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Cerasus fruticosa Pall. (*Rosaceae*) in the region of Kujavia and South Pomerania (N Poland)

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Abstract: *Cerasus fruticosa* is a rare and endangered plant species in Poland. In northern part of the country it occurs on scattered localities of relic, early Holocene (preboreal) character. Most of the species stands known from the end of 19th century have disappeared in the last decades. All data, revised in the field 40 years ago, were checked in 2000–2002. The species survived on 6 localities of 14 ones, confirmed in sixteenth. The hybridization between *C. fruticosa* and *C. vulgaris* is one of the main reasons of extinction of the first species. The floristic composition of plant communities with *C. fruticosa* was examined and compared with relevant literature. The regression of photophilous and thermophilous plant species, characteristic for associations with *C. fruticosa* and moderate invasion of synanthropic ones were observed.

Additional key words: plant protection, anthropopression, species extinction, habitat changes, hybridization

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Introduction

Impoverishment of the floras of various regions has been described several times (Kornaś 1981). It was also summarized for Poland (Zarzycki and Kaźmierczakowa 1993, Kaźmierczakowa and Zarzycki 2001), and regionally for Wielkopolska, Pomerania and Kujavia regions (Żukowski and Jackowiak 1995; Brzeg and Wojterska 1996; Rutkowski 1997).

One of the Red book species in Poland is *Cerasus fruticosa* (Wójcicki 1993, 2001a). It reachs its north-western range limit in Poland (Browicz and Gostyńska 1964; Szafer 1972; Wójcicki 2001a, b). The Pomeranian and Kujavian localities of the species form an island, not connected with main area of the species distribution. *C. fruticosa* is a relic, endangered species withdrawing from the mentioned regions (Rutkowski 1997) and exposed to various unfavourable influences. On more than a half of localities known from literature it was considered to be extinct some 40 years ago (Gostyńska 1965a). Many forms of anthropopression are responsible for reduction of species stands, among other genetic erosion by gene flow from plantations of *C. vulgaris*, as it was shown biometrically (Wójcicki 1988, 1991a, 1991b; Wójcicki and Marhold 1993).

The finding of more efficient ways to preserve the remaining populations of the species was the reason of detailed field investigations. The main aim of the presented work was to describe actual state of existing populations of *Cerasus fruticosa* and to determine their possible threat.

Materials and methods

The objects of the study were *Cerasus fruticosa* Pall. (syn. *Prunus fruticosa* Pall.) and its possible hybrids. The species hybridizes with *C. vulgaris* Mill and C. avium Moench. *Cerasus xeminens* (Beck) Buia (syn. *Prunus xeminens* Beck) is a hybrid of *C. fruticosa* and *C. vulgaris*, *C. xstacei* (Wójcicki) Wójcicki and Marhold (syn. *Prunus xstacei* Wójcicki) a hybrid of *C. fruticosa* and *C. avium*.

The list of localities of *Cerasus fruticosa* in Kujavia and Pomerania was constructed according to data from literature and herbaria (BYAB, KOR, KRA, KRAM, POZ, TRN[1]). Determination of most of the herbarium specimens was verified by Wójcicki in 1980–1982. The localities known only from literature and those, which had not been confirmed in the field by Gostyńska (1965a), were treated as not existing and/or reported by mistake. All other localities were checked *in situ*. Basing on these data a map of species distribution was prepared.

The analysis of particular plants available in herbarium revealed how much the influence of *C. vulgaris* is responsible for extinction of *C. fruticosa*.

The numbers of individuals of *Cerasus fruticosa* in existing populations were compared with data from literature (Abromeit 1989; Preuss 1912; Kulesza 1927; Wodziczko 1926, 1929; Kobendza 1937; Sulma and Walas 1963; Browicz and Gostyńska 1964; Gostyńska 1965a, b; Ceynowa 1968).

The botanists usually documented their field investigations by collection of herbaria representing the possible typical form of species. The large herbarium collection of specimens of *Cerasus fruticosa*, the species which was often the subject of interest in Kujavia (e.g. Preuss 1912; Kulesza 1927; Czubiński 1950; Szafer 1972), made it possible to determinate approximate dates of appearance of hybrid specimens and pure species extinction on particular localities. The participation of the intermediate forms in particular populations, described on the morphological characters by Wójcicki (1987), was treated as an indicator of the on-going genetic erosion.

Analyses of occurrence conditions of *Cerasus fruticosa* populations were carried out in the field in 1999–2002. The physiographic dependences were described, densities of populations were estimated and phytocoenotic documentation was made. The phytosociological relevés were made according to Braum-Blanquet's methode, in modification by Barkman et al. (1964). Only the most homogenic patches of vegetation were investigated. Syntaxonomical character of taxa was determined after Matuszkiewicz (2001). The species were included into the geographic-historical groups after Jackowiak (1990). The names of vascular plant species follow Mirek et al. (1995), and of mosses Szafran (1961). The names of plant communities follow Matuszkiewicz (2001). The field data were compared with those given by Ceynowa (1968).

Results

Only 6 of 14 localities of *Cerasus fruticosa*, confirmend by Gostyńska (1965a), were found in the field as still existing (Fig. 1). One new locality was found, on the slopes of Vistula River near Kulin, (Gostyńska 1961, *in sched*) in the past 40 years. The hybrids between *C. fruticosa* and *C. vulgaris*, and specimens gathered as *C. fruticosa* but determined by Wójcicki as *C. vulgaris*, were collected on most of the localities. The intermediate forms have not been reported only from Tarkowo nature reserve, on some of localities in the vicinity of Toruń and on the slopes of the Vistula River near Kulin (Table 1).

Localities confirmed in the field

1. Nature reserve in Rejna. The first typical (Cf[2]) specimens *Cerasus fruticosa* and its hybrids with *C.*

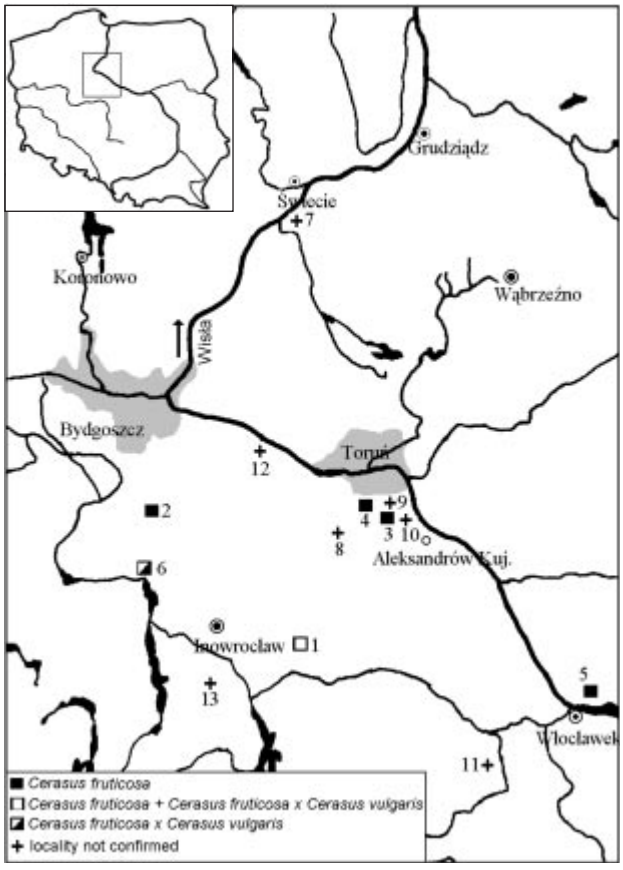

Fig. 1. Distribution of historical and existing populations of *Cerasus fruticosa* in Kujavia and South Pomerania regions (numbers 1–13 correspond with data presented in the lists of localities, pp. 4–6)

[1] Herbaria acronyms follow Holmgren et al. (1990); BYAB – Department of Botany of Bydgoszcz Pedagogic University.

Table 1. Disappearence of typical morphological characters of *Cerasus fruticosa* Pall. in the herbarium collections from Kujavia and South Pomerania (Cf – typical forms of *C. fruticosa*; Cf x Cv – hybrids of *C. fruticosa* x *Cerasus vulgaris*; Cv – typical forms of *C. vulgaris*)

Locality	Data from herbaria collected in periods			Authors field examinations
	1880–1930	1931–1970	1971–1999	
1. Rejna nature reserve	Cf, Cf x Cv	Cf, Cf x Cv	Pf	Cf, Cf x Cv
2. Tarkowo nature reserve	Cf	Cf	Cf	Cf
3. Between Zamek and Orla Góra hills, near the Wudek road S of Toruń	–	Cf	–	Cf
4. Near the road from Sygnałowe Wzgórze hill to Suchatówka, S of Toruń	Cf	–	–	Cf
5. Kulin nature reserve	–	–	Cf	Cf
6. S lopes above Tuczno lake near Leszcze	Cf	Cf, Cf x Cv	–	Cf x Cv
7. Rzadka Wola, slopes of Zgłowiączka valley near Brześć Kujawski	–	Cf x Cv, Cv	–	Cv
8. Chełmno	Cf x Cv	Cv	Not confirmed	Not confirmed
9. Dziwak hill S of Toruń	Cf, Cf x Cv	–	Not confirmed	Not confirmed
10. Popioły S of Toruń	Cf	Cf	Not confirmed	Not confirmed
11. Along the Warszawska road S of Toruń	–	Cf x Cv	Not confirmed	Not confirmed
12. Gaj nature reserve near Marklowice	Cf x Cv	Cf x Cv	Not confirmed	Not confirmed

vulgaris were collected by Spribille in 1888 (POZ$^{Cf, CfxCv}$). The next collections consist of both, the typical forms and hybrids [e.g. Gostyńska 1960 (KOR$^{Cf, CfxCV}$); Wilkoń-Michalska 1964 (TRN^{Cf}); Wójcicki 1975 (KRAM^{Cf})]. Nowadays the typical: hybrids forms ratio of about 1:1 in whole population, but in some parts of the reserve hybrids dominate. It is the most numerous population of *Cerasus fruticosa* in the Kujavia. The species grows there frequently and in places even commonly in the brushwood of the stand of *Calamagrostio-Quercetum*. It sometimes forms the lower shrub layer in the man-made stands of *Pinus sylvestris*, planted on the biotopes of oak and/or pine-oak woods. The most numerous clumps it forms in the more sunny fragments of forest or along the roads, also at the margin of reserve. It also grows singly or in the small patches outside the nature reserve. *Cerasus fruticosa* forms its the community of low thicket on the forest edges along the forest roads. The plant cover of Rejna nature reserve is not much anthropogenicaly changed. The forest vegetation dominates, with inconspicuous participation of anthropophytes. The main threat for the existence of *C. fruticosa* is occurrence of very great number of hybrid specimens.

2. The nature reserve Tarkowo near Nowa Wieś Wielka. Among the analyzed herbarium specimens [leg. Preuss 1908 (TRN^{Cf}); Gostyńska 1960 (KOR^{Cf}); Ceynowa 1964 (TRN^{Cf}); Wójcicki 1975 (KRAM^{Cf}); Bartczak, Boratyński, Waldon 1999 (BYAB^{Cf})], no hybrids were found. The intermediate individuals between *Cerasus fruticosa* and *C. vulgaris* were observed during the field investigation. The species grows there commonly, forming in places dense, large clumps under the canopy of old *Pinus sylvestris* forest on the sandy hill, in an area of about 1 hectare. The reserve is fenced, the stand was thinned out and dense second storey and brushwood was removed some dozen years ago, to exposure *C. fruticosa* shrubs.
3. About 1 km S of Dziwak hill, by the way to Wudek [leg. Grütter 1889, (TRN^{Cf})]; along the Wudek road, between hills Zamek and Góra Orląt S of Toruń [leg. Gostyńska 1961 (KOR^{Cf}, KRAM^{Cf}); Wilkoń-Michalska 1964, (TRN^{Cf})]. *Cerasus fruticosa* grows there in the typical form on the road escarpment, on the forest edge and inside it, in the more open fragments. The numbers of population did not change radically, when compare with Gostyńska's (1965a) data.
4. Proposed, but never established nature reserve Popioły, near road to Popioły S of Toruń. The collected herbarium specimens document occurrence of only the typical *Cerasus fruticosa* [leg. Hohnfeldt 1904 (TRN^{Cf}); Gostyńska (KOR^{Cf}, KRAM^{Cf})]. The individuals observed in the field formed one clump near the forest road and were strongly affected by animals. It is the rest of a larger population now disappearing. The two last populations of *Cerasus fruticosa* are situated on a military area. Approximately 50 years ago, the species was considered as common and even dynamically expanding there

[2] Cf – typical *Cerasus fruticosa*; Cf x Cv – hybrids *C. fruticosa* and *C. vulgaris*; Cv – *C. vulgaris*

(Gostyńska 1965a). During the field investigations carried out in spring of 2001, the most of reported localities (Gostyńska 1965a, localities 10–20) were not found. It is quite possible, however, that further, more detailed investigations would allow to find at least a few of them. Nevertheless, it can not be said that *C. fruticosa* is currently a "dynamically expanding" species there. The most important threats are fires, which affected the stands and caused the change of previous forest vegetation into heathlands. *C. fruticosa* is moderately resistant to fires, but frequent (every year) burning lead to total devastation of the vegetation cover consequently to extinction of the species populations.

5. Kulin nature reserve near Włocławek. Typical specimen of *Cerasus fruticosa* was collected by Gostyńska in 1971 (KOR^{Cf}). The numbers of population was probably reduced during slide of the slope, where the species grows. Only a few typical individuals were observed there in the spring of 2002, at the proximity of the xerothermic grasslands. It was not numerous and thus an endangered population, which could originated from restricted number of individuals.
6. S slopes on the N bank of Tuczno lake near Leszcze. The typical specimens of *Cerasus fruticosa* were collected by Preuss in 1908 (TRN^{Cf}). The next herbarium collections [leg. Gostyńska 1960 (KOR^{CfxCv}); Ceynowa 1964 (TRN^{CfxCv}); Bartczak, Boratyński, Waldon 1999 (BYAB^{CfxCv})] document only the intermediate forms between *C. fruticosa* and *C. vulgaris*. The recently sampled specimens were morphologically even more close to the last species. Only four about 1.4–1.5 m high shrubs of character intermediate between *C. vulgaris* and *C. fruticosa* were found there in 1999 as a rest of the previously typical, more numerous population (Preuss 1912; Gostyńska 1965a). They grew on the upper part of the steep, S-facing slope, in dense thicket, composed mainly of *Prunus spinosa*, *Crataegus monogyna* and *Cornus sanguinea*. The area neighbours with the arable fields and as such it is additionally endangered by overfertilization, which caused the change of the previous grassy and shrubby xerothermic communities (Gostyńska 1965a) into nitrophilous ones.

Localities not confirmed in the field

7. Chełmno, the slopes above Fryba and Parowy Chełmińskie nature reserve. The typical herbarium specimens of *Cerasus fruticosa* from vicinity of Chełmno have not been found. The oldest one [leg. Kalman 1883 (TRN^{CfxCv})] was determined as a hybrid. It indicates an early start and probably subsequent progress of the process of genetic erosion of *C. fruticosa* by the gene flow from *C. vulgaris* plantations situated in the close vicinity of the human settlements. The last collected specimen at Chełmno [leg. Gostyńska 1960 (KOR^{Cv})] was determined by Wójcicki as typical *C. vulgaris*. On the slopes of Parowy Chełmińskie nature reserve typical *C. fruticosa* [leg. Preuss 1908 (TRN^{Cf})] grew about 50 years ago, but it has not been confirmed by Gostyńska (1965a).
8. Near the way from Wzgórze Sygnałowe hill to Suchatówka near Toruń, on the military area. Only one herbarium specimen of typical *Cerasus fruticosa* exists [leg. Krawiec 1927 (POZ^{Cf})]. Locality has never been confirmed. The area has been burned several times and now it is covered with *Calluna vulgaris* community.
9. Dziwak hill S of Toruń. The typical forms of *Cerasus fruticosa* and its hybrids with *C. vulgaris* were collected there [leg. Grütter 1889 (TRN^{Cf}) Matz 1900 (POZ$^{Cf,\ CfxCv}$). Locality has not been confirmed by Gostyńska (1965a). The area has been burned several times and then planted with *Pinus sylvestris*, which is about 20–30 years old now.
10. Between Toruń and Otłoczyn along the old custom road, near the old narrow-gauge railway. The intermediate between *Cerarus fruticosa* and *C. vulgaris* herbarium specimens are only known [leg. Gostyńska 1961 (KOR^{CfxCv}, TRN^{CfxCv})]. The locality in „dense thickets at the both sides of the road" have not been confirmed in the field.
11. Rzadka Wola, slopes above Zgłowiączka near Brześć Kujawski. Locality found more than 80 years ago. One specimens of typical form of *Cerasus fruticosa*, the other intermediate between *C. fruticosa* and *C. vulgaris* and typical *C. vulgaris* [leg. Kobendza ? (WA^{Cf}) (after Wójcicki 1988, *non videtur*); Gostyńska 1962 (KOR$^{CfxCv;\ Cv}$)]. Only few typical *C. vulgaris* specimens were found in this locality, described in detail by Gostyńska (1965a, b).
12. Between Gajtowo and Przyłubie. Not confirmed.
13. Gaj near Markowice, Wymysłowo, near nature reserve of *Sorbus torminalis* [leg. Wodziczko 1927 (POZ^{CfxCv})]. Not confirmed.

Occurrence conditions

Cerasus fruticosa is usually a component of brushwood of the open woodlands or forms its own thicket communities on the forest edges. It blossoms and fructifies abundantly in such places. The species is less vigorous in more shady places, under the dense forest canopy. This confirms the high light demands demands of *C. fruticosa* (Pawłowska 1972; Ellenberg 1991).

The thickets and plant associations with a high participation of *Cerasus fruticosa* develop most frequently on the flat places or on the S-facing slopes. The sandy or loam-sandy soils predominate in the areas, where the species grows. Sometimes the podzolic processes are visible within the soil profile. The spe-

cific character of the occurrence of *C. fruticosa* in the Kujavia is the lack of $CaCO_3$ in the soils and their low pH values (Ceynowa 1968). Most of the species localities can be associated with the potential natural vegetation of the acidophilous oak forest community (*Calamagrostio arundinaceae-Quercetum*) and/or the mixed pine-oak forest community (*Querco roboris-Pinetum*) (Kępczyński and Matuszkiewicz 1995). The detailed determination of the forest associations, however, is sometimes difficult because of anthropogenic transformations of the forest stands, mainly by plantation of *Pinus sylvestris*.

The more natural forest communities with *Cerasus fruticosa* have 2- or even 3-layer structure (Table 2). The stand is usually about 20 m high, composed of *Pinus sylvestris* with admixture of *Quercus robur*, *Q. petraea* and less numerous of *Betula pendula* and *Pyrus communis*. Density of the canopy oscillates predominantly between 20 and 70%, only rarely reaches 90%. The brushwood is two-layered. The upper layer is composed of the younger individuals of the canopy tree species with single specimens of *Corylus avellana*, *Sorbus aucuparia* and inconspicuous participation of the species characteristic of *Rhamno-Prunetea* class. The lower, generally more dense thicket layer forms *C. fruticosa*, which attains about 50–90 cm height. The lack of light is a reason of rather impoverished development of the herb layer, which cover attains 50% in average (10–100%).

The floristic composition of the analysed phytocoenoses is very heterogenic. Most of the species occur there with low degree of stability. There are present the species of wood and non-forest communities alike. Among them occur the thicket species of the class *Rhamno-Prunetea*, the mesophilous forests species of *Querco-Fagetea*, the acidophilous and coniferous forest species of *Vaccinio-Piceetea* and *Quercetea robori-petraeae* as well as the plants of mesophilous forest edges of the class *Trifolio-Geranietea*, the grassy communities of *Festuco-Brometea* and *Koelerio-Corynephoretea*, the forest clearings of *Epilobietea angustifolii* and meadows of *Molinio-Arrhenatheretea* and *Nardo-Callunetea*. The frequent proximity of roads and, in Tarkowo also farm buildings, are the reasons of occurrence of ruderal and segetal plant species, characteristic of the class *Artemisietea vulgaris* and *Stellarietea mediae*.

The grassy herb layer is prevailing in most of the relevés. The highest cover coefficients have *Calamagrostis epigejos* and *Anthoxanthum odoratum*, though 14 other species of *Poaceae* family were also found. *Rubus saxatilis*, *Peucedanum oreoselinum*, *Moehringia trinervia* and in places *Convallaria maialis* are other species which attain high degrees of constancy and cover. Most of the species have an acidophilous character (Table 2).

The moss layer is well developed in the most of relevés, but its cover is diversified, achieving from minimal up to 100%. *Pleurozium schreberi* and *Pseudoscleropodium purum* have the highest participation.

19 plant species were found in average in a singular relevé, but the numbers range from 8 to 32. Totally 96 species have been noticed (Table 2).

It should also be stressed, that in the investigated phytocoenoses one species legally protected in Poland (*Pulsatilla pratensis*) and two partly protected (*Frangula alnus*, *Convallaria maialis*) have been found. *Carlina acaulis* was also confirmed in the field in the Rejna nature reserve (outside the relevés).

Discussion

Slopes of the river valleys, forest edges and also escarpments along the traditional routes are the contemporary sites of the steppe relics, which appeared in the Kujavia in the preboreal period of the Holocene (Czubiński 1950). The steppe plant species can only survive in those places, which are difficult to be colonized by trees. Moderate human activity in the prehistoric and historic times also promoted vegetation of the open areas. The intensive forest management, which started in the Kujavia about 200 years ago (Broda 1993), due to the afforestation of abandoned agriculture lands and a increase in density of the forest stands, were some of the most important reasons of elimination of plant species characteristic for open and semi-open areas. The grassland plant species can survive only on the forest edges, pastures and on the man-made sites, such as escarpments of roads. It concerns also *Cerasus fruticosa*, the typical Pontic species, which occupies specific, xerothermic sites and survived on relic localities in Kujavia (Wodziczko 1926, 1929; Czubiński 1950; Gostyńska 1965a).

The number of localities of *Cerasus fruticosa* in the region was strongly reduced during last 150 years. Considering 24 localities of the species known from literature (Abromeit 1898; Preuss 1912; Kulesza 1927; Wodziczko 1926, 1929; Kobendza 1937; Czubiński 1950; Sulma and Walas 1963; Browicz and Gostyńska 1964; Gostyńska 1965a, b; Ceynowa 1968; Szafer 1972; Wójcicki 1988) the typical form of *C. fruticosa* was confirmed from only 5.

The review of the herbarium specimens of *Cerasus fruticosa* illustrates a disappearence of the taxon's characters and its genetic erosion. Consecutive transformation of populations of *C. fruticosa* to more close to *C. vulgaris* (Table 1) suggests the on-going introgression. This problem is general, however, and concerns more or less the whole distribution area of *C. fruticosa*, but is much more intensive in Central and Western Europe (Wójcicki 1988, 1991a, b; Wójcicki & Marhold 1993). It was also suggested, that *C.*

Table 2. Communities with *Cerasus fruticosa*

No.		1	2	3	4	5	6	7	8	9	10	11	12	13	Constancy	Ceynowa (1968)
No. of record		13	12	7	10	11	9	8	3	1	2	6	5	4		
Date		7.05. 2002	7.05. 2002	7.05. 2002	7.05. 2002	7.05. 2002	7.05. 2002	7.05. 2002	2.05. 2001	2.05. 2001	2.05. 2001	7.05. 2002	7.05. 2002	7.05. 2002		
Exposition		-	-	-	S, SE	-	-	-	-	-	-	N	SE	SE		
Inclination [°]		-	-	-	10	-	-	-	-	-	-	5–10	5–10	5–10		
Density of tree layer [%]	(a)	90	40	40	80	70	20	50	55	-	-	70	-	-		
Density of shrub layer [%]	(b)	60	95	80	100	90	90	100	60	30	95	70	70	80		
Dendity of herb layer [%]	(c)	80	20	80	30	50	30	50	60	100	10	60	60–50	60		
Density of moss layer [%]	(d)	60	70	70	80	90	100	90	60	-	100	80	zn	-		
Area of record [m^2]		50	100	50	200	200	200	200	200	100	25	100	250	50		
Number of species in record		19	19	18	17	23	23	28	32	13	9	21	16	8		
Ch: *Rhamno-Prunetea*																
Cerasus fruticosa	b	3	5	4	5	3	5	5	4	2a	5	3	4	4	V^{2a-5}	4^{3-4}
	c	1	.	.	1	.	.	1	.	.	.	+	1	+	III^{+-1}	2^{+}
Berberis vulgaris	b	.	.	.	.	.	.	.	+	+	.	.	.	.	I^{+}	1^{+}
	c	.	.	.	.	.	.	.	r	.	.	.	.	.	I^{r}	.
Prunus spinosa	b	.	.	.	.	.	.	.	.	+	.	.	.	.	I^{+}	1^{1}
Rosa sherardii	b	.	.	.	.	.	.	.	+	1	.	.	.	.	I^{+-1}	.
Euonymus verrucosus	b	.	+	r	.	.	.	.	.	.	.	.	.	.	I^{r-+}	1^{+}
Rhamnus catharticus	b	.	.	.	.	.	.	.	.	.	.	.	.	+	I^{+}	.
Rosa tomentosa	b	.	.	.	.	+	.	.	.	.	.	.	.	.	I^{+}	.
Crataegus monogyna	b	+	.	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.
Rosa sp.	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3^{+}
Crataegus laevigata	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Ch: *Vaccinio-Piceetea* and *Quercetea robori-petraeae*																
Pinus sylvestris	a	4	3	3	4	4	2a	2a	4	.	.	3	.	.	IV^{2a-4}	3^{3-4}
	b	.	.	.	+	.	+	.	.	+	.	.	.	.	II^{+}	.
Calamagrostis arundinacea		2m	.	+	+	+	+	.	.	.	.	.	.	.	II^{+-2m}	2^{+-1}
Vaccinium vitis-idaea		.	.	.	.	+	.	.	.	.	.	.	.	.	I^{+}	2^{+-1}
Deschampsia flexuosa		.	.	.	.	.	.	.	1	.	.	.	.	.	I^{1}	.
Melampyrum pratense		.	+	.	.	.	.	.	.	.	.	.	.	.	I^{+}	2^{+}
Dryopteris dilatata		.	.	.	+	.	r	.	.	.	.	.	.	.	I^{r-+}	.
Trientalis europaea		+	.	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.
Betula pubescens	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Orthilia secunda		.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Vaccinium myrtillus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Pleurozium schreberi		4	5	.	5	5	.	4	3	.	.	2a	.	.	III^{2a-5}	1^{4}
Hylocomium splendens		.	2b	.	.	.	.	.	.	.	.	.	.	.	I^{2b}	.
Dicranum scoparium		.	.	.	.	.	.	.	.	.	.	2a	.	.	I^{2a}	.
Dicranum undulatum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Ch: *Querco-Fagetea*																
Acer platanoides	a	.	.	.	.	.	.	.	.	.	.	3	.	.	I^{3}	.
	b	.	.	.	.	.	.	.	.	.	.	+	.	.	I^{+}	1^{1}
Malus sylvestris	a	.	.	.	.	.	+	.	.	.	.	.	.	.	I^{+}	.
	b	.	.	.	.	2a	.	.	.	.	.	.	.	.	I^{2a}	.
	c	.	.	.	.	2m	.	.	.	.	.	.	.	.	I^{2m}	.
Corylus avellana	b	1	2m	+	+	1	.	1	.	.	.	.	.	.	III^{+-2m}	4^{+-1}
	c	.	+	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.
Polygonatum odoratum		.	.	+	+	.	.	+	.	.	.	+	.	.	II^{+}	1^{+}
Poa nemoralis		.	.	.	.	.	.	.	.	.	.	+	.	.	I^{+}	1^{1}
Dryopteris filix-mas		.	+	.	.	.	r	.	.	.	.	.	.	.	I^{r-+}	.
Carpinus betulus	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{+}
Fraxinus excelsior	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}

Table 2. cont.

Ch: *Trifolio-Geranietea sanguinei* and *Festuco-Brometea**															
Peucedanum oreoselinum	.	.	.	.	+	+	1	+	.	.	1	+	.	III^{+-1}	4^{+-2}
Hypericum perforatum	.	.	.	.	.	.	+	1	+	+	.	.	.	II^{+-1}	2^{+}
Galium verum	.	.	+	.	.	+	1	1	.	+	.	.	.	II^{+-1}	2^{+-1}
Poa angustifolia	.	.	.	.	.	.	1	.	.	+	1	2m	.	II^{+-2m}	.
*Euphorbia cyparissias**	.	.	.	.	.	.	.	1	.	+	.	+	.	II^{+-1}	2^{+}
Geranium sanguineum	.	.	.	.	.	+	1	.	.	.	.	.	.	I^{r-+}	4^{+-1}
*Artemisia campestris**	.	.	.	.	.	.	.	.	.	.	.	+	.	I^{+}	1^{+}
Astragalus glycyphyllos	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	.
*Carex praecox**	.	.	.	.	.	.	.	.	2b	.	.	.	.	I^{2b}	.
Anthericum ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3^{+}
Fragaria viridis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{+-1}
Trifolium alpestre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{+}
Thalictrum minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Vincetoxicum hirundinaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Galium mollugo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Carex caryophyllea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{1}
*Dianthus carthusianorum**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
*Filipendula vulgaris**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Ch: *Koelerio glaucae-Corynephoretea canescentis*															
*Festuca trachyphylla + F. ovina**	.	.	.	.	1*	.	.	1/+*	.	.	+	1	.	II^{+-1}	.
Rumex acetosella	.	.	.	.	.	.	.	.	+	.	+	.	.	I^{+}	1^{+}
Hieracium pilosella	.	.	.	.	.	.	.	.	+	.	.	.	.	I^{+}	2^{+}
Vicia cfr lathyroides	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	.
Potentilla argentea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{+}
Thymus serpyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{+-1}
Helichrysum arenarium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Koeleria grandis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Ch: *Nardo-Callunetea*															
Calluna vulgaris	.	+	.	.	.	.	+	2a	.	.	.	.	.	II^{+-2a}	2^{+-1}
Viola canina	.	.	.	.	.	+	+	r	.	.	.	.	.	II^{r-+}	1^{+}
Carex cfr ericetorum	.	.	.	.	.	.	.	+	.	+	.	.	.	I^{+}	.
Veronica officinalis	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	2^{+}
Danthonia decumbens	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	1^{1}
Luzula multiflora	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	.
Agrostis capillaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1^{+}
Ch: *Molinio-Arrhenatheretea*															
Achillea millefolium	.	.	.	.	.	+	+	+	.	.	.	.	.	II^{+}	3^{+-1}
Taraxacum officinale	.	.	.	.	.	.	.	r	.	.	.	1	+	II^{r-1}	.
Filipendula ulmaria	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	.
Poa pratensis	.	.	.	.	.	.	.	+	.	.	.	.	.	I^{+}	1^{1}
Molinia caerulea	.	.	.	.	+	.	.	.	.	.	.	.	.	I^{+}	.
Galium boreale	.	.	.	.	+	.	+	.	.	.	.	.	.	I^{+}	4^{+}
Veronica chamaedrys	.	.	.	.	.	.	+	.	.	.	.	.	.	I^{+}	3^{+-1}
Vicia cracca	.	.	.	.	.	.	r	.	.	.	.	.	.	I^{r}	.
Dactylis glomerata	.	+	.	.	.	.	.	.	.	.	.	.	.	I^{+}	1^{+}
Festuca rubra	.	.	.	+	.	.	.	.	.	.	.	.	.	I^{+}	.
Stachys officinalis	.	.	.	.	.	.	.	.	.		.	.	.	.	1^{+}
Ch: *Epilobietea angustifolii*															
Populus tremula	b .	.	+	.	.	+	.	.	.	.	.	.	.	I^{+}	.
Calamagrostis epigejos	.	.	2b	.	.	2m	2b	2b-3	4	1	3	3	4	IV$^{1-4}$	1^{+}
Fragaria vesca	.	.	.	.	.	.	+	.	.	.	.	.	.	I^{+}	2^{+-1}
Rubus idaeus	1	.	.	.	.	+	.	.	.	.	.	.	.	I^{+-1}	.
Epilobium angustifolium	.	.	.	.	+	.	.	.	.	.	.	.	.	I^{+}	.

Table 2. cont.

Ch: *Artemisietea vulgaris* and *Stellarietea mediae**																
Robinia pseudacacia	b	.	.	.	.	.	.	.	.	.	.	.	.	+	I+	.
Moehringia trinervia		1	1	.	+	+	1	+	.	.	.	+	.	.	III+ -1	.
*Fallopia convolvulus**		.	2a	.	.	.	+	+	.	.	.	.	.	.	II+ - 2a	1+
Elymus repens		.	.	.	.	.	.	.	.	.	.	+	1	+	II+ - 1	1 1
Galium aparine		.	.	.	.	.	.	.	.	.	.	.	+	+	I+	.
Lamium album		.	.	.	.	.	.	.	.	.	.	.	+	+	I+	.
Artemisia absinthium		.	.	.	.	.	.	.	.	.	.	.	+	.	I+	.
Artemisia vulgaris		.	.	.	.	.	.	.	.	.	.	.	+	.	I+	.
Berteroa incana		.	.	.	.	.	.	.	.	.	.	.	r	.	Ir	.
*Viola arvensis**		.	.	.	.	.	.	.	.	.	.	.	+	.	I+	.
Geranium robertianum		r	+	.	.	.	.	.	.	.	.	.	.	.	Ir - +	.
Galeopsis tetrahit		.	.	.	.	.	+	.	.	.	.	.	.	.	I+	.
Urtica dioica		.	.	.	.	.	.	r	.	.	.	.	.	.	Ir	1r
Linaria vulgaris		.	.	.	.	.	.	.	.	.	.	.	.	.	.	2+
Other species																
Quercus robur	a	.	.	.	.	.	.	.	.	.	.	+	.	.	I+	2 2 - 4
	b	.	.	2b	.	.	.	.	.	.	.	1	.	.	I1 - 2b	3 + - 1
	c	.	.	+	.	.	.	.	.	.	.	+	r	.	Ir - +	1 1
Quercus petraea	a	2a	.	.	2b	.	2b	2b	.	.	.	.	.	.	II2a-2b	1 1
	b	2a	2b	2b	2b	3	+	2a	.	+	.	.	.	.	IV+ - 3	1+
	c	.	+	+	+	.	.		.	.	.	.	.	.	II+	.
Pyrus communis	a/b	.	.	.	+	.	.	.	.	.	.	.	.	.	I+/	1 1/1+
Betula pendula	a	2m	1	.	.	1	+	2b	+	.	.	.	.	.	III+ - 2m	1 1
	b	1	.	+	2a	.	.	.	.	+	.	.	.	.	II+ - 2a	1+
Sorbus aucuparia	a	2m	.	.	2m	.	.	.	.	.	.	.	.	.	II2m	.
	b	.	+	+	2m	1	.	.	r	.	.	2b	.	.	IIIr -2m	4 +
	c	.	.	.	+	.	.	.	.	.	.	.	.	.	I+	1+
Malus domestica	a	.	.	.	.	.	.	.	.	.	.	r	.	.	Ir	.
Frangula alnus	b	.	.	.	+	1	.	.	.	.	.	.	.	.	I+ - 1	2+
Anthoxanthum odoratum		2m	2m	2m	1	1	2m	2a	.	.	.	.	.	.	III1 -2m	2 + - 1
Rubus saxatilis		+	1	2b	1	1	2m	.	.	.	.	.	.	.	III+ - 2m	2 + - 1
Convallaria majalis		5	.	4	2b	2b	.	.	.	.	.	.	.	.	II2b - 5	3 + - 1
Pulsatilla pratensis		.	.	+	.	.	.	.	r	r	.	.	.	.	Ir - +	2+
Scorzonera humilis		.	.	.	.	.	+	+	.	.	.	r	.	.	Ir - +	.
Drypteris carthusiana		1	.	.	.	2m	.	.	.	.	.	.	.	.	I1 - 2m	.
Maianthemum bifolium		+	.	.	.	.	.	.	.	.	.	.	.	.	I+	.
Rubus laciniatus		+	.	+	.	.	.	.	.	.	.	.	.	.	I+	.
Prunus serotina	c	.	+	.	.	.	.	r	.	.	.	.	.	.	Ir - +	.
Campanula rotundifolia		.	.	.	.	.	.	.	+	.	.	.	.	.	I+	2+
Carex hirta		.	.	.	.	.	.	.	+	.	.	.	.	.	I+	1+
Solidago virgaurea		.	.	.	.	.	.	+	.	.	.	.	.	.	I+	2+
Rubus sp.		.	.	.	.	1	.	.	.	.	.	.	.	.	I+	2+
Ribes uva-crispa		.	.	.	.	.	.	.	.	.	.	.	.	.	.	1+
Pseudoscleropodium purum		.	.	+	.	.	5	1	2b	.	5	.	.	.	II+ - 5	.
Mnium cfr. *affine*		.	.	.	.	.	.	.	r	.	+	+	.	.	Ir - +	.
Brachythecium sp.		.	.	.	.	.	.	.	.	.	.	2b	.	.	I2b	.
Rhytidiadelphus sp.		.	.	.	.	.	.	.	.	.	.	3	.	.	I3	1+

Location of records: 1–7 – Rejna nature reserve; 8–10 – S of Toruń along the Wudek road, NW of Orla Góra; 11–13 – Tarkowo nature reserve near Nowa Wieś Wielka.

vulgaris is a hybrid of *C. fruticosa* and *C. avium* (Brettin et al. 2000; Schuster et al. 2000; Hauck et al. 2002).

The cherry-trees are mainly bee-pollinated. The transportation of pollen grains by these insects is restricted and normally does not exceed the distance of 1.0–1.5 km (Banaszak, personal communication). The real endangerment for *Cerasus fruticosa* are the plantations of sour cherry-trees situated in the distance closer than 1.5 km. The other problem is much greater production of pollen by several *C. vulgaris* individuals, than by dozens of *C. fruticosa* ones. It surely accelerates processs of the gene flow and probably is one of the main reasons of the species disappearance, especially its not numerous populations at the vicinities of the human settlements.

The four historic relevés made in the same places as our ones (Table 2) are floristically more abundant (Ceynowa 1968). Altogether 78 plant species were found, 29 to 47 in particular relevé. The higher abundance of the open area species from the classes *Trifolio-Geranietea*, *Festuco-Brometea* and *Koelerio glaucae-Corynophoretea*, was observed about 35 years ago. 26 species reported by Ceynowa (l. c.) have not been confirmed in our field study, as well as the 9 characteristic species of thermophilous, transitional communities between forests and open areas. Our floristic list contains 46 species not reported previously, which include 10 species typical for the segetal and ruderal classes of *Atremisietea vulgaris* and *Stellarietea mediae*. These differences may have been caused only partly by various numbers of analysed relevés (4 by Ceynowa and 13 ours). The more important seem to be the processes, which took place during last 30–40 years. The increase of density of the forest stands was probably a reason of elimination of several light-demanding plant species. The reforestation with *Pinus sylvestris*, probably already the second generation of the pine plantations on the sites of the mesophilous oak woods, was a reason of acidification of the upper layers of soil. This process promoted acidophilous species. The close vicinity of roads and human settlement (Tarkowo casus) were reasons of an increased participation of nitrophilous, segetal and ruderal plant species.

A comparison of our and historic materials showed the high presence of apophytes, although their decrease during last 35 years is noticeable, as well as non synanthropic spontaneophytes, and a considerable growth of anthropophytes (Fig. 2). The differences mentioned above indicate the growing process of synanthropisation, ongoing independently of the conservation activities implemented in the nature reserves with *Cerasus fruticosa*.

The most important for conservation of the existing remains of *Cerasus fruticosa* populations seems to be the elimination of any possibilities of cross-pollination with *C. vulgaris* and also with *C. avium*. Additionally, the periodic thinning of the forest with *C. fruticosa*, including the brushwood layer is highly recommended. The active management of the forest edges and removing of trees and big shrubs (e.g. *Corylus avellana*, *Crataegus* sp., *Sorbus aucuparia*) every 2–3 years is also advisable.

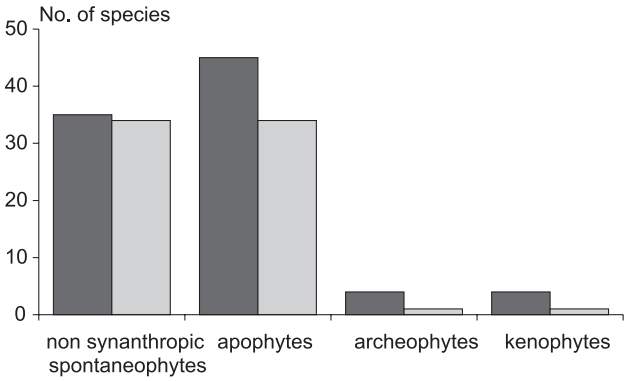

Fig. 2. Participation of non-synathropic spontaneophytes and anthropophytes in historical (according to Ceynowa 1968) (light) and contemporary data (2001–2002) (dark) representing plant communities with *Cerasus fruticosa* in Kujavia and South Pomerania regions

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