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SITE OF SPINY RESTHARROW (*ONONIS SPINOSA* L. FABACEAE) IN THE SOUTH-WESTERN PART OF POZNAŃ

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Abstract. The object of the work was population of spiny restharrow (*Ononis spinosa*) growing within the previous ecological site "Kopanina I" in the south-western part of Poznań. In total 67 specimens were found on the area of 825 m^2. About half of them were in phase of flowering. Most of plants grew in clusters. They were a component of the meadow plant community of *Molinio-Arrhenatheretea* class with different degree of humidity. Together, there were 50 species of vascular plants, including two protected species. Analysis of ecological indicatory numbers revealed predominance of species connected with mineral-humus, meso- and eurotrophic, neutral or alkaine soils.

Key words: *Ononis spinosa*, monitoring, Poznań, ecological indictory numbers

INTRODUCTION

Ononis L. genus (Fabaceae) includes 70 species of subshrubs and perennials, related primarily to the Mediterranean area (Masternak 1998). There are only three species – *O. arvensis* L., *O. repens* L. and *O. spinosa* L. with natural sites in Poland (Rutkowski 2006). *Ononis spinosa* is fairly common in Europe, with the exception of northern peripheries of the continent as well as high mountains. It also occurs in the temperate zone of Asia and North Africa (Piękoś-Mirkowa & Mirek 2003). In Europe the species is represented by four subspecies (Tutin et al. 2010). Two of them – *O. spinosa* subsp. *antiquorum* (L.) Arcangeli and *O. spinosa* subsp. *leiosperma* (Boiss.) Sskirj. are associated with southern Europe. Another one – *O. spinosa* subsp. *spinosa* mainly covers northern regions of the continent. Then *O. spinosa* subsp. *austriaca* (G. Beck) Gams is characteristic for Central Europe. The last two subspecies are also noted in Poland (Rutkowski 2006).

In Poland spiny rest-harrow has got the eastern border of its range. It occurs in the western part of the country up to the lower and middle Vistula river, as well as in the zone of uplands in the south. It usually grows scattered and is a relatively rare plant (Piękoś-Mirkowa & Mirek 2003). More often it can be found in western Poland (e.g. Żukowski et al. 1995, Celka 1999).

It is a perennial or subshrub, about 30–60 cm high, with dark pink flowers and unpleasant odour. *Ononis spinosa* belongs to the photophilous plants, with moderate thermal requirements, growing on dry, sandy or clay soils. The species occurs in a variety of grassland communities, mainly in the xerothermic grasslands of *Cirsio-Brachypodion pinnati* aliance and, occasionally in sandy grasslands of *Koelerio glaucae-Corynephoretea canescentis* (Zarzycki et al. 2002, Piękoś-Mirkowa & Mirek 2003). According to Rutkowski (2006) *Ononis spinosa* subsp. *austriaca* can also be found in wet meadows.

Populations of spiny restharrow usually consist of several specimens, however the plant often grows individually (Piękoś-Mirkowa & Mirek 2003). Species may be either a nonsynanthropic spontaneophyte or apophyte, growing along roadsides and railway embankments (Jackowiak 1993, Żukowski et al. 1995, Celka 1999). Due to the use of restharrow in herbal industry it has been subjected to partial protection in Poland (Rozporządzenie… 2012). A root of restharrow is raw material in pharmacy, having diuretic,

anti-inflammatory effect and it stimulates the secretion of gastric juice (Ożarowski & Jaroniewski 1989).

The aim of the current study was to characterise the population of *O. spinosa* and its participation in the local vegetation within former ecological "Kopanina I", in the south-western part of Poznań city. Based on a detailed stocktaking of the population a map of local range of species was drown up. In addition, possible threats to the existence of characterized species were determined.

MATERIAL AND METHODS

CHARACTERISTICS OF THE STUDY AREA; THE SOIL AND HYDROLOGICAL CONDITIONS

The area of investigation is located in the south-western part of Poznań city, in the valley of Junikowski Stream. The natural values of this district drew attention only in the seventies of the last century. In 1994, considering the wealth of habitats, two ecological sites: "Kopanina I" (in which the current study was conducted) and "Kopanina II" were established (Projekt... 1994). Both objects, with total area of 126 ha are separated by Głogowska street, one of the main roads leading out of Poznań. Permanent existence of the ecological sites was assumed, while creating spatial development plans (Ludwiczak 1995). However, in 2008 the number of ecological sites in Poznań was significantly reduced, from 26 to just four (http://poznan.naszemiasto.pl/... 2014). Unfortunately, the abolition of environmental protection also applied to "Kopanina I" and "Kopanina II".

Within the area of "Kopanina I" some studies on vegetation were carried out (Król et al. 1998, Kluza-Wieloch & Maciejewska-Rutkowska 2008). In particular, much attention was paid to the monitoring of populations of orchid species (Kluza & Maciejewska 1998, 1999, Kluza et al. 1999, Maciejewska-Rutkowska et al. 2008, Kluza-Wieloch & Maciejewska-Rutkowska 2009). Besides, fauna of spiders and birds was also investigated (Ptaszyk et al. 2002).

"Kopanina I" includes an area of 58 hectares. It is prevailingly flat, marshy and covered with sedge meadows and rushes. There are also small clumps of trees or single specimens. The highest elevation within the study object is a slope, near the Poznań Junikowo railway station, falling into the Baczkowski pond below (Ptaszyk et al. 2002).

In terms of geomorphology, the prevailing forms are high terraces of outwashed sands and fluvial gravels, situated on boulder clay. They were composed during the last glaciation (Kaniecki et al. 1993). The soils of the object are fertile, very moist, weakly acidic to alkaline and rich in carbonates. Most frequently peat-mud, mucky and black soils are observed (Mocek et al. 2000, Ptaszyk et al. 2002).

The hydrological network of the object is formed by the Junikowski Stream and several ponds, the largest of which is the Baczkowski pond, covering 10.3 hectares. Its origin is connected with exploitation of loam and clay from the late XIXth till the 70's of the XX c. The waters of the object are heavily polluted with sewage.

METHODS

Ononis spinosa population was monitored from June till September 2011. The location of each specimen was determined using GPS (Table 1). Three plots were marked out, each with an area of about 275 m^2, in which all individuals were counted. The total area of direct field investigations was 825 m^2 (Fig. 1).

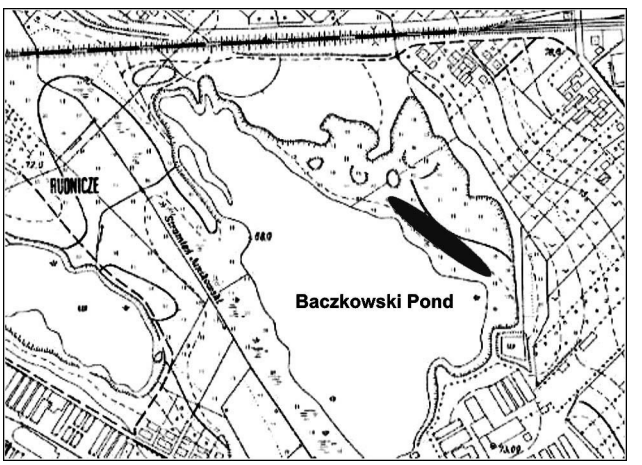

Fig. 1. Location of the population of *Ononis spinosa* in the area of former ecological site "Kopanina I" in Poznań

Table 1. Geographical coordinates of individual specimens of *Ononis spinosa*, diameter ranges of plants and flowering phase

Specimen	North latitude	East longitude	Diameter (cm)	Flowering	No of plot
1	52°22'12.100	16°51'51.205	20–40	+	1
2	52°22'19.950	16°51'45.518	20–40	+	1
3	52°22'19.270	16°51'43.700	20–40	+	1
4	52°22'22.080	16°51'44.845	20–40	+	1
5	52°22'37.138	16°51'36.150	20–40	–	3
6	52°22'37.090	16°51'35.216	20–40	+	3
7	52°22'34.200	16°51'39.055	20–40	–	3
8	52°22'34.060	16°51'40.000	20–40	–	3
9	52°22'32.126	16°51'40.860	20–40	+	3
10	52°22'31.100	16°51'33.670	20–40	+	3

Specimen	North latitude	East longitude	Diameter (cm)	Flowering	No of plot
11	52°22'29.000	16°51'38.350	20–40	–	3
12	52°22'28.075	16°51'41.167	20–40	+	3
13	52°22'27.920	16°51'41.593	20–40	–	3
14	52°22'26.800	16°51'37.485	20–40	–	3
15	52°22'25.265	16°51'35.270	20–40	+	3
16	52°22'25.350	16°51'37.730	20–40	+	3
17	52°22'26.000	16°51'41.110	20–40	–	3
18	52°22'25.400	16°51'40.005	20–40	+	3
19	52°22'26.256	16°51'43.900	20–40	–	3
20	52°22'27.100	16°51'31.537	20–40	–	3
21	52°22'37.040	16°51'31.600	20–40	–	3
22	52°22'17.500	16°51'49.770	40–60	+	1
23	52°22'16.420	16°51'55.200	40–60	–	1
24	52°22'15.850	16°51'55.430	40–60	–	1
25	52°22'15.000	16°51'51.620	40–60	–	1
26	52°22'13.150	16°51'50.578	40–60	–	1
27	52°22'13.230	16°51'51.146	40–60	–	1
28	52°22'13.700	16°51'52.170	40–60	–	1
29	52°22'21.129	16°51'36.690	40–60	–	2
30	52°22'20.325	16°51'31.370	40–60	+	2
31	52°22'20.440	16°51'34.610	40–60	+	2
32	52°22'19.100	16°51'33.790	40–60	–	2
33	52°22'19.150	16°51'35.235	40–60	–	2
34	52°22'20.415	16°51'38.634	40–60	+	2
35	52°22'20.515	16°51'40.185	40–60	+	2
36	52°22'21.234	16°51'42.789	40–60	+	2
37	52°22'36.630	16°51'38.265	40–60	+	3
38	52°22'33.050	16°51'35.849	40–60	–	3
39	52°22'32.155	16°51'36.391	40–60	–	3
40	52°22'29.000	16°51'35.923	40–60	+	3
41	52°22'28.555	16°51'34.395	40–60	+	3
42	52°22'28.428	16°51'39.720	40–60	–	3
43	52°22'25.325	16°51'42.556	40–60	+	3
44	52°22'13.715	16°51'48.112	60–80	+	1
45	52°22'21.835	16°51'31.005	60–80	–	2
46	52°22'21.928	16°51'31.000	60–80	–	2
47	52°22'22.020	16°51'31.345	60–80	+	2
48	52°22'21.217	16°51'34.770	60–80	+	2
49	52°22'22.590	16°51'34.355	60–80	+	2
50	52°22'21.601	16°51'38.400	60–80	+	2
51	52°22'22.245	16°51'38.128	60–80	+	2
52	52°22'22.000	16°51'41.255	60–80	+	2
53	52°22'37.090	16°51'41.020	60–80	+	3
54	52°22'36.805	16°51'40.220	60–80	–	3
55	52°22'35.115	16°51'35.723	60–80	–	3
56	52°22'32.234	16°51'35.155	60–80	–	3
57	52°22'31.810	16°51'37.890	60–80	+	3
58	52°22'31.538	16°51'38.440	60–80	+	3
59	52°22'30.715	16°51'35.260	60–80	–	3
60	52°22'29.100	16°51'33.740	60–80	+	3
61	52°22'27.328	16°51'34.480	60–80	–	3
62	52°22'26.417	16°51'35.690	60–80	–	3
63	52°22'26.505	16°51'34.210	60–80	–	3
64	52°22'25.746	16°51'33.410	60–80	–	3
65	52°22'25.040	16°51'31.085	60–80	+	3
66	52°22'24.640	16°51'31.820	60–80	+	3
67	52°22'27.565	16°51'38.512	60–80	–	3

The diameter of particular specimens, contained in three intervals (20–40 cm, 41–60 cm, 61–80 cm) was determined; the flowering was noted too.

The phytosociological record was taken for each plot basing on Braun-Blanquet's method (Matuszkiewicz 2005). List of life forms and ecological indicatory numbers for noted vascular plants were worked out, basing on Zarzycki et al. (2002). The names of plant species were taken according to Tutin et al. (2010).

RESULTS

In total, there were 67 specimens of spiny restharrow, including 34 flowering plants. The largest number of specimens (39) was noted in the third plot. Most flowering specimens (17) grew in the third plot and the least (6) in the first plot. In the third plot there were also the most individuals of maximum (15) and minimum diameters (17). The largest number of plants in flowering phase was in the range of 60–80 cm in diameter (Tables 2–3, Fig. 2). The average density of *O. spinosa* in the study area was 0.08 individual per 1 m^2, and most of the specimens were distributed in clusters. The highest density (0.14) was determined in plot number 3 (Table 4).

In total, within the study area 49 species of vascular plants, representing 19 families were found. Poaceae family was the most numerous in species (15). Seven species represented Asteraceae and there were four species in Fabaceae and Rosaceae. One species, strictly protected by law (*Epipactis palustris*) was noted. The greatest species diversity (39 taxa) was observed in the third plot (Table 5).

Table 2. Number of specimens of *Ononis spinosa* in three size ranges of diameter

Ranges of diameter	Number of specimens		
	flowering	not flowering	totally
20–40 cm	11	10	21
41–60 cm	10	12	22
61–80 cm	13	11	24

The population of *O. spinosa* was a component of meadow phytocenosis of *Molinio-Arrhenatheretea* class with different degree of humidity. However, based on the collected data it was difficult to determine a definite plant association of this syntaxon. In the third record a high participation of species characteristic of xerothermic grasslands was noted. Moreover, the largest quantitatively coverage of *O. spinosa* was revealed in the same record. Hence, it could be concluded that the third plot represented the driest variant of meadow phytocenosis of *Molinio-Arrhenatheretea* class. The most moist variant of meadow association was observed in the first plot, with frequent appearance of *Phalaris arundinacea* and *Phragmites australis*, plants characteristic of reed and sedge fens (*Phragmitetea australis* class). Record number 2 represented intermediate variant of meadow phytocenosis of *Molinio-Arrhenatheretea* class. However, the presence of species of *Molinio-Arrhenatheretea* class was the most noticeable (Table 6).

Hemicryptophytes were predominant forms of life among all recorded vascular species (42). One taxon was a hemiparasite. Species common throughout the country prevailed (39). More than half of the species (28) were characterised by high dynamics and expansion to new sites in the last decades. In turn, two species were in regression (*Briza media* and *Centaurea cyanus*).

Table 4. Illustrative information on population density of *Ononis spinosa* in the study area

Plot number	Number of specimens per 275 m^2	Density of population per 1 m^2
I	12	0.04
II	16	0.06
III	39	0.14

Table 5. List of participation of specimens of *Ononis spinosa* and number of other species in particular plots

Plot number	Number of other species	Number of *O. spinosa* specimens
I	15	12
II	25	16
III	39	39

Table 3. Number of specimens per particular plots depending on the size of plant diameter

Diameter	No of specimens								
	plot 1			plot 2			plot 3		
	together	flowering	not flowering	together	flowering	not flowering	together	flowering	not flowering
20–40 cm	4	4	0	0	0	0	17	7	10
41–60 cm	7	1	6	8	5	3	7	4	3
61–80 cm	1	1	0	8	6	2	15	6	9
Totally	12	6	6	16	11	5	39	17	22

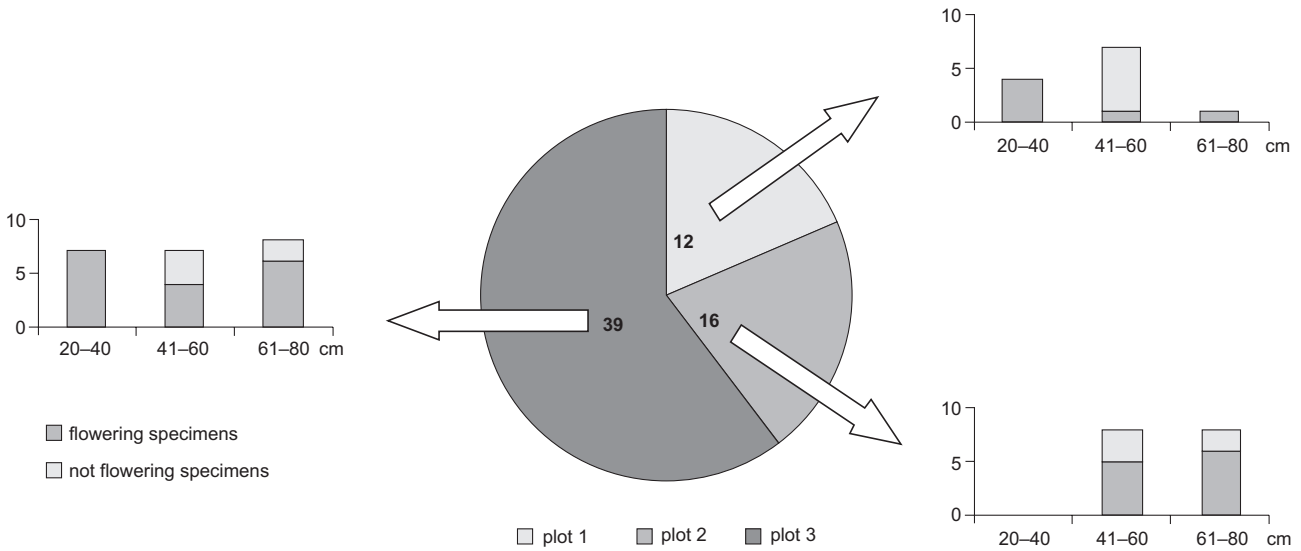

Fig. 2. Share of specimens of *Ononis spinosa* in research plots (central diagram), including diameter ranges and participation of flowering and not flowering plants

Table 6. Phytosociological records within the study area

Record number in field	1	2	3
Data	23.06.11/ 17.09.11	23.06.11/ 17.09.11	23.06.11/ 17.09.11
Area of record (m²)	275	275	275
Density of tree layer a (%)	10	–	–
Density of herbaceus layer c (%)			
Number of species	15	25	39
ChCl. *Phragmitetea australis*			
Phragmites australis	3.2	2.2	–
Glyceria maxima	1.2	–	–
ChAll. *Magnocaricion*			
Phalaris arundinacea	4.4	1.2	1.2
Carex acutiformis	1.2	–	–
ChO./All. *Caricetalia davallianae*			
Epipactis palustris	2.1	+	1.1
ChCl. *Molinio–Arrhenatheretea*			
Ranunculus acris	2.2	1.1	+
Festuca pratensis	–	3.4	3.4
Molinia caerulea	–	3.4	1.2
Prunella vulgaris	–	1.1	1.1
Vicia cracca	+	1.1	–
Alopecurus pratensis	–	–	2.3
Poa trivialis	–	–	2.3
Centaurea jacea	–	–	1.1
Plantago lanceolata	–	–	1.1
Trifolium pratense	–	–	+
ChO. *Molinietalia*			
Cirsium palustre	1.1	+	–
Rhinanthus angustifolius	–	+	+
Equisetum palustre	1.1	–	–
ChO. *Arrhenatheretalia*			
Galium mollugo	2.2	2.2	2.3
Arrhenatherum elatius	2.2	1.1	+
Dactylis glomerata	–	2.2	2.3
Lotus corniculatus	–	–	2.1
Taraxacum officinale	–	–	2.1
Achillea millefolium	–	–	1.2
Daucus carota	–	–	+
Geranium pratense	–	–	+
ChO./All. *Agropyro–Rumicion crispi*			
Ranunculus repens	–	r	r
Potentilla anserina	–	+	–
Potentilla reptans	–	+	–
ChCl. *Festuco–Brometea*			
Bromus erectus	2.2	2.2	2.3
Agrimonia eupatoria	–	1.2	2.2
Ajuga genevensis	–	+	1.2
Euphorbia cyparissias	–	–	2.1
Carex praecox	–	–	1.1
Other species			
Festuca ovina	1.2	2.2	2.2
Ononis spinosa	**1.1**	**1.1**	**2.2**
Bromus inermis	–	1.2	2.3
Rubus caesius	–	+	+
Hypericum perforatum	–	+	+
Betula pendula a	2.3	–	–
Populus tremula a	2.3	–	–
Plantago major	–	–	2.1
Veronica chamaedrys	–	1.2	–
Agropyron repens	–	–	1.2
Briza media	–	–	1.2
Hieracium pilosella	–	–	1.2
Cichorium intybus	–	–	1.1
Trifolium repens	–	–	+
Centaurea cyanus	–	–	+

Basing on the ecological indicatory numbers it was stated that most of the observed species preferred moderate light or partial shade, while 11 species optimally grew in full light. Most of the species were connected with mineral-humus, meso- and eutrophic soils, with a neutral or alkaline pH. Most of the observed species preferred fresh and dry soils and only five were connected with wet sites. Besides, 25 species tolerated increased content of NaCl and six taxa tolerated increased heavy metal content.

DISCUSSION

Meadow communities of *Molinio-Arrhenatheretea* class have a wide ecological amplitude and can be found on organogenic and mineral soils (from strongly acidic to alkaline), with a variable level of groundwater (Grynia 1962). Analysis of edaphic indicatory numbers of flora of the object revealed that local meadow phytocenosis had developed on the mesotrophic, humus-mineral soil, composed of clay sands, with alkaline pH (Zarzycki et al. 2002). In the current study the most variable site factor was humidity. It determined the combination of species in the particular variants of phytocenosis. The most humid variant of meadow became similar to the reed, with a significant share of *Phragmites australis* and *Phalaris arundinacea* – species characterstic of *Phragmitetea australis* class. In the driest variant of meadow the species of *Festuco-Brometea* were very significant in association. In turn, similar participation of species characteristic of *Molinio-Arrhenatheretea*, *Phragmitetea australis* and *Festuco-Brometea* classes were noted in the intermediate variant of meadow. The degree of moistening of phytocoenosis also influenced the qualitative and quantitative diversity in the population of *O. spinosa*. Most specimens of this species, together with the largest diameter, were observed in the third plot, being the driest variant of meadow. According to Zarzycki et al. (2002), as well as Piękoś-Mirkowa & Mirek (2003) optimal plant communities for spiny restharrow are just xerothermic grasslands. On the other hand, in the current study with the increase of moistening of meadow, the decrease of specimen number of *O. spinosa* together with reducing plant diameter was observed. According to Zarzycki et al. (2002) *O. spinosa* is a plant connected to the warmest and moderately warm climate regions, growing in full light. Similarly, within the former ecological use "Kopanina I" spiny rest-harrow grew on the open, unshaded sites, and the appearance of woody plants was associated with a decrease in the number of individuals of this species.

From the area of Poznań agglomeration 41 sites with *O. spinosa* species have been described so far. Seven of them are located in the south-western part of the city. All these places with the species are considered to be receding due to human activity. According to Jackowiak (1993) site of *O. spinosa*, analysed in the current work, is strongly susceptible to anthropopressure. It is mainly associated with ruderal and segetal vegetation, with strong and constant anthropogenic impact and distinct changes in substratum (Sudnik-Wójcikowska 1988). The current analysis of vegetation shows, however, that described population of restharrow should be treated as moderately susceptible to human activity. In the former ecological use "Kopanina I" it is a component of semi-natural vegetation, as it grows together with the plants of *Phragmitetea australis* and *Molinio-Arrhenatheretea* classes. In contrast, *O. spinosa*, as species occurring within Poznań, has been classified into the group of synanthropic spontaneophytes (Jackowiak 1993), that is, species of native origin permanently persistent on anthropogenic, strongly transformed habitats, sometimes achieving optimum of their development on such sites. Similarly, present study has proved the population of *O. spinosa* to be in good condition. But in the whole country the taxon not always shows good development trends. For example, within the Słowiński National Park there are recorded only three sites of this species (Piotrowska et al. 1997).

Ononis spinosa is legally protected in Poland, but in the whole country it is still vulnerable to extinction as a result of plant collecting from natural sites for medicinal purposes. Another significant threat to its existence is a succession of trees and shrubs on the sites of xerothermic grasslands (Kucharska-Żądło & Sadowska-Bujak 2002, Piękoś-Mirkowa & Mirek 2003). The problem of expansion of thicket and forest vegetation also applies to the population of *O. spinosa* of the study area. In addition, this population is endangered due to very strong anthropopressure. The site of *O. spinosa* is trodden out and littered with rubbish (by anglers fishing in the Baczkowski pond, as well as by walking inhabitants of Poznań). Hence, the lack of any form of active protection of the area with the site of *O. spinosa* may raise sustainability concerns regarding both condition and existence of the population of species in the future.

CONCLUSIONS

1. Investigated population of *O. spinosa* is in good condition, with the development trend, a proof of which is superiority of flowering plants over not flowering.
2. Overgrowing site of *O. spinosa* by shrub-like and woody species is an alarming phenomenon, which may decide about continued existence of the population.
3. Another important threat to the described population of spiny restharrow is strong anthropopressure.

4. In view of the risks mentioned above, the site of population of *O. spinosa* should be actively protected.

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