



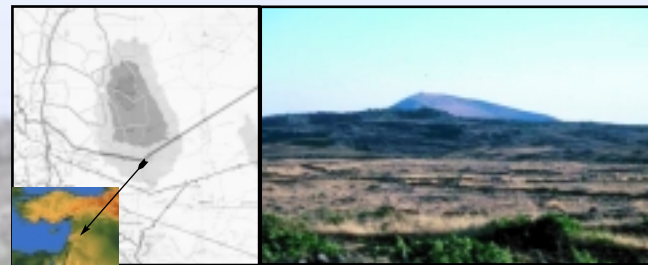
THE ONLY QUILLWORT (*ISOETES*, ISOETACEAE, LYCOPHYTA) IN SYRIA IS THREATENED WITH EXTINCTION

Lytton John Musselman, Mary Payne Hogan Professor of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA lmusselm@odu.edu
Majd Jamal, Professor, Faculty of Agriculture, Damascus University, Post Office Box 30821, Damascus, Syria



The Jebel Druze Region

The Jebel Druze region, also known as *Jebel Hauran* and by the politically correct *Jebel Al-Arab*, is an ancient volcanic range with extensive lava flows, at least one lava tube, and vast fields of basalt boulders. Because the range reaches 1800 m, it intercepts the remaining moisture from the westerly winds off the Mediterranean, this supplies springs and intermittent streams on the summits of the mountains. These are being channelized or pumped for irrigation.



Agriculture at Jebel Druze

Vineyards were widespread at the time of the Romans, but the large basalt boulders strewn across the landscape hindered field crops. Agriculture was largely subsistent and the region remained remote and economically underdeveloped until recently. With the advent of massive machines to remove the stones, much of the area is being cleared for apple trees, an export crop that is well suited for the region (left photo). As a result, much of Jebel Druze is faced with destruction.



Botany of Jebel Druze

We are fortunate to have a flora of the region (Mouterde, 1953), especially in view of extensive habitat perturbation. Jebel Druze has the highest rate of endemism in Syria. One endemic is *Iris aurantiaca* Dinsm (A). Other plants characteristic of the region are the widespread poppy, *Papaver rhoeas* L. (B) -- here growing on black lava at a lava mine near Suweida -- and *Linum mucronatum* Bertol (C).



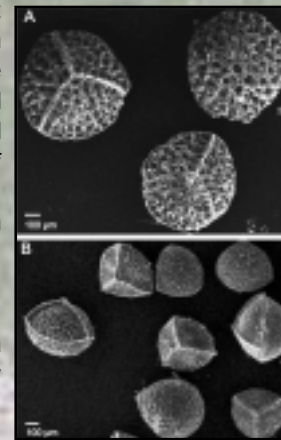
The Quillwort Site

The quillwort site is near the village of Saleh at an elevation of ca. 1650m. In May 2000 we were able to locate approximately one hundred plants at the margin of a dried depression, an intermittent wetland remaining after channelization of the stream. Associated species included: *Lythrum tribracteatum* Salzm. ex Spreng., *Myosurus minimus* L., *Ranunculus marginatus* Urv., *Veronica* sp., *Phalaris* sp., *Juncus* sp., *Carex* sp., and innumerable weedy Asteraceae in clayey mud. In the approximate 0.5 ha, quillworts were found only in an area of a few square meters that had been shallowly ploughed. Heavy grazing was evident later in the season. On the opposite side of the road, where water is ponded, an estimated 25 quillwort plants were growing submersed among *Ranunculus* sp. and *Juncus* sp. These plants have much longer leaves and lacked sporangia.



Which Quillwort Is It?

Isoetes (Isoetaceae, Pteridophyta) is a widespread genus of fern allies. Heterosporous and aquatic in habitat, *Isoetes* species are known by the English common name quillwort in reference to their tapering leaves with swollen bases. Not surprisingly, quillworts are rare in the arid Middle East. They are documented only in Turkey and Syria. Mouterde (1966) observed *I. hystrix* in the Baqa'a Valley of Lebanon but cites no specimens. Most of these wetlands in Lebanon are no longer extant.



Jermy (Jermy in Davis 1965) records three species in the Flora of Turkey: *Isoetes hystrix* Bory (B), *I. duriei* Bory (A), and *I. olympica* A. Braun in Milde. Accordingly, I used Jermy's treatment as a guide to confirm Mouterde and Samuelsson's determination of the Syrian quillwort as *I. olympica*, based on megaspore ornamentation.

Acknowledgments

This work was funded by National Science Foundation Grant DEB 9901970 and was a collaborative work with the Faculty of Agriculture, Damascus University. Special thanks to professors M. Jamal, M. F. Azmeh, I. Hamad, and A. Abou-zakem for their assistance and hospitality. Chromosome figures are courtesy of Rebecca Bray. The phylogenetic tree was provided by Sarah Hoot and Carl Taylor. Poster prepared by Academic Technology Services, Graphics Office, Old Dominion University.

Isoetes olympica A. Braun

Isoetes olympica was described from near Bursa in Turkey (Carl v. Fritsch, 1866) with two more recent collections from the same vicinity -- (Max Nydegger 11519, 1/8/1976)(BM) and A. Byfield (Personal communication). The only other known location is Jebel Druze.



Isoetes olympica was first collected at Jebel Druze in 1933 by one of the earliest botanical explorers of the area, Gunnar Samuelsson (Samuelsson 1938). His collection was distributed as *Gunnar Samuelsson* 8/5 1933.

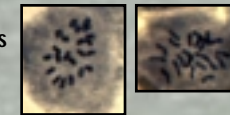
Mouterde (1953) cites several locations for the quillwort at Jebel Druze. Here is his entry on pages 55 and 56:

Isoetes olympica R. Br. Dj. ed droz: inter opp. Soueidah et pagum Saleh, solo basaltico, locis plus minus argillosis hieme inundatis, 1650-1700m, 8. v.1933 (Samuelsson, Cives Novae, p. 40). Meme région, vers Fontaine des Bédouins, 23. IV. 1942, 30. IV. 1943, sp. c., et vers le Tell Souccar, 2. VI. 43, sp. c., sur prairies humides, mains non submergées. [Footnote] Non signalée ailleurs en Syrie et Liban.

We have found the quillwort at only one site at Jebel Druze.

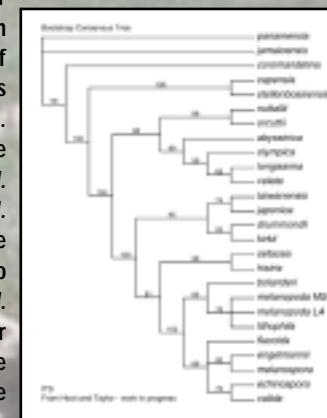
Cytology

Dr. Rebecca Bray has obtained numerous counts of $2n=22$ from root tips.



Molecular Studies

Sarah Hoot and Carl Taylor included material of the Syrian quillwort in their study of relationships within the genus using ITS and LEAFY sequences. This quillwort is in the same clade as the European species *I. velata* A. Braun and *I. longissima* Bory (some treatments consider these two as conspecific) and the African *I. abyssinica* Chiov. Further studies are necessary to resolve relationships in the Mediterranean species.

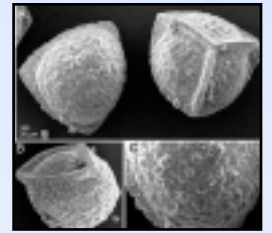


References Cited

Jermy, A. Clive. 1965. Isoetaceae. Pages 36-38 In: Davis, Peter H., editor. Flora of Turkey. Volume One. Edinburgh: University Press.
Mouterde, Paul. 1953. La Flora du Djebel Druze. Paris: P. Lechevalier.
Mouterde, Paul. 1966. Nouvelle Flora du Liban et de la Syrie. Beirut: Editions de L'Imprimerie Catholique.
Samuelsson, Gunnar. 1938. Cives novae Syriacae. Fedde Repertorium. Beiheft C: 38-49.

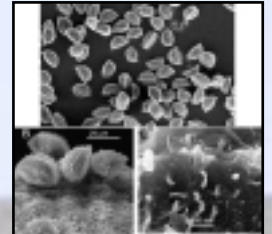
Megaspores (A-C)

Mature megaspores are black when wet. Megaspores are distinctly tuberculate with a broad equatorial ridge that is also ornamented. A distinct feature of the megaspore is a flange-like extension of the equatorial ridge (A).



Microspores (A-D)

Microspores are echinate (D). They have a distinct micro ornamentation consisting of long rod-like protrusions (C).



Vegetative Morphology and Anatomy (A-E)

The leaves resemble those of other quillworts. Peripheral strands and a central intrastelar canal are present (A, B). Stomata occur on the adaxial surface of both emerged and submersed leaves (C,D). Bases of sporophylls are indurated. Scales are present (left photo) but evidently develop at the end of the growing season so are sloughed when growth resumes and seldom seen. Sporangial walls have dark clusters of (sclerified?) cells. The ligule is well developed in younger leaves (B).



Culture

Culturing these quillworts is difficult, perhaps because they need a dry period. Plants collected in May 2000 were placed in plastic containers and allowed to senesce. Then, they were placed in a refrigerator for one month. After removal from the refrigerator, they were watered and placed at room temperature when leaves started to develop.

Future

In a word -- bleak. An intensive search needs to be made of all wetlands in Jebel Druze to determine if any other populations are extant especially in light of the extensive changes being made to the hydrology of the region. Ideally, the half hectare where *I. olympica* grows should be preserved and monitored. Some *Isoetes* sporelings were present at the base of plants, indicating that reproduction was taking place despite disturbance.

