NAT. CROAT. | VOL. 12 | No 1 | 19–29 | ZAGREB | March 31, 2003

ISSN 1330-0520 original scientific paper / izvorni znanstveni rad

THE DISTRIBUTION OF THE GENUS *IMPATIENS* L. (*BALSAMINACEAE*) IN MEDVEDNICA NATURE PARK, CROATIA

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Cigić, P., Nikolić, T., Plazibat, M., Hršak, V. & Jelaska, S. D.: The distribution of the genus *Impatiens* L. (*Balsaminaceae*) in Medvednica Nature Park, Croatia. Nat. Croat., Vol. 12, No. 1., 19–29, 2003, Zagreb.

The flora research in Medvednica Nature Park has shown the presence of four species of the genus *Impatiens*: *Impatiens balfourii* Hooker f., *I. glandulifera* Royle, *I. noli-tangere* L. and *I. parviflora* DC. The species *I. noli-tangere* is the most widespread in the Park, while the other three species are registered for the first time. Distribution mapping was done by using the basic units of the Central European grid for floristic mapping (MTB).

Key words: *Impatiens*, Medvednica Nature Park, distribution maps, Croatia

Cigić, P., Nikolić, T., Plazibat, M., Hršak, V. & Jelaska, S. D.: Rasprostranjenost roda *Impatiens* u Parku Prirode Medvednica, Hrvatska. Nat. Croat., Vol. 12, No. 1., 19–29, 2003, Zagreb.

Analizom rezultata dosadašnjih floristićkih istraživanja, za područje Parka Prirode Medvednica utvrđene su četiri vrste roda *Impatiens*: *Impatiens balfourii* Hooker f., *I. glandulifera* Royle, *I. noli-tangere* L. and *I. parviflora* DC. Najšire rasprostranjena vrsta je *I. noli-tangere*, dok su ostale tri vrste prvi put zabilježene za floru Parka. Kartiranje rasprostranjenosti obavljeno je na temelju osnovnih jedinica srednjoeuropske mreže za kartiranje flore (MTB).

Ključne riječi: *Impatiens*, Park Prirode Medvednica, karte rasprostranjenosti, Hrvatska

INTRODUCTION

In the flora of Europe the balsam or jewelweed family (*Balsaminaceae*) is represented only by the genus *Impatiens* L. with the following species: *Impatiens balfourii* Hooker f., *I. balsamina* L., *I. capensis* Meerb., *I. glandulifera* Royle, *I. noli-tangere* L., *I. parviflora* DC. and *I. scabrida* DC. The genus *Impatiens* L. is mostly distributed

throughout the central part of Europe and is rare or completely absent in the northern and southern part. *I. noli-tangere* (touch-me not) is the only species native to Europe, while all others are neophytes from Asia and North America (MOORE, 1968; SLAVIK, 1996).

In the Croatian flora five of all taxa present in Europe were recorded (MARKOVIĆ, 1997), except the species *I. capensis* which is distributed in Great Britain, France, Germany, Finland and Poland and *I. scabrida* which was found escaped from cultivation in the Czech Republic (MOORE, 1968; SLAVIK, 1996).

Localities of some particular species are listed in older Croatian literature, particularly for the species *I. balsamina*, *I. noli-tangere* and *I. parviflora*, such as in KLINGGRÄFF (1861) for the area of Zagrebačka gora, SCHLOSSER & VUKOTINOVIĆ (1857, 1869) for Zagreb surroundings, Virovitica and Papuk, HIRC (1904) for the surroundings of Zagreb and Samobor, Žumberak, Moslavačka gora, Topličko gora, Gorski Kotar, the valley of the Dobra river and Rudač, FORENBACHER (1908) for Mount Medvednica.

I. glandulifera was recorded as part of the Croatian flora for the first time in 1968 (MARKOVIĆ, 1970) on the Sava river banks and in the surrounding areas of Zagreb. After that numerous new findings were reported: Skrad, Gorski Kotar (TRINAJSTIĆ, 1974), Mt. Medvednica (EGIĆ, 1978), North – West Croatia, Osijek (LUKAČ, 1989), Samobor surroundings, Žumberak (PAVLETIĆ, 1993), Bukevje (TRINAJSTIĆ & FRANJIĆ, 1994), Krapinske Toplice (ŠOŠTARIĆ & MARKOVIĆ, 1998) and other localities throughout Croatia (PANDŽA *et al.*, 2001).

I. balfourii is the most recent member of the genus within the Croatian flora. It was first reported as a new adventive species for Istria by PERICIN (1992) and later on for some other localities: Krapinske Toplice, Kraljevec near Budinšćina in Hrvatsko Zagorje and in the surroundings of Zagreb (ILIJANIĆ *et al.*, 1994; ŠOŠTARIĆ & MARKOVIĆ, 1998).

The relatively quick spread of the genus *Impatiens* within natural and anthropogenically influenced vegetation is made possible by the annual reproductive cycle and the large production of seeds, dispersed by autochoria (the explosive opening of the capsule) and also due to suitable ecological valences. In certain countries, due to the above mentioned reasons, some of the species are treated as an aggressive weed (PERRINS *et al.*, 1993; PYŠEK & PRACH, 1995; TREPL, 1984). The high densities of populations in areas unsuitable for cultivation should not be neglected since they appear there as nectar plants (PAVLETIĆ, 1993).

Although some particular species of the genus *Impatiens* were previously recorded in the area of the Medvednica Nature Park, the exact distribution of the species is still unknown. Considering the fact that the major part of Zagrebačka gora was declared a Nature Park in 1981, it is important to keep track of the distribution of these neophytes within the borders of the protected area and their possible impact on the autochthonous flora and vegetation.

In 1981, the western part of Medvednica (total area 228.26 km^2) was declared a Nature Park by the Nature Protection Act. The Park area is mostly covered by forest (63.7%) and the main vegetation types include beech, oak and beech-fir forests.

Within the area of the Nature Park there are eight special reserves of forest vegetation which take up 1000 ha of the area. The rest of the Park is covered by grasslands, settlements, roads, and arable land. The climate on Medvednica is moderately continental with an average temperature of 6.2°C (BÖHM *et al.*, 1979) and an annual precipitation of 1238 mm for Sljeme (HRŠAK, 1993).

MATERIAL AND METHODS

Study area

Distribution research into species from the genus *Impatiens* took place in the area of Medvednica Nature Park, which comprises the greatest part of Mt Medvednica (Zagrebačka gora). Mt Medvednica is situated to the north above Zagreb, the capital of Croatia, at co-ordinates 15º49′45′′–16º07′45′′ east longitude and 45º49′00′′–45º59′00′′ north latitude (Fig. 1). In the centre of the massif is its highest peak Sljeme (1035 m).

Data on taxa distribution within the Nature Park were collected from three sources: field observations, literature and herbaria.

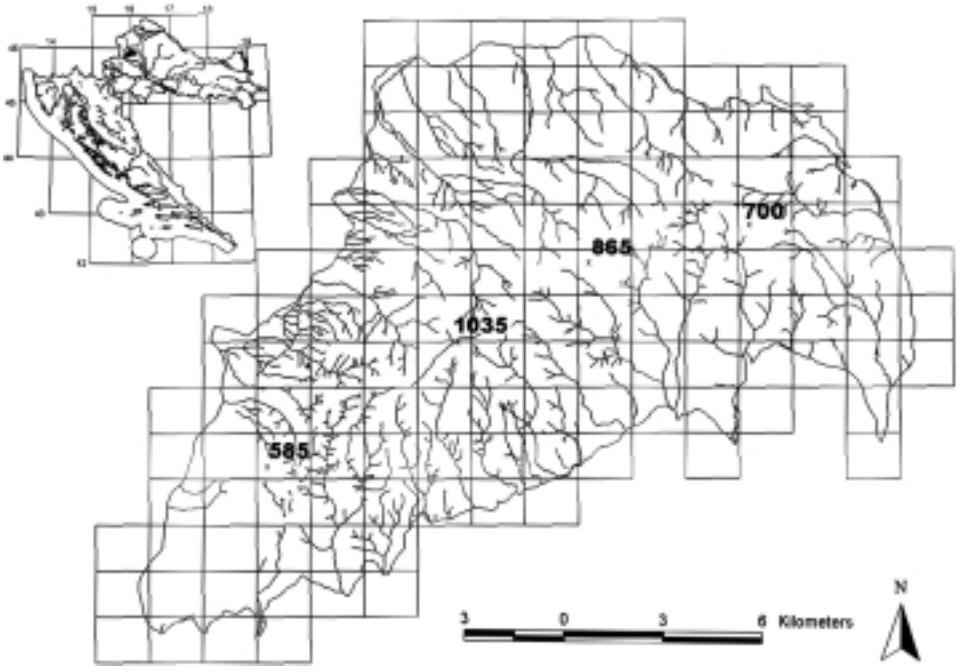

Fig. 1. The position of the research area (Medvednica Nature Park).

Most of the data are the result of field observations that were conducted in the period from 1997 to 1998. Research was done by taking multiple field trips during each vegetation season. Distribution mapping was done by using the basic units of the Central European grid (MTB) for flora mapping with the application of MTB 1/64 basic units. Basic units are rectangles with average measurements of 1.5x1.4 km and an average area of 2.1 km² (NIKOLIĆ *et al.*, 1998). The positioning and identification of the boundaries of the basic units in the field were done with a GPS receiver and 1:25 000 topographic maps.

The recent research was supplemented by literature data on the distribution of species from the genus *Impatiens* in Croatia (DOBROVIĆ, 2001; EGIĆ, 1978; FORENBACHER, 1908; HIRC, 1904; ILIJANIĆ *et al.*, 1994; KLINGGRÄFF, 1861; KUIŠ, 1955; LUKAČ, 1989; MARKOVIĆ, 1970, 1984; PAVLETIĆ, 1993; PERICIN, 1992; ROSSI, 1924, 1930; SCHLOSSER & VUKOTINOVIĆ, 1869; ŠOŠTARIĆ & MARKOVIĆ, 1998; TRINAJSTIĆ, 1974; TRINAJSTIĆ & FRANJIĆ, 1994).

Distribution data were also supplemented by the data from specimens belonging to the herbarium of Ivo and Marija Horvat (ZAHO) and Herbarium Croaticum (ZA) in Zagreb.

The data collected from literature and herbaria were grouped into three age categories: data originating before 1950, data collected between 1950 and 1980 and data collected after 1980.

The nomenclature of plant taxa was given according to Index Florae Croaticae (MARKOVIĆ, 1997).

The geocoding of the field observations was carried out in the field. Literature data and herbarium specimens were geocoded afterwards.

Imprecise data on the finding locations could not be geocoded and used for making distribution maps, but were included in the data analysis.

All the data from the field lists, literature and herbaria were recorded in the CROFlora 2.0 database (NIKOLIĆ *et al.*, 2001), and were used for drawing distribution maps (by applying Arc View 3.2 tool).

RESULTS

Floristic mapping within Medvednica Nature Park has shown that four species of the genus *Impatiens* are present in the area: *I. balfourii*, *I. glandulifera*, *I. noli-tangere* and *I. parviflora*. To this date, only the species *I. noli-tangere* was registered for the area of the Nature Park (DOBROVIĆ, 2001; HIRC, 1904) and the species *I. parviflora* was recorded in EGIĆ (1978). In the recent floristic research, the species *I. balfourii* and *I. glandulifera* were registered for the first time.

During the floristic trips in the course of the year 1998, garden balsam (*I. balsamina*) was found escaped from cultivation close to the village of Štefanovec, but just outside of the Park borders. Distribution maps were made based on the data collected from all three sources (MTB grid 1/64) (Fig. 2–5).

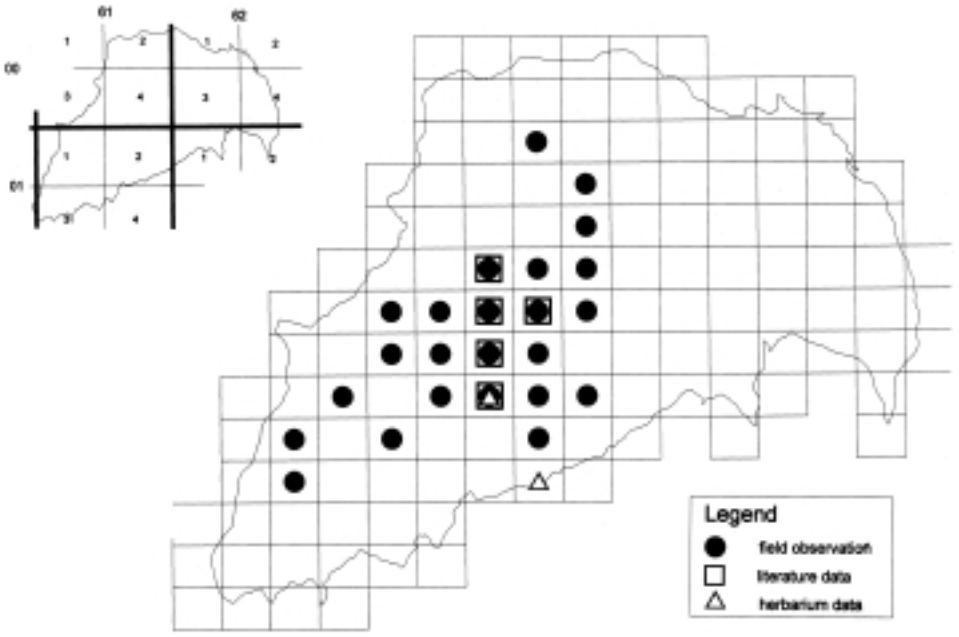

Fig. 2. Distribution of the species *I. noli-tangere* L. in Medvednica Nature Park.

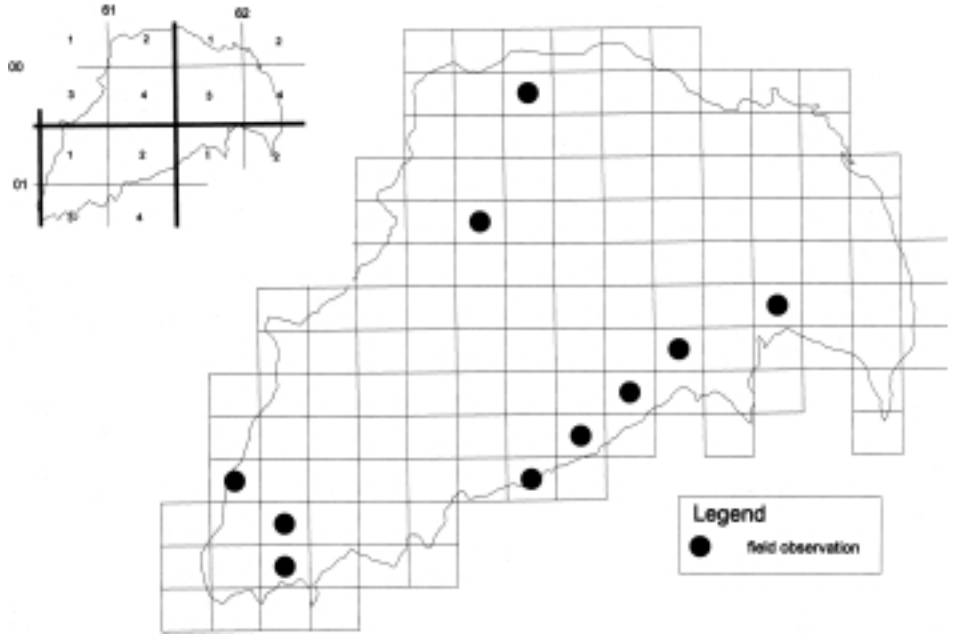

Fig. 3. Distribution of the species *I. balfourii* Hooker f. in Medvednica Nature Park.

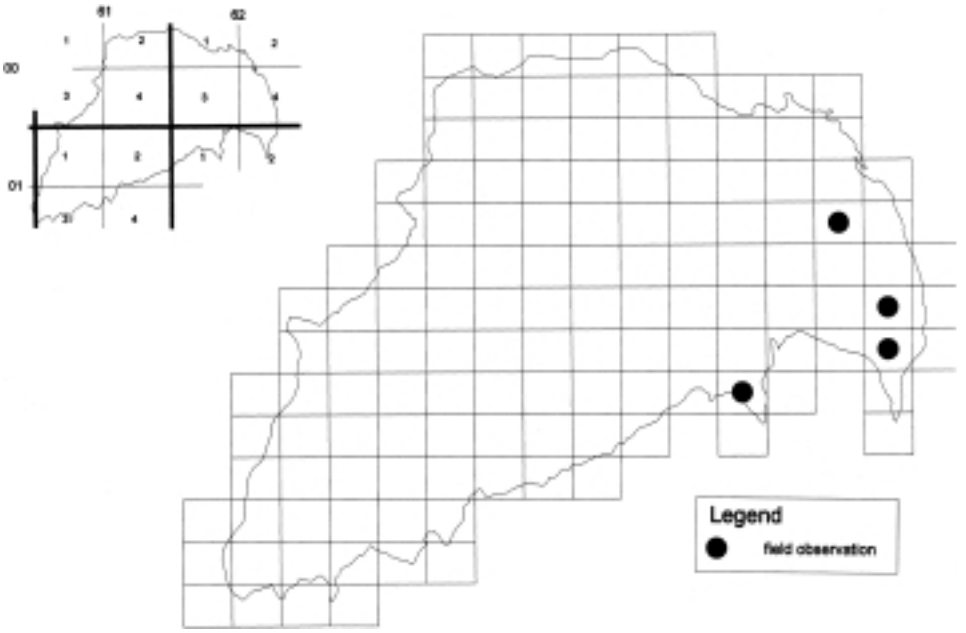

Fig. 4. Distribution of the species *I. glandulifera* Royle in Medvednica Nature Park.

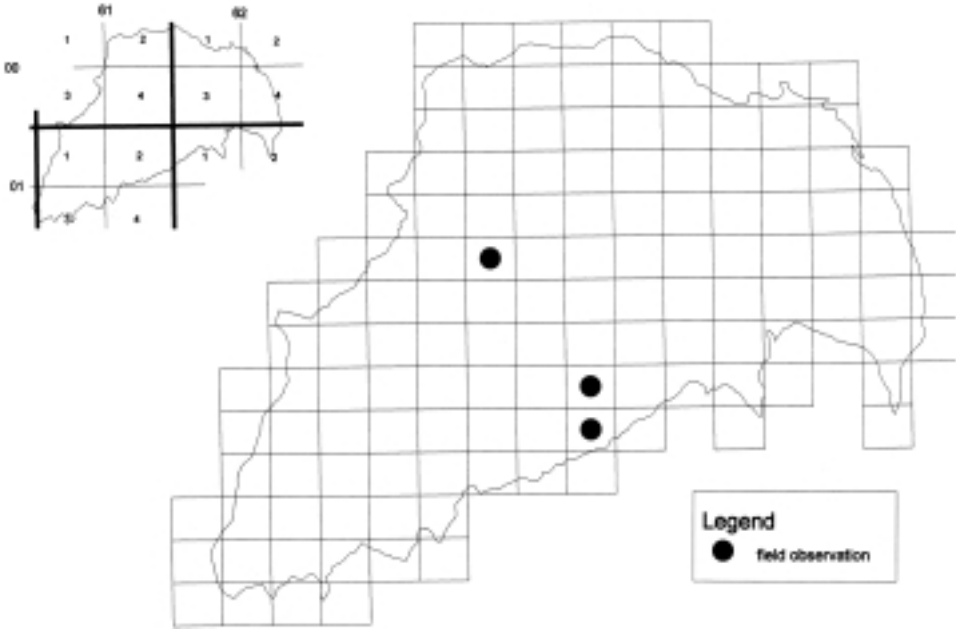

Fig. 5. Distribution of the species *I. parviflora* DC. in Medvednica Nature Park.

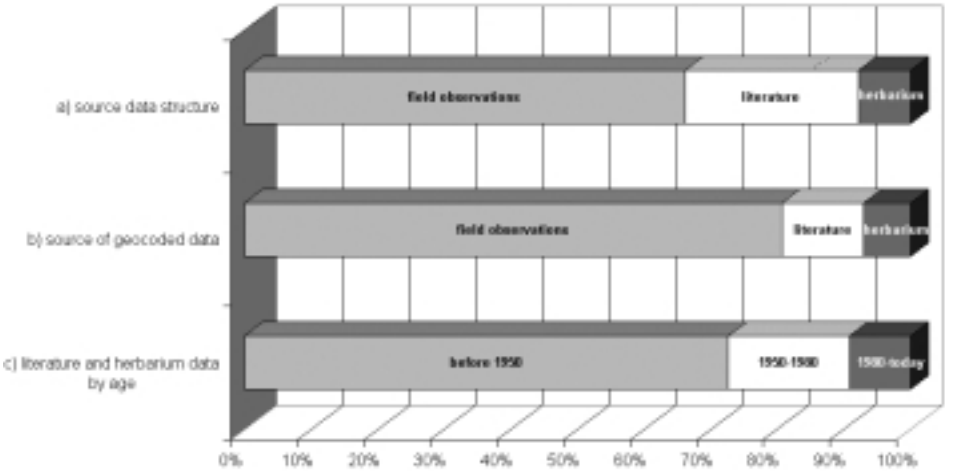

Fig. 6. (a) Structure of data by source, (b) Structure of geocoded data by source, (c) Structure of literature and herbarium data by age.

The species *I. noli-tangere* was recorded in 25 quadrants and it is the most widespread species in the Park (Fig. 2). It is followed by the species *I. balfourii*, which was recorded in 10 quadrants (Fig. 3), *I. glandulifera* in 4 quadrants (Fig. 4), and *I. parviflora* recorded in 3 quadrants (Fig. 5).

Most of the total recorded data are based on 51 field observations, i.e. 66.2%. Twenty data items derive from the literature, i.e. 26% and there are only 6 herbarium-derived data items, i.e. 7.8%. Herbaria ZA and ZAHO contain only *I. noli-tangere* specimens originating before 1950.

Among chorological data, 57, i.e. 74% are geocoded and 20, i.e. 26% data were not usable for geocoding. Data unsuitable for geocoding were mostly data acquired from literature with imprecise locality citations. The majority of literature and herbaria data (72.7%) are more than 50 years old (Fig. 6).

DISCUSSION

Seven species of the genus *Impatiens* are distributed throughout Europe (MOORE, 1968; Slavik, 1996) and five of them are present in Croatia (MARKOVIĆ, 1997). In the Medvednica Nature Park area there are four species of the genus *Impatiens* and the fifth *I. balsamina*, was found in the area just outside the borders of the Park. Data distribution of the species *I. balfourii*, *I. glandulifera* and *I. parviflora* are exclusively a result of the recent floristic research (1997–1998). A small number of the data for the species *I. noli-tangere* come from literature and herbarium data. Having in mind everything mentioned above the following conclusion could be drawn: distribution maps for the species from genus *Impatiens* in the Nature Park area indicate a realistic picture of their distribution at the moment the research took place.

In the Park area the most widespread is the circumboreal species *I. noli-tangere*, which can be found on the forest edges because of its preference for moist and shady locations as an indicator of a moist soil (ELLENBERG *et al.*, 1991; LANDOLT, 1977). Previously, flora research had shown the presence of the species *I. noli-tangere* in the following areas: Zagrebačka gora (DOBROVIĆ, 2001; FORENBACHER, 1908; HIRC, 1904; KLINGGRÄFF, 1861; SCHLOSSER & VUKOTINOVIĆ, 1857), the surroundings of Zagreb (HIRC, 1904; SCHLOSSER & VUKOTINOVIĆ, 1869), the surroundings of Samobor (HIRC, 1904; ROSSI, 1924), Gorski kotar (HIRC, 1904; ROSSI, 1924; 1930) and Moslavina (HIRC, 1904; SCHLOSSER & VUKOTINOVIĆ, 1869).

Field flora research indicates that the species is distributed in the central and western part of the Nature Park. Touch-me-not's high distribution in the Nature Park area was expected because of the abundance of forest-edge localities, which are appropriate for this species.

I. balfourii is the second most distributed species in the Park flora, and it was recorded in 10 quadrants. This neophyte species originates from the Himalayas (MOORE, 1968) and was brought to Europe as a decorative plant. It spread quickly as an uncontrolled weed species (BEGER & SCHMID, 1925). It is present as a part of nitrophilic vegetation, mostly near the forest edges, creeks and roads (ILIJANIĆ *et al.*, 1994). In Croatia it was recorded for the first time in Istria (PERICIN, 1992). Recently, *I. balfourii* was found in the Zagreb area (Jelenovac, Zelengaj), Budinšćina (Hrvatsko Zagorje) (ILIJANIĆ *et al.*, 1994) and Krapinske Toplice (ŠOŠTARIĆ & MARKOVIĆ, 1998). It was recorded as a Nature Park species in localities where indigenous vegetation had withdrawn due to anthropogenic activity.

The species *I. glandulifera* was recorded in four quadrants in the eastern part of the Park. This species also originates from the Himalayas (BEERLING & PERRINS, 1993) and it was brought to Europe in 1839 as a decorative plant. Later it spread from gardens throughout Europe and became a widely distributed European neophyte. This annual plant usually grows in large populations and it can be up to two to three meters tall. Suitable locations for this plant are creek and river banks (BEGER & SCHMID, 1925). In Austria populations of this plant take up a significant area of moist localities, especially in river valleys (PAVLETIĆ, 1993). Those kinds of localities are suitable for forestation, so the species *I. glandulifera* is treated as a weed that is dangerous for survival of forest seedlings. As a wild growing plant this species was recorded in Croatia for the first time in 1968 on the Sava river banks and in the surroundings of Zagreb (MARKOVIĆ, 1970). After that it was recorded in the area of Skrad, Gorski Kotar (TRINAJSTIĆ, 1974). For the area of north-west Croatia recording was done by TRINAJSTIĆ (1974) and MARKOVIĆ (1984). LUKAČ (1989) recorded this species for the area of north-west Croatia, Kutina and Osijek environs. Localities in the Osijek area are the easternmost known localities to date in Croatia. PAVLETIĆ (1993) recorded two new localities: Bregana near Samobor and Stojdraga on Mount Žumberak. The most recent localities of this species are east of Repaš on the left river bank of the Drava (TRINAJSTIĆ *et al.*, 1994) and in the area of Krapinske Toplice (ŠOŠTARIĆ & MARKOVIĆ, 1998). Findings of this neophyte species in Croatia indicate that it is disseminated in two ways: by water streams and spreading from village gardens where it is often present as a decorative plant (PAVLETIĆ, 1993).

I. parviflora is the least distributed species in the area of the Nature Park, recorded in only three quadrants. This neophyte species originates from central Asia (TREPL, 1984). EGIĆ (1978) was the first author to record the presence of this species, in the Grafičar-Mrzlak stretch in the area from 800 till 1035 m a. s. l.

Three neophytes species (*I. balfourii*, *I. glandulifera* and *I. parviflora*) are mainly distributed in the marginal parts of Medvednica Nature Park. This is understandable because those are the parts of the Park where anthropogenic influence is very large due to the proximity of Zagreb in the south-eastern part and the settlements under Medvednica in the north-western part of the Park. The natural vegetation in the area of the Nature Park is being disturbed due to urban development and stronger anthropogenic influence. In this way good conditions are being created for the distribution of neophytes. Sometimes the natural vegetation can be repressed by new populations of mentioned neophytes. Therefore it is necessary to observe any further distribution of the neophytes and their possible influence on the natural vegetation in the Nature Park.

CONCLUSION

Floristic data analysis based on three sources (field research, literature data and herbarium data) for the area of Medvednica Nature Park indicated the presence of four species of the genus *Impatiens*: *I. balfourii*, *I. glandulifera*, *I. noli-tangere* and *I. parviflora*. The species *I. balfourii*, *I. glandulifera* and *I. parviflora* are published for the first time as a part of Nature Park flora. In the area of Mount Medvednica the species *I. balsamina* was recorded but its location was outside of the borders of the Nature Park. The most widespread is the indigenous species *I. noli-tangere*. The remaining three neophyte species do not have a wide distribution. In the future, if the anthropogenic influence in the area of Nature Park increases, further distribution of these (and other) neophytes can be expected.

ACKNOWLEDGMENTS

We would like to express our particular thanks to Dr. Božena Mitić for her comments on the manuscript.

Received December 13, 2002

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SAŽETAK

Rasprostranjenost roda *Impatiens* u Parku Prirode Medvednica, Hrvatska

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Prilikom izrade floristične karte Parka Prirode Medvednica istraživana je i rasprostranjenost roda *Impatiens*. Analizom rezultata dosadašnjih florističkih istraživanja utvrđene su četiri vrste roda *Impatiens* na Medvednici: *Impatiens balfourii* Hooker f., *I. glandulifera* Royle, *I. noli-tangere* L. i *I. parviflora* DC.

Podaci o rasprostranjenosti potječu iz tri izvora: terenskih istraživanja (66.2%), literature (26 %) i herbarija (7.8%). Od ukupnog broja koroloških podataka 57 (74 %) je bilo geokodirano. Najveći dio podataka iz literature i herbara stariji je od 50 godina. Kartiranje rasprostranjenosti obavljeno je na temelju osnovnih jedinica srednjoeuropske mreže (MTB) za kartiranje flore s upotrebom 1/64 osnovnih polja, te su izrađene karte rasprostranjenosti za navedene vrste. Podaci o rasprostranjenosti vrsta *Impatiens balfourii* Hooker f., *I. glandulifera* Royle i *I. parviflora* DC. gotovo isključivo su rezultat recentnih floristička istraživanja (1997–1998. god.), dok manji dio podataka za vrstu *I. noli-tangere* L. potječe i iz druga dva izvora. Najšire rasprostranjena vrsta je *I. noli-tangere*.

U slučaju pojačanog antropogenog utjecaja na prirodnu vegetaciju, u budućnosti se može očekivati dalje širenje ovih (i drugih) neofitskih vrsta.