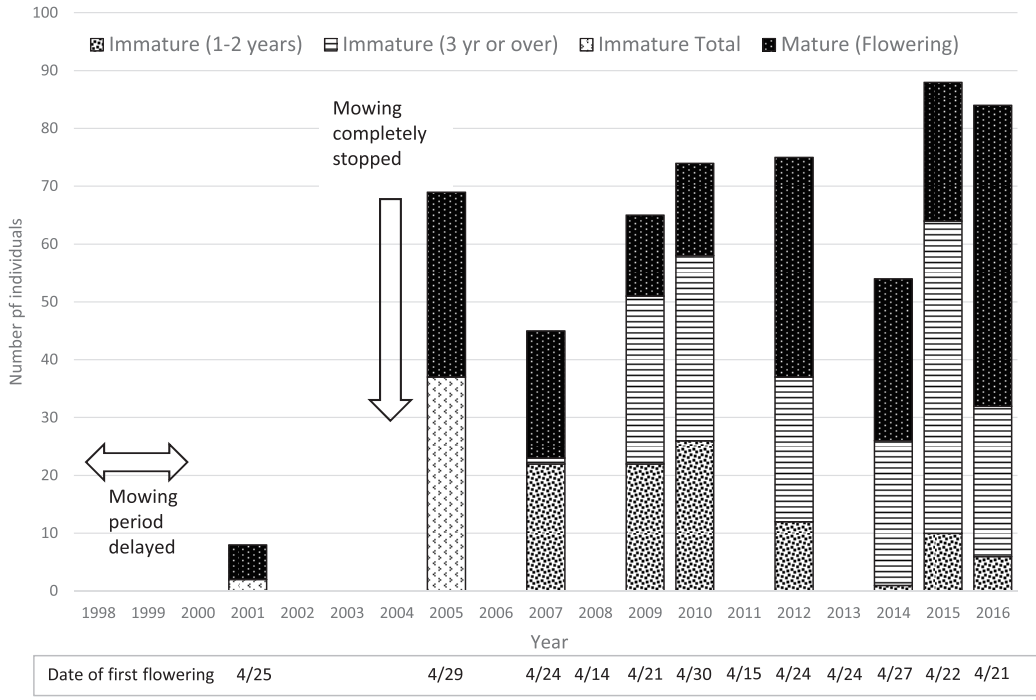


Figure 3 The numbers of individual dogtooth violets categorized into three age groups. 1-2 year and over 3 year-old immatures were put into Immature Total in 2001 and 2015. The first flowering dates are indicated at the bottom, along the x axis. There were years when only the first flower date was recorded.

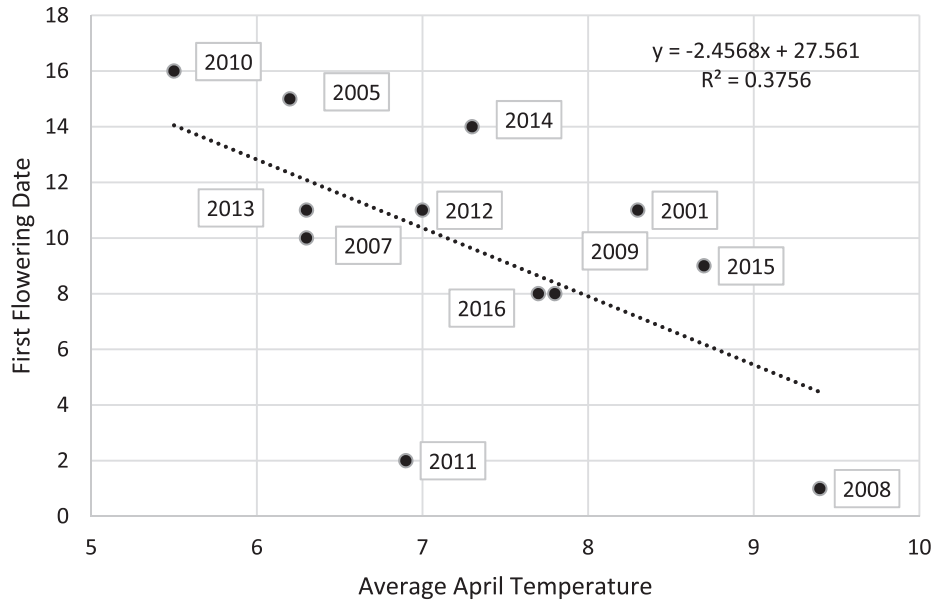


Figure 5 The average April temperature and the first flowering date as expressed as 1 for the earliest record, which was April 14 and 16 for the latest record on April 30.

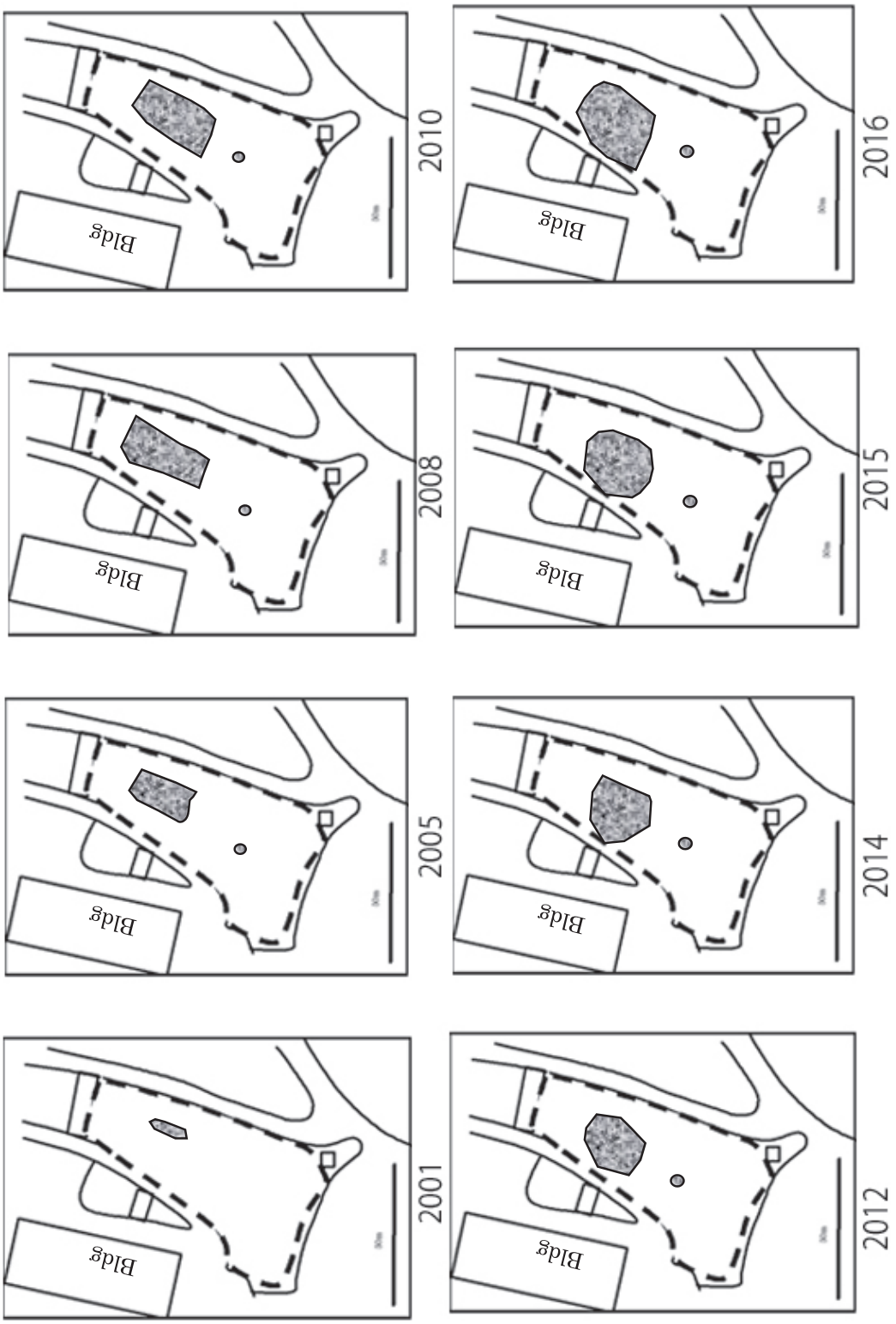


Figure 4 Changes in distribution patterns (shaded areas) of dogtooth violets. The broken line indicates the study area.

Table 1 Plant species list of the study area between 1998 and 2016

Family	Japanese Name	Latin Name	Status (○= emerging throughout the study years, ◎= regular since the first emergence, △= short term)	Year(s) established
トクサ	スギナ	*Equisetum* var. *arvense*	○	
コバノイシカグマ	ワラビ	*Pteridium qlatiusculum*	◎	since 2004
マツ	モンタナマツ	*Pinus mugo*	○	
クルミ	オニグルミ	*Juglans ailanthifolia*	○	
ヤナギ	エゾノバッコヤナギ	*Salix bakko*	○	
カバノキ	シラカンバ	*Betula platyphylla* var. *japonica*	○	
ブナ	ミズナラ	*Quercus mongolica* var *grosseserrata*	○	
	カシワ	*Q.dentata*	○	
ニレ	ハルニレ	*Ulmus daviana* var. *japonica*	○	
	ケヤキ	*Zelkova serrata*	○	
クワ	ヤマグワ	*Morus bombycis*	○	
ヤドリギ	ヤドリギ	*Viscum album ssp. Coloratum*	○	
タデ	イヌタデ	*Viscumalbum*	○	
	オオイタドリ	*Fallopoa sachalinensis*	◎	since 2004
	ヒメスイバ	*Rumex acetosella*	○	
	エゾノギシギシ	*R. obtusifolius*	○	
アカザ	アカザ	*Chenopodium album* var. *centrorubrum*	○	
モクレン	キタコブシ	*Magnolia kobus* var. *borealis*	○	
ドクダミ	ドクダミ	*Houttuynia cordata*	○	
センリョウ	ヒトリシズカ	*Chloranthus japonicus*	◎	since 2004
アブラナ	ナズナ	*Capsella bursa-pastoris*	○	
バラ	ナナカマド	*Sorbus commixta*	○	
	エビガライチゴ	*Rubus crataegifolius*	○	
	ノイバラ	*Rosa multiflora*	○	
	エゾヤマザクラ	*Prunus sargentii*	○	
	ズミ	*Malus sieboldii*	○	
	キンミズヒキ	*Agrimonia pilosa* var. *japonica*	○	
マメ	クサフジ	*Visia cracca*	○	
	イヌエンジュ	*Maackia amurensis* var. *buergeri*	○	
	クズ	*Pueraria lobata*	○	
	シロツメクサ	*Trifolium repens*	○	
	ムラサキツメクサ	*T. pratense*	○	
	シナガワハギ	*Melilotus officinalis* ssp. *suavelens*	○	
カタバミ	カタバミ	*Oxalis corniculata*	○	
フウロソウ	ゲンノショウコ	*Geranium thunbergii*	○	
ウルシ	ヌルデ	*Rhus javanica*	○	
カエデ	イタヤカエデ	*Acer momo*	○	
ニシキギ	コマユミ	*Euonymus alatus*	○	
	ツリバナ	*E. oxyphyllus*	○	
ブドウ	ヤマブドウ	*Vitis coignetiae*	○	
	ノブドウ	*Ampelopsis brevipedunculata*	○	
スミレ	タチツボスミレ	*Viola grypoceras*	○	
アカバナ	メマツヨイグサ	*Oenothera biennis*	○	

ミズキ	ミズキ	*Corunus controversa*	○	
セリ	セントウソウ	*Chamaele decumbens*	◎	after ca. 2000
	ノラニンジン	*Daucus carota* ssp. *Sativus*	○	
モクセイ	ヤチダモ	*Fraxinus mandshurica* var. *japonica*	○	
	レンギョウ	*Forsythia suspensa*	○	
アカネ	クルマバソウ	*Galium odoratum*	○	
サクラソウ	ツマトリソウ	*Trientalis europaea*	△	ca.1999-2001
ヒルガオ	ヒルガオ	*Calystegia pubescens*	○	
オオバコ	オオバコ	*Plantago asiatica*	○	
スイカズラ	エゾニワトコ	*Sambucus siebolkiana* var. *miquelii*	○	
キク	エゾノコンギク	*Aster microcephalus* var. *yezoensis*	◎	after ca.2000
	ユウゼンギク	*A. novi-belgii*	◎	after ca.2001
	アキノキリンソウ	*Solidago virgaurea* ssp. *Leiocarpa*	◎	after ca.2002
	オオアワダチソウ	*S. gigntea* ssp. *Serotina*	○	
	アメリカセンダングサ	*Bidens frondosa*	○	
	セイヨウタンポポ	*Taraxacum officunale*	○	
	ヒメジョオン	*Erigeron annuus*	○	
	ヤマニガナ	*Lactuca rakkeana* var. *elata*	○	
	トゲチシャ	*L. serriola* var. *serriola*	○	
	フランスギク	*Leucanthemum vulgare*	○	
	エゾゴマナ	*Aster glehnii*	◎	after 2004
	ヨツバヒヨドリ	*Eupatorium chinense* var. *sachalinense*	◎	after ca.2000
	ブタナ	*Hypochaeris radicata*	○	
	サワアザミ	*Cirsium yezoense*	◎	after 1999
	ヒメムカシヨモギ	*Conyza canadensis*	○	
	アキタブキ	*Petasites japonicus* subsp. *Giganteus*	○	
ユリ	オオアマドコロ	*Polygonatum odoratum* var. *maximowiczii*	◎	after 1999
	チゴユリ	*Disporum smilacinum*	◎	after 2000
	オオバナノエンレイソウ	*Trillium camschatcense*	◎	since 2004
	エンレイソウ	*T. smallii*	◎	since 2004
	クルマユリ	*Lilium medeoloide*	△	ca. 1998-2003
	マイヅルソウ	*Maianthemum dilatatum*	◎	since 2004
	スズラン	*Convallaria keiskei*	△	ca.2005-2007
	カタクリ	*Erythronium japonicum*	◎	since 2001
イネ	ススキ	*Miscanthus sinensis*	◎	since 2004
	コヌカグサ	*Agrostis gigantea*	○	
	カモガヤ	*Dactylis glomerata*	○	
	オオアワガエリ	*Phleum pratense*	○	
	アキメヒシバ	*Digitaria violascens*	○	
	ハルガヤ	*Anthoxanthum odoratum*	○	
	クサヨシ	*Phalaris arundinacea*	○	
	エノコログサ	*Setaria viridis*	○	
	クマイザサ	*Sasa veitchii*	○	
ラン	ハクサンチドリ	*Orchis aristata*	△	2000
	ノビネチドリ	*Neolindleya camtschatica*	△	2000
	サイハイラン	*Cremastra appendiculata*	△	2000
	クゲヌマラン	*Cephalanthera erecta*	△	ca.2005-2010

and the timing of snow melt determined the timing of flowering. Figure 5 shows a significant negative correlation between the first flowering dates and average April temperatures for the years when the first flowering dates were surveyed (Spearman Rank Correlation, $p<0.05$)

The plant species observed during the study period are indicated in Table 1. A total of 89 species were recorded. While most of the species emerged constantly throughout the years, some were observed only for less than a few years.

Discussion

The observation made in this study probably is one of the few cases in which the start of the dogtooth violet population was documented fairly precisely.

Even though the dogtooth violets grow on partially eroded or collapse land with less vegetation cover, it seems apparent that the grass mowing practices in spring had had an adverse effect on the growth of dogtooth violets and hindered them from germinating and establishing a population in my study area. Mowing may have affected the growth and establishment of the dogtooth violet population in two ways: by directly damaging the plant and by raking away all the plant matter from the site thereby removing seeds and resulting in the loss of elaiosomes, which are crucial for their seed dispersion by ants.

It should also be worth noting that 17 other plant species became established after the termination of grass mowing.

The results of 2013-2014 fauna and flora survey of the 15-ha campus forest located east of the study area showed that the dogtooth violets were almost non-existent[2]. My study area was the only site where a fairly large number of dogtooth violets was found probably within a 1km radius. The closest population is the one in Makomanai Park[4].

There was a considerable fluctuation in the proportion of the age groups (Fig.3). The numbers of flowering individuals also differed from year to year. These may suggest that there were year-to-year fluctuations in the mortality of the dogtooth violets maihly due to predation. Although it was not possible to make direct observations on the dogtooth violets being preyed upon, I saw the flowers having been bitten off and some root parts having been dug up probably by small mammals such as voles.

There was a significant negative correlation between the first flowering date and the average April temperature (Fig.5). Other studies also reported that the first flowering dates were influenced by ambient temperatures[5)6)].

A part of the population found in the southern part of the study area consisted of five to eight individuals. This group stood isolated from the rest of the population ever since they had been found to flower in 2005. Had they been the same individuals since then, they could be more than 15 years old since it takes about 7-8 years for them to flower. Strangely enough, no immature plants had been found around the isolated bunch, while the northern part had many young plants of various ages along with mature flowering individuals. The reason for this is not clear, but is suspected to be caused either by surrounding conditions including soil chemistry and the presence of competitors, or the absence or scarecity of seed dispersers, namely ants. The range of the dogtooth violets seemed to be expanding in the northern area (Figure 4).

Conservation concerns

Although termination of the grass mowing practices seems to have triggered the germination and subsequent expansion of the dogtooth violets, the population is now facing a steady successional changes of its substrate, that is, rapid understory growths of such plants as the Komayumi *E. alatus*, the Mulberry *Morus alba*, the Zumi *Malus toringo*, and the Kumazasa bamboo *S. veitchii*, all of which tend to densely cover the ground.

One way to conserve the recently established population of the dogtooth violets would be to remove such shrubs regularly to secure space for them to emerge every year. This requires a great deal of commitment and effort. It may also be controversial to remove a certain species of plants for the sake of conserving a particular plant species, especially when both the conserved and the removed are native species growing in a semi-natural woods in the process of restoring itself. Would it not be more feasible to follow the nature' s way, that is, the course of plant succession?

The alternative way should be to do nothing except for regular monitoring of the flora. There were a few plant species which emerged for a short period of time from just one season to several seasons and disappeared since (Table 1). Such species include the Kurumayuri *Lilium medeoloides*, the Tsumatoriso *Trientalis europaea*, and the Ezosuzuran *Epipactis papillosa*. These sporadic emergences may mean that the study area has a good "seed bank" from which the suitable ones have the chance to grow and produce seeds when conditions permit. We may well expect that the steep inclination of the study area can keep producing bare soil suitable for the dogtooth violets for some time in the future.

What is promising is the expansion of dogtooth violets to the top of the hill where there are more bare soil and thus fewer competitors. There will not be just one answer as to how we should do to conserve rare species.

The more important consideration should be how we can enhance the biodiversity of the area. Hara (2005) and other workers stressed the importance of monitoring plant populations to correctly access their present conditions and to improvise future conservation measures[7]. What we need to do at the moment may simply be to continue monitoring and accumulate data. However, the provision of some experimental plots to manage understory vegetation to suit the growth of dogtooth violets may serve as a good reference for the future conservation measures for the disturbance-dependent native plant species like the dogtooth violet.

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