

Reporting Intersex Florets in *Salix caprea* L. (*Salicaceae*) from NE Anatolia

Salih TERZİOĞLU¹, Bedri SERDAR^{1*}, Kamil COŞKUNÇELEBİ², Murat ÖZTÜRK¹

¹Karadeniz Technical University, Faculty of Forestry, Department of Forest Botany, Trabzon, TURKEY

²Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, TURKEY

*Corresponding Author: bserdar@ktu.edu.tr

Received Date: 12.02.2019

Accepted Date: 06.01.2020

Abstract

Aim of the study: In the present paper, male or female catkins composed of several intersexes florets in four individuals (all in the same population) of *Salix caprea* are reported from Turkey for the first time.

Study area: Roadsides at Köse Mountain in Gümüşhane (NE Anatolia) wherein Scots pine forest is dominant.

Material and method: Plant materials were collected from the same population belong to goat willow during the excursion around Köse Mountain in 2017 and 2018. All materials consisting male, female and metamorphosans flowered shoots were first processed according to standard herbarium techniques.

Main results: Metamorphosans or intersexes florets in *Salix caprea* were recorded for the first time from Turkey.

Research highlights: In extremely rare cases, metamorphosans florets have been reported in several willow species distributed outside of Turkey. However, native goat willow individuals, in which these florets appear, were recorded here for the Turkish flora. Beside its possible reasons were discussed at local scale.

Keywords: Metamorphosans, Sex Change, Turkey, Willow

İnterseks Çiçekli *Salix caprea* L. (*Salicaceae*)'nın Kuzeydoğu Anadolu'da Varlığı

Öz

Çalışmanın amacı: Bu çalışmada, *Salix caprea*'nın interseks çiçeklere sahip erkek veya dişi kedicikli aynı popülasyondaki dört bireyinin varlığı Türkiye'den ilk kez bildirilmektedir.

Çalışma alanı: Gümüşhane (Kuzeydoğu Anadolu)'de sarıçamın baskın olduğu Köse Dağı yol kenarları.

Materyal ve yöntem: Çalışma materyalleri, Köse Dağı'ndaki aynı keçi söğüdü popülasyonundan 2017 ve 2018 yıllarında gerçekleştirilen arazi çalışmalarında toplanmıştır. Erkek, dişi ve metamorfoz çiçekli sürgünlerin herbaryum örneklerinden oluşan tüm materyaller önce standart herbaryum tekniğine göre hazırlanmıştır.

Temel sonuçlar: Keçi söğüdünün metamorfoz veya interseks çiçeklerden oluşan çiçek kurullarına sahip bireyleri Türkiye'den kaydedilmektedir.

Önemli vurgular: Ülkemiz dışındaki kimi söğüt türlerinde metamorfoz çiçekler çok nadir olarak gözlenmektedir. Bu çalışmada ise metamorfoz çiçekli doğal keçi söğüdü bireyleri Türkiye florasına kaydedilmiştir. Bu durumun olası nedenleri çalışma alanındaki dinamikler çerçevesinde tartışılmıştır.

Anahtar kelimeler: Metamorfoz, Cinsiyet Değişimi, Türkiye, Söğüt

Introduction

Though disagreement on the number of *Salix* L. (willow) species, the genus consists of approximately 450 species mainly distributed in Northern hemisphere (Argus, 2010) and 27 of them are native to Turkey (Güner et al., 2012; Terzioğlu et al., 2014). Willows are ordinarily known as dioecious plants including some extreme abnormalities.

Although the strictly dioecious breeding system with distinct pure both female (with pistillate catkins only) and male (with staminate catkins only) individuals is predominating in willows, some unusual situations observed in some *Salix* taxa (Smith, 1940; Skvortsov, 1999; Rottenberg, 2007). A significant number of willows are reported that the specimens show some



exceptions from strictly dioecious condition such as intersex (Smith, 1940; Mirski, 2014; Harrison, 1924; Myers-Smith & Hik, 2012; Mirski & Brzesko, 2014). Intersexualism is important for genetic diversity in plants. Depending both on natural and artificial factors, 18 willow species showing exceptions from dioecy (Mirski, 2014) which is important for evolutionary biology.

Salix caprea L. (goat willow) is a deciduous small to medium-size tree or shrub among the widespread native species in Turkey (Skvortsov & Edmondson, 1982). Its general distribution spreads from Spain to China, from Turkey to Northern Iran (Meusel et al., 1978). The goat willow is a pioneer and a fast-growing plant. Regarding its demand for light, it is a very shade intolerant species, occurring in open areas with full sun, but it is one of the few willow species able to grow in forest (Enescu et al., 2016).

During the excursion study around Köse Mountain in 2017, the authors collected some samples belong to goat willow with unusual catkins. A close examination and literature survey showed that this kind of catkins were reported previously in *S. caprea* distributed outside of Turkey (Harrison, 1924). Further field study around Köse Mountain in 2018 revealed that this kind of catkins are present in four individuals of *S. caprea* distributed in the mountain range of Köse (Gümüşhane). Present findings are the first to report intersex florets in *Salix caprea* distributed in Turkey.

Materials and Methods

Samples were collected from *Pinus sylvestris* L. forest in Köse Mountain (A7 Gümüşhane) in 2017 and 2018. Locality information regarding to unusual specimen were given in Figure 1 and Table 1.



Figure 1. Location of population of studied intersex (with the numbers 1 to 4), and male/female individuals (with the number 5 and 6) respectively, and a view from habitat in Köse Mountain / Gümüşhane.

All specimens were first processed according to standard herbarium techniques and then identified by using Flora of Turkey (Skvortsov & Edmondson, 1982) and deposited in the Herbarium of Karadeniz Technical University, Faculty of Forestry (KATO). Terminology of intersexes or metamorphosans were firstly used by Heribert-Nilsson (1918) and Rainio (1927) respectively.

Table 1. Studied specimens of *Salix caprea* from Köse Mountain

No	Gender of catkin	KATO number	Coordinates (UTM)	Altitude (m)
1	Intersex	20776	0547251, 4462149	1721
2	Intersex	20777	0547132, 4461472	1748
3	Intersex	20778	0547153, 4461471	1750
4	Intersex	20779	0547973, 4461143	1873
5	Male	20780	0547978, 4461142	1878
6	Female	20781	0547986, 4461137	1881

Results and Discussion

Specimens with male and female (Figure 2 a,b), and unusual catkins (Figure 2 c,d,e,f) are present in the same habitat in Köse Mountain (Gümüşhane). At first glance, some male individuals were observed with male catkins which have metamorphosans female florets (Figure 2 c,d). Rest of the field studies, authors came across the other individuals. They have both female catkins

with metamorphosans male florets and mixed ones (Figure 2 e, f). Metamorphosans or intersexes florets (Figure g, h, i) were obtained from these catkins and photographed in detail. Our observations are in accordance with Harrison (1949) who reported intersex individuals with 10% of catkins consisting both pistillate and staminate florets in *S. caprea*.

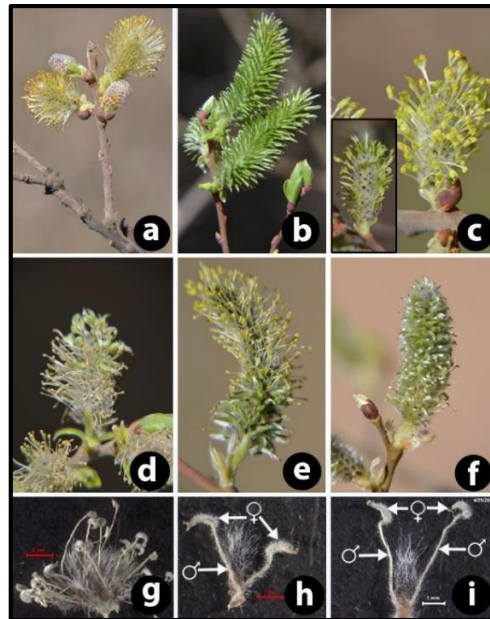


Figure 2. Catkins of *Salix caprea*: **a-** Male catkins; **b-** Female catkins; **c,d,e,f-** Extraordinary catkins consist of intersexual or metamorphosans types of florets; **g, h, i-** Distinct filaments together with the anthers take on the appearance of abnormal ovaries

In the genus *Salix* (comprises dioecious species) the sexes are normally separate having pistillate or staminate flowers. Small minority of sexual organisms, which are geographically and taxonomically widespread, may change their sex (including dioecious) during their lifetime (Policansky, 1982; Martinez et al., 2018). Significant changes in metabolism of the plant, depending on environmental factors, is reported the reason of sex change (Mirski, 2014). Furthermore, anthropogenic habitat change can also be of importance (Faliński, 1998). Eriophyid mites (as parasite) is reported to change both sex from male to female (Harrison 1924) and leaf characteristics (Mosbacher et al., 2013) in some willow taxa. As well, many reports cited the similar modifications of sex

changes due to both of insects and indirect action of fungi which produce effected chemical substances (Loehwing, 1938; Smith, 1940).

Such sex changes are reported in different *Salix* species, such as *S. alba*, *S. fragilis*, *S. pentandra*, *S. aurita*, *S. cinerea* and *S. caprea* (Harrison, 1924), *S. podophylla*, *S. brachycarpa* and *S. pseudolapponum* (Smith, 1940). Regular hermaphroditism was reported in *S. martiana* by Rohwer & Kubitzki (1984). Metamorphosans florets as reported in the present study are one of the other handicaps that they not reflect the original generative characters of the taxa. According to Harrison (1949) and Mirski (2014), global climate changes, road construction/maintenance and grazing may cause such sexual changes in flowering

plants. Road construction together with other anthropogenic factors may cause sexual changing in goat willow distributed in Köse mountain. Depending on regional climate model, in the next century, the temperature and precipitation will increase 2-4 °C and 200-300 mm, respectively for the mountainous range of Eastern Black Sea region wherein the study area stay (Terzioğlu et al., 2015). This is possibly among the threats likely to results alteration of generative organs of the reported willow individuals examined in the present paper.

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