

Collecting Umbellifer Crops' Wild Relatives in Albania

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Introduction

Although a small country, Albania is distinguished for its rich biological diversity. The variation of geomorphology, climate and terrain creates favourable conditions for a number of endemic and sub-endemic species with 27 endemic and 160 sub-endemic vascular plants present in the country. The total number of plants is over 3250 species, approximately 30% of the entire flora species found in Europe. The main elements of the Albanian flora are Mediterranean (24%), Balkan (22%), European (18%) and Eurasian (14%) (MoEFWA 2011).

The preservation of biodiversity and natural variation within species has become a global concern. Natural variation is essential to the evolutionary process and the long-term survival of species. Land conversion resulting in habitat loss, fragmentation, and degradation is the most significant factor responsible for the endangerment of species in Albania. Lands have been, and continue to be, converted for commercial, touristic and residential purposes.

Old landraces and obsolete cultivars represent a national heritage that must be conserved for future generations. On the other hand, wild species, which are related to ancestral forms of cultivated crops (crop wild relatives, CWRs), are a valuable gene pool for plant breeding, or for direct introduction as a new crop (Guarino et al. 1995). In the early 1970s, a programmed collection of vegetable landraces and old cultivars was initiated by the ex-Institute of Vegetable and Potato in Tirana. Important attempts to gather landraces in the Albanian territory were made in 1941-42 by H. Stubbe (Stubbe 1982) and more recently in 1993 and 1994 by the German, Italian, Polish and Albanian genebanks led by Hammer, Gladis, Pistrick, Laghetti, Perrino, Pignone, Podyma and Xhuveli (Hammer et al. 1994, Gladis et al. 1995). The highest priority of the above-mentioned missions was given to the collection of Albanian landraces but, when the opportunity arose, wild relatives of cultivated species were also gathered.

Among the CWRs, most species are common; however, there are many species which are of limited occurrence, endangered, or critically endangered (MoEFWA 2011). New projects for collecting extant fragments of CWRs and landraces have been started in the last 5-6 years, such as this project for the collection of Umbellifer CWRs.

Materials and methods

The motivation for this collecting mission was the interest in genetically diverse material from wild relatives of cultivated Umbellifers and their landraces. Wild plants (CWRs), useful for man and agriculture, were preferably collected from primary sites that were not subjected to intensive agriculture. Among the wild plants and landraces, the following species of the family Apiaceae (Umbelliferae) were targeted during collecting: dill (*Anethum*), carrot (*Daucus*), fennel (*Foeniculum*), parsley (*Petroselinum*), coriander (*Coriandrum*), celery (*Apium*), caraway (*Carum*), parsnip (*Pastinaca*) and chervil (*Chaerophyllum*). The field collections were directed toward the botanically rich regions, such as the coastal and western lowland territory, but also covering various climatic and geographic regions of the country. The principal method was the gathering of bulk samples from many plants (at least 30, if possible). All sites were located using GPS. Ecological conditions were noted, together with geographical data, and then recorded into the collecting database.

Information from specimen labels of the Museum of Natural Sciences' Herbarium was used to determine locations of wild carrot species. Information on other Umbellifer wild relatives that may have potential for cultivation and utilization was also gathered.

Seeds were collected from as many mature heads and plants as possible, and information on site habitat, plant morphology and phenology recorded. Digital photographs were taken at all sites.

Seeds were processed and inventoried by personnel at the Albanian Gene Bank, and information was sent to be entered into the National Plant Germplasm System.

Results and discussion

The present collecting mission was conducted as a joint project between Bioversity International and the Agricultural Technology Transfer Center (ATTC)-Lushnje, Albania. Local expertise for Albania was provided by botanists from the Faculty of Natural Sciences in Tirana University.

Preparatory phase

The purpose of this phase was to ensure efficient "homework". This included having very clear collecting objectives. Another major preparatory activity was the gathering of as much information as possible about the target germplasm and area where the collecting would take place (Demiri 1983). Much available information was found on the Internet and in the literature; it was also very useful to visit herbaria with material of the target species to accumulate data that might not been available on the Internet. The contact with the local specialist in the target area in advance facilitated the collecting mission.

Collecting activity

Collecting of CWRs and landraces was carried out in two steps. In the first step, an exploratory mission carried out between 20 May and 18 June 2013 revealed variation of wild carrot types and other umbellifer species in the Fier, Lushnje, Kavaja and Durres districts (the western lowland and coastline of Albania), including the Karavasta nature reserve close to the village of Divjaka and the Marinz oil seal area of the Fier district (Fig. 1). Some exploratory trips were made in villages located on both sides of the Fier-Tirana highway (Mbrostar, Lushnje, Lekaj, Golem and Maminas). In the Karaburun Peninsula, a trip was made in the Orikum nature reserve on the coast of the Ionian Sea. In the northern lowlands of western Albania, exploratory trips were made in residential areas and roads along the Tirana-Shkoder highway. Another was made in Prespa nature reserve close to the village of Pustec. These exploratory trips revealed variation in wild carrot types and other umbellifers, such as thin and strong stems, long and short stems, intensity of purple colour, flat and convex umbels of carrots. *Anethum graveolens* was found with vigorous plants with long and strong stems, grown in agricultural plots. It is a rare plant, found around the Lushnje and Fieri cities, where it is used as kitchen aromatic herb. *Petroselinum hortense* was found with long and thin stems, small and very aromatic leaves (Lushnje district). *Antrischus sylvestris* and *Foeniculum vulgare* grow on the roadsides, in the green fences and the old walls or near canals in a wide territory, from Tirana to Vlora. *Coriandrum sativum* grows in a wide territory, from Shkoder in the north to Vlore district in south Albania. A landrace of *Pimpinella anisum* grows in south-eastern Albania (Permet district) and is used as kitchen herb. *Ammi visnaga* and *Conium maculatum* grow on roadsides in a wide area, while *Smyrniolum olusatrum* is limited around the Bay of Vlora. *Athamanta cretensis* is a rare plant found on mountainous areas on limestone rocks; wet and cool climates (see pictures in Annex).

In all these exploration trips the population size was estimated, geographical references and geographic distribution areas were recorded, and the selected plants were marked to be harvested for seed, after their maturity.

The second step was a seed collecting mission conducted from 31 July to 5 August 2013. Additional collecting missions were made in Permet, Korça and Dibra regions, respectively 8-10 August, 11-13 and 17-18 September.

The route travelled and approximate location of collecting sites are shown in Fig. 1. The full site description is given in Table 1. The number of samples collected for each species is given in Table 2, and their biological status and collecting source in Table 3.

All collected samples were assigned collecting and site numbers and recorded into the collecting database, as well as passport data of the collecting site (geography, ecology, and vegetation).



Fig. 1. Route travelled and approximate location of collecting sites.

Table 1. Site information for 35 Umbellifer accessions collected during 2013

No.	Site	Species	GPS-N	GSP-E	Alt (m)	Village	District	County
I Carrot (<i>Daucus carota</i> L.)								
1	QTTB-serra(kanali)	<i>D. carota</i>	40°57'11.55"	19°41'01.87"	11.0	Plug	Lushnje	Fier
2	QTTB-serra(kombajna)	<i>D. carota</i>	40°57'16.02"	19°41'06.54"	12.0	Plug	Lushnje	Fier
3	QTTB-serra(Muri me karburant)	<i>D. carota</i>	40°57'17.42"	19°41'05.88"	12.0	Plug	Lushnje	Fier
4	Shenepremte-Divjake	<i>D. carota</i>	41°02'08.33"	19°32'55.51"	4.0	ShenePremte	Lushnje	Fier
5	Kavaj-Varrezat	<i>D. carota</i>	41°10'30.97"	19°33'03.37"	12.0	City	Kavaje	Tirane
6	Berxulle fushe	<i>D. carota</i>	41°23'40.87"	19°42'17.94"	36.0	Berxull	Tirane	Tirane
7	Muriqan	<i>D. carota</i>	42°00'45.36"	19°24'25.16"	20.0	Oblik	Shkoder	Shkoder
8	Gjorice e eperme	<i>D. carota</i>	41°31'08.64"	20°27'04.93"	479.0	Gjorice	Bulqize	Diber
9	Pustec bregliqeni	<i>D. carota</i>	40°47'04.11"	20°54'04.93"	850.5	Pustec	Korce	Korce
10	Vithkuq rruge	<i>D. carota</i>	40°31'41.08"	20°35'18.78"	1195.0	Vithkuq	Korce	Korce
11	Qarr rruge	<i>D. carota</i>	40°30'06.50"	20°41'05.31"	968.0	Qarr	Korce	Korce
II Dill (<i>Anethum graveolens</i> L.)								
12	QTTB-serra	<i>Anethum</i> sp.	40°57'18.61"	19°41'05.54"	12.0	Plug	Lushnje	Fier
13	QTTB-serra(Mandarina)	<i>Anethum</i> sp.	40°57'18.47"	19°41'05.81"	12.0	Plug	Lushnje	Fier
14	Hoteli	<i>Anethum</i> sp.	41°41'11.19"	20°25'06.21"	749.0	City	Peshkopi	Diber
15	Qilarisht	<i>Anethum</i> sp.	40°14'04.11"	20°23'28.34"	424.0	Qilarisht	Permet	Gjirokaster
III Parsley (<i>Petroselinum hortense</i> Hoffm.)								
16	Ferma	<i>Petroselinum</i> sp.	40°20'10.57"	20°41'00.60"	1029.0	City	Erseke	Korce
17	Qilarisht	<i>Petroselinum</i> sp.	40°14'04.11"	20°23'28.34"	424.0	Qilarisht	Permet	Gjirokaster
18	Oblike	<i>Petroselinum</i> sp.	42°00'58.68"	19°26'40.04"	6.0	Oblik	Shkoder	Shkoder
IV Cow parsley (<i>Anthriscus sylvestris</i> Hoffm.)								
19	QTTB-Zyrat qender	<i>A. sylvestris</i>	40°56'51.50"	19°41'48.05"	30.0	City	Lushnje	Fier
V Fennel (<i>Foeniculum vulgare</i> Mill.)								
20	Beline	<i>Foeniculum</i> sp.	40°44'40.25"	19°38'27.74"	10.0	Beline	Fier	Fier
21	Lekaj-Harizaj	<i>Foeniculum</i> sp.	41°06'58.61"	19°36'14.13"	21.0	Lekaj	Kavaj	Tirane
22	Konjat	<i>Foeniculum</i> sp.	41°00'57.33"	19°40'02.07"	26.0	Gramsh	Lushnje	Fier
23	Qarr rruge	<i>Foeniculum</i> sp.	40°30'06.50"	20°41'05.31"	968.0	Qarr	Korce	Korce
VI Coriander (<i>Coriandrum sativum</i> (L.) Lam.)								
24	Konjat	<i>Coriandrum</i> sp.	41°01'32.69"	19°41'04.35"	41.0	Gramsh	Lushnje	Fier
25	Berxulle fushe	<i>Coriandrum</i> sp.	41°23'40.87"	19°42'17.94"	36.0	Berxull	Tirane	Tirane

No.	Site	Species	GPS-N	GSP-E	Alt (m)	Village	District	County
VII Anise (<i>Pimpinella anisum</i> L.)								
26	Qilarisht	<i>P. anisum</i>	40°14'04.11"	20°23'28.34"	424.0	Qilarisht	Permet	Gjirokaster
VIII Bishop's weed (<i>Ammi visnaga</i> L.)								
27	Jogodine (Marinz)	<i>A. visnaga</i>	40°45'41.97"	19°40'49.07"	11.0	Jogodina	Fier	Fier
28	Mbrostar-fushe	<i>A. visnaga</i>	40°45'47.14"	19°36'11.75"	7.0	Mbrostar	Fier	Fier
29	Kavaj	<i>A. visnaga</i>	41°09'58.76"	19°33'49.92"	20.0	City	Kavaje	Tirane
IX Poison hemlock (<i>Conium maculatum</i> L.)								
30	Marinze	<i>C. maculatum</i>	40°41'04.13"	19°40'21.34"	19.0	Marinza	Fier	Fier
31	Kavaje	<i>C. maculatum</i>	41°10'30.97"	19°33'03.37"	12.0	City	Kavaje	Tirane
X Alexander (<i>Smyrniolusatum</i> L.)								
32	Orikum – Dukat	<i>S. olusatrum</i> L.	40°19'17.81"	19°28'53.10"	24.0	Dukat	Vlore	Vlore
XI Oenanthe (<i>Oenanthe pimpinelloides</i> L.)								
33	Orikum – Dukat	<i>Oenanthe</i> sp.	40°18'06.60"	19°28'07.94"	48.0	Dukat	Vlore	Vlore
34	Qerret-Kavaj	<i>Oenanthe</i> sp.	41°13'31.02"	19°30'23.73"	3.0	Qerret	Kavaje	Tirane
XII Chervil (<i>Anthriscus cerefolium</i> Hoffm.)								
35	Oblike	<i>A. cerefolium</i>	42°00'58.68"	19°26'40.04"	6.0	Oblik	Shkoder	Shkoder
XIII Heloseiadium (<i>Heloseiadium nodiflorum</i> Koch.)								
1	Lushnje	<i>H. nodiflorum</i>	40°57'11.55"	19°41'01.87"	11.0	Plug	Lushnje	Fier
2	Karavasta-Divjake	<i>H. nodiflorum</i>	40°58'01.38"	19°31'37.90"	-0.62	Karavasta	Lushnje	Fier
XIV Athamanta (<i>Athamanta cretensis</i> L.)								
1	Karaburun	<i>A. cretensis</i>	40°21'7.81"	19°21'39.64"	13.8	Dukat	Vlore	Vlore

Note: For species nos. XIII and XIV the location sites are indicated, but since they are not related to a cultivated plant, seeds were not collected.

Table 2. Number of samples collected for each species (Albania, 2013)

No.	Common name	Species	Samples collected		
			Total	Wild	Landraces
1	Carrot	<i>Daucus carota</i> L.	11	10	1
2	Dill	<i>Anethum graveolens</i> L.	4	0	4
3	Parsley	<i>Petroselinum hortense</i> Hoffm.	3	0	3
4	Cow parsley (Wild chervil)	<i>Anthriscus sylvestris</i> Hoffm.	1	1	0
5	Fennel	<i>Foeniculum vulgare</i> Mill.	4	4	0
6	Coriander	<i>Coriandrum sativum</i> L.	2	1	1
7	Anise	<i>Pimpinella anisum</i> L.	1	0	1
8	Bishop's weed	<i>Ammi visnaga</i> (L.) Lam.	3	3	0
9	Hemlock	<i>Conium maculatum</i> L.	2	2	0
10	Alexander	<i>Smyrniolum olusatrum</i> L.	1	1	0
11	Oenanthe	<i>Oenanthe pimpinelloides</i> L.	2	2	0
12	Chervil	<i>Anthriscus cerefolium</i> Hoffm.	1	0	1
13	Heloseiadium	<i>Heloseiadium nodiflorum</i> Koch.	0	0	0
14	Athamanta	<i>Athamanta cretensis</i> L.	0	0	0
	Total		35	24	11

Note: For species nos. 13 and 14 the number of samples are indicated, but since they are not related to a cultivated plant, seeds were not collected.

Table 3. Biological status and collecting source of samples collected (Albania, 2013)

No.	Accession number	Species	Biological status	Collecting source
1	SJ001	<i>Daucus carota</i> L.	Wild	Wild habitat
2	SJ002	<i>Daucus carota</i> L.	Wild	Wild habitat
3	SJ003	<i>Daucus carota</i> L.	Wild	Wild habitat
4	SJ004	<i>Anethum graveolens</i> L.	Landrace	Farm
5	SJ005	<i>Anethum graveolens</i> L.	Landrace	Farm
6	SJ;AI006	<i>Anthriscus sylvestris</i> Hoffm.	Wild	Wild habitat
7	SJ;AI007	<i>Daucus carota</i> L.	Wild	Wild habitat
8	SJ;ET008	<i>Smyrniolum olusatrum</i> L.	Wild	Wild habitat
9	SJ;ET009	<i>Oenanthe pimpinelloides</i> L.	Wild	Wild habitat
10	SJ010	<i>Ammi visnaga</i> (L.) Lam.	Wild	Farm(Fallow land)
11	SJ011	<i>Conium maculatum</i> L.	Wild	Wild habitat
12	SJ012	<i>Foeniculum vulgare</i> Mill.	Wild	Wild habitat
13	SJ;ET013	<i>Daucus carota</i> L.	Wild	Wild habitat
14	SJ014	<i>Coriandrum sativum</i> L.	Landrace	Farm
15	SJ;ET015	<i>Daucus carota</i> L.	Wild	Wild habitat
16	SJ;ET016	<i>Petroselinum hortense</i> Hoffm.	Landrace	Farm
17	SJ;ET017	<i>Daucus carota</i> L.	Wild	Wild habitat
18	SJ;AI018	<i>Foeniculum vulgare</i> Mill.	Wild	Wild habitat
19	SJ;AI019	<i>Foeniculum vulgare</i> Mill.	Wild	Wild habitat
20	SJ020	<i>Coriandrum sativum</i> L.	Wild	Farm
21	SJ;ET021	<i>Ammi visnaga</i> (L.) Lam.	Wild	Wild habitat
22	SJ;ET022	<i>Conium maculatum</i> L.	Wild	Wild habitat
23	SJ;ET023	<i>Oenanthe pimpinelloides</i> L.	Wild	Wild habitat
24	SJ024	<i>Ammi visnaga</i> (L.) Lam.	Wild	Wild habitat
25	SJ;ET025	<i>Pimpinella anisum</i> L.	Landrace	Farm
26	SJ;ET026	<i>Anethum graveolens</i> L.	Landrace	Farm
27	SJ;ET027	<i>Petroselinum hortense</i> Hoffm.	Landrace	Farm
28	SJ;ET028	<i>Daucus carota</i> L.	Landrace	Farm
29	SJ;ET029	<i>Daucus carota</i> L.	Wild	Wild habitat
30	SJ;ET030	<i>Daucus carota</i> L.	Wild	Wild habitat
31	SJ;ET031	<i>Foeniculum vulgare</i> Mill.	Wild	Wild habitat
32	SJ;ET032	<i>Petroselinum hortense</i> Hoffm.	Landrace	Farm
33	SJ;ET033	<i>Anethum graveolens</i> L.	Landrace	Farm
34	SJ;ET034	<i>Daucus carota</i> L.	Wild	Wild habitat
35	SJ035	<i>Anthriscus cerefolium</i> Hoffm.	Landrace	Farm

Site mapping

All collecting sites (over 40) were located by GPS and plotted on the map (Fig. 1). In the case of crop wild relatives, the coordinates were taken roughly in the middle of the plant population. In the case of landraces, the coordinates of the family gardens where they were located were taken with precision. It is possible to assume that the western lowland and coastal zones of Albania have been thoroughly covered by collecting activities. Original and unique forms of Umbellifer CWRs were found in protected areas and uncultivated territories on the sides of the roads, canals, meadows and on surfaces covered with green fences, while landraces were more available in the country's inland regions.

Conclusions

By adopting the programmes on collecting, mapping and monitoring of crop wild relatives and landraces, the spectrum of Gene Bank activities has moved to a new level. The share of those materials in the national collections has been significantly increased. Material of Umbellifer CWRs from Albania is now available for research and breeding, as well as being conserved for the long term. It was possible to identify threats to selected wild plants either currently or potentially useful for agriculture, and to start *in situ* projects as new methods for the conservation of agro-biodiversity.

As mentioned above, the project did not involve the protection of the entire spectrum of plants important to agriculture that are threatened by extinction. The project approach was the development of a replicable model of agricultural biodiversity protection for a group of the selected crop wild relatives (Umbelliferae) in one region of Albania, which could be used as a strategy in other regions or for other crops.

The results obtained during the several months dedicated to this project show that the country's richness in genetic diversity of Umbellifer wild relatives requires community support to preserve them *in situ*, through the distribution of knowledge, publicity and cooperation with scientific researchers and governmental structures. Approaches and tools developed by the project will be tested on other crops and in other regions of Albania.

Recommendations

On the basis of the main findings of this study, the following recommendations are made:

1. More research is needed to gather data on variations within Umbellifer species as this was not exhaustively explored.
2. There is also a need to explore further the wild relatives and landraces of Umbellifer vegetables that are said to have disappeared.
3. Farmers' attitudes toward specific species need further exploration, as this could be useful for making policy recommendations on their promotion.
4. Farmers' attitudes and their perceptions on traditional umbellifer vegetables need to be studied. This information could be useful in any endeavours or efforts made to promote the production and utilization of Umbelliferae species among the local population.

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Annex. Some pictures illustrating collecting activities for Umbellifer CWRs

A. Preparatory phase



**Consulting and gathering information (with specialist and farmers in exploration regions)
(ATTC-Lushnje and Divjaka municipality)**



Gathering information in the market (Permet)

B. Collecting activities

B.1. Exploratory missions



(Dragoti bridge)



(Dukat-Vlora)



(Parsley in a home garden)



(Observation of a wild fennel form)



Identifying variations of wild carrot (ATTC-Lushnje)



(Observation of a carrot landrace-Pustec, Korçe)

B.2. Collecting missions



Sample no.SJ001 (wild carrot)



Sample no.SJ003 (wild carrot, the giant plant)



Sample no.SJ; ET017 (wild carrot, red stems, Kavaj)



Sample no.SJ012 (wild fennel, Beline-Fier)



Sample no. SJ010 (*Ammi visnaga*, Jogodine-Fier)



Sample no. SJ;ET021 (*Ammi visnaga*, Kavaj)



Sample no.SJ004 (Dill landrace, the giant plant)



Sample no.SJ014 (Coriander landrace, Berxull, Tirane)

B.3. Harvesting process



Harvesting carrots' maturity plants



Harvesting wild fennel, Qarre-Korce

C. Drying process

