

THE

# FRITILLARIA

GROUP



The Fritillaria Group of the Alpine Garden Society  
Journal 31 Autumn 2012



**Editor:** Pat Huff  
**Botanical advisor:** Martyn Rix

The Fritillaria Group welcomes articles, short notes and photographs – especially of plants in the wild—line drawings, and other material concerning Fritillaria.

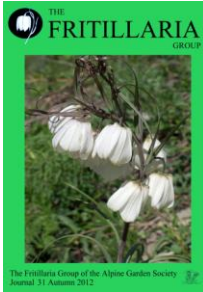
**Copy dates:** 1 May and 1 October

**Articles** are quicker and easier to handle if they are produced electronically, but typed and manuscript copy is also very welcome.

**Photographs** should be in the form of 35mm transparencies, or on photo CD. If possible, please send transparencies ahead of the copy to allow for scanning. Electronically produced images will only be accepted at a resolution of 300dpi.

The image on the back cover is of *Fritillaria pallidiflora*.  
It was taken by Bob Charman when in Kazakhstan.

## Contents Autumn 2012



*Fritillaria verticillata*  
photographed by Bob Charman  
in Kazakhstan. Cover image.



4 *Fritillaria alburyana* in  
the wild and in  
cultivation. By Pat Craven.



10 Photographing fritillaries.  
By Jon Evans.

13 Tips, Tricks & Technology  
By Paul Cumbleton

15 Some Recent Literature  
By Bob Wallis

17 The 2012 Spring Show  
By Bob Charman

22 Bulb Mites  
By Marion Charman

24 Seed Exchange  
By Pat Craven



25 *Fritillaria biflora* in  
Southern California  
By Harold Koopowitz  
And Ron Vanderhoff

32 A Trip to Azerbaijan  
By Luc Scheldman

33 Conservation of Fritillaria  
By Pat Craven

34 Fritillaria Growing in  
Germany  
By Walter Friedrich

## From the Editor

This number is full of good things, including a time-sensitive message from Pat Craven, Seed Distribution Manager. If you want to contribute to this year's distribution, please let Pat know by **24<sup>th</sup> August**. See the article on page 20. Pat has also contributed an excellent piece on his experiences with *Fritillaria alburyana* in the wild and in cultivation. Professor Harold Koopowitz and Ron Vanderhoff have collaborated on a fascinating study of a population of *Fritillaria biflora* in Southern California, while Luc Scheldman has furnished photos of the even more challenging habitat of *F. crassifolia kurdica* in Azerbaijan.

## Fritillaria Group of the Alpine Garden Society

Autumn Meeting and AGM

Sunday, 30 September 2012

Hillside Events Centre, RHS Garden Wisley, Surrey

9.00 Doors open and coffee. Plants and bulbs will be on sale throughout the day.

10.00 AGM

11.00 Brian Mathew speaks on “Fritillaria Hunters and Authors”

12.30 Lunch break

14.00 Three short presentations:

Ilia Leitch from Kew “Probing the DNA for evolutionary insights”

Bob Wallis “New mysteries and new discoveries”

Bob Charman “Fritillaries in the Lake Van area”

15.30 Raffle

16.00 End of show

All times are approximate. For more information see our website:  
[www.fritillaria.org.uk](http://www.fritillaria.org.uk)

DIARY DATE

Spring Show and Display

Sunday 17 March 2013

With talks by Ian Young and Helen Seal

## *Fritillaria alburyana* in Cultivation and in the Wild

Words & images by Pat Craven

In 2011 Rosemary Cox sent seed of *Fritillaria alburyana* to the seed exchange, and sent me a brief note on growing this species outdoors:

“Some years ago I bought a bulb of *Fritillaria alburyana* and flowered it successfully each year. It had huge, open looking flowers. Not long after this acquisition I was given a plant which had the same coloured pink flowers but, certainly in the first year, had more bell shaped flowers. I cross pollinated the 2 plants, produced masses of seed and raised a number of plants. I am fascinated by the forms. The result of such seed production was that the bell shaped flower bulb went right back to bulbils and took several years to flower again. The other was reduced to several bulbils, one of which flowered as before, though only a single flower on the stem.

Someone mentioned that it was thought that the *Fritillaria alburyana* in cultivation is a hybrid because the flowers are bells, whilst in the wild they are larger and open. I have both growing successfully in pots in the cold frame and in a very sharply drained spot in my raised bed. The flowers are not identical year on year and I suspect from this year's flowers that it is due to the growing conditions. In the wild there will be large quantities of melt water at flowering. This year I watered well because of the long, dry, cool, sunny conditions and they all ended up with large outward facing flowers.”

These comments prompted me to write some observations on my own experiences with this species.

### **Cultivation Outdoors**

Growing *Fritillaria* in the open ground may seem somewhat risky. I moved in 2007 to a sandy silt soil. It is a small garden and so there was no room for anything other than my most favourite plants in a small cold frame. I gave/sold most of my collection but retained 4 pots of *Fritillaria alburyana*. I couldn't afford the space for all four

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
so took a deep breath and released one pot full into my 'raised bed'. It is about a meter high 'crag' of dry stone wall on the SW side and gently dipping washed sharp sand pile to the S, E and NE. The N side is a sharply dipping sandy crag (dry stone outcrops in the pile of sand). The *Fritillaria alburyana* is just below the summit beside the dry stone 'crag' on the SW side. The sand there is very sharply draining, hot and dry in summer. I top dress in spring with some blood fish and bone and water the crag side when I think it is too dry. The first couple of winters I covered the *Fritillaria* bulbs with a small sheet of perspex. Last year I didn't. They have flowered each year, though of varying quality. In 2010 it was a splendid show, but I didn't water and so the leaves dried up too quickly. This year I watered more assiduously so hopefully the display will improve. I've now given away 2 of the pots full and lots of seed, but I'm hedging my bets and retaining one pot in the cold frame – just in case!



*Fritillaria alburyana* with raindrops grown in the 'raised bed'

### **Cultivation in Pots**

Geoff Rollinson, who annually exhibits a show-stopping pot of *F. alburyana*, provided Bob and Rannveig with some guidance on cultivation. The compost: 1 part J13, 1 part leafmould, 2 parts grit with a little added bonemeal. He shows in a 16cm pot which is half

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
filled with compost on a stainless steel drainage mesh. The bulbs are placed on the surface of the compost and the pot is filled to the top with neutral grit. After repotting, the pot is plunged in sand in the alpine house and *only* watered in the plunge. From October to February the pot is kept in a fridge and put to stand in ½” water for an hour once per month.

### **In the Wild**

I have two clones of *F. alburyana*, a perpetually single bulb from Paul Christian that I’ve had for some years, and which flowers occasionally, and the other a purchase from Jim Archibald’s stock as *F. armena* that flowered after only a few months in my keeping, showing itself to be *F. alburyana*. When I bought the second it had a few rice grains as well as the small bulb, and repotting showed that it had produced more.

On an AGS tour to Eastern Turkey in 2005, we found evident hybrids growing between colonies of *F. armena* and *F. alburyana*. These were unlike either of the parents and were quite distinctive. There was an abundance of young plants; whether from seed or bulblets was not evident.



Hybrids growing between colonies of *F. armena* and *F. alburyana*





The colony of *F. armena* was fairly typical and showed no signs of introgression



The *F. alburyana* showed only a little variation in form



We visited the same site in 2011. There were many fewer *Fritillaria* in flower and the flowering plants in the spot where we had found hybrids previously were indistinguishable from the *Fritillaria alburyana* elsewhere on the site.



We later found *F. alburyana* at another location, where it was more strongly coloured and almost lacking tessellation (see photograph above). And lower down the slope in wetter conditions we found *F. armena* with *F. alburyana*, but without any evidence of hybrids with intermediate characteristics (see photograph below).



As Rosemary says, when *F. alburyana* is in growth there is plenty of snow melt, and the ground can be pretty wet. But *F. armena* seems to grow in even wetter conditions and when close to *F. alburyana* is generally lower down the slope.

In the above photographs, none of the *F. alburyana* has any young plants around it, while the *F. armena* and the *F. armena x alburyana* both show an abundance of young plants around them. Since its introduction, *F. alburyana* has been uncommon in cultivation and expensive to buy, which suggests that it is slow to propagate, and then probably only by seed. But the strains which produce bulbils may be hybrid and may prove more amenable to bulking up. We shall see.

### Postscript

In 2010 the AGS Tour to Turkey visited the 2005 site and saw many *Ff. alburyana*, *armena* and intermediates. Bob Wallis photographed a range of forms:



## Photographing Fritillaries

Images by Jon Evans

In the last issue Jon Evans shared his techniques for making your fritillary photographs truly professional. Lack of space meant that the article itself wasn't illustrated nearly lavishly enough. Here are some examples of what we missed.



*Fritillaria crassifolia*



*Fritillaria hermonis*



*Fritillaria ariana*



*Fritillaria pyrenaica*

You, too, can take pictures like these! The series on how to do it continues in the Spring 2013 journal.



*Fritillaria pinetorum*

## Tips, Tricks & Technology

Words and images by Paul Cumbleton

I was asked if I would write up the information I gave in my talk at this year's Spring meeting, so here goes.

### Seramis

The first part of the talk was about growing Fritillaria from seed in Seramis and about certain types of cat litter being a cheaper substitute for Seramis. I wrote extensively about all this in the Spring 2009 Journal (no. 24, pages 4 to 11), followed by a note about cat litter in the Autumn 2009 Journal (no. 25, page 9). I won't repeat all of that here other than to update a couple of things: the "Tesco Premium Cat Litter" I mentioned in Journal 25 has now been replaced by "Tesco Low Dust Lightweight", so this latter along with "Sophisticat Pink" are the two brands that I currently know to be suitable. The "Sophisticat Pink" has granules about the same size as Seramis, while the Tesco version is rather finer. One reason for using cat litter was its availability, as Seramis is now hard to find. Hydroponic suppliers sometimes have Seramis, and one that I know still has stocks at the time of writing is an internet shop at [www.greenshorticulture.co.uk](http://www.greenshorticulture.co.uk).



## Composts & Drainage

We all know that our plants require “good drainage” – but why? I explained that what they really need is the *result* of good drainage, which is *good aeration*. They have evolved in areas where drainage is naturally good and the result is that after rain, excess water drains away to leave lots of air spaces in the soil. So they are used to having lots of air or, to be more precise, lots of oxygen around their roots. Without high levels of oxygen the roots cannot perform their functions. So for our plants to thrive we need to create potting mixes that drain well so as to leave behind lots of air spaces around the roots. We can do this by adding suitable materials such as coarse grit to our mixes. Two things are important about such materials if they are to work properly:

### The Particle Size

The particle size of the materials we use is important. I illustrated this by pouring water first through coarse grit (a 6mm diameter size grit): it poured out of the bottom of the pot. Then I poured water through fine silver sand. It had difficulty getting through this, took ages before any came out of the bottom and then only a little dripped out. I explained that large air spaces (like between the bits of coarse grit) drain water quickly, whereas small air spaces (like the tiny ones between the particles of sand) hold on to water very strongly due to high surface tension and capillary action.



Coarse grit and fine sand



So it is important to use only coarse materials to add drainage to our mixes. If you add fine ones such as sand, the small particles fall into any large air spaces already present in the compost and fill them up, thus creating lots of much smaller air spaces which hold on to water rather than draining it. So you end up with a wetter, poorly draining mix. Research has shown that the smallest size particles that have a drainage effect rather than a water-holding effect, are ones with a diameter of 1.6mm. *Anything smaller than this will make your compost wetter, not better drained.* Material rather chunkier than 1.6mm diameter will work better. I usually use either a 4mm or 6mm diameter grit (depending purely on what's available at the time).

### Quantity

*How much* grit should we add to give good drainage? I asked the rather ridiculous question of whether you thought just a single piece of grit added to a mix would have an effect. What about two pieces? or 6? or 20? – all leading to asking the question of just how much grit *is* enough to be useful? The point at which the amount you are adding stops being of no effect and starts having one is called the “threshold proportion”. Research has shown that this figure is about 30%. So at least 30% of our mix needs to be grit before it is of any use in providing a drainage effect. I would guess most of use more like 50% grit in our mixes, so this should work just fine.

*[Part 2 of this article, including advice on the all-important perched water table, will be in the Spring 2013 number of the Journal.]*

### Some Recent Literature

By Bob Wallis

I thought that it would useful to include an update on current scientific literature on the genus in “Fritillaria” that I feel could be of interest. This has been made possible thanks to the very thorough work of Laurence Hill in the Kew library and the listing of all relevant articles in his website: <http://www.fritillariaicones.com/>. In

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
this series of articles I will try to give a summary of the key findings  
and a personal view on how it affects our knowledge of the genus.

Temperature control of seed germination in *Fritillaria tubiformis* subsp. *moggridgei* (Liliaceae) a rare endemic of the South-west Alps. Valentina Carasso, Fiona R. Hay, Robin J. Probert and Marco Mucciarelli in *Seed Science Research* 21 33–38 (2011).

The authors used fresh seed of this alpine grassland species and assessed germination by incubating it in vitro through various temperature regimens simulating either summer then autumn then winter or directly into winter where the latter is a constant 5°. Germination was highest in seeds kept at 5° for longer than 60 days, and preferably 90 days or more, irrespective of the summer/autumn pretreatment. Since we all try to grow fritillaries from seed, I felt that this would be of considerable interest as I suspect that the temperature preferences for this species could well be similar to those from similar habitat. *F. tubiformis* subsp. *moggridgei* grows between 800 and 2000m in the Ligurian Alps where it has winter snow cover. I wonder if we could apply the same principle to, for example, the high altitude species from the Middle East or even Central Asia. After all we keep the bulbs of some of them in the 'frig for 90 days or more over winter. How about trying some seed this way?

A new species of *Fritillaria* L. (Liliaceae) from West Sayan. D.N. Shaulo & A.S. Erst in *Turczaninowia* 13(3) 46–49 (2010).

New species keep on being described and this one, *F. sonnikovae* D. Schaulo et A. Erst, has been found in the Russian Province of Krasnoyarsk, southern Siberia, not far from the border with Mongolia. This places it on the same latitude as Birmingham and on a northern outlier of the Altai mountains where it grows in scrub and light forest at 300 – 750 m. It is a lovely bright green species with long narrow leaves arranged in whorls and a single bract leaf. Its closest relative seems to be *F. dagana* and is said to differ from it by its narrower leaves and the shape and colour of the flowers but I must confess it does look very similar. Illustrated: [http://ssbg.asu.ru/turcz/turcz\\_13\\_3\\_46-49.pdf](http://ssbg.asu.ru/turcz/turcz_13_3_46-49.pdf). *F. dagana* is reported from this region.

## The 2012 Spring Show

Words and images by Bob Charman

### **1 *Fritillaria yuminensis* X.Z.Duan**

Found in north-eastern China and in Kazakhstan, in mountain scrub at around 1899m. Bulb - to 4cm across. Stem - 15-40cm tall. Leaves - many, linear, whorled, the upper with curling tips. Flowers - up to twenty in a raceme, conic-campanulate, pale lilac to palest pink, unmarked, scented of primroses. Tepals - about 2.5cm long, with a small nectary about 1mm above the base. Style - slender, undivided.

### **2 *Fritillaria rixii* Deg & Stoj**

Found in Bulgaria and north-eastern Greece Mountains of Evvoia, in hazel and beech scrub 800–1500m. Bulb - to 2cm in diameter. Stem - 17-30cm high. Leaves - all alternate, linear-lanceolate up to 6mm wide. Flowers - often more than one narrowly campanulate bloom, yellowish-green. Tepals - 1.6-2.5cm long, nectary 2mm at the base. Style - slender, papillose, 8-10mm, trifid at the apex for 1mm. Capsule - not winged.

### **3 *Fritillaria rhodocnakis* Orph. Ex Bak**

Found in Greece, on the island of Idhra (Hydra), Spersai and on the adjacent mainland. Bulb - to 2cm across. Stem - 10-15cm high. Leaves - five to seven, green ovate-lanceolate to lanceolate, the lowest sometimes opposite, the rest alternate. Flowers - one or two, broadly campanulate, brownish-purple with brownish-yellow tips, not tessellated, having a spermiatic scent. Tepals - about 2cm long, with an oval nectary at the angle of the bell. Style - papillose or smooth, 7-8mm, trifid, the branches 3mm long. Capsule - not winged

### **4 *Fritillaria affinis* (Schults) Sealy**

Found in North America from British Columbia to central California east to Idaho in scrub, often in heavy but humus rich soil up to 1000m. Bulb - with numerous rice-grain bulbils around the lower half. Stem - 15-120cm tall. Leaves - lanceolate, in one to three whorls of three to five. Flowers - up to twelve, broadly bell-shaped, greenish checkered with brown, having a spermiatic scent. Tepals - 2-4cm long, with a large nectary above the base. Style - divided, with recurved branches. Capsule - winged.





5/ 6 *Fritillaria stenantha* (Reg.) Reg

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
Found in Uzbekistan, the Tien Shan and Pamir-Alai mountains, on grassy foothills and screes, at 1000-2000m, flowering in March-May. Bulb - to 2cm across. Stem - 5-12cm tall, densely papillose all over. Leaves - four to six, glaucous, the lowest ovate or lanceolate, opposite, the rest narrower, plus bract leaves in pairs at each pedicel. Flowers - one to eight, narrowly conic, in a dense raceme, without scent, pinkish with a purplish base, the tepals sometimes reflexed. Tepals - 1.8-2cm long, with an indented nectary at the base. Style - 5mm long, slender, undivided, papillose, bent downwards. Capsule - winged.

### **7 *Fritillaria bucharica* Reg**

Found in Soviet Central Asia and northern Afghanistan, on earthy and rocky slopes, sometimes in juniper scrub at around 1800m. Bulb - to 4cm across, without bulbils. Stem - 10-35cm in height, papillose. Leaves - lanceolate to ovate, the lower in pairs, the rest alternate, with two bract leaves at the base of each flower stalk. Flowers - one to ten in a raceme, cup-shaped or flat, whitish with green veins, without scent. Tepals - 1.4-2cm long, each with a deeply impressed nectary 3mm long, at about the middle. Style - 3-4mm, slender, undivided. Capsule - winged

### **8 *Fritillaria hermonis* Fenzl in Kotschy**

Bulb - depressed globose 2cm across, usually with bulblets, sometimes with runners. Stem - 6-18 (-21) cm tall, smooth. Leaves - 4-8(-10), all alternate, the lowest 4-9x0.9-2.2cm, the rest narrower, all glaucous; leaves on unflowered bulb markedly glaucous. Flowers - 1-3 nodding, broadly campanulate, often flaring at maturity, green partly tessellated and often marked with brownish-red on the outer edges of the limb; in some specimens the tepal colour is entirely reddish brown. Tepals - 1.5-3.3mm long, the outer ovate-lanceolate, obtuse or acute, 6-16mm wide, the inner obovate, obtuse or acute, 8-22mm wide. Nectaries - clearly defined, ovate-lanceolate, occasionally lanceolate, 4-9 x 2-4mm from base of the tepal, the ratio of tepal length to nectary length 0.15-0.36. Stamens - filaments usually papillose 6-9cm long, anthers 4-5mm long. Style - usually papillose, 6-13mm long, anthers 4-5mm, trifold for one third to half its length. Capsule - ovoid.

### **9 *Fritillaria crassifolia* ssp *Kurdica* Boiss. & Reut.**

Found on mountain steppe in eastern Turkey, western Iran and northern Iraq. Bulb to 2.5cm across, sometimes with a few bulbils. Leaves - usually has five to seven glaucous leaves, narrower than subspecies *crassifolia*; this is a very variable plant. The nectary forms a raised ridge on the inside of the blunt-tipped inner tepals. Flowers - greenish or yellowish, marked and

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
tessellated with brown, having a spermatic scent. Tepals - 1.5-2.8cm, with a  
linear nectary running from the angle of the bell toward the apex. Style -  
trifid, smooth, divided to about halfway. Capsule - not winged.

### 10 *Fritillaria ayakoana* Murayama & Naruhashi

Found in Japan in woods. Bulb - 1cm across, often less. Stem - 5-10cm tall.  
Leaves - linear-lanceolate, the lowest opposite, the upper in a whorl of three  
Flowers - conic, from a narrow base to a wide mouth, white with pinkish  
veins, unscented. Tepals - about 2cm long, acuminate, the nectary yellow,  
green at the base, 8-10mm long, 2mm above when ripe, with a pear-shaped  
seeds.

## The Spring Show



## Bulb Mites

Bulb mites were drawn to our attention by one of our members from Germany who discovered that some of his collection of Fritillaria bulbs had been destroyed.

Bulb mites (*Rhizoglyphus* species) are found in several countries, including Europe. They belong to the Arachnida class (spiders, daddy-long legs etc). They are very small and wingless, and the head, thorax and abdomen appear to be fused together giving the body an oval to oblong shape. They are very small, shiny white with reddish brown legs, sometimes having two brown spots on the back.

### Life Cycle

The female may live for about a month, but the male dies soon after mating. The eggs are white, tiny and are laid singly on the bulbs. A female may lay 50 – 100 eggs, and they hatch in 2 – 7 days. Under favourable conditions, an entire life cycle may be completed in 2 – 4 weeks. It has a larval stage and two nymphal stages, plus an additional nymphal stage when it is at its most active. It is able to wander about, and be transported considerable distances by attaching itself to insects such as whitefly, thrips or fungus gnats. When a suitable host plant is found, it moults and turns into the adult stage.

They feed in colonies, usually at or below ground level. You may see groups of tiny white specks, some of which may be seen to be moving slowly. They cause damage with their piercing-sucking mouth parts, and infest bulb crops in the Liliaceae family among others. Damage is often not detected until the populations are extensive. They feed upon the bulb's scales, penetrating the basal plate or outer skin layers, and the injury caused by feeding allows an opportunity for soil-borne fungal pathogens to attack.

Infested bulbs have a reddish brown discolouration on the fleshy scales, and often rot before or after planting. If the infested bulb grows, the leaves will be stunted, distorted and will soon turn yellow. The flower stalk will be destroyed, or will fail to develop. If the



Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
temperature is above 50F, the mite will continue to multiply and will migrate to other bulbs, resulting in the infestation of an entire collection. They are most active when the humidity is high and the temperature is between 60F and 80F. The mite becomes inactive at temperatures below 50F and above 90F.

## Management

Storing bulbs under appropriate environmental conditions (cool temperature and low relative humidity) reduces diseases and helps prevent a build-up of bulb mites. At planting time, make sure that the bulbs are sound. Bulbs which are soft when squeezed should be destroyed at once. At the moment there are no chemicals available to control or regulate bulb mite populations in greenhouses. They may be suppressed by using a soil dwelling predatory mite – *Hypoaspis aculeifer* – which is commercially available. Its effectiveness to suppress bulb mites depends on the level of infestation and exposure to the predatory mite. Bulb mites may have penetrated the inner layers of bulbs, which may be more difficult for the predatory mite to locate. Check bulb collections frequently for the first signs of damage! We would like to hear from any members who have had experience of the damage caused by bulb mites.

[Kansas State University Agricultural Experiment Station has done a great deal of work on the two most common bulb mite species, and suggests a second method of control: “The ability of *H. aculeifer* to suppress or regulate bulb mites depends on population density and exposure to the predatory mite. Bulb mites may hide and establish in the inner folds (layers) of bulbs, which may be more difficult for the predatory mite to locate. Bulb mite populations may be suppressed by immersing infested plants in 110°F (43°C) water for 30 minutes. Although this may be a viable management strategy, greenhouse and nursery producers should realise this is only a short-term remedy with no residual effect, and may directly or indirectly damage some bulb crops.” The Editor used to assist former National Collection Holder Veronica Read when she subjected her *Hippeastrum* collection to its annual hot-water treatment. It seemed to work.]

## Seed Exchange

By Pat Craven

Over the last few years there has been a shift from being paper based to being email based, and almost all members now receive information about the exchange by email. Over the same period the postal service has become more expensive and the introduction of different rates depending on envelope size and thickness has caused problems. "Not to Exceed" cheques also cause problems. I dealt with the seed from Jim Archibald differently from the main exchange, in that I packed only after I had received requests, so maximising the amount of seed in each packet, and I informed members of the seed available to them and its cost. They then sent payment, and I posted out their seed. This seemed to work well.

For this year it is proposed that: Information about the exchange and the seed list will be sent out by email to all members for whom I have an email address. Members who wish to receive printed information by post are asked to contact me by letter, phone or email.

**It is important that I have up to date email addresses. If you are in any doubt, or have changed your email address since last year please inform me of your current email address as soon as possible.**

Seed requests will no longer require a stamped addressed envelope; I will provide padded envelopes and add the cost of packing and postage to the cost of seed (probably £1 for UK, and £1.50 overseas). I will notify members of the cost of their seed, and when I receive payment, I will post out the seed.

**Please send seed donations to arrive no later than 24 August 2012,** or let me know what you intend to donate if it will arrive later. I will send out the list the following week, and ask for requests to reach me within two weeks after that.

### **Archibald seed round 2**

Bob and Rannveig Wallis have sent me a second, smaller batch of seed from Jim Archibald. If there is a lot of interest in this, I will deal with it as last year, but if the interest is low (many members took a lot last year, and I have no feedback on germination), I will include it in the main exchange. If you are interested, please let me know so that I can make appropriate arrangements.

**Pat Craven, 24 Leven Road, Yarm TS15 9JE, tel 01642 780109, patcraven24@gmail.com**

## Observations on a population of *Fritillaria biflora* in Southern California

By Harold Koopowitz and Ron Vanderhoff

*Fritillaria biflora* is widely distributed through California. Of the many Californian species of this genus, it appears to have the most southerly distribution. Plants occur in small, isolated populations, generally on gentle north-facing slopes and on clay soils. We have been observing a population in the southwestern corner of Riverside County. This is in the southern Santa Ana Mountains, and the plants grow at an altitude of 1020 m. Southern California has a Mediterranean climate, with rainfall generally in the winter and spring. This most recent season was drier than average, with only about two-thirds of the normal precipitation. *Fritillaria biflora* grows

during the winter months and flowers in the early spring season.



*Fritillaria biflora* on Elsinore Peak.  
Photo R. Vanderhoff.

Chocolate Bells, as this species is commonly called, is actually somewhat variable in color, with pendant bells ranging in color from green shaded with brown to rich mahogany and even a deep blackish-brown. In common with many other *Fritillaria* species, the flowers often, but not always, have a green longitudinal stripe running down the midline of each tepal. There also seemed to be reasonable variation in flower morphology among the

plants we observed. Some perianths were noticeably long and thin, while others were stout. The degree of overlap of the tepals varied as well, resulting in some variation in the lobes created by the tepals.

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012

The species name suggests that the flowers are borne in pairs, but this year they ranged in number from single bells to five flowers on the stem. A photograph from the previous year showed at least one plant in this population that carried six flowers. During the 2012 season, the population had 28 mature plants that flowered, and the average number of blossoms per stem was 2.4. The population was in peak bloom on March 29, with only a few buds left to open and none of the florets starting to senesce. We visited the site again on May 24. At this time the leaves had all yellowed, and all of the fruits were mature and beginning to dry off. Only one capsule had started to dehisce.



*Fritillaria biflora* with two flowers. Photo R. Vanderhoff.

Plants in this area could be divided into three distinct sub-populations depending on where the plants grew. The largest of the Chocolate Bells were either associated with dwarf nurse shrubs, a buckwheat (*Eriogonum fasciculatum*), and grew among the twiggy branches that plant produced. The *Eriogonum* did carry some flowers at the same time that the fritillaries were in bloom. Another small group of Chocolate Bells was growing in the shade of low trees, mountain mahogany (*Cercocarpus betuloides*). The third site was in open grassland. The entire study area encompassed no more than about 0.25 acre.



*Fritillaria biflora* flowering among the branches of *Eriogonum fasciculatum*. Photo H. Koopowitz

Plants in the open grassland area are much shorter than those that have the shelter of bushes or trees. Whether this is due to the amount of exposure to sun, soil, and nutrition or to the age of the plants is difficult to determine. Pocket gophers (*Thomomys bottae*) are rife in the open grassy area. If they either eat or disturb the bulbs, this could account for those bulbs growing in the protection of *Eriogonum* or *Cercocarpus* roots living to an older age and thus producing more flowers on the stem. We found that there was no above-ground predation on leaves, stems, flowers, seed capsules or seed.

At this site the *Fritillaria* flowers produce a rather faint vinegary scent. We observed several wasps of the same species, *Polistes dorsalis*, repeatedly visiting the flowers and emerging from the bells with pollen on their bodies. Only this one insect species was seen visiting the flowers, but the short time of our observations does not preclude other pollinators. Jane McGary has observed both small wasps and flies visiting her plants of *F. biflora* in cultivation. What is apparent from our second site visit was how effective the pollinators were. We examined all of the plants that had flowered and counted both the number of seed capsules and the total number of flowers that the plants had produced. We found that the population had produced 53 seed capsules from a total of 67 flowers—79% pollination success.



*Polistes dorsalis californicus* on *Fritillaria biflora*. Note the pollen on its back. Elsinore Peak. Photo R Vanderhoff.

The least successful subgroup was the plants in the shade of the *Cercocarpus*. Here only 8 of the 16 flowers produced capsules. This was a small group with only four plants, and the sample size is too small to be of significance. Within this small group was one plant bearing three capsules; it had borne five flowers but the entire plant appeared to be dying and it is unlikely that those capsules would have produced mature seeds.

Plants growing in association with the nurse shrubs were the most successful at setting seed capsules, and here the 13 mature plants produced 32 capsules out of a possible 33 flowers. There were eleven plants in the open grassland area that had produced a total of 19 flowers of which 13 matured capsules. To sum up, in the tree shade only 50% of the flowers had been pollinated, while in the open area 68% had been pollinated, and of the plants associated with the nurse-plants, pollination was over 96%. The numbers of samples are too small to know if the differences are actually significant. It is not clear why pollinators should be more effective with the group associated with nurse shrubs. Perhaps they also visit the *Eriogonum* for floral rewards?

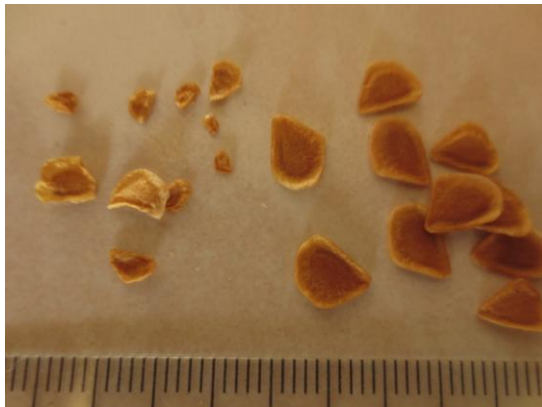


Five mature seed capsules were collected. Capsules were judged to be mature if the chlorophyll in the walls had bleached out and the substance had become papery. They were dried in separate paper bags until they had dehisced and the seed could be collected and analyzed. The capsules varied in size; two were small and the other three we considered either large or very large. We noted that not all the seeds matured to be viable, (— that is, to contain visible embryos). In many cases, some of the seeds' development was curtailed and

Alpine Garden Society Fritillaria Group Journal No 31: Autumn 2012  
those seeds failed to develop properly. Incomplete development of some seeds suggests that following fertilization, unknown events had intervened in those seeds' development.

We counted the number of mature seeds with well-developed endosperm as well as seeds that were unable to complete their development. The former were considered to be "viable" seeds. Rather surprisingly, the largest seed capsule actually produced the fewest viable seeds. In that case the pod contained a total of 138 seeds of which only 77 had matured into viable seeds and 61 seeds that had failed to mature fully.

On average, capsules produced 89.4 "viable" seeds and 32.2 seeds that failed to develop properly. The sample size is small, so one should consider these data to be preliminary, but it may show an interesting phenomenon worthy of further consideration. The entire population is small, and there is a good chance that all of the plants are closely related. We may be seeing inbreeding depression in action. Inbreeding occurs when closely related individuals mate and is usually associated with a drop in fecundity. Other corollaries include depressed germination and increased mortality before maturity. We have not tested for this.



*Fritillaria biflora* seed. Note seeds which did not mature. Scale on the bottom is in millimetres. Photo H Koopowitz.



If our average seed production rates are accurate, we can extrapolate to the whole population. Assuming that average seed production is 90 viable seeds and there were 53 capsules, then the 2012 season should have produced approximately 4,770 seeds. Obviously, most of the seeds produced fail to establish themselves and grow to maturity within this population. This is not unusual. In most flowering plant species, seed and juvenile plant mortality is very high, explaining why southern California is not carpeted with *F. biflora*.

What we have presented here is a snapshot in time. We do not know if this is a typical and average season's performance for this group of plants. With higher rainfall, would there be more flowers and better seed production? When R.V. visited the population in 2010 and 2011, he had the impression that there were many more plants of *F. biflora* which were larger and carried more flowers, but unfortunately no counts were made in those years. Only by comparing the data over several years will we be able to sort out what is normal, usual or not.

In addition, we have no data on how typical this one population might be. It would be interesting to compare this population with other populations of this species in our region [or indeed in other parts of California where *F. biflora* grows], especially with more coastal populations, which may utilize different pollinators. Another interesting question one might ask is what is the relationship between population size and ability to reproduce? One might expect smaller populations to show more inbreeding than larger populations, and this could show up as either fewer seeds per plant or fewer viable seeds per capsule. If populations are always small, then one might also expect to discover some variation between populations. This could depend on founder effects as well as inbreeding.

#### Acknowledgements:

We would like to thank Jane McGary for commenting on and editing this paper.

## A Trip to Azerbaijan

Images by Luc Scheldman

One of our Fritillaria group members from Belgium recently visited Azerbaijan (he assured us that this was to look at plants, not to see the Eurovision Song Contest!). The season was early and the spring was extremely dry, which was disappointing as especially in the lower parts of the country the flowering season was over. He was only able to find one species of frit (crassifolia ssp kurdica). This was found in the Talysh near the Iranian border; the plants were growing on south facing slopes in heavy clay.



The habitat in Azerbaijan



*Fritillaria crassifolia kurdica*

## Conservation of Fritillaria

By Pat Craven

As members of the Fritillaria Group of the Alpine Garden Society, we probably all have some concerns about conservation of the genus, both in cultivation, and in the wild. Keeping sustainable stocks in cultivation depends in large part on the group's members. Some species are grown commercially, but the range is small, and often involves a very limited number of clones and forms.

Our knowledge of the status of species in the wild has increased greatly in recent years as travel to suitable locations has become easier. Some of what has been learned is encouraging, in that species have been found over a wider range than previously reported. But almost everywhere bulbous plants are under threat from development and change of land use, and in some areas from overgrazing. The choice species may also be threatened by commercial collection, and several countries prohibit the collection and export of wild plant material. So a starting point in conserving cultivated stocks might well be to assess whether species (or their subspecies and varieties) are surviving sufficiently well at present, or whether some measures to ensure more systematic cultivation might be beneficial.

Although the seed exchange provides some data on the status of Fritillarias in cultivation, the data are difficult to interpret. In some years there is an abundance of a wide range of seed, in others seed is in relatively short supply, and over the years it is noticeable that some species appear in the list rarely, if ever. I think for example that there is evidence of a marked decline in the cultivation in the UK of a number of the North American species.

The Group's committee think that it would be useful to start to build up a database of Fritillaria in cultivation, and then to use this information to ensure that genetic diversity is maintained in cultivation, and that measures are taken to conserve sustainable stocks in cultivation. It is not immediately obvious what information should be sought, and I think we need to progressively evolve a recording system that will prove useful.

Bob and Rannveig Wallis have already sent me records of their Fritillaria in cultivation, and I have a comprehensive database of my own efforts, as well as detailed records of all donations to our seed exchange since I took it over in 2003. I will start by looking at these data to extract the salient features.

If you feel that conservation is important, and would be prepared to provide some information on what you grow, how your stocks are faring, and whether you would be prepared to exchange material (seeds and/or bulbs) in the interests of conservation, please contact me. All information will be treated in the strictest confidence, and will not be divulged to third parties.

## Fritillaria Growing in Germany

Images by Walter Friedrich

Walter Friedrich, a member from Germany is a very keen Fritillaria grower. His garden is situated east of Nuremberg, Bavaria/Germany. It is a gentle slope to the west on an altitude of about 400 metres.

Walter started growing Frits years ago, but found the bulbs for sale in Germany were very limited. He has told us that since joining the Fritillaria Group he started his own "*Kindergarten*" with the seed and rice he purchased through the seed exchange. He grows all his Frits in the open garden, although they are sometimes kept in a cold frame until the start of flowering. Cultivation is not always easy as it is sometimes too wet in the summer and in the winter they often have severe frosts, so he needs to protect some of the plants from the weather.

Walter has started to grow his Frit seeds in Seramis, and he said that his germination rate has much improved. He does make the point that there are so many variations, identification is not always easy!



The 'Kindergarten' with its happy and healthy inhabitants



A beautiful *Fritillaria imperialis*



*Fritillaria meleagris alba*  
(above) and *F.*  
(left). The man himself in his  
garden full of treasures (below).  
*Fritillaria persica* (inside back  
cover.)







£3.50

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