

# STUDIES IN THE FLORA OF ARABIA X: *Juniperus phoenicea* L. and *J. excelsa* M. Bieb.

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**ABSTRACT.** A preliminary account of *Juniperus phoenicea* L. in the Arabian peninsula includes its distribution and phytosociology. Its geographical relationship to the only other juniper occurring in Arabia, *J. excelsa* M. Bieb., is discussed and it is confirmed that the overall southern limit of *J. phoenicea* and the northern W Arabian limit of *J. excelsa* meet in SW Saudi Arabia.

This contribution is the first conspectus of *Juniperus* in the Arabian peninsula and the data presented confirm the existence and accurately define the distributional limits of *J. phoenicea* L. in the region. A full account of this omni-Mediterranean taxon throughout its range is in preparation (Kerfoot, in prep.; see also Kerfoot in *Ann. Mus. Goulandris* 3:13, 1977 and Lack, 1979). There are only 2 species of juniper in Arabia, *J. phoenicea* and *J. excelsa*. They can easily be distinguished as follows:

1. Juvenile leaves abundant, acicular, adult leaves scale-like with a distinct, denticulate scarious border and an oblong, depressed gland on the dorsal surface; ripe cone bright to dark red; seeds 3-9 . . . . . *J. phoenicea* L.
- + Juvenile leaves few in number; adult leaves scale-like, border not denticulate or scarious and a conspicuous oval or linear gland on the dorsal surface; ripe cone dark purplish brown; seeds rarely more than 6 . . . . . *J. excelsa* M. Bieb.

*J. phoenicea* occurs in Macaronesia and throughout the Mediterranean basin with the exception of Syria, Lebanon and Israel and the coastal deserts of Libya and Egypt. It occurs in northern Sinai, Jordan and the mountains of the Hijaz in Saudi Arabia; fossil records indicate that it was once more widespread in Sinai and also occurred in the Negev of Israel where it is now extinct (Danin, 1983).

*J. excelsa* occurs in Yugoslavia, Bulgaria, Greece, Crete, Cyprus, Turkey, southwards to Lebanon, and through the Caucasus to the Himalayas. It occurs in Saudi Arabia, the Yemeni Republics (N and S) and in Oman, in Africa, in the Sudan, Djibouti, Somali Republic, Ethiopia, Kenya, Uganda, Tanzania, Zaire, Malawi and Zimbabwe. With the exception of *J. communis* L. sens. lat. it is the most widely distributed species of the genus.

Research on the genus has inevitably necessitated revision of certain taxa in sect. *Sabina* Endl. It is the opinion of one of us that *J. procera* Endl., *J. polycarpus* C. Koch, *J. macropoda* Boiss, *J. turcomanica* B. Fedtsch, and *J. seravaschanica* Komarov are synonyms of *J. excelsa*; data substantiating this opinion are being prepared for publication (Kerfoot, in

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prep.). Only the first three species names above are of relevance in the present context.

#### DISTRIBUTION

Much of the previous uncertainty concerning the presence of *J. phoenicea* in Arabia has resulted from wrongly named specimens collected in the region during the last 145 years. In part this is due to inadequate material, particularly that collected from the area north of Jabal Al Hadda (Fig. 1), but is also due to taxonomic confusion (Kerfoot, 1961, 1971; Hubbard, pers. comm; von Wissmann, 1972; Browicz, 1978). Recent collections have made good the deficiencies in material, but it is apparent that the nomenclature is still confused (Hepper & Wood, 1979).

The earliest suggestion that the essentially Mediterranean *J. phoenicea* might occur in Arabia is contained in the unpublished journal of G. H. W. Schimper. His manuscript was probably destroyed in the bombardment of Strasbourg in 1870, but fortunately it was seen and cited in fair detail by Ritter (1847). Schimper botanised on Jabal Qora (Jabal Al Hadda) in December 1835 and noted '... a young coniferous tree ... which as regards its leaf formation seems very closely related to the *Juniperus phoenicea* which grows on the south coast of France by Hyères'. Although both Ritter and Schwartz (1939) record that Schimper collected assiduously in this area, we have not been able to trace any specimens of his juniper in European herbaria. Nevertheless, it is strange that Schwartz does not give the Hijaz as a station for the genus in his *Flora des tropischen Arabien*.

There is little doubt that Schimper's reference was the first intimation of the species in Arabia. Recent field work by Mrs I. S. Collenette and J. J. Lavranos in the area in question has shown it to be the southernmost distributional limit of *J. phoenicea*.

In 1878 Captain R. F. Burton collected a specimen, on Jabal Sharr in central Midian some 1000 km northwest of Jabal Qora, which was identified by Prof. D. Oliver at Kew as *J. phoenicea*; by another Kew botanist in 1960 as *J. polycarpus*, and yet again in 1971 as *J. phoenicea*. It must be admitted that Burton's specimen is without female cones and on the botanical evidence then available from SW Arabia, it is not altogether surprising that there was doubt about its correct identity. In fact one of us, in compiling an earlier paper, was also lukewarm about accepting the presence of *J. phoenicea* in Arabia (Kerfoot, 1961); ironically, excellent material collected by Ahmed Khattab on Jabal Al Hadda in 1945 was brought to his attention after the article had gone to press (Drar, pers. comm.). This gathering, together with good material of recent date, confirms that the distribution of *J. phoenicea* reaches its southern extremity a few kilometres south of Jabal Al Hadda (21°23' N 40°14' E) and occurs on all peaks, where the environment is commensurate with the ecological amplitude of the species, northwards to the Jordanian border beyond which, of course, its distribution is well documented (Zohary, 1951; Kasapliligil, 1956; Long, 1957; Zohary, 1973; Danin, 1983).

With hindsight it is remarkable that botanists failed to detect the presence of a species whose female cones are so characteristic. Both Vesey-Fitzgerald and Philby have written a great deal on the vegetation in

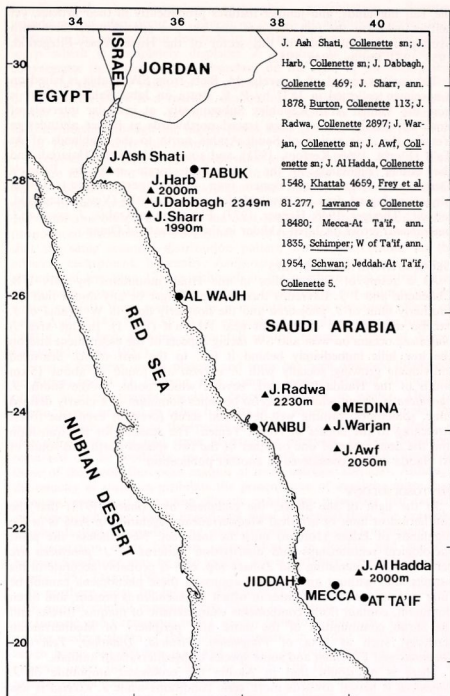


FIG. 1. Map showing the localities where *Juniperus phoenicea* has been collected in western Saudi Arabia. In the south of this area at At Ta'if, *J. phoenicea* and *J. excelsa* grow together—the only location in Arabia where they overlap. The inset lists collectors numbers with localities.

the Taif highlands, and juniper features prominently in their articles, yet neither recorded the fact that not one but two species were there with overlapping distributions in this sector of the Hijaz (Vesey-Fitzgerald, 1955, 1957; Philby, 1946, 1952).

The earliest record of *J. excelsa* M. Bieb. from SW Arabia is based on a specimen collected in 1837 by P. E. Botta on Jabal Sabir, in what is now the Yemen Arab Republic. Subsequently, at irregular intervals of time, its distribution has been traced northwards at higher altitudes in Yemen, the Asir region of Saudi Arabia north to the highlands of At Ta'if (Florin, 1966; Kerfoot, 1971), and southwards to the Hajariah and the border highlands in the Aden Protectorate—now the People's Democratic Republic of Yemen (van Lessen, pers. comm.). Useful phytosociological data are available for many localities (Vesey-Fitzgerald, loc. cit.; Thesiger, 1948; Hepper, 1977). Elsewhere in Arabia, *J. excelsa* (*J. macropoda*) grows on Jabal Akhdar in the Sultanate of Oman.

#### GEOGRAPHICAL RELATIONSHIPS

As a result of field studies in the Hijaz mountains by Mrs I. S. Collenette and J. J. Lavranos there can no longer be any doubt that the southerly limit of *J. phoenicea* and the northerly limit in W Arabia of *J. excelsa* meet on the escarpment near At Ta'if (Fig. 1). In this area *J. phoenicea* occurs on west and SW facing aspects of the escarpment and on the low hills immediately behind it (i.e. to the east of it). Scattered individuals growing socially with *J. excelsa* are found to about 15 km south of the Hadda-Ta'if road, beyond which point, to the south, *J. phoenicea* is absent while *J. excelsa* becomes dominant in a clearly defined zone, sometimes forming well-developed scrub forest or even true forest stretching to the border of North Yemen. The reasons for the transition and the dominance of one or other of the two species north and south of Al Hadda will be considered in another publication.

#### PHYTOSOCIOLOGY

In the light of the above, the comment by Zohary (1973) that the southernmost limit of arboreal Mediterranean vegetation in Asia is in the highlands of Edom (Jordan) must be incorrect. Nevertheless, the plant sociological relationships and distribution patterns of *J. phoenicea* are certainly very interesting and Zohary (op. cit.) is probably accurate in his surmise that without an historical approach these phenomena cannot be fully understood. Communities in which *J. phoenicea* is present, and often dominant, contain floral components characteristic of maquis, forests and the shrub communities of the more arid periphery of Mediterranean territory; such as taxa of *Phagnalon*, *Pistacia*, *Dianthus*, *Teucrium*, *Rhamnus* and *Trifolium* and some species of Mediterranean annuals.

There is no doubt that in Arabia the ecological amplitude of *J. phoenicea* is biased towards more xeric conditions while *J. excelsa* is less tolerant of drought. The sector where both species grow in juxtaposition is one of climatic transition. This area is one where cyclonic rain, associated with cold fronts reaching the mountains from the Mediterranean via the Red Sea, occurs during the cool season and is also

supplemented by irregular orographic precipitation. Summer thunderstorms also occur. *J. phoenicea* occurs at altitudes greater than 2000 m on the plateau, but descends to 1600 m or lower on the west-facing scarp where it completely displaces *J. excelsa*. In the area of the convergence the latter is more abundant on the crest of the escarpment and in the shallower valleys of the plateau immediately to the east. North of Al Hadda there is a marked diminution in rainfall and orographic effects are even more pronounced. The pattern is more definitely Mediterranean although the higher peaks such as Jabel Radwa (24°34' N 38°18' E) may receive rain from local heavy thunderstorms in summer.

Precise climatic data of ecological value are unobtainable. Figures from Ta'if are reliable but hardly significant in the present context as the town lies at 1682 m, east of the escarpment and outside the range of either species of *Juniperus*. The average rainfall there over a 10 year period is 162.4 mm and occurs mainly in the cool season (October–March) with a pronounced maximum in November. It is not unreasonable to suppose that the same seasonal distribution pattern would also obtain on the adjacent escarpment. Normally, *Juniperus* in Arabia does not occur at altitudes of less than 1750 m although in the northern and central Hijaz escarpment zone where the pattern is (essentially) one dominated by winter rainfall, there seems to be a mountain mass elevation effect: on Jabal Awf (23°45' N 39°32' E) for example, *J. phoenicea* may be found at 1400 m. The best account of rainfall in the region is that of Vesey-Fitzgerald (1955, 1957).

Frost is frequent on the plateau and snow has been observed [Schimper (in Ritter) and R. O. Jackson, pers. comm.]. Jabal Al Hadda, at the crest of the Ta'if escarpment regularly experiences frost in winter. This, of course, is not unusual in other habitats of *J. phoenicea*; for example, the most southerly station of the species in Jordan, Wadi Musa near Petra, is also subject to frost and snow at irregular intervals. In fact, Schimper remarked on the similarity, in Arabia, of both vegetation and climate to those of the south European maquis at more extreme altitudes. Although the paucity of statistics prohibits the presentation of anything more than a general picture of prevailing climatic conditions, it is clear that rainfall and topography are closely linked and more influential than, for example, edaphic factors in conditioning plant distribution. Long's comment that an association exists between juniper forest in Jordan and siliceous Nubian Sandstone may be true locally, but is certainly not generally valid (Long, 1957; Danin, 1983).

In northern Sinai, on Jabal Al-Maghara (750 m) and J. Yelleg (1087 m) with annual rainfall ranging from 90 mm to 200 mm, *J. phoenicea* grows on Jurassic and Cretaceous rocks, mostly limestone outcrops. The rainfall on the western slopes of the Tafila mountains in Jordan would appear to range from 200–400 mm p.a. and juniper is found between 600 m (its extreme lower limit) and 1500 m or more. The Hijaz mountains are in general composed of granitic and gneissic crystalline rocks. According to Collenette (pers. comm.), all her sightings of juniper are associated with granite rocks. However, Lavranos has observed both species on phyllites and similar rocks as well as on younger eruptives. It would appear, therefore, that as far as substrate is concerned, *J. phoenicea* has a wide

range of tolerance and its distribution pattern must be explained in terms of differing combinations of rainfall and topography. These, together with problems of origin and migration of the whole genus in the Mediterranean region and Asia, form the substance of a further communication.

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#### REFERENCES

- BROWICZ, K. (1978). *Chorology of trees and shrubs in South-West Asia*. Vol. 1. Inst. of Dendr. Polish Acad. Sci. Kornik, Poznan.
- CUFODONTIS, G. (1951). Wilhelm Georg Schimper, ein Pionier der botanischen Erforschung Aethiopiens. *Phyton* 3:84-89.
- DANIN, A. (1983). *Desert Vegetation of Israel and Sinai*. Jerusalem.
- FLORIN, R. (1966). The distribution of Conifer and Taxad genera in time and space: additions and corrections. *Acta Hort. Berg.* 20:319-326.
- GILLETT, J. B. (1972). W. G. Schimper's botanical collecting localities in Ethiopia. *Kew Bull.* 27:115-128.
- HEPPER, F. N. (1977). Outline of the vegetation of the Yemen Arab Republic. *Publ. Cairo Univ. Herb.* 7-8:307-322.
- & WOOD, J. R. I. (1979). Were there trees in the Yemen? *Proc. Semin. Arab. Stud.* 9:65-72.
- KASAPLIGIL, B. (1956). *An ecological survey of the vegetation in relation to forestry and grazing*. Report to the Government of the Hashemite Kingdom of the Jordan. FAO 156/9/7164. Report 549, Project JOR/FO. 39 pp. 2 maps (Mimeogr.).
- KERFOOT, O. (1961). *Juniperus procera* Endl. (The African pencil cedar) in Africa and Arabia. *E. Afr. agric. for. J.* 26:170-177.
- (1971). Le genre *Juniperus* en Afrique au sud du Sahara. *Bull. Soc. d'études de l'Afrique Orientale.* 3:3-12.
- LACK, H. W. (Ed) (1979). *Current projects on the Mediterranean flora*. Optima Secretariat and Publication Commission, Berlin.
- LONG, G. A. (1957). *The bioclimatology and vegetation of eastern Jordan*. FAO/57/2/1109:97 pp. 1 map (Mimeogr.).
- PHILBY, H. ST. J. B. (1946). *A pilgrim in Arabia*. Robert Hale Ltd, London.
- (1952). *Arabian Highlands*. Cornell Univ. Press. Ithaca, New York.
- RATHJENS, C. & WISSMAN, H. VON (1947). Landschaftskundliche Beobachtungen in südlichen Hedjaz II. *Erdkunde* 1, 200-205.
- ITTER, C. (1846/47). *Die Erkunde von Asien. Band VIII Die Halbinsel Arabien*. Berlin: Reimer. 2 vols.



- SCHWARTZ, O. (1939). Flora des tropischen Arabien. *Mitt. Inst. f. allg. Botanik, Hamburg* 10:1-393.
- THESIGER, W. (1948). A journey through the Tihama, the Asir, and the Hijaz mountains. *Geogr. J.* 10:195-199.
- VESEY-FITZGERALD, D. F. (1955). Vegetation of the Red Sea coast south of Jeddah, Saudi Arabia. *J. ecol.* 43:477-489.
- (1957). The vegetation of the Red Sea coast north of Jeddah, Saudi Arabia. *J. ecol.* 45:547-562.
- WISSMANN, H. VON (1972). Die Juniperus—Gebirgswälder in Arabien in TROLL, C. (ed.) *Geocology of the high-mountain regions of Eurasia* 157-176. F. Steiner Verlag, Wiesbaden.
- ZOHARY, M. (1951). *The arboreal flora of Israel and Transjordan and its ecological and phytogeographical significance*. I.F.I. Institute Paper 26. University of Oxford.
- (1973). *Geobotanical foundations of the Middle East*. Gustav Fischer, Stuttgart.