



Identification of Invasive Alien Species using DNA barcodes

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General introduction to this factsheet

The Barcoding Facility for Organisms and Tissues of Policy Concern (BopCo) aims at developing an expertise forum to facilitate the identification of biological samples of policy concern in Belgium and Europe. The project represents part of the Belgian federal contribution to the European Research Infrastructure Consortium LifeWatch.

Non-native species which are being introduced into Europe, whether by accident or deliberately, can be of policy concern since some of them can reproduce and disperse rapidly in a new territory, establish viable populations and even outcompete native species. As a consequence of their presence, natural and managed ecosystems can be disrupted, crops and livestock affected, and vector-borne diseases or parasites might be introduced, impacting human health and socio-economic activities. Non-native species causing such adverse effects are called Invasive Alien Species (IAS). In order to protect native biodiversity and ecosystems, and to mitigate the potential impact on human health and socio-economic activities, the issue of IAS is tackled in Europe by EU Regulation 1143/2014 of the European Parliament and Council. The IAS Regulation provides for a set of measures to be taken across all member states. The list of Invasive Alien Species of Union Concern is regularly updated. In order to implement the proposed actions, however, methods for accurate species identification are required when suspicious biological material is encountered.

Because morphology-based species identifications are not always possible (e.g. cryptic species, trace material, early life-stages), the purpose of the present work is to investigate and evaluate the usefulness of DNA sequence data to identify each of the IAS included in the EU Regulation. The results are presented as factsheets (one per IAS) compiled using publicly available DNA sequence data and information aggregated from various sources. Each factsheet consists of two major parts; (i) a short introduction to the specific IAS compiling information on its taxonomy and current occurrence/distribution in Europe; (ii) an investigation with respect to the usefulness of publicly available DNA sequences to identify this IAS to the taxonomic level stated in the EU list using DNA barcoding. For further information about the reasoning behind the applied approach and details on the materials and methods utilised, please see below and Smitz *et al.* [1].

More info about BopCo on <http://bopco.myspecies.info/> or contact us via bopco@naturalsciences.be.

More info on the EU Regulation on http://ec.europa.eu/environment/nature/invasivealien/index_en.htm.

Impatiens glandulifera

Royle, 1835

Common names:

English: Himalayan balsam, Indian balsam, ornamental jewelweed, policeman's helmet, touch-me-not

French: balsamine de l'Himalaya, balsamine glanduleuse, balsamine géante

German: drüsiges Springkraut, Indisches Springkraut, Riesenspringkraut

Dutch: reuzenbalsemien

Last update: August 2020



General information on *Impatiens glandulifera*

Classification

Kingdom	Phylum	Clade	Order	Family	Genus
Plantae	Magnoliophyta	Eudicots	Ericales	Balsaminaceae	<i>Impatiens</i>

Species in the same genus: N = ca. 1047 [2, 3]

Note: We follow the classification of WCVP.

Impatiens and the genus *Hydrocera* (with one species) make up the whole family.

Infra-species level: N = 2 [2]

Note: Two forms are accepted: *I.g.* forma *albida* and *I.g.* forma *pallidiflora*.



Native range: [4, 5]

Western Himalayas; northern India, Nepal, northern Pakistan.

Invasive range: [4, 5]

Europe (geographical):

Austria, Belarus, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.

For more detailed locality information and the most recent distribution updates, please visit:

www.gbif.org/species/2891770

<https://gd.eppo.int/taxon/IPAGL/distribution>

<http://alien.jrc.ec.europa.eu/SpeciesMapper>

Outside Europe (geographical):

Canada, Japan, New Zealand, Russia, United States of America.

Morphology, biology, invasion, negative effects and remedies

For more information on *Impatiens glandulifera* please see the references and online information listed at the end of this document.



Species identification based on DNA barcodes

Introduction

DNA barcoding is a species identification method that uses a short genetic sequence (DNA barcode) to compare an unknown sample to a database of reference sequences with known species affiliations. The underlying rationale is that the divergence of nucleotide sequences among different species is larger than the nucleotide divergence between sequences within a species. DNA barcoding can facilitate the identification of IAS samples, especially when morphological characteristics are absent or useless. To assure correct species identifications, however, reference libraries need to include a sufficiently large number of sequences of (i) the IAS under investigation, in order to assess the intraspecific genetic divergence; (ii) the closely related species, in order to evaluate the interspecific genetic divergence; (iii) the different geographical areas covering the distribution range (native and invasive) of the IAS in order to detect potential population structure or local hybrids.

Against this background, BopCo evaluated the inclusion of the IAS and their close relatives in both publicly available reference libraries BOLD (www.boldsystems.org/) and GenBank (www.ncbi.nlm.nih.gov/nuccore/) to estimate the reliability with which a species identification can be obtained using DNA barcoding.

Material and Methods [1]



Conclusion

Based on the present evaluation of the available sequence data, the ITS regions are the most reliable DNA markers for the identification of *Impatiens glandulifera*.

Discussion

DNA markers for which *Impatiens* sequences were available, were downloaded from GenBank and BOLD for all represented species of the genus *Impatiens*. Seven DNA markers were evaluated (Table 1).

The **full ITS** region and the component **ITS1** and **ITS2** regions, have similar datasets including by far the highest number of represented species of all evaluated DNA markers (Table 2). In each dataset *I. glandulifera* is represented by sequences from both native and invasive regions which are found to form a single, well-supported cluster. For the component ITS1 and ITS2 datasets a single *I. glandulifera* sequence does not cluster with all others (GenBank accession number KC905488), yet this might involve a misidentification. If so, the full ITS as well as the individual components ITS1 and ITS2 represent DNA marker regions which can be used to differentiate *I. glandulifera* from other *Impatiens* species.

Using the universal barcode marker **matK**, results in a supported clustering of the available *I. glandulifera* sequences. However, the latter all originate from Canadian populations and there is a very low overall species representation (Table 2). Notwithstanding the lack of data, the marker seems valuable to distinguish *I. glandulifera* from the similar looking species *I. capensis*, *I. noni-tangere* and *I. parviflora*. Additional sequences for *I. glandulifera* (from the native regions) and the missing congeners would allow to better evaluate the performance of the marker for species identification.

The dataset for the universal barcode marker **rbcl** is also very limited and additionally shows little genetic variation. In the current state of the online reference libraries it is therefore not advisable to apply this marker for species identification.

Although bigger datasets are available for the markers **DEF1** and **DEF2**, few sequences are available for *I. glandulifera*. It is currently impossible to assess the usefulness of these markers. However, since many *Impatiens* species are already represented, it might be interesting to further investigate these markers once additional *I. glandulifera* sequences become available.

For the **atpB-rbcl**, **trnH-psbA** and **trnL-trnF** intergenic spacer and the **trnL** gene fewer sequences are available, the species *I. glandulifera* is not or poorly represented and/or the marker shows little genetic variation for among the different species. Therefore, it is currently impossible to assess the ability of these markers to identify *I. glandulifera*.



Table 1: Overview of the encountered issues concerning the DNA-based identification of the IAS [1]: (1) Insufficient publicly available DNA sequences of the IAS to capture the intra-species divergence; (2) Poor geographical coverage of the IAS sequences (native or invasive range missing); (3) The IAS sequences do not form supported clusters; (4) Potential misidentification of a specimen which influences the clustering of the IAS sequences; and (5) Not all congeneric species are represented in the final NJ-tree. An 'X' indicates that the issue was encountered, a '1' indicates only one unique *I. glandulifera* sequence was available.

Markers analysed	1	2	3	4	5
rbcl	X	X	X		X
matK	X	X			X
Full ITS			X	X	X
ITS1			X	X	X
ITS2			X	X	X
DEF1	1	X	1		X
DEF2	X	X	X		X

Table 2: Publicly available sequences downloaded (March 2019) from BOLD and GenBank (including sequences extracted from plastid genomes) which were withheld as reliable and informative in the final alignment that was used for building the NJ-trees. The species names follow [2]. The list of species is limited to those members of *Impatiens* for which at least one sequence was used in any of the NJ-trees. Species names with * are not accepted in [2] but used on GenBank. An 'X' indicates that at least one sequence was used in the final alignment, an '(X)¹ or ²' indicates only ITS region 1 or 2 was available for analysis.

Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens aadishankarii</i>					
<i>Impatiens acaulis</i>			X		
<i>Impatiens acehensis</i>			X		
<i>Impatiens acuminata</i>					
<i>Impatiens adenioides</i>			X		
<i>Impatiens alboflava</i>			X		
<i>Impatiens allanii</i>			X		
<i>Impatiens ambanizanensis</i>			X	X	
<i>Impatiens amoena</i>			X		
<i>Impatiens amplexicaulis</i>	X				
<i>Impatiens anaimudica</i>			X		
<i>Impatiens andersonii</i>			X		
<i>Impatiens andohahelae</i>			X		
<i>Impatiens andringitrensis</i>			X	X	
<i>Impatiens angulata</i>			X		
<i>Impatiens anovensis</i>			X		
<i>Impatiens apalophylla</i>			X		
<i>Impatiens apsis</i>			X	X	
<i>Impatiens aquatilis</i>			X		X
<i>Impatiens arachnoides</i>				X	
<i>Impatiens arguta</i>	X		X	X	X
<i>Impatiens assurgens</i>				X	X
<i>Impatiens aurella</i>	X	X			
<i>Impatiens auricoma</i>			X	X	X
<i>Impatiens auriculata</i>			X		
<i>Impatiens austroyunnanensis</i>			X		
<i>Impatiens bababudenensis</i>			X		
<i>Impatiens bahanensis</i>					
<i>Impatiens balansae</i>			X		
<i>Impatiens balfourii</i>	X		X	X	X
<i>Impatiens balsamina</i>	X		X	X	X
<i>Impatiens barbata</i>	X		X		
<i>Impatiens baronii</i>			X	X	
<i>Impatiens batangadisensis</i>			X		
<i>Impatiens beccarii</i>			X		
<i>Impatiens begoniifolia</i>			X	X	X
<i>Impatiens bequaertii</i>			X	X	X
<i>Impatiens bicaudata</i>			X	X	X
<i>Impatiens bicolor</i>			X	X	X
<i>Impatiens bicornuta</i>	X		X		
<i>Impatiens biophytoides</i>			X	X	
<i>Impatiens bisaccata</i>			X	X	X
<i>Impatiens blinii</i>			X		
<i>Impatiens bokorensis</i>			X		



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens bombycine</i> *			X	X	X
<i>Impatiens bonii</i>			X		
<i>Impatiens brachycentra</i>	X	X	X		
<i>Impatiens briartii</i>				X	X
<i>Impatiens buccinalis</i>			X		
<i>Impatiens burtonii</i>			X	X	X
<i>Impatiens bururiensis</i>					X
<i>Impatiens calcicola</i>			X		
<i>Impatiens campanulata</i>			X	X	X
<i>Impatiens capensis</i>	X	X	X	X	
<i>Impatiens casseabriae</i>			X		
<i>Impatiens catati</i>			X	X	X
<i>Impatiens cecillii</i>				X	X
<i>Impatiens charanii</i>			X		
<i>Impatiens charisma</i>			X		
<i>Impatiens chekiangensis</i>			X		
<i>Impatiens chevalieri</i>					X
<i>Impatiens chiangdaoensis</i>			X		
<i>Impatiens chimiliensis</i>			X	X	
<i>Impatiens chinensis</i>			X	X	X
<i>Impatiens chishuiensis</i>			X		
<i>Impatiens chiulungensis</i>			X		
<i>Impatiens chlorosepala</i>			X		
<i>Impatiens chonoceras</i>			X		
<i>Impatiens chumphonensis</i>			X		
<i>Impatiens chungtienensis</i>			X	X	X
<i>Impatiens cinnabarina</i>				X	X
<i>Impatiens circaeoides</i>			X		
<i>Impatiens clavicornu</i>				X	X
<i>Impatiens clavigera</i>			X		
<i>Impatiens coelotropis</i>			X		
<i>Impatiens columbaria</i>			X	X	X
<i>Impatiens compta</i>			X		
<i>Impatiens conchibracteata</i>			X	X	X
<i>Impatiens confusa</i>				X	X
<i>Impatiens congolensis</i>			X	X	X
<i>Impatiens corchorifolia</i>			X		
<i>Impatiens cordata</i>			X		
<i>Impatiens curvipes</i>			X		
<i>Impatiens cuspidata</i>			X	X	X
<i>Impatiens cyanantha</i>			X		X
<i>Impatiens cyathiflora</i>			X		
<i>Impatiens cymbifera</i>	X		X		
<i>Impatiens dalzellii</i>			X		
<i>Impatiens damrongii</i>			X		
<i>Impatiens daraneenae</i>			X		
<i>Impatiens dasysperma</i>			X		
<i>Impatiens davidii</i>			X	X	X
<i>Impatiens debilis</i>			X		
<i>Impatiens decurva</i>			X		
<i>Impatiens delavayi</i>			X	X	X
<i>Impatiens desmantha</i>			X	X	
<i>Impatiens devolii</i>			X		
<i>Impatiens diepenhorstii</i>			X		
<i>Impatiens digitata</i>				X	X
<i>Impatiens discolor</i>	X		X		
<i>Impatiens disotis</i>			X		
<i>Impatiens dolichoceras</i>					
<i>Impatiens drepanophora</i>			X	X	
<i>Impatiens duclouxii</i>			X		
<i>Impatiens eberhardtii</i>				X	X
<i>Impatiens ecalcarata</i>			X		



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens ecornuta</i>		X	X		
<i>Impatiens edgeworthii</i>	X	X	X	X	X
<i>Impatiens ekapaksiana</i> *			X		
<i>Impatiens elatostemmoides</i>			X	X	X
<i>Impatiens elephanticeps</i>			X		
<i>Impatiens elianae</i>			X		X
<i>Impatiens engleri</i>				X	X
<i>Impatiens eriosperma</i> *			X		X
<i>Impatiens eryaleia</i>					X
<i>Impatiens ethiopica</i>					
<i>Impatiens etindensis</i>			X		
<i>Impatiens eubotrya</i> *			X		
<i>Impatiens faberi</i>			X	X	X
<i>Impatiens falcifera</i>	X		X		
<i>Impatiens fenghwaiana</i>			X		X
<i>Impatiens firmula</i>			X		
<i>Impatiens fischeri</i>			X	X	
<i>Impatiens fissicornis</i>			X		
<i>Impatiens flaccida</i>			X	X	X
<i>Impatiens flanaganiae</i>			X	X	X
<i>Impatiens floribunda</i>			X		
<i>Impatiens florulenta</i>			X		
<i>Impatiens forrestii</i>			X	X	X
<i>Impatiens foxworthyi</i>					
<i>Impatiens fragicolor</i>			X		
<i>Impatiens fuchsioides</i>			X		
<i>Impatiens fugongensis</i>			X		
<i>Impatiens furcata</i>			X	X	X
<i>Impatiens galactica</i>			X	X	X
<i>Impatiens gardneriana</i>			X		
<i>Impatiens gesneroidea</i>				X	X
<i>Impatiens glandiflora</i> *			X		
<i>Impatiens glandulifera</i>	X	X	X	X	X
<i>Impatiens gongshanensis</i>			X		
<i>Impatiens gordonii</i>	X			X	X
<i>Impatiens goughii</i>			X		
<i>Impatiens grandis</i>			X		
<i>Impatiens hamata</i>				X	X
<i>Impatiens harae</i>			X		
<i>Impatiens hawkeri</i>	X	X	X	X	X
<i>Impatiens hendrikii</i>			X	X	X
<i>Impatiens henslowiana</i>			X	X	X
<i>Impatiens herbicola</i>			X		
<i>Impatiens hians</i>			X	X	X
<i>Impatiens hochstetteri</i>				X	X
<i>Impatiens hoehnelii</i>	X		X	X	X
<i>Impatiens holocentra</i>			X		
<i>Impatiens hongkongensis</i>			X		
<i>Impatiens huangyanensis</i>			X		
<i>Impatiens hunanensis</i>			X		
<i>Impatiens hydrogetonoides</i>				X	X
<i>Impatiens hypophylla</i>		X	X		
<i>Impatiens imbecilla</i>			X	X	X
<i>Impatiens inaperta</i>			X	X	X
<i>Impatiens ioides</i>				X	X
<i>Impatiens irvingii</i>				X	X
<i>Impatiens issembei</i>			X		
<i>Impatiens javensis</i>			X		
<i>Impatiens jerdoniae</i>			(X) ²		
<i>Impatiens johnii</i>			X	X	
<i>Impatiens junghuhnii</i> *			X		
<i>Impatiens kachinensis</i>					



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens kamerunensis</i>				X	X
<i>Impatiens kamtilongensis</i>			X		
<i>Impatiens keilii</i>			X	X	X
<i>Impatiens kerinciensis</i>			X		
<i>Impatiens kerriae</i>			X	X	X
<i>Impatiens kilimanjari</i>			X	X	
<i>Impatiens kinabaluensis</i>				X	X
<i>Impatiens kleiniformis</i>			X		
<i>Impatiens kunyitensis</i> *			X		
<i>Impatiens laevigata</i>			X		
<i>Impatiens langbianensis</i>				X	X
<i>Impatiens larsenii</i>			X		
<i>Impatiens lateristachys</i>			X		
<i>Impatiens latifolia</i>			X	X	X
<i>Impatiens laurentii</i>			X	X	X
<i>Impatiens lawii</i>			X		
<i>Impatiens laxiflora</i>			X		
<i>Impatiens lecomtei</i>			X	X	
<i>Impatiens leptocaulon</i>			X		
<i>Impatiens leptopoda</i>			X		
<i>Impatiens leschenaultii</i>			X		
<i>Impatiens levingei</i>			X	X	
<i>Impatiens ligulata</i>			X		
<i>Impatiens lingzhiensis</i>					
<i>Impatiens lobbiana</i>			X		
<i>Impatiens lobulifera</i>			X		
<i>Impatiens longiloba</i>			X		
<i>Impatiens lukwangulensis</i>				X	X
<i>Impatiens lutzii</i>			X	X	X
<i>Impatiens lyallii</i>			X		X
<i>Impatiens mackeyana</i>			X	X	X
<i>Impatiens macroptera</i>			X	X	X
<i>Impatiens macrosepala</i>			X		
<i>Impatiens macrovexilla</i>			X		
<i>Impatiens maculata</i>			X		
<i>Impatiens majumdarii</i>			X		
<i>Impatiens malipoensis</i>			X		
<i>Impatiens manaharensis</i>			X	X	
<i>Impatiens mandrakae</i>			X		X
<i>Impatiens mannii</i>				X	X
<i>Impatiens manteroana</i>			X		
<i>Impatiens margaritifera</i>			X		
<i>Impatiens marojejyensis</i>			X	X	X
<i>Impatiens masoalensis</i>			X	X	X
<i>Impatiens masonii</i>			X		
<i>Impatiens max-huberi</i>			X	X	X
<i>Impatiens mazumbaiensis</i>				X	X
<i>Impatiens meruensis</i>			X	X	X
<i>Impatiens microcentra</i>			X		
<i>Impatiens microstachys</i>			X		
<i>Impatiens mildbraedii</i>				X	X
<i>Impatiens miniata</i>			X		
<i>Impatiens minor</i>	X		X		X
<i>Impatiens mirabilis</i>			X		
<i>Impatiens modesta</i>			X		
<i>Impatiens monticola</i>			X	X	X
<i>Impatiens morsei</i>			X		
<i>Impatiens msimwanensis</i>				X	X
<i>Impatiens munronii</i>					
<i>Impatiens muscicola</i> *			X		
<i>Impatiens mysorensis</i>			X		
<i>Impatiens nalampoonii</i>			X		



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens namkatensis</i>			X		
<i>Impatiens nana</i>				X	X
<i>Impatiens napoensis</i>			X	X	X
<i>Impatiens navicula</i>			X	X	X
<i>Impatiens neglecta</i>			X		
<i>Impatiens neomunronii</i>			X		
<i>Impatiens niamniamensis</i>			X	X	X
<i>Impatiens noei*</i>			X		
<i>Impatiens noli-tangere</i>	X	X	X		
<i>Impatiens nomenyae</i>			X	X	
<i>Impatiens nubigena</i>	X		X		
<i>Impatiens nyimana</i>			X		
<i>Impatiens nyungwensis</i>				X	
<i>Impatiens obesa</i>			X		
<i>Impatiens oblongata</i>			X		
<i>Impatiens occultans</i>	X		X		
<i>Impatiens ohwadae *</i>		X	X		
<i>Impatiens omeiana</i>			X	X	X
<i>Impatiens opinata</i>			X		
<i>Impatiens oppositifolia</i>			X		
<i>Impatiens oreophila</i>			X		
<i>Impatiens oxyanthera</i>			X	X	
<i>Impatiens pallida</i>	X	X	X	X	X
<i>Impatiens pallide-rosea</i>				X	
<i>Impatiens palpebrata</i>			X	X	X
<i>Impatiens pandata</i>			X	X	
<i>Impatiens pandurata</i>			X		
<i>Impatiens parasitica</i>			X	X	X
<i>Impatiens parishii</i>			X		
<i>Impatiens parviflora</i>	X	X	X	X	X
<i>Impatiens patula*</i>			X		
<i>Impatiens paucidentata</i>				X	
<i>Impatiens peltata</i>			X		
<i>Impatiens pendula</i>			X		
<i>Impatiens percordata</i>				X	X
<i>Impatiens percrenata</i>			X		
<i>Impatiens phahompokensis</i>			X		
<i>Impatiens phengklaii</i>			X		
<i>Impatiens phoenicea</i>			X		
<i>Impatiens phuluangensis</i>			X		
<i>Impatiens pilosivittata*</i>			X		
<i>Impatiens pinganoensis</i>				X	X
<i>Impatiens pingxiangensis</i>			X		
<i>Impatiens piufanensis</i>	X	X	X		
<i>Impatiens platychlaena</i>			X		
<i>Impatiens platypetala</i>			X	X	X
<i>Impatiens platysepala</i>			(X) ¹²		
<i>Impatiens poculifer</i>	X	X	X	X	X
<i>Impatiens poilanei</i>				X	X
<i>Impatiens porrecta</i>			X		
<i>Impatiens prainii</i>			X	X	X
<i>Impatiens principis</i>			X		
<i>Impatiens pritzelii</i>			X		
<i>Impatiens pseudohamata</i>				X	X
<i>Impatiens pseudomacroptera</i>			X	X	X
<i>Impatiens pseudoviola</i>			X	X	X
<i>Impatiens pseudozombensis</i>				X	X
<i>Impatiens psittacina</i>			X		
<i>Impatiens psychadelphoides</i>				X	X
<i>Impatiens pterosepala</i>			X		
<i>Impatiens puberula</i>	X				
<i>Impatiens pulcherrima</i>			X		



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens pulchra</i>			X	X	X
<i>Impatiens purpurea</i>			X	X	X
<i>Impatiens putaoensis</i>			X		
<i>Impatiens putii</i>			X		
<i>Impatiens pyrhotricha</i>			X		
<i>Impatiens qingchengshanica</i>			X		
<i>Impatiens racemosa</i>	X		X		
<i>Impatiens radiata</i>	X	X	X		
<i>Impatiens ragoonensis</i>			X		
<i>Impatiens raphidothrix</i>				X	X
<i>Impatiens raziana</i>			X		
<i>Impatiens rectangula</i>			X	X	X
<i>Impatiens renae</i>			X	X	
<i>Impatiens repens</i>	X		X		
<i>Impatiens rivularis</i>			X	X	X
<i>Impatiens rosea</i>			X		
<i>Impatiens rothii</i>			X		X
<i>Impatiens rubricaulis</i>			X		
<i>Impatiens rubromaculata</i>				X	X
<i>Impatiens rubrostriata</i>			X	X	X
<i>Impatiens rufescens</i>			X		
<i>Impatiens ruiiensis</i>					
<i>Impatiens rutenbergii</i>			X	X	X
<i>Impatiens ruthiae</i>			X		
<i>Impatiens sakeriana</i>				X	X
<i>Impatiens salaengensis</i>			X		
<i>Impatiens salpinx</i>				X	X
<i>Impatiens sambiranensis</i>			X		
<i>Impatiens santisukii</i>			X		
<i>Impatiens scabrida</i>			X	X	X
<i>Impatiens scabriuscula</i>			X		
<i>Impatiens scapiflora</i>			X	X	
<i>Impatiens scripta</i>			X	X	X
<i>Impatiens scullyi</i>			X		
<i>Impatiens scutisepala</i>			X	X	
<i>Impatiens serpens</i>				X	X
<i>Impatiens serrata</i>	X				
<i>Impatiens shimianensis</i>			X		
<i>Impatiens shirensis</i>					
<i>Impatiens siamensis</i>					
<i>Impatiens siculifera</i>			X		X
<i>Impatiens sidikalangensis</i>			X		
<i>Impatiens silviana</i>				X	X
<i>Impatiens sirindhorniae</i>			X		
<i>Impatiens sodenii</i>			X	X	X
<i>Impatiens soulieana</i>			X	X	
<i>Impatiens spathulata</i>			X		
<i>Impatiens spectabilis</i>			X		
<i>Impatiens stenantha</i>				X	
<i>Impatiens stenosepala</i>			X	X	
<i>Impatiens stuhlmannii</i>			X	X	X
<i>Impatiens subabortiva</i>			X		
<i>Impatiens subecalcarata</i>	X				
<i>Impatiens sulcata</i>	X		X		
<i>Impatiens sunkoshiensis</i>			X		
<i>Impatiens susan-nathansoniae</i>			X	X	X
<i>Impatiens sylvicola</i>				X	X
<i>Impatiens tangachee</i>			X		
<i>Impatiens tanintharyiensis</i>			X		
<i>Impatiens tapanuliensis</i>			X		
<i>Impatiens tayemonii</i>			X		
<i>Impatiens teitensis</i>			X		X



Species in genus	rbcl	matK	Full ITS (ITS1 & ITS2)	DEF1	DEF2
<i>Impatiens textori</i>	X	X	X		
<i>Impatiens thamnoidea</i>				X	X
<i>Impatiens thomensis</i>			X		
<i>Impatiens tianlinensis</i>			X		
<i>Impatiens tienmushanica</i>			X		
<i>Impatiens tigrina</i>			X		
<i>Impatiens tinctoria</i>			X	X	X
<i>Impatiens tomentosa</i>			X		
<i>Impatiens tortisepala</i>			X		
<i>Impatiens travancorica</i>			X		
<i>Impatiens tribounii</i>			X		
<i>Impatiens tribuana</i>			X		
<i>Impatiens trichoceras</i>			X	X	X
<i>Impatiens trichosepala</i>			X		X
<i>Impatiens tripetala</i>			X		
<i>Impatiens tuberculata</i>			X		
<i>Impatiens tuberosa</i>			X	X	X
<i>Impatiens tubulosa</i>			X		
<i>Impatiens tweedieae</i>				X	X
<i>Impatiens uliginosa</i>			X	X	X
<i>Impatiens ulugurensis</i>				X	X
<i>Impatiens umbellate</i>			X		
<i>Impatiens uncinata</i>			X		
<i>Impatiens uniflora</i>	X		X	X	X
<i>Impatiens urticifolia</i>	X		X		
<i>Impatiens usambarensis</i>			X	X	X
<i>Impatiens vaughanii</i>			X		
<i>Impatiens vilersii</i>			X		
<i>Impatiens violacea</i>			X		
<i>Impatiens violiflora</i>			X	X	X
<i>Impatiens viscida</i>			X	X	X
<i>Impatiens viscosa</i>			X		X
<i>Impatiens volkensii</i>				X	
<i>Impatiens walleriana</i>	X		X	X	X
<i>Impatiens wallichii</i>	X				
<i>Impatiens warburgiana</i>					X
<i>Impatiens wenshanensis</i>			X		
<i>Impatiens wightiana</i>			X		
<i>Impatiens wilksiana</i>			X		
<i>Impatiens wilsonii</i>			X		
<i>Impatiens wuerstenii</i>				X	X
<i>Impatiens xanthina</i>			X	X	
<i>Impatiens yaoshanensis</i>			X		
<i>Impatiens yingjiangensis</i>			X	X	X
<i>Impatiens zollingeri</i>			X		
<i>Impatiens zombensis</i>				X	X
TOTAL species	37 /1047	14 /1047	314 (315)¹ (316)² /1047	155 /1047	141 /1047

For a more elaborate discussion of the available databases, the sequence selection process, the outcome of the NJ-tree analyses, the usefulness of the investigated DNA sequences for species identification, as well as information on how to send samples for analyses please contact BopCo directly.



References and online information

Online information

http://www.q-bank.eu/Plants/Factsheets/Impatiens_glandulifera_EN.pdf
http://www.europe-aliens.org/pdf/Impatiens_glandulifera.pdf
<http://www.iucngisd.org/gisd/species.php?sc=942>
http://www.centrederesources-loirenature.com/sites/default/files/ged/Fiche%20-%20Impatiens-glandulifera_sr.pdf [FR]
<http://www.centrederesources-loirenature.com/sites/default/files/ged/Impatiens-glandulifera.pdf> [FR]

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References

- [1] N. Smits, S. Gombeer, K. Meganck, A. Vanderheyden, Y. R. Van Bourgonie, T. Backeljau, and M. De Meyer, "Identifying IAS based on DNA barcoding using currently available sequence data: details on applied material and methods." 2019. [Online]. Available from: <http://bopco.myspecies.info/content/invasive-alien-species-ias-factsheets>.
- [2] WCVP, "World Checklist of Vascular Plants, version 2.0" 2020. [Online]. Available: <http://wcvp.science.kew.org/>. [Accessed: 15-Apr-2020].
- [3] Royal Botanical Gardens Kew., "*Impatiens* Riv. ex L." *Plants of the World Online*. [Online]. Available: <http://plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:325983-2>. [Accessed: 18-Mar-2019].
- [4] H. Helmisaari, "NOBANIS – Invasive Alien Species Fact Sheet – *Impatiens glandulifera*" 2010.
- [5] R. Tanner and K. Pollard, "*Impatiens glandulifera* (Himalayan balsam)" *CABI Invasive Species Compendium*, 2018. [Online]. Available: <https://www.cabi.org/isc/datasheet/28766>. [Accessed: 08-Mar-2019].

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