Bulletin of the *Cupressus* Conservation Project

No 20 Volume 8 No 2 — 31 December 2019

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D. Maerki

Abstract : Different bird species were observed feeding on seeds of *Platycladus orientalis*; it seems that it is the first such documented report.

This Bulletin is edited by the ***Cupressus* Conservation Project**, a non-profit organisation based in Geneva, Switzerland. It deals mainly with *Cupressus* species, but accepts manuscripts on other species of conifers. Emphasis is given to threatened and endangered taxa. Manuscripts are accepted in the following languages: English, French, German, Spanish, Italian and Russian. The Bulletin is peer reviewed.

Reference: *Bull. Conservation Cupressus Proj*.
Prices: online pdf version : free access;
printed version : 30 CHF or 26 Euro per issue. Airmail shipping worldwide included. Publication is irregular. Payment after delivery. After one's subscription, the next issues will be sent automatically, unless cancellation of the subscription takes place before shipping. www.cupressus.net/subscription.html
Web site : www.cupressus.net – Bulletin web site: www.cupressus.net/bulletin.html
The Bulletin is using the International System of Units (SI) and for the date and time the ISO 8601 format.

Online PDF Version: ISSN 2235-400X **Bulletin No 20**

Cover photo: Monumental *Cupressus sempervirens*, cultivated, France. 26 November 2019. © CCP.

Editorial

« Détruire une erreur, c'est servir la science. » – E.-A. Carrière[1]

A critical review of some recent articles is proposed here.

Since the discovery of *Cupressus vietnamensis* by a team of Vietnamese botanists in 1999, a lot of new research is being conducted on the *Cupressus* genus and the Cupressaceae family. Earlier it did not attract researchers, when the family – and especially the genus *Cupressus* – had little economic value. Now a continued series of articles, mainly through molecular analyses, is bringing new information,.

One question is rarely asked: does nature and evolution in particular follow mathematic models and computer algorithms? This question remains unresolved. My opinion is that molecular analyses, although quite useful, will never replace field observations and field experimentations, dealing with entire living plants and populations. My opinion is that it is necessary to adopt a critical stance as well as always to check the coherence and the pertinence of the results. This will be especially dealt with the second article reviewed in this series which is a master example of the problem (cf. p. 57).

Unfortunately too many errors are present in a few but important articles. Some corrections have already been published concerning for instance the validity of the combination *Callitropsis nootkatensis* by Ørsted[2], the type of *Cupressus nootkatensis*[3], the taxonomy of some Himalayan cypresses[4], the neotypification of *Cupressus cashmeriana*[5] or the validity of the species rank for more than one *Cupressus* taxa[6].

To be continued.

Article reviews

On Mediterranean *Cupressus* species

Sękiewicz, K., M. Dering, A. Romo, M. Bou Dagher-Kharrat, K. Boratyńska, T. Ok & A. Boratyński (2018). Phylogenetic and biogeographic insights into long-lived Mediterranean *Cupressus* taxa with a schizo-endemic distribution and Tertiary origin. *Bot. J. Linn. Soc.*, 188: 190-212.

Abstract:

"Mediterranean *Cupressus* taxa (*C. atlantica*, *C. dupreziana* and *C. sempervirens*) exemplify a schizo-endemic distribution resulting from vicariant speciation related to climate-induced contraction and fragmentation of their ancestral geographical range. Here, we investigate the evolutionary history of Mediterranean *Cupressus* taxa and the phylogeographic structure of *C. atlantica* and *C. sempervirens* to resolve systematic uncertainty and evaluate patterns of genetic diversity, using Bayesian inference based on plastid DNA and nuclear microsatellite markers. Based on our data, the eastern Mediterranean and African *Cupressus* lineages were clearly delineated. African *C. atlantica* and *C. dupreziana* showed species-specific haplotypes and were well separated from eastern Mediterranean *C. sempervirens*. The diversification of Mediterranean *Cupressus* was estimated to encompass the period between the early Miocene and the late Pleistocene, coinciding with the aridification events that occurred in the Mediterranean. The disjunct distribution of Mediterranean *Cupressus* taxa is reflected in their interspecific genetic divergence, providing

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[1] "To destroy an error is to serve science".

[2] *Callitropsis nootkatensis* was validly published by Ørsted in 1864. 1: 19-21. (All references of the editorial: *Bull. Cupressus Conservation Proj.*)

[3] Rediscovery of the holotype of *Cupressus nootkatensis* D.Don. 2: 3-7.

[4] Two distinct Himalayan cypress species: *Cupressus tortulosa* and *Cupressus cashmeriana*. 3: 99-115.

[5] *Cupressus cashmeriana* Neotype. 3: 116.

[6] - *Cupressus revealiana* (Silba) Bisbee, *comb. nova* validation as a new *Cupressus* species, with notes on identification and distribution of other nearby cypress species. 1: 3-15.
- *Cupressus pygmaea is a valid species*. 1: 27-33.
- *Cupressus butanoensis* (Silba) Malone & Bisbee, a new cypress species. 1: 55-59.
- Nomenclature and Taxonomy of *Cupressus gigantea* Cheng & Fu. 2: 17-22.

support for their separation at the species rank. Genetic diversity of *C. atlantica* and *C. sempervirens* was high, but the level of differentiation in *C. sempervirens* was higher than that in the endemic *C. atlantica*. A minor geographically dependent distribution of diversity was detected for *C. atlantica* relative to that identified for *C. sempervirens*, which probably reflects relatively recent range fragmentation and a decline in population size. In *C. sempervirens*, a clear pattern of differentiation corresponding to the geographical regions of the range of the taxon was inferred, confirming the prominent role of geological and palaeoclimatic factors in the evolution of Mediterranean species and supporting the pattern of differentiation reported for other tree species in the eastern Mediterranean."

The first important point of this article is to settle the taxonomy of the Mediterranean cypresses[7]. The three taxa described by Linnaeus, Camus and Gaussen are acknowledged as valid independent species after they had been variously lowered to almost every possible infra-specific rank by Silba and sometimes accepted without a critical examination[8]. The second is that the different populations of Greece, western Turkey, eastern Turkey and Lebanon are studied genetically. The results show that these populations do not all have the same genetic material and that differences are congruent with those of other species, implying at least two or three different bio-geographical areas. In our recent article[9] we inferred precisely from the biogeography of other conifer species[10] that a difference between the populations of Western and Eastern Turkey may be a reasonable hypothesis, when in the Bagnoli *et al.* article (2008) only the Western Turkish populations of *C. sempervirens* were studied in support of their hypothesis of a native cypress in Italy. Also noted by the authors are the different conifer associations between the East and Western Mediterranean regions reflecting the establishment of a geographic barrier allowing different speciation processes.

Unfortunately populations of Libya, Cyprus[11] and Iran are still missing in this well designed study. And thus further investigations will be needed to give a complete view of *C. sempervirens* variability. One of the first queries would be to check if the few southern and very small Iranian populations are still alive.

A very thorough bibliography completes this throughout well thought article and reflects the mass of information contained in it.

The one questionable affirmation is about the potential non monophyly of the genus *Cupressus*. But, as the authors admit, this is outside the range of their investigation dedicated to the Mediterranean cypresses.

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Pichot, C., B. Fady & I. Hochu (2000). Lack of mother tree alleles in zymograms of *Cupressus dupreziana* A. Camus embryos. *Ann. For. Sci.* 57: 17-22.

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[7] "Regarding taxonomic issues, our results do not correspond with the current classification, which recognizes *C. sempervirens* and *C. dupreziana* at the species rank and assigns infraspecific status to *C. atlantica*." (p. 204)

[8] For instance *Cupressus dupreziana* cannot hybridise with any other *Cupressus* species, let alone *C. atlantica* or *C. sempervirens* by the fact that its pollen is diploid (cf. Pichot 1998, 2000, 2001). When such a physiological barrier (and also a geographical one in that case) is established, the conditions for a speciation process are met. The descriptions of the taxa as species in the first place is also significant. The Mediterranean cypresses are not the only example of this kind of treatment.

[9] Maerki & Frankis 2018.

[10] *Abies cilicica*, *Cedrus libani*, *Juniperus drupacea*.

[11] Cypresses from Cyprus were observed as different for the ones in Creta (field observation, A. Treil, pers. comm.).

On monoecy and dioecy in *Juniperus* species and their evolution

Adams, R.P. (2018). Evolution of dioecious/ monecious taxa in *Juniperus*, contrasted with *Cupressus*, *Hesperocyparis*, *Callitropsis* and *Xanthocyparis* (Cupressaceae). *Phytologia* 100: 248-255.

Abstract:
"Dioecy and monoecy were mapped onto phylogenies of *Juniperus* and related genera. Related genera were uniformly monecious. In contrast, the direct ancestor of *Juniperus* appears to have been dioecious, because dioecy exhibits universal occurrence in sect. *Caryocedrus* (*J. drupacea*) and for all species of sect. *Juniperus*. Monoecy appears to have re-emerged in section *Sabina*. The re-emergence of monoecy appears to have occurred in 5 evolutionary events: in the *californica-grandis-occidentalis-osteosperma* species of the serrate leaf junipers of North America; almost universally in the smooth leaf, turbinate, 1-seeded cone, clade centered in eastern Mediterranean and central Asia; in the *excelsa* complex; in the *chinensis* complex of central Asia and China; and in the *phoenicea*/ *turbinata* clade of the Mediterranean region. The genus *Juniperus*, seems to run counter-current to other closely related genera (*Cupressus*, *Hesperocyparis*, *Callitropsis*, *Xanthocyparis*) which are uniformly monoecious. In contrast, *Juniperus*, perhaps the most recently evolved conifer, initially evolved the atypical dioecious sexual system, then later in its evolution has (re-)evolved monoecy among many phylogenetically advanced species."

This review compares and evaluates a computer generated phylogenetic tree (interpreted by Adams, based on molecular analyses) and morphologic observations as the best method to retrace evolution.

Adams has published in different articles and other research works the following phylogenetic tree for the genus *Juniperus* (here simplified).

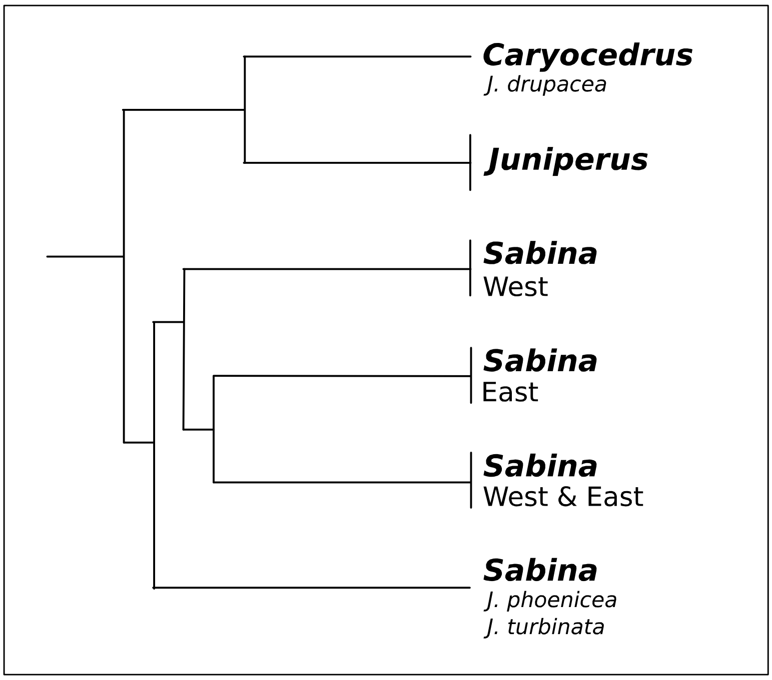

Fig. 1: Phylogenetic tree of the genus *Juniperus* (simplified from Adams). See original diagram with all *Juniperus* taxa p. 253, Fig. 1 of the article under review.

Considering the place of the sections *Caryocedrus* and *Juniperus* in those diagrams following molecular analysis results, the author considers them as basal for the genus. This implies as explained in the article that those sections represent the ancestor model of all junipers at one time in the past. As several taxa of the *Sabina* section are monoecious, it is necessary to acknowledge not less than five distinct evolutionary events restoring partially or completely the monoecy in the extant *Juniperus* species. All Cupressaceae taxa – aside from the junipers and some Callitroideae[1] – are monoecious. The closest relative to junipers, the cypresses, are all monoecious. What is the chance that a *Juniperus* ancestor will develop dioecy when the common ancestor of cypresses and junipers was more than likely monoecious? Considering the section *Sabina* and the genus *Cupressus*, they have something else in common which is not present in the sections *Caryocedrus* and *Juniperus*:

- a terminal position of the pollen cones – see Figs 2-6 (the pollen cones of the two others sections are axillary – see Figs 7-8);
- an adult foliage with needles applied to the shoot – see Figs 2-6 (scale like, smooth foliage while the adult foliage of the two others sections is not applied to the shoot and the needles are prickly – see Figs 7-8).

One question is not treated in the article: what is the origin of dioecy? Or said otherwise, what is the evolutionary advantage to have male and female cones on different plants? The author is referencing an article dealing with dioecy among gymnosperms (Walas 2019 – see the article

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[1] *Fitzroya cupressoides*, *Diselma archeri* and *Libocedrus uvifera* (for further details, see next article p. 63-67).

review below). The observation is that dioecy in gymnosperms is linked either with insect pollination or animal dispersion. As all Cupressaceae are wind pollinated, we have to deal in the case of the junipers with animal dispersion[2].

Which are the respective evolutionary advantages and inconveniences of dioecy versus monoecy?

In case of a dioecious species, each specimen male or female is entirely devoted to produce only one kind of cones and we propose the hypothesis that each plant is able to produce more of one kind of cones than two monoecious plants and possibly more regularly and sometimes at an earlier stage of development. As the seed cones are small with a limited number of seeds in each one, but scattered over all the foliage, the pollen production should be massive to assure the fertilisation of the seed cones. Another advantage lies in the fact that self pollination is impossible. Usually self pollination results in smaller than usual germination rates and a percentage of dieback during the further growth of the seedlings. This auto-fertilisation is altogether avoided by dioecy.

The main disadvantage of a dioecious species is that an isolated tree, especially a male one, will not likely be able to reproduce itself. On the other hand the dispersal by animals insures that it will be optimal in terms of distance and response to changing ecological conditions. It may follow routes usually taken by animals. The repetition of that not random dispersal insures in turn the formation of new fertile groves. The success of dioecy for junipers is such that they have the widest extant distribution of all Cupressaceae, with one species, *Juniperus communis*, present on all northern continents, another species, *Juniperus procera*, present south of the equator, with other taxa present at higher altitudes and latitudes and finally the largest number of species in their family by a wide margin.

An isolated monoecious tree is able to produce viable seeds by self pollination, but as noted above, with a lower germination rate. The grove which could result from such an individual tree will display a very low genetic variability over time and be prone to a disease once one plant is infected. By comparison with dioecious plants, self pollination is impossible resulting in a higher fertility rate and likely a higher genetic variability.

Placing sections *Caryocedrus* and *Juniperus* in the basal position requires – in addition to the five independent retro-evolutions from dioecy to monoecy[3] postulated in the paper – also the change from smooth to acicular needles and back to smooth leaves, and the change of the position of the pollen cones from terminal to axillary on the shoot and then back to terminal.

Another evidence consists in the respective number of taxa among the different *Juniperus* sections and in the distribution ranges. Indeed the *Juniperus* section shows significantly fewer species than section *Sabina*. The members of the later section are present and numerously in both western and eastern hemispheres when the *Juniperus* section is represented by only one species in the western hemisphere. These facts indicate a longer evolution history for the *Sabina* section. Section *Caryocedrus* with only one species, *Juniperus drupacea*, is present only in part of the eastern Mediterranea, even if it had a larger distribution range in the past[4].

It is not even necessary to invoke the Occam's razor principle to understand that considering the *Juniperus* section as basal for the genus is not sustainable. The phylogenetic diagrams resulting from molecular analyses and computer algorithms fail to represent the evolution of the *Juniperus* genus.

Further the *Caryocedrus* and *Juniperus* sections represent a case of neoteny, when the foliage keeps its juvenile character, developing stronger acicular and spreading needles as a defence against browsing by animals. It represents thus an evolutionary advantage, especially in arid environments

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[2] It is worth noting that animal dispersion does not involve ipso facto dioecy: in the case of the Nut Pines (*Pinus cembra*, *P. albicaulis*, *P pinea*, etc.), seeds are dispersed by birds, but these *Pinus* species like all others inside the genus remain monoecious (cf. Lu 2006), except one species: *P. discolor* (treated in L. Flores-Rentería *et al.* 2013 under *P. johannis*).

[3] If the hypotheses described here above are correct, these retro-evolutions to monoecy would be counterproductive, unless the seeds are no longer dispersed by animals. This is not the case for the mentioned monoecious species.

[4] See Maerki & Frankis 2015 and Walas *et al.* 2018.

where plants are scarce. It follows that the species of the *Juniperus* section are the most derived taxa among the genus and basal specimens should be searched among the *Sabina* section. Perhaps the obvious candidate here is the species pair *Juniperus phoenicea* and *J. turbinata* which are largely monoecious and are basal to the remainder of section *Sabina* in Figure 1 in the paper.

J. drupacea, the only member of the *Caryocedrus* section, is in turn the most derived species compared to the taxa of the section *Juniperus* (cf. Maerki & Frankis 2015). Its unique seed cone shows a complete adaptation to animals which eat the drupes fallen on the soil under the tree and disperse them in diverse directions. This kind of dispersal is the only way for the species to colonise higher altitudes as the seed cones are too heavy to "climb" a slope. It has also compound pollen cones, thus completely different from all others species of both the *Juniperus* and *Cupressus* genera.

Splitting the *Cupressus* genus in four genera makes no sense and above all shows no coherence when the genus *Juniperus* is at the same time kept together: there are more visible and obvious differences between the three sections of the junipers than between all the *Cupressus* species. Hybridisation is possible and documented between the species of the artificially created genera while such a hybridisation between members of the *Sabina* and *Juniperus* sections still has not been demonstrated. Or for that matter a hybrid between a *Cupressus* and a *Juniperus* as some phylogenetic trees are placing them closest to each other with a group of more distant other cypresses.

Finally Adams' article is quite useful in establishing that a computer generated phylogenetic tree cannot be interpreted literally, but shall be weighed with other evidence, in fact with all other available evidence. Mathematical models are simplifications of the reality, past and present, but are necessary to some extant to understand a very complex world. But in the end nature cannot be reduced to a mathematical model. Models cannot stand alone.

Fig. 2: *Calocedrus decurrens* foliage with terminal pollen cones. Cultivated, 2019-11-15.

Fig. 3: *Cupressus pygmaea* foliage with terminal pollen cones. Cultivated, 2019-11-16.

Fig. 4: *Juniperus semiglobosa* foliage with terminal pollen cones. Cultivated, 2019-12-06.

Fig. 5: *Cupressus* species, foliage with terminal pollen cones. Cultivated, 2019-12-07.

Fig. 6: *Juniperus ashei* foliage with terminal pollen cones. Cultivated, 2019-12-04.

Fig. 7: *Juniperus drupacea* foliage with axillary compound pollen cones. Wild, Peloponnese, 2003-05-01. See Maerki & Frankis 2015, for the description of these cones.

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Fig. 8: *J. communis* var. *saxatilis*, foliage with axillary simple pollen cones. Wild, Alps, 2002-06-02.

On monoecy and dioecy in gymnosperms

Walas, Ł., W. Mandrykb, P.A. Thomas, Z. Tyrała-Wierucka & G. Iszkuło (2018). Sexual systems in gymnosperms: A review. *Basic and Applied Ecology* 31: 1-9.

Abstract:

"The aim of this study was to update figures for the presence of dioecy among the gymnosperms and investigate its correlation with climate, growth form, pollination and seed dispersal syndromes, and risk of extinction. Dioecy was found in almost 65% of contemporary gymnosperm species, a higher percentage than previous estimates. It dominates in 8 of the 12 families. As in angiosperms, dioecious gymnosperms are particularly common in climbers and are more commonly found in tropical climates. Analysis of the degree of threat using IUCN red list categories showed that the proportion of threatened species is higher in dioecious than in monoecious species only in temperate climate. The high sensitivity of dioecious species to environmental changes associated with human activity in temperate climate may explain this phenomenon. The monophyly of extant gymnosperms and the relatively small number of species (about 1000) create the possibility of treating them as a model group in investigating the evolution of sexual systems."

This review lists 80 references on dioecious gymnosperms and angiosperms as a comparison and discusses the importance of dioecy in the former compared to the latter. All the articles present in this bibliography are in English. Statistical tables are proposed such as: the respective number of dioecious and monoecious species in each of the 12 gymnosperm families; the growth forms; the presence of the different species in the different climatic zones; the modes of pollination and of seed dispersion; the IUCN conservation statutes; and a correlation between climate and a simplified conservation status[1]. All those relationships or connections allow the authors to draw some interesting provisional conclusions.

Some observations are proposed below which could improve the statistics although they will change only marginally the final results. For instance it is debatable which rank is the best for this kind of analysis: individual, taxon, species, genus or family. Here all the data are viewed at the species level. However depending on the taxonomy used, there can be some notable differences. For the Cupressaceae, Farjon's taxonomy was chosen and the total number of species amounts to 135. With up to date information, following Adams' taxonomy for junipers (75 species in Adams 2018) and the *Cupressus* Conservation Project for *Cupressus* (33 species), there are for the Cupressoideae section already 127 species and for the Cupressaceae, 174 species. This is a significant difference of 39 species. Table 1 (p. 64) is constructed with these updated data. There is no meaningful difference for the dioecious species, but the species which may be monoecious or dioecious, i.e. mixed, appear under-evaluated by more than half. Considering in turn the genus level, the percentages change radically (cf. Table 2, p. 65).

The main result is that dioecy is dominant in extant gymnosperms. It is true at a species or family level (8 families out of 12 are only dioecious or by more than 90% according to the authors). But this is not true at the individual level, as the monoecious taxa of the Pinaceae cover huge ranges at high latitudes and high altitudes in the northern hemisphere, forming climax forests, while the other families mostly comprise relict genera, with the exceptions of the Podocarpaceae. At the genus level the junipers and the yews are currently among the rare more-successful taxa in their own families. These two genera for instance were able to recover quickly in the areas liberated by the retreating glaciers during the Holocene. We have to comment further on this observation below.

In the Taxaceae the authors cite only two species as not exclusively dioecious: *Taxus brevifolia* as mixed and *Taxus canadensis* as monoecious. There are at least five other species in which monoecy was observed: *Torreya nucifera* and *Cephalotaxus fortunei* (see the translation of Carrière's articles p. 68-70), *Taxus baccata* and *Pseudotaxus chienii* (Dörken) and *Torreya californica* (pers. obs., Fig. 1). With seven species (instead of two) not strictly dioecious the percentage of dioecious species among the Taxaceae falls to 78.1%, (instead of 93.7%). Not a significant difference, but it would be interesting to investigate if the other species of *Cephalotaxus* (11), *Torreya* (6) or *Taxus* (11) also present some forms of monoecy. There is no reason to think *a priori* that the seven taxa listed here are exceptions. Observations on *Taxus baccata* and *Pseudotaxus chienii* report that they can change from one gender to the other in the course of time with

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[1] The choice of the authors to group the Near Threatened (aka Lower Risk/near threatened) taxa with the threatened ones (Vulnerable, Endangered, Critically Endangered and Extinct in the Wild) is questionable.

transitional forms. On mainly male trees some female structures were also found, [2] and on mainly female trees, some male structures. Thus, for both taxa it was observed that over the years they can turn from unisexual to bisexual and back to unisexual again (Dörken, pers. comm.).

These monoecious *Torreya* and *Cephalotaxus* specimens were observed on cultivated plants, possibly all isolated ones (like the *Torreya californica* in Geneva). One hypothesis is that without the presence of other individuals of the same species, monoecy could develop as a survival strategy. This is opening a new field of research for molecular investigations (genetic and physiological analyses) as the mechanism of dioecy – to our knowledge – has not been studied at this level in gymnosperms[3]. Another interesting path of research will be to graft female or male shoots on plant of the other gender. So far only hypotheses can be formulated as to the fate of such shoots: continuing to produce the cones of the original gender or shifting to the gender of the host tree. It could give a first clue on the physiology involved in the production of the different cones. Such experiments should be conducted on isolated trees as well as inside a grove.

Table 1: Cupressaceae: number of species by genus and repartition of monoecy/dioecy for each genus. Bottom of table: Walas *et al.* data in percent, for comparison.

	species	source	monoecious	mixed	dioecious
Cupressaceae genus	**174**		**101**	**23**	**50**
Percentage by species			58.05%	13.22%	28.74%
Calocedrus	4	C.Earle	4		
Chamaecyparis	6	C.Earle	6		
Cupressus	33	CCP	33		
Juniperus	75	Adams	5	22	48
Platycladus	2	C.Earle	2		
Tetraclinis	1	C.Earle	1		
Thuja	5	C.Earle	5		
Thujopsis	1	C.Earle	1		
Actinostrobus	3	C.Earle	3		
Austrocedrus	1	C.Earle	1		
Callitris	16	C.Earle	16		
Diselma	1	C.Earle			1
Fitzroya	1	C.Earle		1	
Libocedrus	6	C.Earle	5		1
Neocallitropsis	1	C.Earle	1		
Papuacedrus	1	C.Earle	1		
Widdringtonia	4	C.Earle	4		
Athrotaxis	3	C.Earle	3		
Cryptomeria	1	C.Earle	1		
Cunninghamia	1	C.Earle	1		
Glyptostrobus	1	C.Earle	1		
Metasequoia	1	C.Earle	1		
Sequoia	1	C.Earle	1		
Sequoiadendron	1	C.Earle	1		
Taiwania	2	C.Earle	2		
Taxodium	2	C.Earle	2		
Walas *et al.*: Percentages by species			64.44%	5.93%	29.63%

C. Earle website was consulted on the 2019-12-14: https://www.conifers.org/cu/Cupressaceae.php

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[2] See also http://theconversation.com/can-trees-really-change-sex-50226; 2019-12-15.

[3] The following study shows that dioecy evolved from monoecy in an angiosperm family: S. Renner & H. Won (2001). Repeated evolution of dioecy from monoecy in Siparunaceae (Laurales). *Syst.Biol.* 50:700– 712,

Table 2: Percentages of monoecious/dioecious Cupressaceae by genera.

	total	monoecious	mixed	dioecious
Cupressaceae: genera	26[4]	22	3	1
		84.62%	11.54%	3.85%

In Cupressaceae there are 13 monotypic genera (50%!) and only 3 genera with more than 6 species (11.5%). All monoecious genera linked to a temperate to warm climate (hardiness zones 7 to 10) have limited distribution ranges. Only two of the smaller genera, *Thuja* and *Platycladus*, have adapted to very cold climatic conditions although their ranges do not extend far beyond the 50th parallel in a continental climate. In this family, the junipers represent 40% of the species and have by far the largest distribution area (see p. 57 above). A greater dispersal potential means greater chances for speciation processes to take place. Compared to its sister genus *Cupressus*, the junipers, thanks to the mutualism with birds (= extant dinosaurs), are less likely to become extinct.

The article (p. 6) is quoting a paper where dioecy is considered a dead end for gymnosperms[5]:

> The greater proportion of dioecious gymnosperms threatened with extinction may support the evolutionary dead end hypothesis (Heilbuth, 2000) for dioecious gymnosperms.

Immediately the authors temper that idea by mentioning that other ecological factors – such as climatic conditions – may be involved. In the preceding paragraph on “pollination and seed dispersal” they are speaking of “associations” between plants and animals. There is more than that. There is what is called co-evolution. And it is a key element to understand the evolution and the success of the dioecious gymnosperms. Most gymnosperm orders are relict ones which were already present (according to Labandeira *et al.*, 2007, Fig. 1A), at the end of the Palaeozoic: Cycadales, Gnetales, Ginkgoales and Pinales. There are also elements which makes it likely for the Cupressaceae to have been present from the same period. Rather than a dead end, it is likely these relict taxa survived *thanks to* their dioecy linked to a co-evolution which lasted millions of years, for it is a crucial evolutionary advantage: increased fertility rate and/or efficient dispersal (cf. also previous review on juniper dioecy). In these orders (Cycadales, Gnetales, Ginkgoales) no strictly monoecious taxon survived according to Walas *et al.* (but see below). The greatest threat to all dioecious species which need animals for pollination or dispersal is the extinction of the co-evolving animals. It is possible to hypothesise that the animals linked to genera like *Torreya*, *Cephalotaxus*, *Ginkgo*[6] (see Labandeira *et al.* 2007: 670, Nepi *et al.* 2017: 933) disappeared, and by this very fact those species become endangered in case of environmental disturbance.

Fig. 1: *Torreya californica*, cultivated, monoecious tree, Geneva.

There is the interesting case of *Torreya taxifolia*, a critically endangered Taxaceae. Its heavy seeds cannot travel far away by themselves (except eventually by stream) and typically fall under the crown of the mother tree or a few metres away. This species is trapped in a restricted area along the Appalachicola River between North Florida and South Georgia, unable to move north where it could find a suitable habitat as demonstrated by the *Torreya* Guardians. Currently volunteers are caring for an assisted migration: *Homo sapiens* supplants another animal which no longer exists for the dispersal of the seeds and prevents the extinction of this species.

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[4] *Microbiota* was merged into *Platycladus* by Jagel & Dörken (2015).

[5] As for angiosperms, this affirmation is denied in: A. Muyle *et al.* (2018). Dioecy in plants: an evolutionary dead end? Insights from a population genomics study in the *Silene* genus. Published online. Walas *et al.* compare the 6% of angio-species to the 65% of the gymno-species. The dioecious angiosperms are ~15,000, the dioecious gymnosperms are ~700. That is less than 5% of all dioecious species.

[6] Monoecious *Ginkgo* specimens have been observed (Vázquez-Lobo, 2009, quoting Bhatngar & Moitra, 1996).

Another similar example is *Juniperus drupacea*. Mammals eat the drupe-like cone and later disseminate the seeds (which are enclosed in an indigestible nut) away from the mother tree. These nuts may contain from one to three seeds. During our survey in the Peloponnese (Maerki & Frankis 2015), we could see scattered young junipers over a hill, a few km away from the main stands. This distribution (Fig. 2) can only be explained by animal dispersal, probably mainly wild boars *Sus scrofa* and foxes *Vulpes vulpes*. The major threat here consists in reduced populations of those mammals as well as the presence of goats *Capra hircus* which can eat the drupes, but the seedlings as well (Fig. 3).

Fig. 2: Young *Juniperus drupacea* scattered on a hillside in Peloponnese, Greece. 2003-05-01. **Fig. 3:** Browsed *J. drupacea* despite acicular leaves, showing topiary forms. Greece. 2002-10-26.

Otherwise young seedlings were found only under the crown of a few trees. Inside a thick grove, fallen drupes were colouring the ground. Obviously no animal was there to eat them. When they germinate under a heavy shade, the future of such seedlings is dim. In another singular case, a juniper was growing at an unusual low altitude along a stream, the seed having been carried by the water. Human activities are likely to reduce the wild fauna (hunting, agriculture) and constitute an indirect major threat to such dioecious species.

Unlike seeds dispersed by mammals (mainly *J. drupacea*, *Torreya* sp., *Cephalotaxus* sp. among the conifers), seeds dispersed by birds enjoy a major advantage of being flown over mountains or water, and have thus the opportunity to germinate in a great variability of environmental conditions.

A special mention for *Libocedrus uvifera* (syn. *Pilgerodendron uviferum*). Bannister *et al.* 2013 studied the dispersal potential of the species only to observe that it is very limited. A great majority of the seeds fall within 5 m from the mother tree and there is no recruitment away from a radius of 20 m. These observations are incompatible with an animal dispersal and thus dioecy becomes a disadvantage, especially when the majority of the trees are male.

Research to verify the dioecy of *L. uvifera* and *Fitzroya cupressoides* was conducted by Grosfeld & Barthélémy (2001). No monoecious specimen was found for the former and only one for the latter species.

Another main threat to gymnosperms is the concurrence of angiosperms (for instance invasive species), constraining the gymnosperms to special niches or areas like arid or xeric zones (Ephedraceae, Welwitschiaceae, *Juniperus*), serpentine or podzolic soils (some *Cupressus*), high altitudes and latitudes (Pinaceae, *Juniperus*) and so on. Or they are dispersed among dense angiosperm vegetation where the concurrence is at its peak (Gnetaceae). Conifers are absent in the Amazon and Congo basins, regions of high biodiversity, a biodiversity diminishing toward high altitudes and latitudes as well as concurrence is decreasing. The history of the Phanerozoic is a history of warm and humid climates with glacial periods being the exceptions: late Ordovician, Carboniferous-Permian and Pleistocene glaciations. Generally, gymnosperms evolved for millions of years since the end of the Palaeozoic without a meaningful glacial era and consequently adapted to warm climates.

The relationship between dioecious gymnosperms and tropical climates is also explained by the fact that insects will not be able to perform fertilisation activities during the coldest months of the temperate climates. Several *Cupressus* species release their pollen between November and February when insect activity is low. Juniperus too does not use entomophily. What is true for insect is also valid for other animal dispersers. As noted by Givnish (1980: 964): “Frugivorous birds and mammals are less common at higher latitudes and therefore are a less dependable means of dispersing seeds there”[7].

> Dioecious species may be more sensitive to environmental changes [...], which could explain their threatened status in temperate climates. (p. 6)

Two things should be considered here: adaptive physiology to colder climates, and migration possibilities. As relict taxa, Cycadales are simply not cold hardy. It is also the case for *Welwitschia mirabilis*, the tropical Gnetaceae, and the majority of the Podocarpaceae[8]. As for migration routes, they are becoming less obvious in a world where *Homo sapiens* is pullulating (hunting, pollutions, physical obstacles, etc.). Also most terrestrial animals are territorial and are linked to a determinate climate. The latter is also true for most tropical birds.

The authors consider the following families as 100% dioecious: Cycadaceae, Ephedraceae, Ginkgoaceae, Gnetaceae, Welwitschiaceae and Zamiaceae.

It was already cited above that a few specimens of *Gingko biloba* can be monoecious. In the Gnetales (Ephedraceae, Gnetaceae and Welwitschiaceae), bisexual organs have been found[9], but the ovules in the great majority of the cases do not develop and remain sterile (cf. Haycraft & Carmichael 2001). There are a few exceptions listed by Govil (2014: 229): *Ephedra foliata*, *E. americana*, *E. intermedia* and *E. campylopoda*, which can rarely show monoecy. As bisexual reproductive organs seem to have assured the success of the angiosperms, it remains to explain how it was not the case with the Gnetales.

From all these observations and the cases where one species has specimens either monoecious or dioecious, it appears that the frontier between monoecy and dioecy is not clear cut and that it follows an evolutionary path from monoecy to dioecy triggered by a co-evolution with one or more animals. This evolution seems to keep tracks of its ancestry (atavism) and present a major advantage as long as the co-evolving species are present.

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[7] It is true that there are fewer bird species, but very large populations of those few, e.g. *Bombycilla garrulus, Turdus* spp. (Frankis, pers. comm.)

[8] The northernmost *Podocarpus* (*P. macrophyllus*) is given as hardy to zone 8, the southernmost (P. nubigenus) zone 7.

[9] Indicating in those cases that monoecy can be considered as basal, and dioecy as derived, like in junipers.

The two following articles, published in the 19th century, testify how important field observations are.

Translation from French:
Carrière, E.-A. (1873). Du Torreya nucifera à propos des sexes. *Rev. Hort. (Paris)* 45: 314-316.

On *Torreya nucifera* about the sexes

When dealing with plants that are either monoecious or dioecious, it is often difficult to make an absolute judgment about the distribution of the sexes. It is especially so in conifers, and above all in some genera, that the difficulties are greatest, that the thing is sometimes almost impossible.

Already several times, especially in our *Traité des conifères*, 2nd edition, pp. 47, 721 and 743, we sought to draw attention to the variability of the sexes and their unequal distribution in these plants, especially with regard to certain genera, for instance *Juniperus*, *Cephalotaxus*, and finally *Taxus*. This question, of great importance, and which can have first-rate consequences when it comes to the sexuality of plants, commits us to return to it again with the genus *Torreya*, whose sexual characteristics do not appear to us very well known, and to reproduce the few passages we have just mentioned, and which seem to us to throw some light on this question.

About *Juniperius virginiana*, we wrote, *loc. cit.*, p. 47, the following lines: “I will make for *J. virginiana* an important observation: it is that we find all the intermediates between monoecy and dioecy[1]. In fact, there are exclusively male individuals, others exclusively females, and others who, to different degrees, bear both sexes. What is yet to be remarked is that these characters act on the *facies*, and that they often give the plants a very particular aspect.

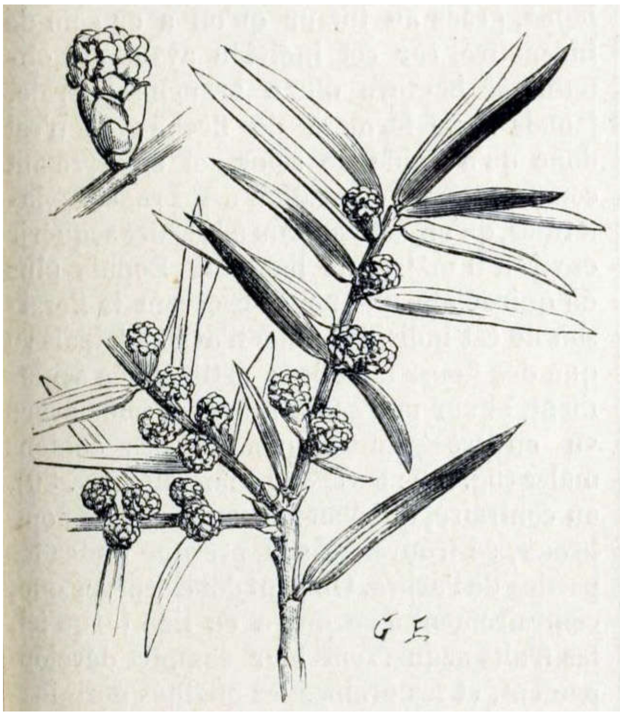

Fig. 29. – Male branch of *Torreya nucifera*, actual size. Flower detached, magnified three times.

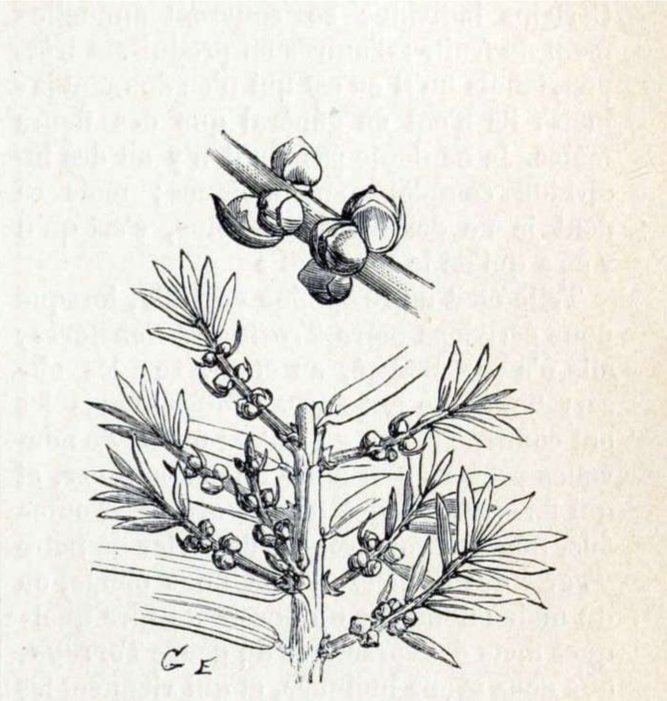

Fig. 30. – Female branch of *Torreya nucifera*. Twig portion enlarged.

“This peculiarity, which probably applies to other species of *Juniperus*, might perhaps explain the multiplicity of species which, for many, are probably only forms of the same type.”

Relatively to the genus *Cephalotaxus*, with regard to the sexes, *loc. cit.*, p. 721, we wrote as follows:

“Is the genus *Cephalotaxus* frankly dioecious? I would not dare to say so, having seen on some individuals rudiments of organs whose gender was ambiguous. This is, however, only an hypothesis which I offer, in order to draw attention to monoecy or dioecy, peculiarities which, in many genera of conifers, are very ill-defined, and which, in some genera seem to me very badly known, and to present even rather

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[1] In his 2018 article (p. 252), Adams is considering *J. virginiana* as strictly dioecious (see above p. 57-62).

singular anomalies, which I have already mentioned when speaking of *Juniperus*. As there are very fertile individuals in the same species, and others which are very less fertile, it would be possible also to find intermediates in the disposition of the sexes, as is the case with *Juniperus*, that is to say, individuals who demonstrate that monoecy and dioecy have nothing absolute. I would not even be surprised if, in the sowing of dioecious plants, monoecious plants were produced, and *vice versa*.

"Regarding the order of the appearance of the sexes, there is nothing absolute any more, and although the male sex, in general, appears before the female sex, there are nevertheless cases where the contrary has place, where the female flowers appear before the male flowers."

On the subject of the yews, we wrote (*loc. cit.*, p. 743) the following:

"... All the authors who described the genus *Taxus* considered this genus dioecious; is it really so? Yes, in a relative way; no, in an absolute way. In this case again, with regard to the sexuality of the *Taxus*, it is almost like *Juniperus*, perhaps also as *Cephalotaxus*: we find all the intermediate degrees of fertility. Some individuals cover themselves with fruit every year; others produce very little, while there are some which never give it: they generally have only male flowers. I do not doubt that there are completely dioecious individuals; but what I do not doubt is that there are some which are not."

Such was our opinion in 1867, when we wrote our *Traité des conifères*; it has not changed, on the contrary: the observations which we have made since have confirmed them, by adding even new proofs which we shall indicate, and which form the subject of this article. However, since we have just spoken of our *Traité des conifères*, this obliges us, or at least makes it our duty to say a few words of the characters of the *Torreya* genus, which we have indicated, and which modify them a little.

The various authors who had described this genus before us had described it as dioecious (1). In spite of this, the study we had made convinced us that it was *monoecious*; also, we had indicated it as such in our 1st edition. But several competent persons, especially a very distinguished botanist, pointed out to us that the fact was not certain; that we were not "strong enough" to decide such a question, to be as affirmative as we were; that it was exposing us by supporting the contrary of what had been advanced by leading scientists, etc. In short, struck by these observations, and fearing to appear to want to be stronger than the masters, we came back on our account, which explains how, in the 2nd edition of our *Traité*, by speaking of the *Torreya*, instead of monoecious, we wrote *dioecious*, which seems to us to be contrary to the truth, at least as regards the *Torreya nucifera*, as we shall see. One specimen of this species, planted in the School of Botany of the Museum for more than twenty-five years, has developed fairly well, thanks to the stake which was carefully attached to it, for this individual obtained by cutting of a lateral branch, never would have developed a leader; it was therefore only by means of care, and by constantly stopping the elongation of the lateral branches, that it was succeeded in making it acquire about six meters in height. For more than fifteen years since we observed the flowering of this specimen, we had never seen anything but female flowers; this year alone, and on a single branch, we have seen very large numbers of male catkins (Fig. 29); the female catkins (Fig. 30), on the contrary, which were much more numerous, were found on almost all parts of the tree. It may be hoped that, contrary to what had happened so far, the fruits will acquire their complete development, and the seeds the fertile qualities necessary to reproduce the species. If this happens, it will be a precious thing from the ornamental point of view, because, having seed plants, we will be able to enjoy the beauty of *T. nucifera*, which is exceptional, and of which it is impossible to get an idea from the few miserable individuals we meet here and there in cultivation, and who *all* come from cuttings of branches.

E-A. CARRIÈRE.

(1) Just recently, in the 16th volume of the *Prodromus*, by M. De Candolle, M. Parlatore, p. 504 of this work, repeating what all the authors had said before him, wrote that the genus *Torreya* is dioecious, which is not so, at least in an absolute way, as we can see after the article we publish here. (Editor [of the *Rev. Hort. (Paris)*].)

Translation from French:
Carrière, E.-A. (1878). Du *Cephalotaxus fortunei* à propos des sexes. *Rev. Hort. (Paris)* 50: 116-117.

On *Cephalotaxus fortunei* about the sexes

To destroy an error is to serve science; here is another one which we particularly mention to botanists; it relates to a kind of coniferous neighbour of the yews, the *Cephalotaxus*. To this day, all the botanists who had cared about these plants had said or written that they were dioecious, and we, in our long career of observer, had never noticed that it was different. Yet, on several occasions, in this journal, we have drawn attention to this subject and have sought to demonstrate that monoecy and dioecy can only be relative, and that, between these things, there are always intermediaries who connect them, but which often escape observation. This is shown in Fig. 24, with respect to the genus *Cephalotaxus*. It was at Trianon, in the nurseries run by our colleague and friend, Mr. Briot, that the fact that we are going to report occurred.

Fig. 24: Branch of *Cephalotaxus fortunei* with male flowers and female flowers (fruits).

The specimen on which this occurred, planted in the nurseries of Trianon, about twenty years old, nearly four meters tall, and having flourished for a long time, had never, until the year 1876, produced anything else than male flowers, and the following year again, in 1877, it was by thousands of thousands that we could count them, while a single twig (the one we reproduce) carried with ripe fruits a very large quantity of young fruits, which would ripen only the following year.

This fact, as exceptional as it is, does not surprise us, for we have not only seen similar ones, but even a nearly identical one, except that it has occurred inversely. It happened on a very close genus of *Cephalotaxus*, on the *Torreya nucifera*; we have made it known and have even given a figure in the *Revue horticole*, 1873, p. 314. We have just said that this last fact occurred inversely; indeed, until now the tree of which we speak produced only female flowers, and only then did a branch give rise to two ramifications, one of which bore male flowers, while another wore female flowers.

Everything leads us to believe that analogous facts must be found in almost all genera of conifers, — maybe even in all plants, — of which the sexes are separated, that consequently the dioecy and the monoecy are only relative, particular states of polygamy, which is normally found in certain plants, a state itself which has nothing absolute and can be related to hermaphrodism.

The sexes, we repeat it, are consequences of facts of vegetation and can present variations, to be even lacking, then to appear irregularly, then to finally be regularised, without however that there is nothing absolute and without it being possible to have return tendencies. The genus *Araucaria*, as far as sexuality is concerned, seems to us to be comparable to the genus *Cephalotaxus*. We will talk about it soon.

E-A. CARRIÈRE.

Les articles originaux en français sont disponibles ici:

Du *Torreya nucifera* à propos des sexes.
Du *Cephalotaxus fortunei* à propos des sexes.

Bull. Cupressus Conservation Proj. 8 (2): 71-88 (12.2019) **D. Maerki & A. Treil**

Naturalisation of a *Cupressus sempervirens* population in the south of France

In the Aude department exists a very old monumental specimen of *Cupressus sempervirens* which is at the origin of a regenerating and naturalised cypress population growing in currently wild conditions with no human disturbance[1]. Some 70 years ago (or more) the place was cultivated and the tree was on the border of the field, as it is possible to observe on an aerial photograph from 1948 (Fig. 1). Traces of human activities are still all over the place: a shelter, stonewalls, piles of small stones likely removed from the field. Then the parcel was abandoned and a wild and naturalised vegetation took back its rights.

The locality is exceptional for more than one reason. It forms a terrace on an otherwise full southern slope. The soil in its current state cannot support grasses, but only drought adapted shrubs and trees. Among other species are identified: *Lonicera etrusca*, *Bupleurum fruticosum*, *Rosmarinus officinalis*, *Smilax aspera*, *Osyris alba*, *Coronilla glauca*, *Quercus pubescens*, *Q. ilex* and *Q. coccifera* (AT). The other present conifers are *Pinus pinea* (present also on the slopes above the terrace), *Juniperus communis* (only on the western part of the field) and *J. oxycedrus* (more rare). The exceptional cypress is estimated at least two centuries old and possibly much more. A first assessment of 500 years was lowered after the presence discovery of a spring. The water could have helped and sustained a more rapid growth.

On the border of the terrace a small stone shelter overlooking a rather steep slope was built when the field was exploited. On its side other cypresses were planted, but these trees to the contrary of the older specimen represent the fastigiated form. These cypresses are also regenerating, so that both forms are currently present in the population. The fastigiated form is slowly colonising the steep slope below the path at the southern border of the terrace. On the flat field, the cypresses get less high and less dense in accordance with the increasing distance to the original monumental tree, accounting to a slow, but steady development of the grove to the west and the south (Figs 3 & 26). From 1976 to 2010, the regeneration is so important that the last aerial photograph – with a much better quality than the previous years – displays the importance of the grove and its density, which increased again during the last 9 years. The crown of the monumental cypress is partly shaded by a *P. pinea*, and it appears in light dull green colour compared to the darker colour of the pine.

All cypresses from the height of 1.50 m are producing seed cones, very often in an impressive number as the saplings get older. At maturity almost all cones are opening and releasing their seeds. It was possible to find only one tree with cones pollinated in 2018 with its cones still closed (Figs 8-10). Instead of brown (Fig. 13a), the old cones are univocally completely grey (Fig. 9, 10, 13). The systematic opening of the cones is likely linked to the aridity of the site (with one specimen been able to find resources the others can't, or it could be genetically determined). Further observations would be necessary during the next years. Usually this species is actively serotinous: the cones remain closed as long as they are vascularised. Here it is not the case, but for one exception.

Another observation of interest is the high position of an unusual number of seed cones right to the top of the leader (Figs 26, 30, 32, 36). This would likely help the dissemination of the seeds when the cones are systematically opening at maturity and the freed seeds blown away by the wind.

The main concurrence is represented by *Pinus pinea* which could overgrow the cypresses and shade them with their wide spreading crown, once mature. Such a pine was growing too close to the patriarch tree, threatening one side of the cypress crown, by shading it. Fortunately this pine died.

One cone was observed being half opened, obviously eaten by an animal (Fig. 40). This represents a first observation on this species.

The locality of this exceptional population will not be disclosed to preclude disturbance and official protection will be recommended.

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[1] Currently the only activity is hiking on a narrow path along the border of the terrace (cf. Fig. 3). The dense vegetation prevents entering the field. During the visit at the end of November, I met no one. It is different in Summer.

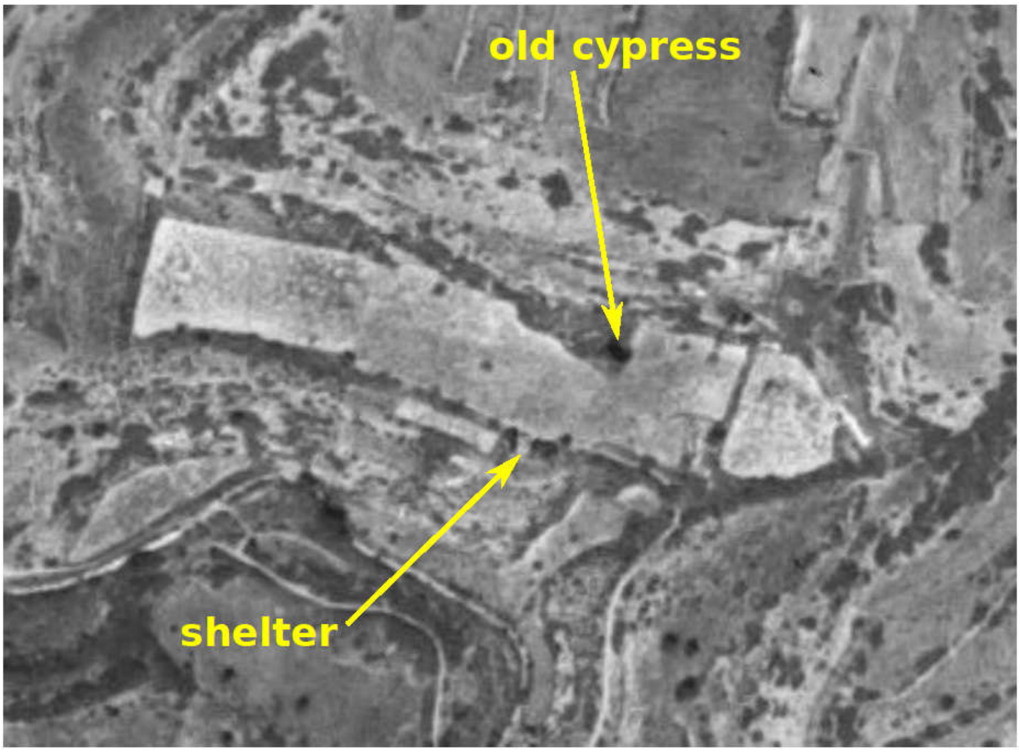


Fig. 1: Aerial photograph, 1948. The terrace is visible in light grey forming more or less a regular rectangle. It is some 220 m long and on average 35 m wide.

The monumental cypress is already clearly visible as well as the shelter surrounded by other cypresses. The field looks cultivated.

All aerial photos: © IGN, France.

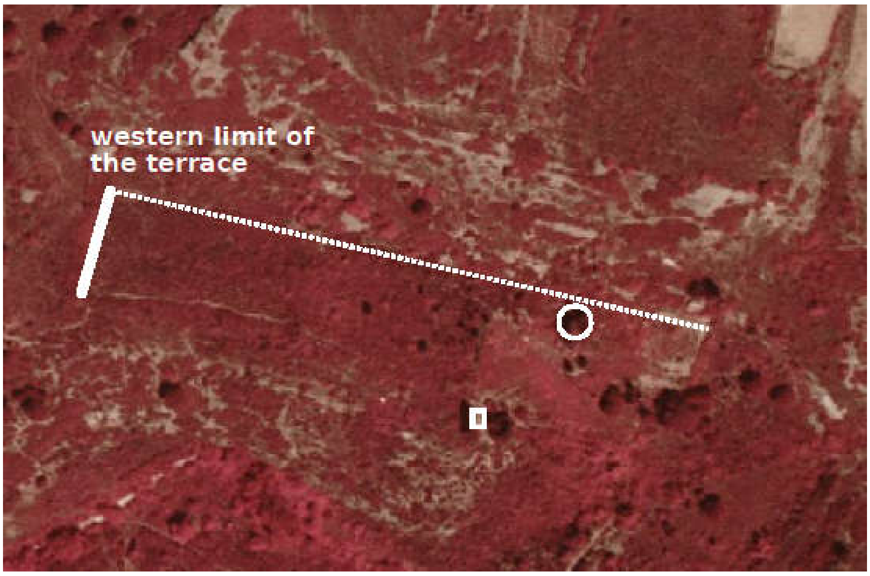


Fig. 2: Aerial photograph, 1976. Some trees are already colonising the place on the centre-east of the terrace and to the south of the old cypress.

Dotted line: size of the terrace, ~220 m;
White circle: old cypress;
White rectangle: shelter.

Figs 1 & 2: Scale: ~1:2,620

Fig. 3: Aerial photograph, 2010. See text.

Scale: ~1:1,470

Fig. 4: Monumental *Cupressus sempervirens* with three main trunks. A dead *Pinus pinea* can be seen behind the cypress. Its trunk looks like a branch of the cypress between the trunks. Its dry branches are visible behind the cypress and through its branches. Cf. Figs 21 & 41.

All photos taken on 2019-11-26.


Fig. 5: One of the first cypresses to west. **Fig.6:** Walking to the east, the cypresses become more numerous.
Fig. 7: Entering the terrace from the west.

Fig 8, 9 &10: The only specimen with more than one year old closed seed cones. Like the open cones on the other trees, these cones are light grey.

Fig. 11: Spreading and fastigiated shapes regenerate together.

Fig. 12: Almost impenetrable thicket.

Fig. 13: Seed cones already open 20 months after pollination.

Fig. 13a: The usual brown colour of the mature cone on cultivated common cypresses in the south of France. 2019-12-9.

Fig. 14: First year seed cones growing on a sapling.

Fig. 15: Arriving at the shelter, surrounded by fastigiated cypresses, some dead.

Fig. 16: The crown of the monumental tree seen from below. The shaded part by the *P. pinea* looks poor.

Fig. 17: The large trunk at the base before the split into three secondary trunks.

Fig. 18: The irregular circumference at the base of the trunk below the partition was measured at 1 m high to 4.85 m (AT).

Fig. 19: A young cypress with darker foliage grows not so far from the monumental tree.

Fig. 20: The monumental tree is still producing seed cones.

Fig. 21: The dead branches of the *P pinea* are visible on the upper middle to the right. The foliage of the monumental cypress appears to the left in lighter green colour.

Fig. 22: The densest part of the grove.

Fig. 23: Below the shelter, most cypresses are fastigiate.

Fig. 24: Two fastigiate specimens manage to grow beside a *P. pinea* trunk

Fig. 25: View of the shelter from the south.

Fig. 26: Leaders full of cones.

Fig. 27: Detail of the shoots just below the top. Tree on the right.

Fig. 28, 29 & 30: Same individual with details showing the stem and the seed cones at the top.

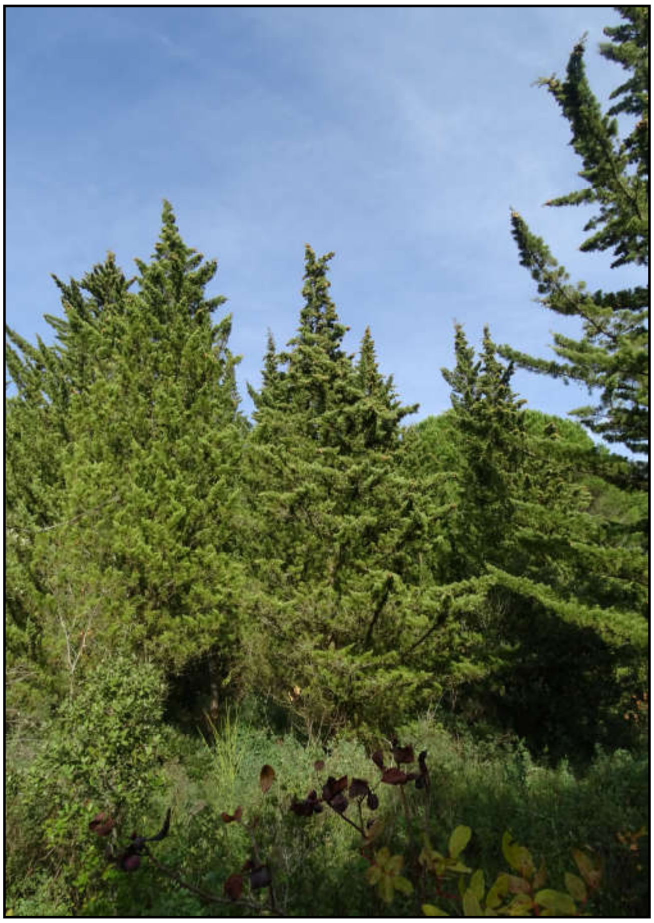


Fig. 31: View on the tallest naturalised trees.

Fig. 32: Summit of the tree in the middle of Fig. 31.

Fig. 33: Another impressive specimen.

Fig. 34: Top of tree on Fig. 33.

Fig. 35: Young tree with a lighter green colour.

Fig. 36: Trees show a great diversity in shapes despite the limited genetic pool at the origin of the population.

Fig. 37: Top of the tree on Fig. 36.

Fig. 38: *Juniperus communis* with dead branches. Young cypresses are beginning slowly colonise the western side.

Fig. 39: *Juniperus oxycedrus* at the western limit of the terrace. Notice the stones removed from the field.

Fig. 40 (above): Single cone partially opened by an animal. Almost nothing is known on such attacks. For instance serotinous *Cupressus* cones remaining closed for several years on the branches are very seldom subject to damage by insects (to the contrary of several conifer species especially in the Pinaceae family).

Fig. 41: Dead *Pinus pinea* to the north-east side of the monumental cypress. As cypresses are shade intolerant, the presence of such pine with a wide spreading umbrella crown could have left that remarkable tree with a one sided crown.

Bull. Cupressus Conservation Proj. 8 (2): 89-96 (12.2019) **T. Hamilton**

Cupressus arizonica Dragoon Mountains 2019 trip report

In September of 2019 I made a trip to the Dragoon Mts to see the Cochise Stronghold area and walk as much of the trail as possible from the east side to the west side in one day. This was an area that the Chiricahua Apache Indians often used as a campground. I was also there to ascertain the current state of the Arizona Cypress populations located there, and their approximate range. Information I had read on-line about the Arizona Cypress in this mountain chain was sketchy at best. The best locations that were reputed to contain populations of Arizona Cypress were the Western Stronghold Canyon and Slavin Gulch, both of which drain to the west. There was conflicting information as to whether the Eastern Stronghold Canyon had any Arizona Cypress trees still alive.

A check with the Forest Rangers indicated that the dirt road to the west side of the mountains was in bad shape and would require a 4-wheel drive vehicle. As I only had one day allotted to this and the east side access road was in good shape I went that way. Before arriving at the Forest Service campground, I was glad to see that there were quite a few Arizona Cypress scattered along the creek that winds along the road and circles the campground. A check of these trees by bark texture, cones, and smell all indicated these trees to be *Cupressus arizonica*, the rough-bark cypress.

These trees were all along the creek that runs along the entrance road into the East Stronghold Canyon and circles the campground there. They were confined to this stream bed or its banks. I was able to observe them growing quite a way upstream along this creek into the mountain, but was unable to travel up it because of the many huge boulders that were there and there being no trail. Up to the campground, a large percent of the mature trees had died. A 30-40% mortality was observed. There was also regeneration of new trees observed. The ratio was roughly one 3-5 years sapling observed for each dead mature tree. Mature trees here were somewhat shorter than those at the Chiricahua National Monument, 10-12 m (35-40') being the maximum observed height, with average closer to 9 m (30'). The average annual rainfall here is 330 mm (13"). Compare this to 480 mm (19") for the Chiricahua Mountains. The other difference I noted was that these trees were slightly darker greener than those of the Chiricahuas.

I then walked two miles up the trail to just past the "Half Moon Tank", but before getting to the divide. No other Arizona Cypress were observed anywhere else. Not having a good topo map, I did not realize that the East Stronghold Canyon Creek actually wound its way up the mountain and crossed the trail near the divide. It would have been interesting to see if the trees continued upstream to the trail crossing.

Fig. 1: Old dead tree surrounded by smaller live trees.

I was unable to go to the west side of the divide and verify any Arizona Cypress growing there.

There were a number of young Arizona Cypress in the Forest Service Campground scattered among the campsites. These were obviously planted and not native. They were not the native Rough-Bark Cypress but *C. glabra*, the commercially available Smooth-Bark Cypress. The planting of these trees among the native population risks degrading the isolated gene-pool that is the Rough-Bark Cypress of the Dragoon Mountains.

My analysis of the population is that it is somewhat stunted but hanging on in the East Stronghold Canyon along the one creek bed and its banks. This isolated gene-pool should be protected. It currently appears to be static numerically speaking.

The Fort Bowie ruins are located on the north side of the Chiricahua Mountains near the famous Apache Pass through the foothills. The pass has been the site of two battles, and several ambushes. It contains the famous springs, the only reliable source of water for about 65 km (40 miles). As the Fort had held over 140 cavalry men and 140 horses, I was looking forward to seeing it. It was a disappointing sight, as it was just a little more than a seepage flow, not nearly enough for 20-30 men and their horses, much less 140. A check with the Rangers there brought out the fact that the flow of the spring was much higher 100 yrs ago than it is today. This indicates that we are in a hotter and drier period now than 100 yrs ago, which of course impacts the Arizona Cypress populations found there.

Fig. 2 & 3: Close to the Creek (quite visible on Fig. 3) while driving into the Cochise Stronghold Park. Elevation ca. 1450 m (4800’). Note the dead tree on the left of Fig. 2.

Fig. 4 & 5: Trees at the park. Elevation 1450-1525 m (4800-5000’).

Fig. 6: Close-up of barks showing its fibrous characteristic typical of *C. arizonica*.

Fig. 7: Cones already open and seeds dumped. The only closed cones observed were the green immature ones.

Fig. 8: *C. arizonica* at ~1490 m (~4,880').

Fig. 9: Cypress in the creek bed at 1512 m (4,960').

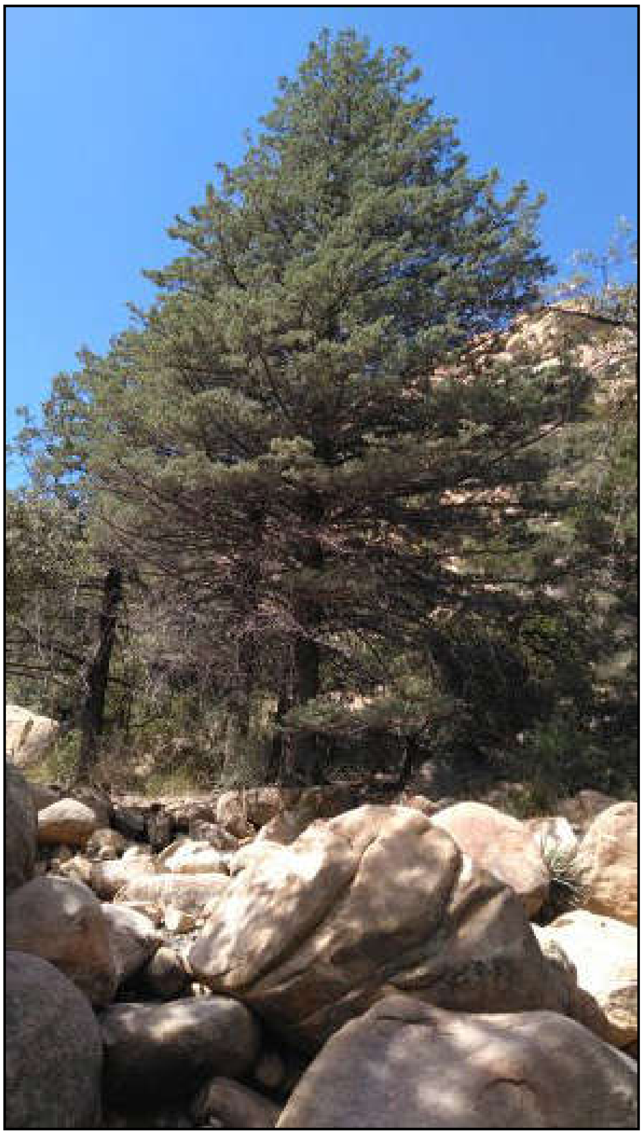


Fig. 10 (above): Seedlings regeneration.

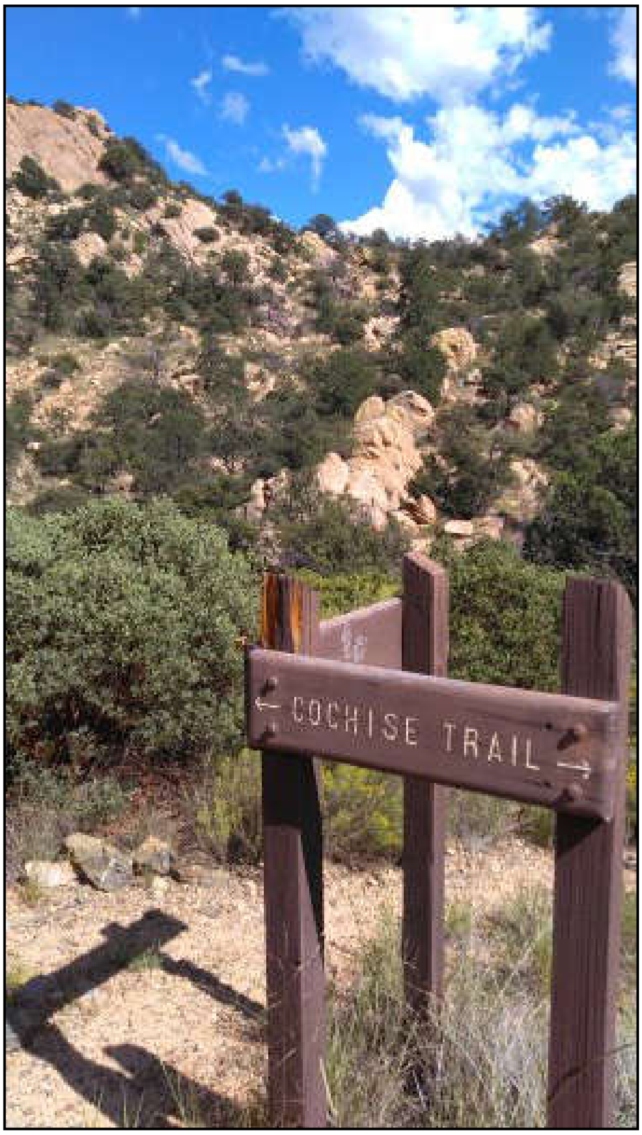
Fig. 11: View hiking up the trail. No cypress noted.

Fig. 12: Another view up trail – elevation 1645 m (5,400').

Fig. 13: More views. No cypress Elevation: 1710 m (5,600').

Fig. 14: Another view on the same trail without cypress.

Fig. 15: Half Moon Tank . – elevation 1740 m. (5,700').



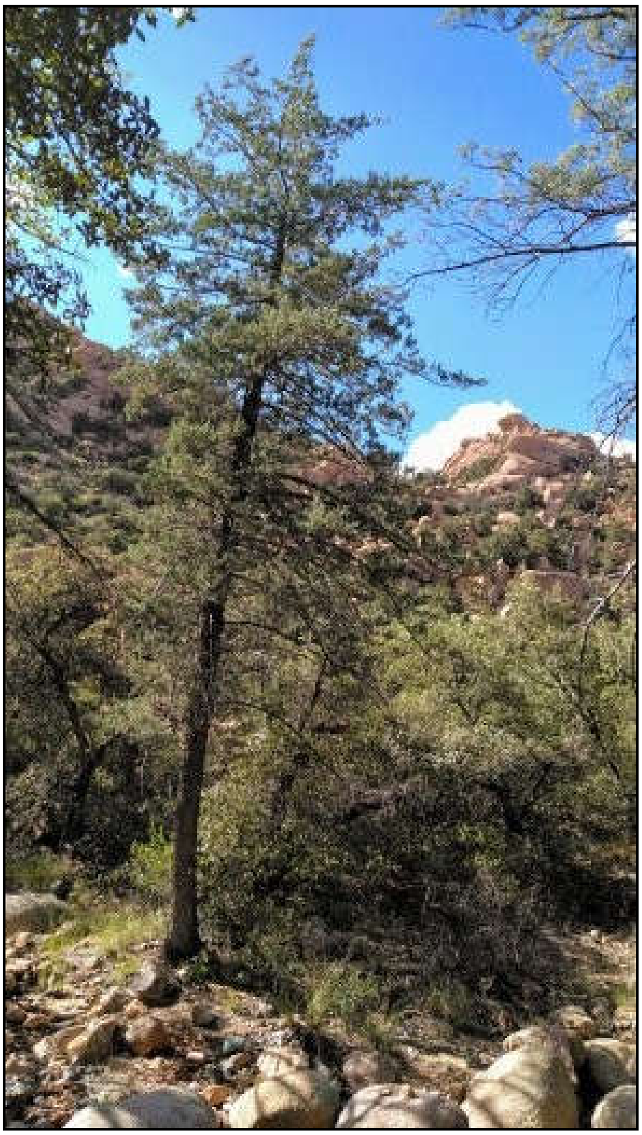


Fig. 16: Junction of two trails. We were on the Cochise Trail – elevation ~1575 m (~5,160"). regeneration.

Fig. 17 (above right): Last Picture of cypress at 1525 m (5,000 ft) on creek bank. View looking up creek over large rocks.

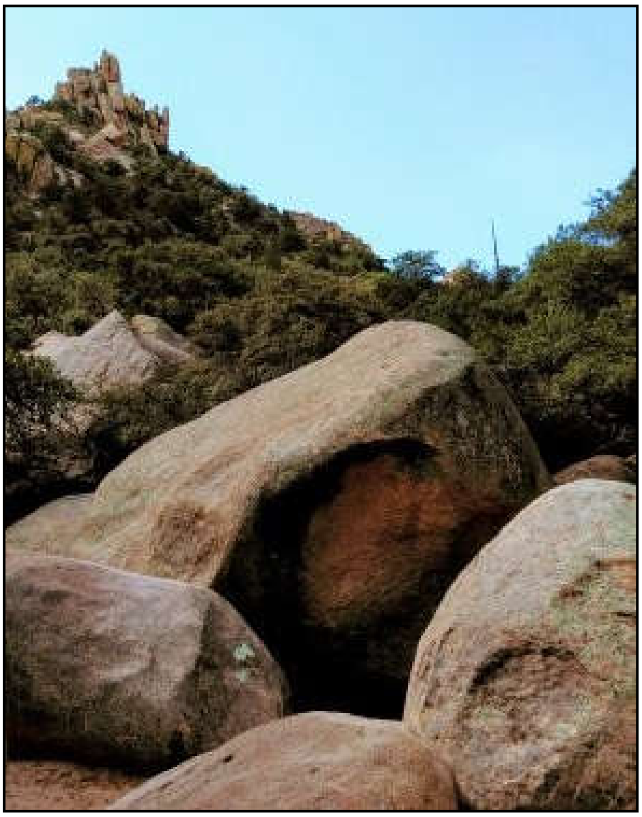
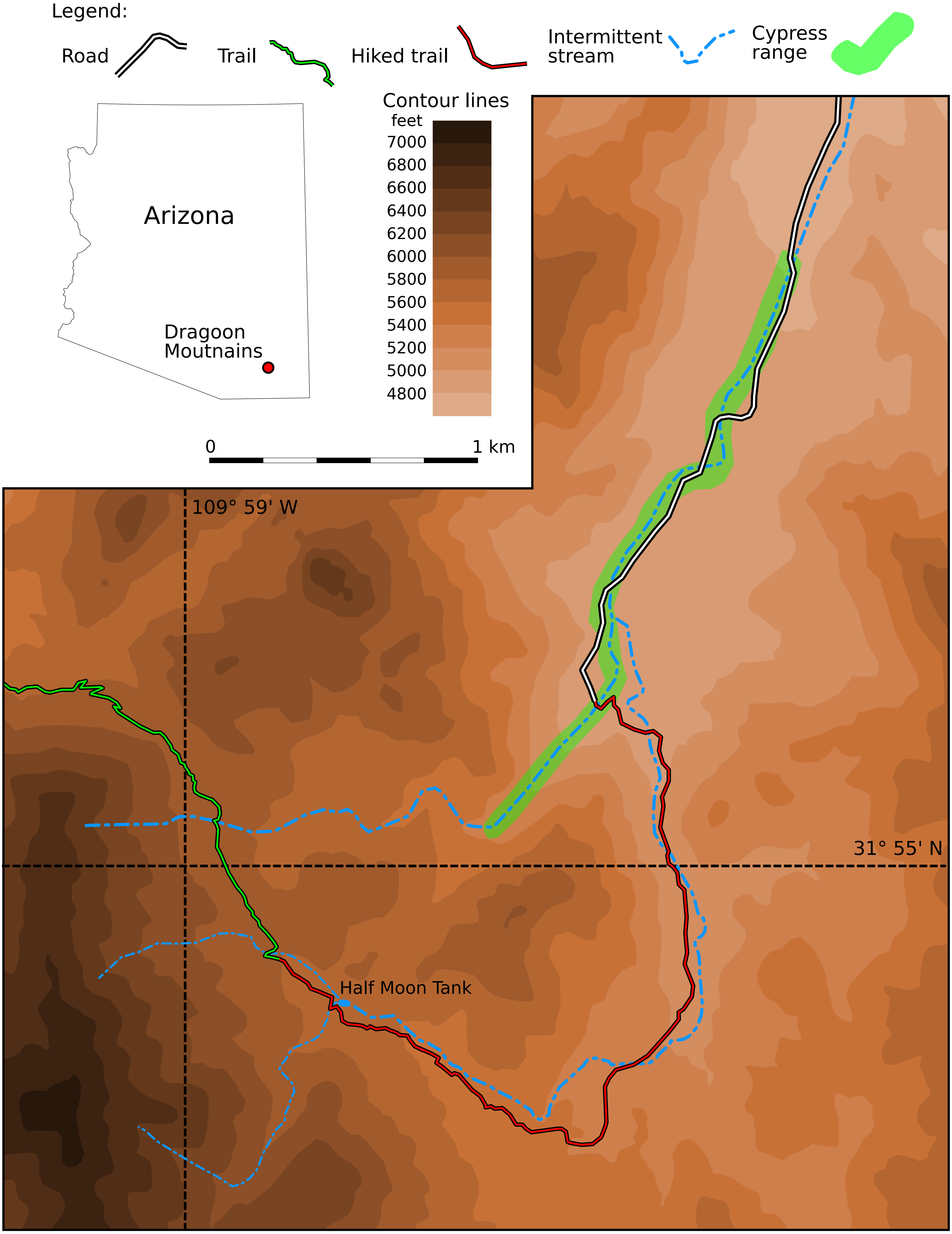


Fig. 18: The trees at skyline in distance that are where the creek bed is located are cypresses. It was too rough to go up this creek further due to large rocks and thick brush. What I didn't know at the time, was that this creek is accessible from the Cochise trail about 800 m (a 1/2 mile) past Half Moon Tank at elevation 1585 m (5,850'), which is where we stopped and turned back.

Map 1: Cypress range in the Dragoon Mountains, east Cochise Stronghold, Arizona, USA.



Bull. Cupressus Conservation Proj. 8 (2): 97-100 (12.2019)

D. Maerki

Different species of birds feeding on *Platycladus orientalis* seeds in France

The observations were carried on a cultivated *Platycladus orientalis* in the south of France from the winter 2018 to the fall 2019. The tree is some 40 years old and 7.60 m high. Seven different bird species visited the tree and fed on its seeds. In winter although the cones are open, most of the seeds usually remain inside because of the upright orientation of many cones. The seeds are nested between the dry brown scales, so that the birds only have to pick them up. In autumn on the contrary, the cones are still closed[1] with fleshy scales covered by a whitish wax. The birds have to open the cones to get to the seeds. Once forced open, the cone scales quickly turn brown, and the difference in colour gives an estimate of the number of cones already visited by the birds. All such cones are higher than 2 m on the tree.

All birds were identified by M.P. Frankis.

Fig. 1: *Platycladus orientalis*, cultivated. 2017-11-19.

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[1] At the same time, on smaller plants it was possible to see cones already opening.

Fig. 2: *Fringilla coelebs* (Common Chaffinch – Pinson des arbres) on *Platycladus orientalis*.
2018-02-04.

Videos of *Chloris chloris*, *Passer domesticus*, *Fringilla coelebs*, *Carduelis carduelis* and *Parus major* feeding on the *Platycladus orientalis* seeds are accessible here: **VIDEOS**

Fig. 3: *Chloris chloris* (European Greenfinch – Verdier d'Europe) on *Platycladus orientalis*.
2019-10-12.

Fig. 4: *Passer domesticus* (House Sparrow – Moineau domestique) on *Platycladus orientalis*.
2019-10-28.

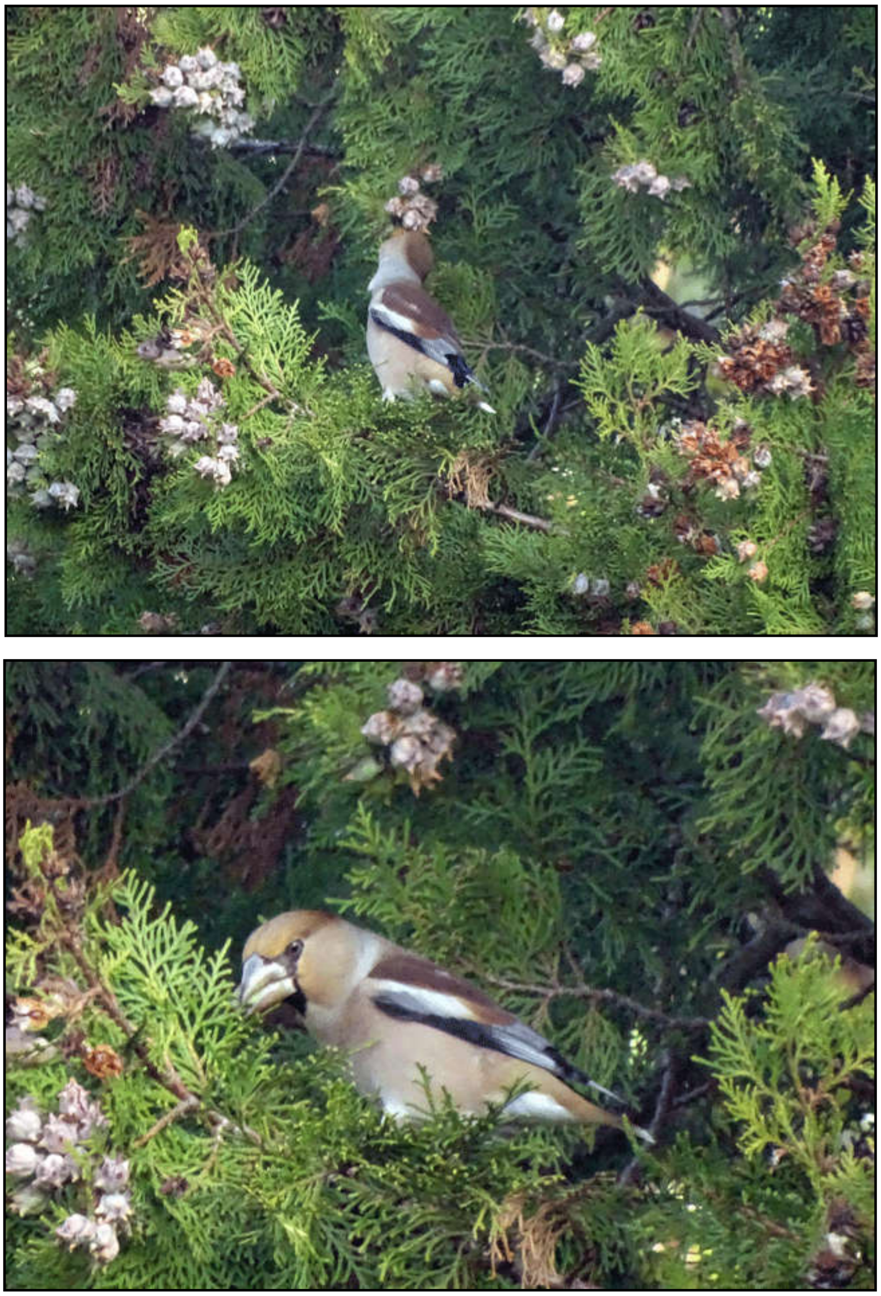

Fig. 5 & 6: *Coccothraustes coccothraustes* (Hawfinch – Gros-bec casse-noyaux) on *Platycladus orientalis*. 2019-10-28.

Fig. 7: *Poecile palustris* (Marsh Tit – Mésange nonnette) on *Platycladus orientalis*. 2019-10-28.

Fig. 8 & 9: *Cardualis carduelis* (European Goldfinch – Chardonneret élégant) on *Platycladus orientalis*. 2019-11-27.

Fig. 10: *Parus major* (Great Tit – Mésange charbonnière) on *Platycladus orientalis*. 2019-12-03.