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Iran's Protected area network insufficiently represents climatic niches of endemic plants

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Abstract

Protected Areas (PA) play a pivotal role in Conservation Biology. Anthropogenic climate change challenges the concept of static PAs as species may shift their distribution outside of current PA boundaries. Here, I compare the climatic niche of species with the climatic conditions that the species find within their associated PAs. Therefore, I use a newly introduced method that is particularely suitable when occurrence data of species is scarce. I focus on Iran, a centre of endemism in Southwest Asia. Based on the Iranian PA network, I assess the representation of the climatic niches of Iran's endemic plants in the national PA network under current and future climatic conditions. I find that niche representation of endemic species in PAs reaches only ca. 50% under the current climate, and that it will further decrease to 20 – 30% in the future, depending on the climate scenario used. Low and high elevation species show least climatic representation of climatic niches within PAs. In the future, endemic species with narrow ranges within Iran will lose much more climatic representation than endemics that are widespread within the country. These results suggest that the Iranian PA network is not fit for climate change. Efficient conservation planning must focus on increasing elevational gradients within PAs and on the identification of microrefugia that allow for long term species' persistence.

Keywords: climatic niche, protected areas, niche modelling, mountain ecology, climate change, endemic plants

Abstract (deutsch)

Schutzgebiete (SG) spielen eine zentrale Rolle in der Naturschutzbiologie. Der anthropogene Klimawandel fechtet das Konzept von statischen SG an, da Arten ihre Verbreitung aus den SG Grenzen hinaus verschieben. In dieser Studie vergleiche ich die klimatische Nische von Arten mit den klimatischen Bedingungen, die Arten in ihren umliegenden SG finden. Dafür benutze ich eine neu eingeführte Methode, die sich besonders eignet, wenn wenig Verbeitungsdaten von Arten vorliegen. Ich fokussiere mich auf den Iran, ein Zentrum für Endemismus in Südwest-Asien. Basierend auf dem iranischen SG-Netzwerk bewerte ich die klimatische Abdeckung der iranischen, endemischen Pflanzen im nationalen SG Netzwerk unter derzeitigen und zukünftigen klimatischen Bedingungen. Ich stelle fest, dass die Abdeckung der Nischen der Endemiten in SG nur 50% unter aktuellem Klima beträgt. In Zukunft sinkt diese Abdeckung, abhängig vom Szenario, auf 20-30%. Arten tiefer und hoher Lagen haben die geringste Repräsentierung der klimatischen Nische in SG. In Zukunft werden Arten mit eingeschränkter Verbreitung mehr klimatische Repräsentierung verlieren als weitverbreitete Arten. Diese Ergebnisse deuten darauf hin, dass das iranische SG-Netzwerk nicht fit ist für den Klimawandel. Effiziente Naturschutzplanung muss Höhengradienten innerhalb von SG erhöhen und Mikrorefugia identifizieren, die eine Persistenz der Arten über einen langen Zeitraum ermöglichen.

Schlagwörter: klimatische Nische, Schutzgebiete, Nischenmodellierung, Gebirgsökologie, Klimawandel, endemische Pflanzen

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Einleitung

Der anthropogene Klimawandel sorgt für ein weltweites Ansteigen der Temperaturen auf der Erde (IPCC, 2019). Seit dem Beginn der Industriellen Revolution ist die Temperatur der Erdoberfläche kontinuierlich wärmer geworden (Shukla et al., 2019). Verantwortlich hierfür ist in erster Linie der Treibhauseffekt, der über die Menge an Treibhausgasen in der Atmosphäre gesteuert wird (Manabe, 2019). Die Treibhausgase verändern das Energiepotenzial in der Atmosphäre, indem sie die kurzwellige Strahlung der Sonne ungehindert auf die Erdoberfläche treffen lassen. Die daraufhin von Erde zurückgestrahlte langwellige Strahlung wird von den Treibhausgasen zurückgehalten und in alle Richtungen abgestrahlt. Natürlicherweise existieren mehrere Treibhausgase in der Atmosphäre, einen Großteil macht Wasserdampf H_2O aus. Andere bedeutende Treibhausegase sind Kohlendioxid (CO_2), Ozon (O_3), Lachgas (N_2O) und Methan (CH_4) (Tuckett, 2019). Durch die Verbrennung von Kohle und Gas hat der Mensch den CO_2-Anteil in der Atmosphäre seit der Industrialisierung von 280 parts per million (ppm) auf über 400 ppm erhöht (IPCC, 2019).

Das Klima der Zukunft wird in Klimamodellen dargestellt, sogenannte GCMs (General Circulation Model) (Randall, 2000). Diese Modelle berechnen das zukünftige Klima mit Hilfe von Schlüsselkompontenten des Klimasystems, wie zum Beispiel der Atmosphäre oder den Ozeanen (z.B. Zhang et al., 2020). Wie sich die Konzentration der Treibhausgase in Zukunft verändert hängt auch von dem Handeln der Menschen heute und in Zukunft ab. Um diese Entwicklung abzuschätzen stellen Wissenschaftler in unterschiedlichen sozioökonomischen Szenarien dar, welche klimarelevante Entscheidungen in Zukunft getroffen werden könnten und welcher Treibhausgasausstoß damit verbunden ist (sogenannte Relative Concentration Pathways (RCP)(Moss et al., 2010). Auf Basis dieser RCPs wird von verschiedenen wissenschaftlche Institutionenen mit Hilfe selbst-entwickelter GCMs das Klima der Zukunft berechnet (z.B. Séférian et al., 2019 Hajima et al., 2020). Der Weltklimarat IPCC (intergovernemental Panel on Climate Change) fasst die Ergebnisse der verschiedenen Institutionen zusammen und bereitet sie für Entscheidungsträger auf (IPCC, 2019). Die verschiedenen Modelle stimmen darin überein, dass die Temperatur in den nächsten Dekaden ansteigen wird. Neben den steigenden Temperaturen verändern sich auch die Niederschlagsmuster (Konpala et al., 2020). Durch den höheren CO_2-Gehalt in der Atmosphäre steigt der pH-Wert der Ozeane (Doney et al., 2009). Im Eis gespeichertes Wasser an den Polen sowie in Gletschern wird ebenfalls rapide abschmelzen (Allison et al., 2009, Haeberli et al., 2007). Eine weitere wichtige Erkenntnis der Klimawandelforschung ist, dass extreme Wetterereignisse, wie Dürreperioden oder Starkniederschlage zunehmen werden (Sillmann & Roeckner, 2008).

Das Studium der Effekte des Klimawandels auf die Artenvielfalt ist ein wissenschaftliches Feld, dass in den letzten Dekaden stark an Bedeutung gewonnen hat (Bellard et al., 2012; Araujo & Rahbeck, 2006, Trew et al., 2021). Die Ergebnisse dieser Forschung zeigen, dass Klimawandel die Artenvielfalt auf unterschiedliche Art und Weise beeinflussen kann. Eine weitverbreitete und häufige Reaktion von Arten ist die Anpassung von Verbreitungsgebieten an die sich verändernde Klimageographie (Chen et al., 2011). Diese Änderungen in den Verbreitungsmustern sind gut dokumentiert (Parmesan et al., 2003). Allgemein gilt, dass Arten der Äquator-naher Lagen dem Klimawandel folgen, indem sie sich in Richtung der Pole ausbreiten (Parmesan et al., 1999, Brommer et al., 2012). Arten der Gebirge wandern in höhere Lagen, um den zunehmend heißeren Temperaturen zu entkommen (Habel et al., 2019, Rumpf et al., 2019, Steinbauer et al., 2018). Es ändern sich jedoch nicht nur geografische Muster, sondern auch die Phänologie der Arten ist durch den Klimawandel beeinflusst (Menzel et al., 2006). Der Laubaustrieb von Pflanzen erfolgt früher im Jahr und der Laubabwurf später aufgrund der länger günstigen Bedingungen. Auch bei Tieren ist dieser Effekt sichtbar (Cohen et al., 2018). Vögel & Amphibien schieben ihren Zeitpunkt ihrer Fortpflanzung innerhalb des Jahres nach vorne (Hällfors et al., 2020, While & Uller, 2014). Für Libellen wurden frühere Flugzeiten im Zusammenhang mit steigenden Temperaturen im Frühling festgestellt (Dingemanse & Kalkman, 2008). Auch trophische Interaktionen wie etwa geografische oder phänologische Diskrepanzen zwischen Vertebraten, Insekten und Pflanzen sind eine Konsequenz des Klimawandels (Renner & Zohner, 2018).

Unter anderem um Prognosen über Veränderungen geografischer Verbreitungen von Arten unter dem Einfluss des Klimawandels zu machen, wurde Ende der 90er Jahre sogenannte Species Distribution Models (SDM) entwickelt (Thuiller et al., 2005). Sie basieren auf dem Konzept der ökologischen Nische, die in der Literatur unterschiedlich definiert wird (Ansprüche einer Art an ihre Umwelt sensu Grinnel & Hutchinson / Auswirkungen einer Art auf ihre Umwelt sensu Elton & MacArthur). Im Falle von SDMs ist die Verbreitung der Art durch biotische Interaktionen und Ressourcenlimitierung beschränkt und kommt demnach der realisierten, ökologischen Nische nach Hutchinson am nächsten (Chase & Leibold, 2009). Bis heute sind SDMs das weitestverbreitete Mittel um Aussagen über die zukünftige Verbreitung von Arten in einem geänderten Klima zu machen. SDMs sind empirische Modelle, die Umweltprädiktorvariablen mit Daten über die Verbreitung der

Zielart verbinden. Die beiden Datentypen, Umwelt und Vorkommen, werden über eine statistische Funktion verbunden. Diese Funktion kommt aus dem Bereich der frequentistischen Statistik, dem Bereich des ‚machine learning' oder der Bayesschen Statistik. Das Endergebnis des Models ist eine Karte, die die Vorkommenswahrscheinlichkeit der Art basierend auf den ausgewählten Umweltprädiktoren, angibt. Häufig wird die prognostizierte Karte mittels statistischem Schwellenwert in eine Präsenz-Absenz Karte umgewandelt (Allouche et al., 2006). SDM-Studien, die zukünftige Verbreitungen von Arten modellieren, zeigen ein eindeutiges Bild. Für den Großteil der Arten sinkt das potenzielle Verbreitungsgebiet (Didersky et al., 2018, Niskanen et al., 2019). Besonders gefährdet erscheinen dabei Arten, die in den Hochlagen der Gebirge vorkommen (Engler et al., 2011). Neben Prognosen zu zukünftigen Artenverbreitungen werden SDMs auch benutzt, um die Effizienz von Schutzgebieten zu ermitteln (Araújo et al., 2011).

Trotz der gewaltigen Vorteilen die SDMs der Forschung zu Biodiversität und Klimawandel gebracht haben, ist die Methode nicht frei von konzeptuellen Mängel (Schurr et al., 2012). So muss man bedenken, dass die geografische Verbreitung einer Art nicht unbedingt ihrer realisierten, ökologischen Nische nach Hutchinson entspricht. Nicht überall nämlich wo die Art vorkommt, ergibt die Zusammensetzung an Umweltvariablen eine positive Wachstumsrate. Ein Beispiel dafür sind source-sink Dynamiken (Holt, 2009). Sink-Populationen sind nicht fähig mit den herrschenden Umweltbedingungen langfristig zu überleben und können demnach SDM-Resultate verfälschen. Des Weiteren gibt es gewisse Migrationsimitierungen von Arten, die verhindern, dass Arten tatsächlich überall dort vorkommen, wo ein SDM sie hinprojizieren würde. Beispielsweise haben die Endemiten der Ostalpen ein viel größeres potenzielles Verbreitungsgebet als sie momentan besiedeln, sie waren (bislang) jedoch nicht in der Lage sich in diese Gebiete auszubreiten (Dullinger et al., 2012b). Schließlich gibt es Arten, die in Gebieten vorkommen, in denen eine positive Wachstumsrate aufgrund einer rezent veränderten Umwelt nicht mehr möglich ist. Je nach Biologie der Art können Populationen diese Änderungen aber unterschiedliche lange tolerieren oder überdauern. Das Ergebnis ist das Entstehen einer Aussterbeschuld, unter anderem als Folge rascher Klimaveränderung (Dullinger et al., 2012b). Ein letzter kritischer Punkt in der Erstellung von SDMs ist die Anzahl an Datenpunkten, die für eine Art zur Verfügung stehen. Um zuverässige Resultate zu produzieren, sollten gewisse Schwellenwerte nicht unterschritten werden (van Proosdij et al., 2016). Dies ist ungünstig, weil für seltene Arten, wie beispielsweise Endemiten, oft wenig Datenmaterial zur Verfügung steht.

Endemiten sind Arten, die auf ein bestimmtes geografisches Gebiet beschränkt sind (Anderson 1994; Townsend & Watson, 1998). Häufig bezieht man sich dabei auf politische Grenzen, um die Anzahl an Endemiten für ein bestimmtes Land anzugeben. Darüber hinaus spricht man von Subendemiten, wenn sich zumindest 80% der Verbreitung in einem bestimmten Land befinden. Endemismus ist besonders auf Inseln und in Gebirgen ausgeprägt und unterschiedliche Faktoren beeinflussen den Grad an Endemismus in einem Gebiet (Flantua et al., 2020). Erwähnenswert ist die historische klimatische Stabilität (Sandel et al., 2016). Sie ermöglicht ein Überleben von Arten, die in angrenzenden Gebieten mit starken klimatischen Oszillationen nicht überleben können. Die Ostalpen Österreichs liefern dafür gute Beispiele (Tribsch, 2004). Während der letzten Eiszeit waren die periglazialen Randbereiche der Alpen im Osten weitaus weniger stark vergletschert als die Zentralalpen – heute ist dafür der östlichste Teil der Alpen weitaus endemitenreicher als der zentrale Teil. Darüber hinaus ist ein weiterer Treiber von Endemismus die topographische Heterogenität (Dobrowski, 2011). Diese ermöglicht das Überdauern von ungünstigen Bedingungen in vom Regionalklima entkoppelten Mikrorefugia. Durch das Überleben in diesen Refugia wurden Populationen von ihren Schwesterpopulationen isoliert und entwickelten sich schließlich zu eigenen Arten.

Weil Endemiten eine kleinräumige Verbreitung und daher meist auch kleine Gesamtpopulationen aufweisen, spielen sie im Naturschutz eine zentrale Rolle (Manes et al., 2021). Neben dem Klimawandel bedrohen eine intensivierte Landnutzung, invasive Arten und Umweltverschmutzung zusätzlich ihr Überleben (und die Artenvielfalt im Allgemeinen (Diaz et al., 2019)). Für alpine Endemiten werden besondes starke Verbreitungsrückgänge als Folge des Klimawandels prognostiziert (Dirnböck et al., 2011). Als Gegenmaßnahme, insbesondere um die gleichzeitige Bedrohung durch andere Faktoren zu verringern, spielen Schutzgebiete (SG) eine wichtige Rolle. Die potentielle Effizienz von SG zeigt sich unter anderem in den größeren Populationen bedrohter Arten in SGs und deren Bedeutung als Zielort und Schrittstein für Arten, die ihre Areale dem Klimawandel anpassen (Thomas and Gillingham, 2015). Die Ausweitung der SGs ist daher auch ein naturschutzpolitisches Ziel, das in den letzten beiden Jahrzehnten erfreulicherweise bedeutende Fortschritte gemacht hat (Diaz et al., 2019).

Die vorliegende Arbeit beschäftigt sich mit den endemischen Pflanzen Irans und deren Repräsentation im nationalen Schutzgebietsnetzwerk. Der Iran ist ein artenreiches Land und besonders reich an Endemiten (Assadi, 2019, Noroozi et al., 2019a). Der kaukasische, sowie der irano-anatolische „Biodiversitäts-Hotspot“ befinden sich zum Teil auf iranischem Boden, wobei der Anteil am irano-anatolische Hotspot im Iran bei über 50% liegt (Mittermeier et al., 2011). Der Iran ist klimatisch sehr variabel und dies spiegelt sich in den diversen Ökosystemen wieder. Allgemein unterscheidet man drei Großklimata (Djamali et al., 2011). Diese decken sich mit den drei biogeografischen Regionen Irans. Die Nordseite der Gebirgskette Elburs ist sehr niederschlagsreich. Die hohen Temperaturen sowie ein gleichmäßiger Niederschlagsverkauf übers Jahr sorgen dafür, dass die Nordhänge des Elburs bis zu 3000m über dem Meeresspiegel mit dichtem, sommergrünem Wald bedeckt sind (Gholizadeh et al., 2020). Diese Vegetationsform, Teil des kaukasischen Biodiversitäts-Hotspot, bedeckt nur einen geringen Teil der iranischen Landfläche (Noroozi et al., 2020) und ist hinsichtlich ihrer Flora eng mit euro-sibirischen biogeografischen Region verwandt. Der Großteil Irans wird von mediterranoidem bis wüstenartigem Großklima dominiert. Niederschlagsmaxima treten im Spätherbst, Winter und Vorfrühling auf. In den Tieflagen dominieren Wüsten und Halbwüsten. Mit steigender Seehöhe findet man unterschiedliche Vegetationstypen vor (lockere Eichen-Bestände, von Sträuchern dominierte Vegetation, alpine Dornpolsterfluren)(Akhani et al., 2013; Noroozi et al., 2020). Diese Region wird dem irano-anatolischen Biodiversitäts-Hotspot zugeordnet, sowie der irano-turanischen, biogeografischen Region. Der letzte große Klimatyp ist der tropische Klimatyp. Es ist die trockenste klimatische Ausprägung im Iran und beschränkt sich auf den Süden. Das Niederschlagsregime ist ähnlich dem des mediterranoiden Klimatyps, jedoch ist die Niederschlagsmenge geringer, die Trockenperioden länger und die Temperaturen sind höher. Dieser Klimatyp entspricht der saharo-sindischen biogeografischen Region (Noroozi et al., 2020).

Die hohen Gebirgszügen Irans sind besonders reich an Endemiten (Noroozi et al., 2019). Der relative Anteil an Endemiten steigt mit der Seehöhe, wobei 62% der alpinen Pflanzen als endemisch gelten. Um Regionen mit besonders hohen Endemismuswerten zu identifizieren, hat Noroozi et al., 2018 ‚Areas of endemism‘ (AE) innerhalb Irans bestimmt. Diese AE sind Regionen, die sich in der Endemitenvielfalt signifikant von umliegenden Gebieten unterscheiden. Insgesamt wurden bei der Studie von Noroozi et al., 2018 5 AE bestimmt, wobei sich diese 5 Gebiete mit den 5 größten Gebirgsregionen Irans überdecken. Azerbaijan, Alburz, Kopet-Dagh, Zagros und Yazd sind die Gebirgsketten, die jeweils ein AE beinhalten. Alle AE befinden sich in der irano-turanischen Region. Noroozi et al., 2019b hat den staatlichen Schutz dieser Gebiete thematisiert. Dabei stellte sich heraus, dass über die Hälfte dieser AE nicht durch Schutzgebiete langfristig gesichert sind. Neben dem unzureichenden rechtlichen Schutz ist der hohe Beweidungsdruck eine Gefahr für die regionale

Flora Irans, die neben einer Reduktion der Biodiversität auch zu starker Bodenerosion führt (Noroozi et al., 2008; Soofi et al., 2018).

Neben der schwachen Abdeckung durch Schutzgebiete und dem hohen Beweiungsdruck wird der Klimawandel die Endemiten Irans möglicherweise zusätzlich unter Druck setzen. Studien zu Klimawandeleffekten auf die Biodiversität Irans sind rar und beziehen sich auf wenige Arten (Safaei et al., 2021; Haidarian et al., 2021). Ein Grund dafür ist die dünne Datengrundlage, die für den Großteil der Arten zur Verfügung steht. Prognosen über zukünftige Verbreitung von Pflanezn mit Hilfe von SDMs sind daher nicht möglich. Semenchuk et al. (in review 2021) haben aber eine Methode entwickelt, die Prognosen über die zukünftige Abdeckung der Klimanische von Arten durch Schutzgebiete auch auf der Basis spärlicher Datengrundlagen ermöglicht. In meiner Master-Arbeit wende ich diese Methode für die endemischen Pflanzen im Iran an. Dabei interessiert mich, wie sich die Repräsentation der klimatischen Nischen in Schutzgebieten unter momentanen Bedingungen darstellt und wie sie sich unter verschiedenen Klimawandelszenarien ändern würde. Außerdem frage ich, welche Rolle die Größe des aktuellen Verbreitungsgebiets sowie die mittlere Seehöhe der Verbreitung einer Art für die zukünftigen Gewinne oder Verluste an klimatischer Nischenabdeckung durch Schutzgebiete spielt.

Manuskript

Introduction

A deadly cocktail of anthropogenic changes to the planetary ecosystem challenge the survival of many species and may result in a sixth mass extinction (Barnosky et al., 2011; Stephens et al. 2019). Effective conservation measures are key to prevent biodiversity loss (Diaz et al., 2019) and area-based conservation is an important strategy in this context. Indeed, increasing PA cover is the Aichi target of the Convention on Biological Diversity that shows the strongest progress so far (Diaz et al., 2019).

In an area of climate change, however, area-based conservation faces the challenge that the geographic ranges of species will shift (Chen et al., 2011), while PA boundaries remain static. As a consequence, the overlap between species' ranges and the area covered by PA's will change (Lawler, 2015; Hoffmann et al., 2019). Species with sufficient dispersal capacities may be least affected from this emergent mismatch because they are able to overcome the unsuitable non-PA matrix and disperse to adjacent PA's to track their climatic niche (Thomas and Gillingham, 2015). However, these relocation processes are limited by low dispersal ability, geographical barriers (Burrows et al., 2014) and/or the climatic and structural connectivity between PA's (Ward et al., 2020; Parks et al., 2021).

Climate change velocity describes the rate by which climatic conditions shift in geographical space (Laurie et al., 2009). Because of steep climatic gradients it is usually low where topographic heterogeneity is high (Sandel et al., 2016; Harrison and Noss, 2017). This allowed even low-mobility species to follow climatic changes in the past and also fostered survival in microrefugia. The implicit 'climate-change buffer' is one of the reasons why many regions with high relief energy, essentially mountains, are rich in species in general, and often also in endemics (Dobrowski, 2011). While topographic heterogeneity may also buffer regional biodiversity against future climate change impacts (Harrison and Noss, 2017), high endemicity nevertheless makes these areas potential hotspots of (global) biodiversity loss. Moreover, endemic species often are endemic because they are poor dispersers, and those, that are restricted to high elevations may lose large parts of their suitable ranges completely (Dirnböck et al., 2011, Engler et al. 2011). "Climate-smart" conservation appears thus particularly important in these endemism hotspots, for example, by designing PAs such that tracking climatic niches is facilitated without moving outside of PA boundaries (Elsen et al., 2020).

Shifts of climatically suitable ranges are often anticipated by so-called species distribution models (Guisan & Thuiller 2005), and their projections can then be used in designing 'climate-smart' PAs (Guisan et al. 2013). However, these models have data requirements that are often not met for endemic species, because their narrow ranges are often associated with a low number of occurrence records (van Proosdij et al., 2016). On the part of the PAs, the performance of these under-documented species under climate change is mostly assessed by comparing the amount of climatic conditions represented in PAs with the overall climatic conditions in a region or a country (Elsen et a., 2020). This method has the major shortcoming that it disregards the climatic needs of the target species that live in PAs and which may overlap with PA conditions to a variable extent. In a recent study, Semenchuk et al., (in review 2021) used information on species' elevational limits to approximate climatic niches of endemic species independent of occurrence data and compared these inferred niches to the climatic conditions available in PAs within the species' range boundaries. They thereby shifted the focus from the geographical to the ecological domain and asked which part of the inferred niche of species is represented in regional PAs now and in a warmer future. Because

small heterogeneous landscapes can contain more climatic variability than large but homogeneous ones, this shift of focus delivers information that can deviate from estimates of geographical range change. While the latter is clearly important (Staude et al., 2018), ecological niche loss can also have strong implications for the fate of species because it affects future intraspecific diversity and hence, among other things, the potential of evolutionary adaptation to a changing climate (e.g. Balint et al. 2011).

Iran is a country with a complex topography and covers more than 50% of the Irano-Anatolian biodiversity hotspot (Noroozi et al., 2018). Endemic species particularly contribute to the flora of the high mountain chains that intersect the country, with 62% of alpine plants considered endemic to Iran (Noroozi et al. 2015). At the same time, occurrence records of endemic vascular plants are scarce (Noroozi et al., 2019a), mainly due to the large and difficult-to-access terrain as well as limited financial resources for botanical exploration. The Iranian mountain areas are moreover poorly protected through PAs (Noroozi et al., 2019b) and possible effects of climate change on their future ranges have been hardly explored so far.

Here, I apply the method of Semenchuk et al., (in review 2021) to the endemic flora of Iran. Based on information on the geographical and elevational distribution of those endemic and subendemic vascular plants with relatively well documented occurrence, I determine the representation of each species' niche within the PA network under current climate and under future climatic conditions. Further, I analyze whether high-elevation species suffer from disproportional loss of niche representation in PAs in the future and whether there is a link between geographic range and climatic niche representation within PAs.

Material and Methods

Study area

Iran, with its 1.6 million km² total surface, is a country situated in Southwest Asia. The heterogenous geology and topography are the result of high tectonic activity (Berberian & King, 1981). Vast deserts and semi-deserts dominate central and eastern Iran. They are surrounded by high mountain ranges which restrain precipitation from reaching the interior of the country (Djamali et al., 2011). The Irano-Turanian and the Caucasian biodiversity hotspot intersect the territory of Iran highlighting its outstanding biodiversity (Mittermeier et al., 2011). Five Areas of Endemism (AE) are located within the Irano-Turanian hotspot. These AE are particularly rich in endemic species (Noroozi et al., 2018, Noroozi et al., 2019a) and each AE is associated with one of the five major mountain areas of Iran (Azerbaijan Plateau, Alborz, Kopet Dagh-Khorassan, Zagros and the Yazd-Kerman massifs). The contribution of endemics to the total flora in these areas increases with elevation and peaks in the alpine life zone (Noroozi et al., 2008). Despite their significant contribution to biodiversity, the legal protection status of the AE is insufficient (Noorozi et al., 2019b).

Species and Protected Area data

I used occurrence point data for all known 2597 endemic and subendemic (range > 80% in Iran) vascular plants in Iran (Noroozi 2019a). However, most of these species are understudied and the elevational and geographical distribution is insufficiently documented. To avoid bias resulting from these knowledge gaps, I excluded species with a recorded elevational range lower than 800 meters, leaving me with 1277 species. For this subset, I defined their elevational range by the lowest and highest elevation reported with any occurrence record, respectively. Finally, these elevational ranges were controlled and adjusted by Jalil Noroozi, an expert on Iran's endemic flora.

I buffered all reported occurrences of each species by a geographical radius of 20km and interpreted the intersection of all these buffer areas as the species' current potential extent of occurrence. I

overlaid this extent of occurrence by a 250 x 250m digital elevation model (Jarvis et al. 2008) and selected all cells that fall within the elevational range of the species. These cells I considered as the species' potential area of occupancy (cf. Fig. 1).

The Iranian Department of Environment provides data on the national Protected Area (PA) network (Kolahy et al., 2013). I overlaid the PA network with each species' potential area of occupancy and defined, for each species, the PAs within its current extent of occurrence as reachable and hence relevant for the respective species until the end of the century. In doing so, I implicitly assume that each species' unrecorded occurrence and/ or dispersal capacity is bound with the extent of occurrence as defined above.

Climate data and scenarios

I used mean annual temperature (Tmean) and mean annual precipitation (Prec) to create raster maps of current and future climatic conditions for Iran. Data were extracted from the WorldClim data base for current and future climate in 30" resolution (www.worldclim.org). Among Global Circulation Models (GCM) available in this database, I selected ACCES1-0 (Ackerley, D. and Dommenget, D., 2016) as it is among the best GCM's in modelling climatic key processes (McSweeney et al., 2015). To account for uncertainty in climatic predictions, I used predictions for two IPCC5 scenarios representing medium (RCP 4.5) and severe (RCP 8.5) climate change and I selected two time steps (2050 and 2070).

I overlaid the species' area of potential occupancy and the PA maps with the climatic raster maps to calculate (1) the species' climatic niches (based on current climate), (2) its future potential area of occupancy (based on its climatic niche), and (3) the climatic space within the associated PAs under both current and future climatic conditions.

Temperature and Precipitation are major drivers of species distribution (Gaston, 2003). However, constructing the climatic niches of the species based on Tmean and Prec may neglect the specific climatic requirements of individual species (Körner and Hiltbrunner, 2018). However, with the data available, species-specific climatic niche construction is impossible. Hence, I keep with Semenchuk et al., (in review 2021) and consider the selected climatic variables as best available niche descriptors , in particular as Tmean and Prec often closely correlate with other climatic variables.

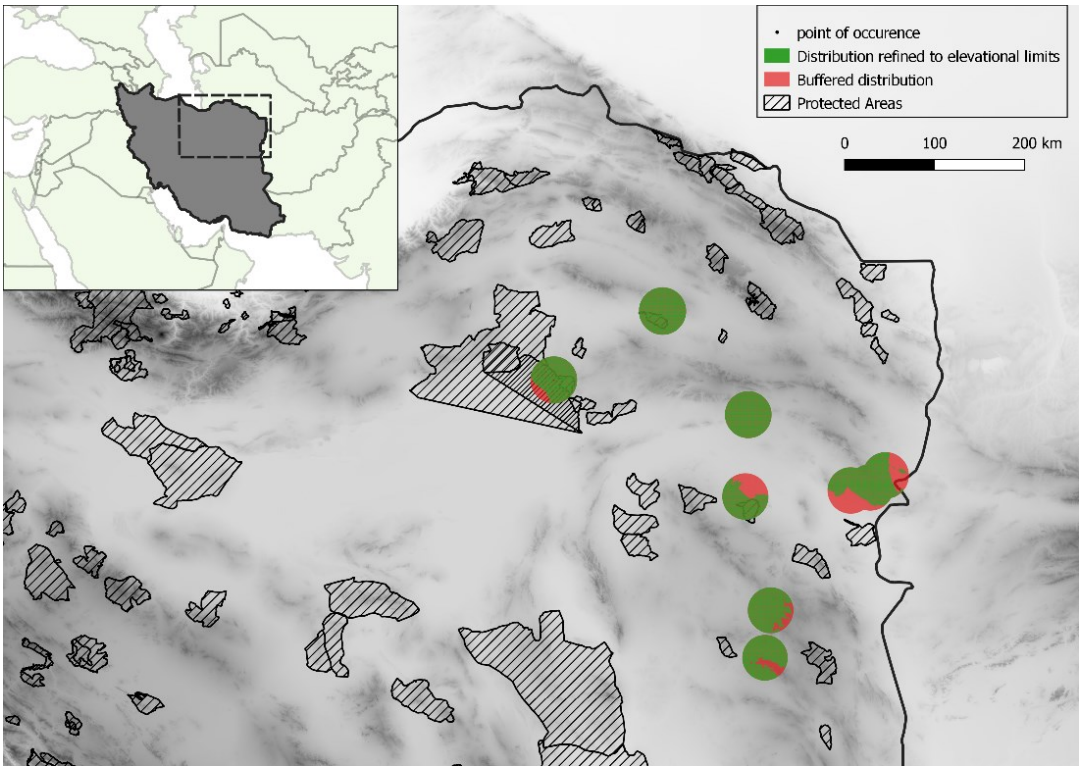

Figure 1: Derivation of potential area of occupancy from occurrence point data and information on elevational range limits illustrated for the vascular plant species Acantholimon austro-iranicus. The red area is the buffer (20 km) around the occurrence points, the sum of which represents the potential extent of occurrence, and the green area is the area within the buffer restricted to the elevational range limits. For more details see text. Background map is a digital elevation model. Darker shades represent higher altitudes.

Climate niche construction

I used the function ecospat.grid.clim.dyn from the package ecospat in R (Di Cola et al. 2017) to calculate a bivariate (in Tmean and Prec) density kernel (ranging from 0 to 1) for both the species' potential area of occupancy and its associated PAs under current as well as under future climatic conditions (cf. Fig. 2). I defined the kernel of the species' potential area of occupancy under current climatic conditions as its climatic niche and the kernels of the associated PAs as the climatic niche space offered by these PAs under either current or future conditions. I used the species' potential area of extent as the 'background area' necessary for calculation of the density kernels of species and PAs and their further comparison.

The future climate will be different from the current one. Currently available (analogous) combinations of climatic factors will be complemented by new (non-analogous) combinations of climate variables. This non-analogous climate is new for the species and the individual species' response to it is unpredictable (Fitzpatrick & Hargrove, 2009). I thus restricted all analyses to analogous climates and did not consider the emergence of non-analogue climates in PAs or species' area of occupancy in my calculations. In doing so, I neglect the possibility of niche adaptation and remain conservative in my predictions.

Semenchuk et al. (in review 2021) assume that dispersal does not limit the species in colonizing its future climatic niche within their current extent of occurrence. However, the extent of occurrence remains unchanged, i.e. migration beyond its borders is not considered, based on the assumption

that many endemics are likely strongly dispersal-limited. Likewise, PA's geographic distribution are assumed to remain unchanged in the study because I want to evaluate the potential of the current PA network.

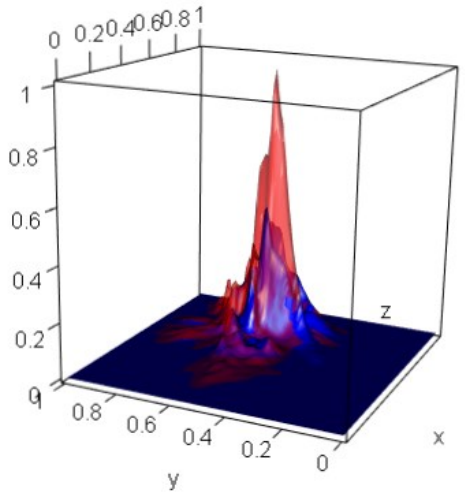

Figure 2: Bivariate density kernel (= climatic niche) of Cousina calocephala (red) and the climatic space in the associated PA's (blue) under current climate. The overlap between the two volumes is the suitable climatic space for the species in its associated PA's with Tmean on the x-axis, prec on the y-axis and the volume of the climatic niches of the species and theclimatic space in associated PAs on the z-axis.

Climatic niche representation

The representation of the species' climatic niche in its associated PAs is the percentage of volume of the species' bivariate density grid (species' grid) covered by the PA's bivariate density grid (PA grid). To calculate this percentage, I overlaid the species' grid and the PA grid. I removed the densities in the PA grid where the species' grid was zero. Then, I divided the PA grid's remaining non-zero values by the values of the species' grid. The outcome is a value ranging from 0 (no representation) to 1 (full representation). I calculated the representation of each species for each combination of time step and scenario.

Statistical analysis

I describe the temporal variation of the climatic representation in PAs for all species and for all time steps and scenarios with a generalized linear mixed effect model using the functions glmmTMB and betareg in R (Brooks et al., 2017; Cribari-Neto et al., 2009; R Core Team, 2017). The response variable in the model is the climatic niche representation (0 to 1) and I include species as random factor. Assuming the response to follow a beta distribution I applied the beta-family in the model. Some species have no climatic representation in their associated PA's at one or several time steps. Therefore, I applied the lemon squeezer transformation of Smithson and Verkuilen (2006) to deal with the zero values in the data prior to modelling. This is a necessary step as the link function of the beta distribution is not defined for values equal to zero (or one, but climatic representation never reached one). In total, I apply two models, differing in their predictor interaction term.

For the first model, the transformed climatic niche representation is the response and the different combinations of time step and scenario serve as predictor variables. I add mean elevation as an

interaction term to the time step/scenario predictors to account for the expected effect of elevational distribution on climatic niche representation. The visual inspection of the data suggests a unimodal distribution of the response variable. Therefore, I include mean elevation as a quadratic interaction term. I tested whether the interaction between time step/ scenario and mean elevation was significant by comparing the full model to the corresponding additive model by means of a likelihood ratio test. Then, I performed Tukey-corrected pair-wise comparisons across all factor levels in the model to test whether the climatic scenarios and mean elevation differ statistically significantly in terms of niche representation, taking pair-wise contrasts as significantly different with $p < 0.05$.

In a second model, I want to evaluate whether geographical range size affects the climatic niche representation in PAs. Therefore, I group the species according to the number of sectors (= 0.5 x 0.5° cells) they occur. Species present in three or less sectors are considered as range-restricted, while species present in more than three grid cells are considered as (relatively) widespread endemics (Noroozi et al., 2019a). I use this categorical variable together with time step/scenario as interactive fixed effect in my second model. The response variable is, as in the first model, the transformed climatic niche representation. Significance tests are analogous to the first model.

Results

From the 1277 species considered in my study, 85 species have no PA within their extent of occurrence or the elevational ranges of the species and its associated PAs do not match. Hence, 1192 species remain for the calculation of climatic representation of the species within their associated PAs.

In 2020, an average of 51.8% of the species' climatic niche was represented in the associated PAs. Only seven species have no representation of their climatic niches within their associated PAs whereas 27 species show over 90% climatic representation.

In 2050, mean climatic representation significantly decreases to 31.4% and 29.3% and to 26% and 22.9% in 2070 for the 4.5 and the 8.5 scenario, respectively (Fig.3). While differences among scenarios are insignificant in 2050, they become significant in 2070. In 2070, the climatic representation drops down to zero for 72 species under the moderate scenario. For the severe scenario, 69 species experience complete loss of their climatic representation in PAs in 2070. Regarding the winners in climatic representation, 169 species gain climatic representation in comparison to 2020 at any time step or scenario. In 2070, 85 species have an increased climatic representation in PAs under the moderate scenario and 59 species under the severe scenario.

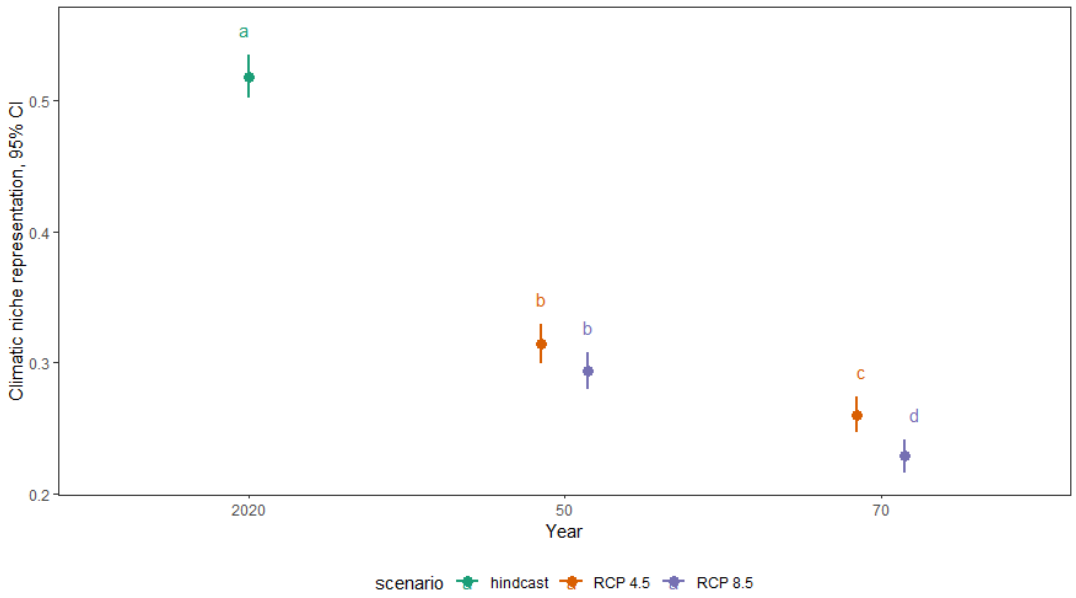

Figure 3: Climatic representation within associated PAs across all endemic species analysed. Shown are estimates and 95% confidence intervals (CI) from a generalized linear mixed effects model including a significant interaction between time step/scenario. Different colors represent different climatic scenarios, RCP 4.5 being a moderate and RCP 8.5 a severe scenario. Letters indicate significant pair-wise contrasts (p<0.005).

Under current climatic conditions, climatic representation is not equally distributed across elevation but peaks at a mean elevation of about 2500 m.a.s.l. (Fig. 4). Under future climate this peak decreases in elevation to about 2000 m.a.s.l. and the decrease in climatic representation becomes particularly pronounced at highest elevations. As a consequence, a likelihood ratio test between a model including the interaction of elevation with time step and scenario and an additive model was highly significant ($p < 0.0001$)

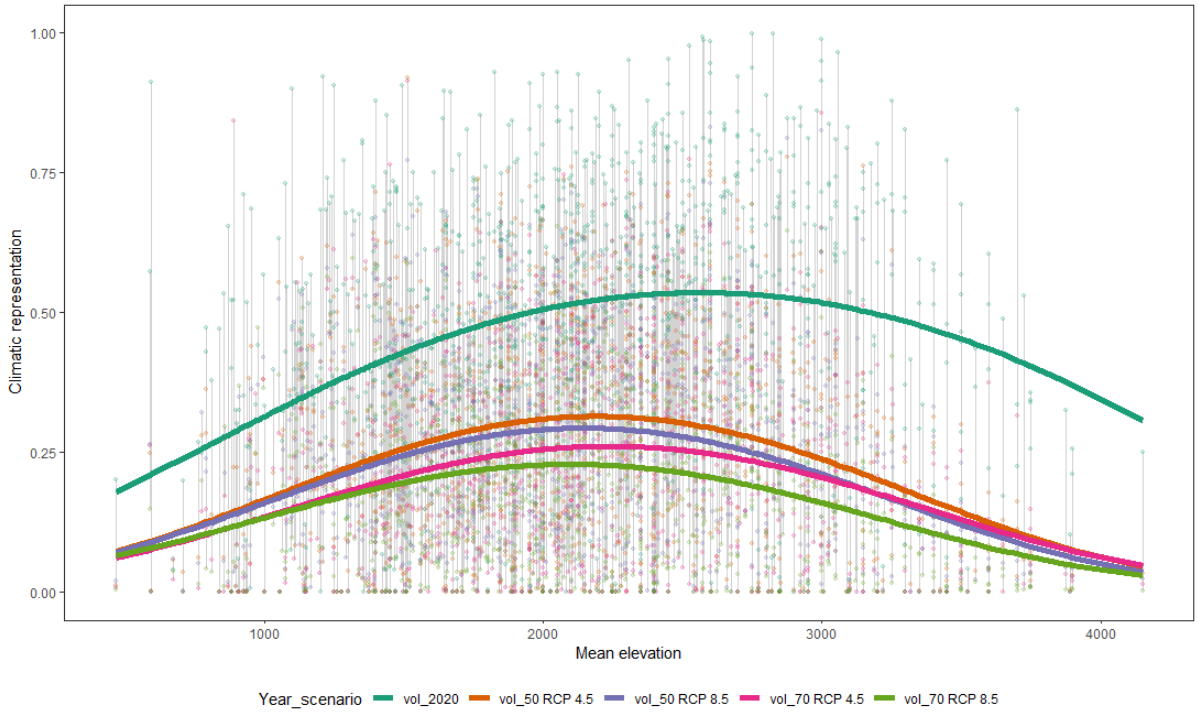

Figure 4: Representation of species' climatic niches within PAs in relation to mean elevation. Colored lines represent different combinations of time steps (2050 & 2070) and scenarios (RCP 4.5 & RCP 8.5). Grey vertical lines connect data points of one species.

Current climatic representation did not differ among restricted or widespread species. Under future scenarios and time steps, however, range-restricted species lost significantly more climatic representation than widespread endemics (Tukey-corrected pair-wise comparisons $p<0.05$). Hence a model including an interaction between the predictor variables time-step/ scenario and the categorial variable "range-restricted" was explaining the data significantly better than an additive model ($p < 0.0001$). For range-restricted species, the current climatic representation of 47.9% drops to 13.5% in 2050 and further to 8.9% in 2070 for RCP 8.5. The climatic representation of widespread species in PAs is at 48.5% today, and shrinks down to 26.9% in 2050 and 19.5% in 2070 for RCP 8.5. Under RCP 4.5, decreases in climatic representation are less pronounced for widespread species, but almost equally pronounced as in RCP 8.5 for range-restricted species. As a consequence, for widespread species, the difference between the scenarios was significant at both time steps (Tukey-corrected pair-wise comparisons $p<0.05$), while it was insignificant for range-restricted species at both time steps.

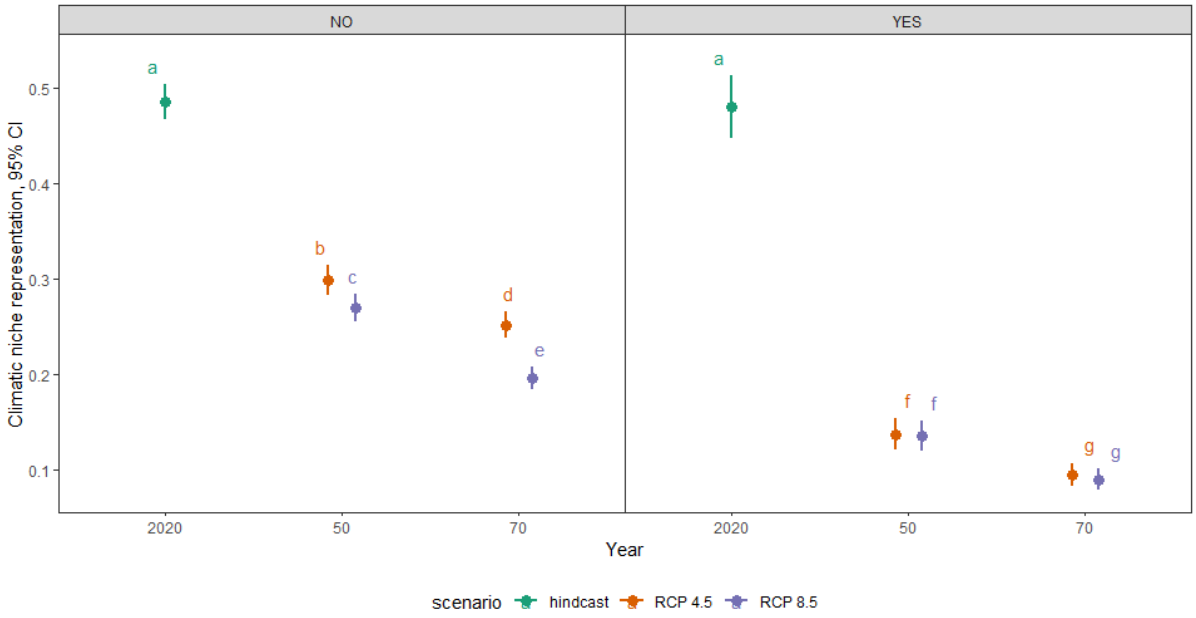

Figure 5: Climatic representation within associated PAs for widespread and range-restricted species separately. Shown are estimates and 95% confidence intervals (CI) from a generalized linear mixed effects model including a significant interaction between time step/scenario and extent of geographic distribution grouping. Different colors represent different climatic scenarios, RCP 4.5 being a moderate and RCP 8.5 a severe scenario. Letters indicate significant pair-wise contrasts (p<0.005).

Discussion

Under current climatic conditions, the Iranian PA-network covers the climatic niches of Iran's endemic plants only to about 50%, on average. With climate change, the fraction of endemics' niches protected further decreases to values below 30%. These findings suggest that the Iranian PA network is not prepared for the challenges imposed by anthropogenic climate change, at least not with respect to protecting the endemic flora of the country.

My results suggest that the climatic niches of species thriving at lowest and highest elevations have particularly poor representation within PAs. Under current conditions, this suggests that PAs cover the largest fraction of the total Iranian mountains at intermediate elevations. As the climate warms, the climatic niches of the species become increasingly rare in geographical space because colder temperatures are not realized anymore in the landscape, i.e. mountains are not high enough. As a consequence, the fraction of the niche covered by PAs also shrinks. These findings corroborate earlier evidence that endemics of high elevations are particularly vulnerable to climate change (Dirnböck et al., 2011). By contrast, the endemics of lower elevations mostly thrive in lower parts of mountain chains, but have a great proportion of their (spatially) associated PAs located in extensive, desert PAs bordering these mountains. As many of these endemics are not adapted to the dry desert climate, but need somewhat moister conditions offered at least locally in mountainous terrain, their climatic niches are hardly covered by desert PAs under current conditions. In the future, when conditions in desert PAs becomes even warmer and drier, this mismatch even increases and is obviously only partly buffered by an increased overlap with climatic conditions offered by higher lying PAs, because PA-cover has its peak at elevations at least 1000 m above the foothills of the mountains (Malakoutikhah et al., 2018). The species the climatic ranges of which are currently represented best by the Iranian PA occur predominantly around 2500 m. In the future, this peak

shifts to a lower elevation (~2000 m) because the species that currently have their peak at this elevation will then have their niches represented in the greater area of PAs higher up.

Range-restricted and widespread endemics significantly differ in their climatic representation within PAs in the future. While under current climatic conditions climatic representation is similar, representation losses in the future are much more pronounced for range-restricted endemics. Whatever the reason of this difference, it suggests that the magnitude of ecological response to climate change may indeed be related to range size (Williams et al., 2021) and that climatic niche size may be correlated to future climatic disequilibrium (Perret et al., 2018). Hence, weak niche representation of range-restricted species in PAs might increase their extinction risk in comparison to species with a wider distribution. (Staude et al., 2018).

As distributions of endemic plants in Iran are associated with topographic heterogeneity, many species will likely find microrefugia within their range (Noroozi et al., 2019a). Climatic conditions of such microrefugia are decoupled from regional climate and vary on a small spatial scale (Dobrowski, 2011). The coarse resolution of the climatic data used to create species' climatic niches misses such small-scale variation in the climatic conditions. Hence, finer-scaled climate data is needed to integrate the critical role of microrefugia for species' survival (Potter et al., 2013). This also applies to survival of species in PAs in general, and to representation of species' niches in a particular area. However, a shift of the macroclimate away from the climatic requirements of species will most likely reduce the area of appropriate climate available to the species (Scherrer & Körner 2012). So even if a macroclimatic study like mine cannot quantify area or niche loss accurately, the main trends of decrease or increase are most likely captured correctly.

A critical assumption of the study is the limited dispersal ability of the species. Species are assumed to be unable to disperse outside of their current range extent and this constrains the colonization of new PAs. For endemic plants, the lack of dispersal ability often is an important reason of their narrow ranges (Essl et al., 2011). However, genetic shifts in the dispersal ability might occur rapidly under high environmental pressure (Bradshaw et al., 2001). The field of dispersal genetics is poorly investigated and therefore predictions about the genetic response to climate change are contentious (Saastamoinen et al., 2018). In this context, the longevity of endemic plants and the predicted pace of climate change both counteract anticipated gene shifts (Cotto et al., 2017).

Another key assumption of the study is the species' (potential) distribution which is defined as the entire space within the elevational range limits. This is unlikely for most of the species as several factors further restrict the distribution of a species. Besides temperature and precipitation, other abiotic factors such as geology control species distributions (Gaston et al., 2003). Biotic interactions further interfere with abiotic species distribution patterns. Indeed, climate change-induced tree line shifts are common and put alpine species under competitive pressure (Valavi et al., 2019, Gatti et al., 2019). Facilitation is another key component shaping biodiversity in alpine environments (Cavieres et al., 2014). Cushion plants in Iran's alpine habitats ameliorate local microclimatic conditions and allow the establishment of species that are adapted to less severe environments (Butterfield et al., 2013). Hence, the future distribution of such cushion plants (e.g. many species of *Acantholimon*) will affect future diversity patterns. Finally, the study does not account for changes in climatic representation that are based on species-specific ecological niche differences among spatially separated subpopulations (Wasof et al., 2013).

To conclude, my results suggest that the endemic flora in Iran will increasingly lack adequate area-based protection in the future. Identification of microrefugia could help to close conservation gaps and make the Iranian PA network fit for climate change. In this context, the tight link between water

availability and microrefugia emphasizes research on the spatial distribution of ‘hydrologic climate buffers’ (Gentilli et al., 2020, McLaughlin et al., 2017). From a species perspective, protection of range-restricted species distributed at low and high altitudes should be prioritized as compared to those predominating at intermediate elevations. The methods applied here are certainly too coarse to allow for accurate quantifications of niche representation loss, but they give a first impression on the extent of threat of endemic biodiversity in this understudied biodiversity hotspot.

Schlussfolgerungen

Meine Master-Arbeit bewertet zum ersten Mal Klimawandeleffekte für einen großen Teil der endemischen Flora Irans. Dabei fokussiere ich mich auf die klimatische Nische der Art. In der Tat ist das Klima auf einer makroökologischen Skala ein Hauptfaktor für die Artenverteilung in der Landschaft (Gaston et al., 2003). Ich beziehe mich ausschließlich auf die Abdeckung der klimatischen Nischen in SG, weil die intensivierte Landnutzung auch ohne Klimawandel bereits massive Bestandesrückgänge der Artenvielfalt außerhalb von SG fordert. SG bilden die letzte Bastillon, in denen Arten basierend auf einem rechtlichen Fundament von Bedrohung durch Landnutzung zumindest theoretisch geschützt sind. Der Klimawandel unterscheidet jedoch nicht zwischen geschützten und ungeschützten Flächen. Dies unterstreicht das theoretische Konzept, das dieser Arbeit zugrunde liegt.

Bereits unter momentanen Klimabedingungen muss man nach meinen Ergebnissen dem iranischen SG-Netzwerk eine ungenügende Note eintragen. Mit durchschnittlich 50% Abdeckung der klimatischen Nische in SG ist die endemische Flora Irans bereits jetzt unzureichend geschützt. Das starke Ungleichgewicht zwischen dem Beitrag dieser Arten zur nationalen und globalen Artenvielfalt und der Aufmerksamkeit, die ihnen in naturschutzpolitischen Entscheidungsprozessen gewidmet wird, ist auffällig. Meine Ergebnisse unterstreichen den unzureichenden Schutz von Irans floristisch wertvollsten Gebieten, auf den bereits Noroozi et al., 2019b aufmerksam macht. Tatsächlich korrelieren meine Ergebnisse mit den seinen, wenn auch der methodische Zugang ein anderer ist. Um die momentane Situation zu verbessern ist es erforderlich, neue SG auszuweisen. Schließlich muss verhindert werden, dass Beweidung die potenziellen Erfolge dieser SG zunichtemacht. Irans ländlicher Raum ist von der Landwirtschaft dominiert. Durch Aufklärung der lokalen Bevölkerung über die Bedeutung von SG kann eine Symbiose zwischen Naturschutz und Bevölkerung entstehen. Gleichzeitig wird dieses Unterfangen nur dann funktionnieren, wenn man die finanzielle Situation der Menschen verbessert. In dem von wirtschaftlichen Sanktionen erschöpften Iran können SG auch dabei helfen, die Ökonomie der ländlichen Region zu verbessern. Ökotourismus ist ein wachsender Wirtschaftszweig und der Iran hat dafür die perfekten Vorraussetzungen (Fennell, 2020).

Damit solche Ideen auch in die Realität umgesetzt werden können, braucht es zuallererst die Planung neuer SG und ein effizientes Schutzgebietsmanagement. Meine Ergebnisse zeigen nämlich eine dramatische Reduzierung der Abdeckung der klimatischen Nischen der Endemiten in der Zukunft. Je nach Szenario und Zeitpunkt sinken die Werte auf durchschnittlich 20-30%. Diese Verluste an klimatischer Abdeckung sind nicht homogen entlang des Höhengradienten verteilt. Das schlechte Abschneiden von Tiefland- und Hochgebirgsarten ist Segen und Fluch zugleich. Neue SG einrichten ist möglich, mit einem immer stärker werdenden Klimawandel werden die Arten der Geschwindigkeit der Erwärmung allerdings nicht folgen können. Schließlich setzen die Berggipfel den einer möglichen Migration von Arten ein Ende. Daraus schließe ich, dass der Schutz der Tieflandarten mit vergleichsweise mäßigem Aufwand verbessert werden kann. Das Schicksal der Hochgebirgsarten dagegen wird vor allem von dem Ausmaß an klimatischer Erwärmung bestimmt werden.

Ich habe die geografische Verbreitung der Arten in 2 Klassen (weitverbreitet und eingeschränkt verbreitet) eingeteilt. Dabei erkennt man eine bessere Abdeckung der klimatischen Nischen von weitverbreiteten Arten. In der Praxis bedeutet dies, dass bei der Planung von SG Arten mit beschränkten Verbreitungen höher gewichtet werden sollten als weitverbreitete Arten.

Die Planung und Implementierung neuer SG ist unumgänglich, wenn der Iran seine Artenvielfalt erhalten will. Konflikte mit traditioneller Landnutzung durch die ländlichen Bevölkerung sollten nach

Möglichkeit verhindert werden. Eine positive Grundhaltung der lokalen Bevölkerung, durch Aufklärung und Einbindung in die SG-Gestaltung ist für den Naturschutz-Erfolg wesentlich. Um die Planung von SGs effektiver zu gestalten muss außerdem die Datengrundlage verbessert werden, insbesondere auch im Hinblick auf die Verbreitung schützenswerter Arten. Dafür ist es notwendig, genügend finanzielle Ressourcen bereit zu stellen. Gebiete mit einer hohen Anzahl an Endemiten, insbesondere solcher mit kleinem Verbreitungsgebiet, sollten bei der Einrichtung von SG als prioritär betrachtet behandelt werden. Eine klimawandelangepasste Planung potenzieller SG sollte Gebiete mit möglichst ausgeprägten klimatischen Gradienten bevorzugen. In ariden Gebieten wie dem Iran spielt dabei neben den Temparturgradienten die Wasserverfügbarkeit eine entscheidende Rolle (Rodriguez-Iturbe et al., 2007). Gebiete, deren Wasserhaushalt von der umgebenden Landschaft entkoppelt ist, können als Refugien für speziell angepasste Arten dienen (McLaughlin et al., 2017). Als Grundlage für eine gezielte Planung könnten in dieser Hinsicht Modelle dienen, die die Wechselwirkungen von Vegetation und Bodenfeuchtigkeit simulieren (Tietjen et al., 2009). Schießlich spielt für die langfristige Erhaltung der Artenvielfalt aber eine konsequente, weltweite Klimawandelpolitik die wichtigste Rolle.

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Appendix

List of tables

Table of figures

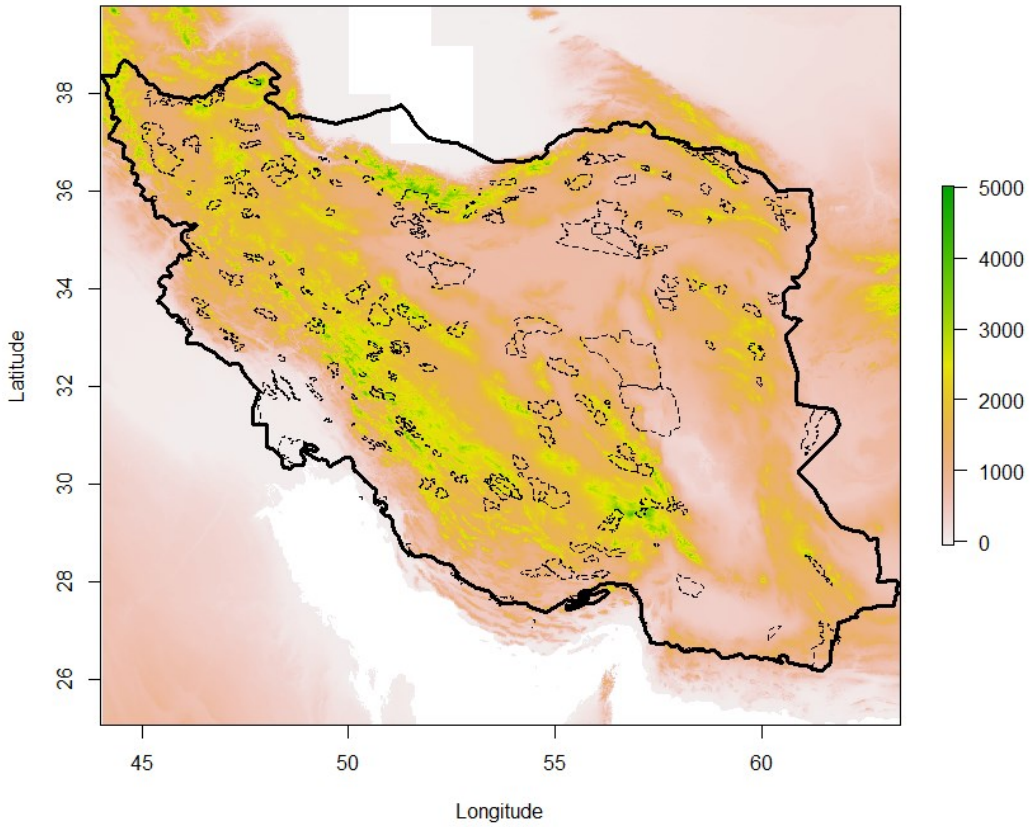

Fig. A1: Borders of Iran (solid line) and the Protected Area network (dashed lines). Background map is a digital elevation model (DEM).

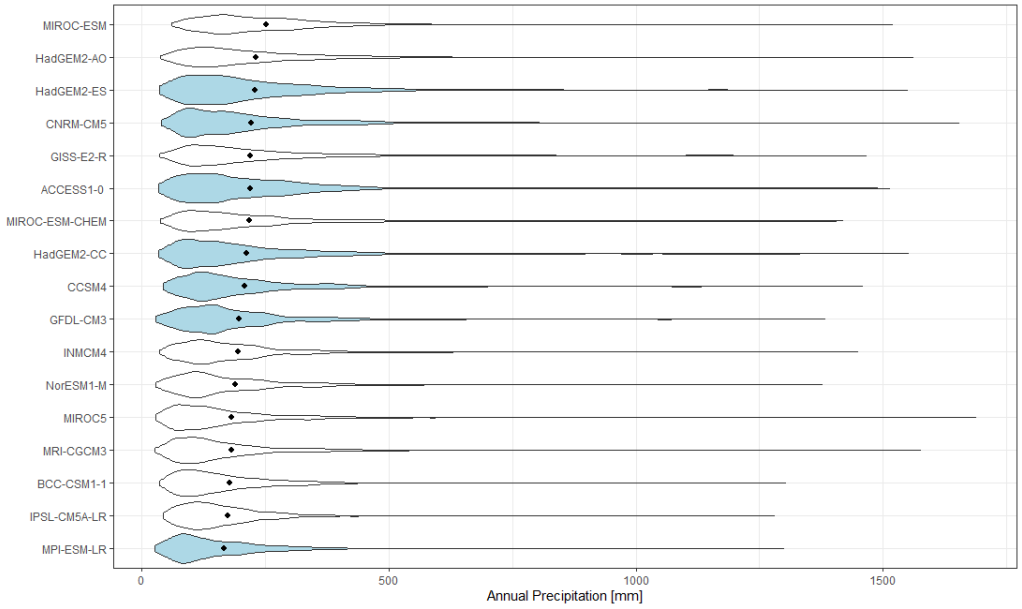

Fig. A2: Mean annual precipitation (mm) predicted by the GCMs of CMIP5 with 30" resolution which are available on WorldClim (www.worldclim.org) for the year 2070 under the climate scenario RCP 8.5. Coloured GCMs indicate good performance in McSweeney et al., 2015. Mean annual precipitation is shown on the y-axis, common abbreviations of GCMs on the x-axis.

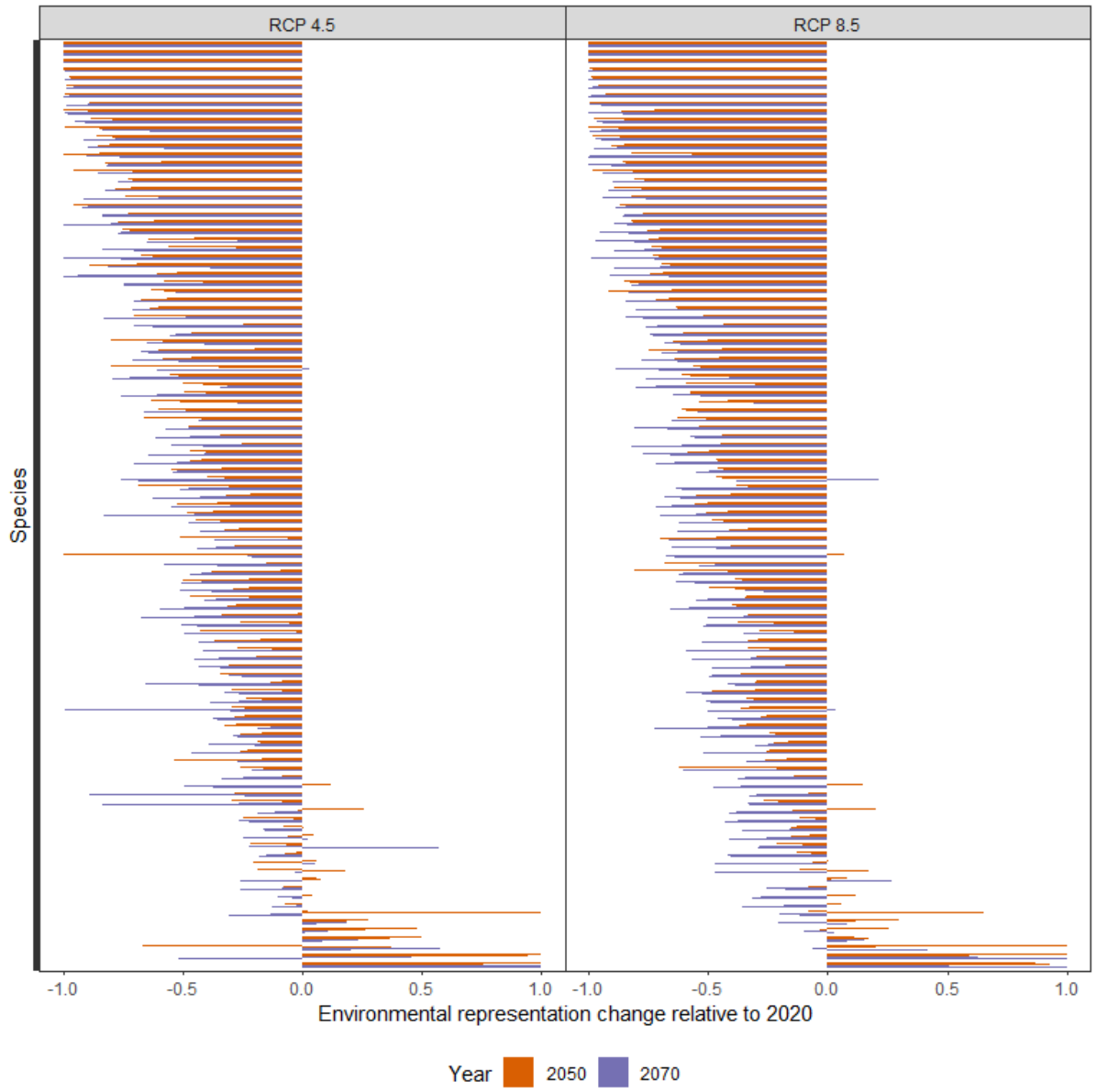

Fig. A3: Relative change in climatic representation in associated PAs for each species (n= 1192) seperately. Shown is the difference between 2020 and 2070 for RCP4.5 (left panel) and RCP8.5 (right panel). Relative change values are displayed on the x-axis and individual species on the y-axis (species names omitted). Values range between -1 (complete loss of climatic representation) and 1 (doublng of climatic representation). Species with values higher than 1 were set to 1 for clearer display.

Table A1: Species with sufficient elevational range (>800m) to be included in the study. Max and min describe highest and lowest elevation of documented records per species. Elev. range is the elevational range resulting from max. – min.

Species	min.	max.	elev. range
Acantholimon acmostegium Boiss. & Buhse	800	2600	1800
Acantholimon aspadanum Bunge	1200	2882	1682
Acantholimon asphodelinum Mobayen	1611	3000	1389
Acantholimon atropatanum Bunge	1300	2200	900
Acantholimon austro-iranicus Rech.f. & Schiman-Czeika	900	1900	1000
Acantholimon bodeanum Bunge	1250	3000	1750
Acantholimon brachystachyum Boiss. ex Bunge	2250	3500	1250
Acantholimon bromifolium Boiss. ex Bunge	1620	2800	1180
Acantholimon cephalotoides Rech.f. in DC.	2100	3750	1650
Acantholimon chlorostegium Rech.f. & Schiman-Czeika	2000	3661	1661
Acantholimon collare Koeie & Rech.f.	1100	2438	1338
Acantholimon curviflorum Bunge	850	1920	1070
Acantholimon cymosum Bunge	1100	2500	1400
Acantholimon demavendicum Bornm.	3300	4200	900
Acantholimon eschkerense Boiss. & Hausskn.	1850	3300	1450
Acantholimon festucaceum (Jaub. & Spach) Boiss.	1100	3300	2200
Acantholimon flabellum Assadi	1500	2500	1000
Acantholimon flexuosum Boiss. & Hausskn. ex Bunge	1600	3200	1600
Acantholimon gilliatii Turrill	500	2700	2200
Acantholimon glabratum Assadi	2100	2950	850
Acantholimon incomptum Boiss. & Buhse	1210	2700	1490
Acantholimon kermanense Assadi & Mirtadz.	2601.86	3440.05	838.19
Acantholimon melananthum Boiss.	2500	3900	1400
Acantholimon modestum Bornm. ex Rech.f. & Schiman-Czeika	1836	4012	2176
Acantholimon nigricans Mobayen	2480	3900	1420
Acantholimon oliganthum Boiss.	1600	3507	1907
Acantholimon olivieri (Jaub. & Spach) Boiss.	1290	3100	1810
Acantholimon ophiocladus Rech.f. & Schiman-Czeika	1652	3000	1348
Acantholimon pterostegium Bunge	1000	2500	1500
Acantholimon quinquelobum Bunge	1000	1900	900
Acantholimon restiaceum Bunge	900	1975	1075
Acantholimon rhodopolius Rech.f. & Schiman-Czeika	1420	2350	930
Acantholimon scabrellum Boiss. & Hausskn.	2000	4100	2100
Acantholimon schahrudicum Bunge	1060	2600	1540
Acantholimon scirpinum Bunge	1200	3500	2300
Acantholimon scorpius (Jaub. & Spach) Boiss.	600	2700	2100
Acantholimon serotinus Rech. f. & Schiman-Czeika	1408	2857	1449
Acantholimon senganense Bunge	1600	3000	1400
Acantholimon sirchense Assadi & Mirtadzadini	2007.12	3200	1192.88
Acantholimon spinicalyx Koeie & Rech.f.	1150	2465	1315
Acantholimon talagonicum Boiss. in DC.	1250	3000	1750
Acantholimon tomentellum Boiss.	3000	3900	900
Acantholimon tragacanthinum (Jaub. & Spach) Boiss.	1300	2600	1300

Acantholimon wendelboi Rech.f. & Schiman-Czeika	1509	2800	1291
Acantholimon zaeifii Assadi	1800	3551	1751
Acanthophyllum crassifolium Boiss.	1120	3500	2380
Acanthophyllum leucostegium Schiman-Czeika	650	2300	1650
Acanthophyllum pachycephalum Schiman-Czeika	1160	2033	873
Achillea aucheri Boiss.	2500	4220	1720
Achillea eriophora DC.	746	2850	2104
Achillea oxyodonta Boiss.	1700	2900	1200
Achillea pachycephala Rech.f.	1200	3000	1800
Achillea talagonica Boiss.	1300	3000	1700
Aethionema semnanensis Mozaffarian	1900	3300	1400
Aethionema stenopterum Boiss.	1600	3352.05	1752.05
Aethionema umbellatum (Boiss.) Bornm.	3300	4200	900
Agropyron brachyphyllum Boiss. & Hausskn. ex Boiss.	2110	3300	1190
Ajuga chamaecistus Ging. ex Benth.	1000	3000	2000
Albraunia foveopilosa Speta	100	1500	1400
Alcea arbelensis Boiss. & Hausskn.	500	2900	2400
Alcea glabrata Alef.	700	2800	2100
Alcea gorganica (Rech.f.	100	2050	1950
Alcea koelzii I.Riedl	1020	2800	1780
Alcea kurdica (Schlecht.) Alef.	1000	2200	1200
Alcea lenkoranica Iljin	20	1600	1580
Alcea loftusii (Baker) Zohary	300	2000	1700
Alcea schirazana Alef	889	2850	1961
Alcea tarica Pakravan & Ghahreman	1000	2900	1900
Alcea wilhelminae I. Riedl	250	2500	2250
Alchemilla amardica Rothm.	2000	2900	900
Alchemilla citrina S. E. Fr”hner	2000	3682.01	1682.01
Alchemilla fluminea S. E. Fr”hner	1800	3750	1950
Alchemilla melancholica S. E. Fr”hner	1400	2950	1550
Alchemilla microscopica S. E. Fr”hner	1302.05	2200	897.95
Alchemilla pectiniloba S. E. Fr”hner	2000	3200	1200
Alchemilla plicatissima S. E. Fr”hner	1302.05	2600	1297.95
Alchemilla surculosa S. E. Fr”hner	1800	3000	1200
Alkanna bracteosa Boiss.	1500	3000	1500
Alkanna frigida Boiss.	1300	3400	2100
Allium akaka S.G. Gmel. ex Schult. & Schult.f.	1300	2810.97	1510.97
Allium aladaghense Memariani & Joharchi	1700	2800	1100
Allium alamutense Razyfard	1250	3100	1850
Allium austroiranicum R.M. Fritsch	1700	3300	1600
Allium bakhtiaricum Regel	1700	3000	1300
Allium brachyodon Boiss.	1441.96	3835.01	2393.05
Allium breviscapum Stapf	1875.08	3202.02	1326.94
Allium capitellatum Boiss.	3100	3900	800
Allium caspium (Pall.) M. Bieb.	500	1900	1400
Allium cathodicarpum Wendelbo	1537.32	3800	2262.68

Allium chrysantherum Boiss. & Reut.	1500	2300	800
Allium cristophii Trautv.	100	2200	2100
Allium derderianum Regel	1200	3400	2200
Allium egorovae M.V. Agab. & Ogan.	1200	3000	1800
Allium elburzense Wendelbo	1600	3500	1900
Allium ellisii Hook.f.	1000	2400	1400
Allium fedtschenkoi N b lek	1509	3068.74	1559.74
Allium grande Lipsky	650	3100	2450
Allium graveolens (R.M. Fritsch) R.M. Fritsch	950	3000	2050
Allium haemanthoides Boiss. & Reut. ex Regel	1400	3700	2300
Allium helicophyllum Vved.	1200	2500	1300
Allium jesdianum Boiss. & Buhse	1550	3420	1870
Allium kazerouni Parsa	1660	2860	1200
Allium keusgenii R.M. Fritsch	1450	2500	1050
Allium koelzii (Wendelbo) K. Perss. & Wendelbo	1312.24	3108.61	1796.37
Allium kuhsorkhense R.M. Fritsch & Joharchi	900	2500	1600
Allium lalesaricum Freyn & Bornm.	3200	4000	800
Allium latifolium Jaub. & Spach	1384.69	3000	1615.31
Allium longivaginatum Wendelbo	1800	4140	2340
Allium materculae Bordz.	950	2400	1450
Allium minutiflorum Regel	1545.02	2431.88	886.86
Allium moderense R.M. Fritsch	1930	2880	950
Allium monophyllum Vved.	1527.98	2697.02	1169.04
Allium montelburzense R.M. Fritsch	2280	3620	1340
Allium orientoiranicum Neshati	1300	2300	1000
Allium pseudobodeanum R.M. Fritsch & Matin	1422.89	2600	1177.11
Allium pseudohollandicum R.M. Fritsch	1400	2700	1300
Allium remediorum (R.M. Fritsch) R.M. Fritsch	1454.95	2800	1345.05
Allium sabalense R.M. Fritsch	1800	3000	1200
Allium sahandicum R.M. Fritsch	1350	3000	1650
Allium saralicum R.M. Fritsch	800	2221.85	1421.85
Allium scotostemon Wendelbo	950	3400	2450
Allium shelkovnikovii Grossh.	800	3200	2400
Allium subakaka Razyfard & Zarre	1430	2900	1470
Allium ubipetrense R.M. Fritsch	1100	3100	2000
Allium zagricum R.M. Fritsch	1454.95	2795.33	1340.38
Alnus dolichocarpa Zare	-14	1200	1214
Alrawia bellii (Baker) K. Persson & Wendelbo	1100	2800	1700
Alyssum bracteatum Boiss. & Buhse	1000	2023	1023
Alyssum lanigerum DC.	1400	2800	1400
Alyssum mozaffarianii Kavousi	2000	2900	900
Alyssum polycladum Rech. F.	1650	4000	2350
Amygdalus eburnea Spach	200	2614	2414
Amygdalus elaeagnifolia Spach	1300	3500	2200
Amygdalus haussknechtii (C.K.Schneider.) Bornm.	1330	3100	1770
Anabasis calcarea (Charif & Aellen) Bokhari & Wendelbo	850	2250	1400

Anabasis haussknechtii Bunge ex Boiss.	1065	2502	1437
Anchonium elichrysifolium (DC.) Boiss.	2100	3800	1700
Andrachne fruticulosa Boiss.	1000	2000	1000
Anthemis atropatana Iranshahr	760	2000	1240
Anthemis austroiranica Rech.f. Aell. & Esfand.	1	2127	2126
Anthemis brachystephana Bornm. & Gauba	909	2060	1151
Anthemis gayana Boiss.	900	2650	1750
Anthemis gilanica Bornm. & Gauba	246	2200	1954
Anthemis lorestanica Iranshahr	251	2060	1809
Anthemis moghanica Iranshahr	80	2702	2622
Anthemis persica Boiss.	234	1900	1666
Anthemis schizostephana Boiss. & Hausskn.	300	2028	1728
Anthemis susiana NAB.	18	889	871
Anthemis talyschensis A. Fedor.	1250	2084	834
Anthochlamys multinervis Rech. f.	795	1800	1005
Aphanopleura breviseta (Boiss.) Heywood & Jruy	750	2500	1750
Arabis ottonis-schulzii Bornm. & Gauba	1450	2700	1250
Arabis rimarum Rech. F.	2200	3200	1000
Arenaria persica Boiss.	2500	3850	1350
Arenaria polycnemifolia Boiss.	1500	3250	1750
Arenaria szowitsii Boiss.	1385	2300	915
Arenaria zargariana Parsa	1190	2500	1310
Argyrolobium trigonelloides Jaub. & Spach	122	2300	2178
Aristolochia hyrcana Davis & M.S.Khan	200	1700	1500
Aristolochia olivieri Collengo in Boiss.	700	2500	1800
Artemisia kermanensis Podl.	1254	2475	1221
Artemisia khorassanica Podl.	700	2258	1558
Artemisia melanolepis Boiss.	3000	4000	1000
Artemisia splendens Willd.	2200	3700	1500
Arum giganteum Ghehreman	1275	2651	1376
Asparagus touranensis Hamdi & Assadi	36	1724	1688
Asperula fragillima Boiss. & Hausskn. ex Boiss.	1800	3610.94	1810.94
Asperula gorganica Schonb.-Tem. & Ehrend.	600	2080	1480
Asperula mazanderanica Ehrend.	950	2700	1750
Asperula microphylla Boiss.	300	2500	2200
Asperula rechingeri Ehrend. & Schonb.- Tem	2000	3261.67	1261.67
Asperula seticornis Boiss.	1900	3000	1100
Astragalus abnormalis Rech.f.	1125	2489	1364
Astragalus ahmad-parsae Maassoumi	1500	2350	850
Astragalus albispinus	1715	2650	935
Astragalus alyssiformis Maassoumi	1875	3000	1125
Astragalus anguranensis Podlech & Maassoumi	1950	2800	850
Astragalus angustistipulatus Podlech	2800	4000	1200
Astragalus anserinaefolius Boiss.	100	2230	2130
Astragalus argyrostachys Boiss.	1650	2500	850
Astragalus askius Bunge	1370	3800	2430

Astragalus aspadanus Bunge	1010	3013	2003
Astragalus atricapillus Bornm.	2900	3800	900
Astragalus avicennicus Parsa	1730	3200	1470
Astragalus baba-alliar Parsa	139	2130	1991
Astragalus babakhanloui Maassoumi & Podl.	1500	3600	2100
Astragalus bazarganii Podlech & Zarre	867	1919	1052
Astragalus bazmanicus Podlech	2000	3000	1000
Astragalus beckii Bornm.	1800	3700	1900
Astragalus belgheisicoides Podlech & Maassoumi	1900	2900	1000
Astragalus belgheisicus Maassoumi	600	2900	2300
Astragalus birangae Maassoumi	160	1650	1490
Astragalus biserrula Bunge	850	2000	1150
Astragalus bodeanus Fisch.	1600	2705	1105
Astragalus bojnurdensis Podlech	1082	1938	856
Astragalus borujenensis Ranjbar & Maassoumi	1100	1950	850
Astragalus bounophilus Boiss. & Hohen.	1567.22	3241.68	1674.46
Astragalus brachyodontus Boiss.	200	2600	2400
Astragalus bradosticus Maassoumi & Podlech	700	2700	2000
Astragalus brevirhachis Tietz & Zarre	1800	2700	900
Astragalus brunsianus Bornm.	1350	2200	850
Astragalus callainus Podlech	938	2100	1162
Astragalus calliphysa Bunge	750	2708	1958
Astragalus campylanthus Boiss.	1100	3114	2014
Astragalus capax Maassoumi	1500	3800	2300
Astragalus carmanicus Bornm.	2000	3700	1700
Astragalus catacamptus Bunge	800	2577	1777
Astragalus cemerinus Beck	1500	2500	1000
Astragalus cephalanthus DC.	1100	3400	2300
Astragalus chalaranthus Boiss. & Hausskn. in Boiss.	2148	3200	1052
Astragalus chartostegius Boiss. & Hausskn.	2300	4000	1700
Astragalus chrysanthus Boiss. & Hohen	2100	3532.35	1432.35
Astragalus chrysotrichus Boiss.	1200	3081	1881
Astragalus circumlacustris Podlech & Sytin	1300	2122	822
Astragalus clivicola Podlech & Maassoumi	1500	2350	850
Astragalus confusus Bunge.	2300	3500	1200
Astragalus curviflorus Boiss.	200	2700	2500
Astragalus cyclophyllon Beck	1000	3000	2000
Astragalus daenensis Boiss.	3300	4200	900
Astragalus darlingtonii Podl.	1600	2751	1151
Astragalus demavendicola Bornm. & Gauba	1483	3300	1817
Astragalus demavendicus Boiss. & Buhse	900	2450	1550
Astragalus dictyolobus Bunge	1100	2900	1800
Astragalus doghrunensis Maassoumi & Podlech	1488	3550	2062
Astragalus dschuparensis Freyn & Bornm.	1762	3500	1738
Astragalus durandianus Aitch. & Baker	1473	3500	2027
Astragalus ebenoides Boiss.	1160	2700	1540

Astragalus eburneus Bornm. & Gauba	300	1920	1620
Astragalus ecbatanus Bunge	342	2130	1788
Astragalus echidna Bunge	1115	2300	1185
Astragalus elwendicus Bornm.	1480	2500	1020
Astragalus eriopodus Boiss.	1000	2724	1724
Astragalus eriostomus Bornm.	1675	2500	825
Astragalus erubescens Podl.	1018	1997	979
Astragalus erwinii-gaubae Sirj. & Rech.f.	895	2120	1225
Astragalus erythrolepis Boiss.	1600	2500	900
Astragalus esferayenicus Podl. & Maassoumi	1400	3000	1600
Astragalus evanensis Maassoumi & Podl.	300	2000	1700
Astragalus expetitus Maassoumi	1761	2665	904
Astragalus exspectatus Maassoumi	1720	3900	2180
Astragalus fagh-soleimanensis Maassoumi & Podlech	1325	2130	805
Astragalus farsicus Sirj & Rech.f.	15	2224	2209
Astragalus fasciculifolius Boiss.	50	2230	2180
Astragalus filifoliolatus Maassoumi	772	1811	1039
Astragalus fischeri Fisch.	500	2432	1932
Astragalus floccosus Boiss	900	3100	2200
Astragalus fragiferus Bunge	1700	3600	1900
Astragalus fridae Rech.f.	1150	2800	1650
Astragalus fuliginosus Beck	280	1594	1314
Astragalus gaubae Bornm.	684	1530	846
Astragalus ghahremanii Maassoumi & Podl.	89	1280	1191
Astragalus ghashghaicus Tietz & Zarre	2550	3700	1150
Astragalus gigantirostratus Maassoumi et al.	800	1800	1000
Astragalus glaucacanthus Fisch.	107	2500	2393
Astragalus glaucops Bornm.	1780	3100	1320
Astragalus glumaceus Boiss.	1100	2500	1400
Astragalus griseus Boiss.	1300	3950	2650
Astragalus gueldenstaedtiae Bunge	1290	2500	1210
Astragalus gulul-saranii Podlech	800	2900	2100
Astragalus gypsaceus Beck	750	2160	1410
Astragalus hamadanus Boiss.	1200	2500	1300
Astragalus harazensis Zarre & Podlech	1464	2500	1036
Astragalus herbertii Maassoumi	1900	3000	1100
Astragalus heterodoxus Bunge.	2000	3600	1600
Astragalus hirticalyx Bunge	1601.11	3200	1598.89
Astragalus holopsilus Bunge	1420	2700	1280
Astragalus holosemius Bunge	1450	2900	1450
Astragalus horridus Boiss.	2300	3950	1650
Astragalus huthianus Freyn & Bornm.	1600	3081	1481
Astragalus hymenocalyx Boiss.	1500	2750	1250
Astragalus hymenostegis Fisch. & C.A. Mey.	1400	2450	1050
Astragalus hypsogeton Bonge	1393	3000	1607
Astragalus ibicinus Boiss. & Haussk. in Boiss.	1500	3250	1750

Astragalus icmadophilus Hand.-Mazz.	1940	3500	1560
Astragalus impexus Podl.	1500	3000	1500
Astragalus indistinctus Podl. & Maassoumi	931	2900	1969
Astragalus iodotropis Boiss. & Hohen.	2500	3852.3	1352.3
Astragalus iranicus Bunge	950	3000	2050
Astragalus ischredensis Bunge	900	3100	2200
Astragalus jacobsii Podlech	1300	2200	900
Astragalus jesdianus Boiss. & Buhse	569	2484	1915
Astragalus jessenii Bunge	600	2500	1900
Astragalus johannis Boiss.	1257	3700	2443
Astragalus joharchii Ghahremani nejad & J. F. Gaskin	680	2100	1420
Astragalus kashafensis Podl.	907	1854	947
Astragalus kashmarensis Maassoumi & Podl.	1000	1950	950
Astragalus kentrophyllus Podlech	300	1300	1000
Astragalus keredjensis Podlech	850	2500	1650
Astragalus khoshjailensis Sirj. & Rech.f.	600	2170	1570
Astragalus kordloricus Zarre	1560	2550	990
Astragalus kuhidashtehensis Podlech	2100	3050	950
Astragalus lacus-valashti Maassoumi	430	2600	2170
Astragalus laristanicus Bornm. & Gauba	200	1755	1555
Astragalus lateritiiformis Zarre	2100	3100	1000
Astragalus lateritius Boiss & Hausskn. In Boiss.	600	2600	2000
Astragalus ledinghamii Barneby	650	2900	2250
Astragalus leonardii Maassoumi	1647	3000	1353
Astragalus lepidus Podl.	1700	3000	1300
Astragalus leptynticus Maassoumi	1350	3050	1700
Astragalus lilacinus Boiss.	1350	3100	1750
Astragalus longicuspis Bunge	1000	2150	1150
Astragalus longirostratus Pau	1340	2800	1460
Astragalus longistylus Bunge	1200	3500	2300
Astragalus lycioides Boiss.	1200	3900	2700
Astragalus macrosemius Boiss. & Hohen.	3300	4100	800
Astragalus magistratus Maassoumi	1050	2300	1250
Astragalus megalocystis Bunge	1380	2400	1020
Astragalus melanocalyx Boiss. & Buhse	1750	3500	1750
Astragalus melanodon Boiss.	1600	3900	2300
Astragalus membranostipulus Maassoumi	1457	2300	843
Astragalus microphysa Boiss.	1860	3800	1940
Astragalus modestus Boiss. & Hohen.	2500	3500	1000
Astragalus monanthemus Boiss.	1700	3700	2000
Astragalus mucronifolius Boiss.	921	2700	1779
Astragalus murinus Boiss.	1760	3740	1980
Astragalus myriacanthus Boiss.	1200	3750	2550
Astragalus naftabensis Sirj. & Rech.f.	2300	3200	900
Astragalus neochaldoranicus Podlech & Maassoumi	1680	2800	1120
Astragalus nigrohirsutus (Tietz & Zarre) Borijan	1750	3600	1850

Astragalus nubicola Podlech	1450	3200	1750
Astragalus nurensis Boiss. & Buhse	150	2800	2650
Astragalus ochreatus Bunge	1300	2131	831
Astragalus ochrochlorus Boiss. & Hohen.	1700	3900	2200
Astragalus ovigerus Boiss.	2200	3600	1400
Astragalus ovoideus Sirj. & Rech.f.	550	2757	2207
Astragalus paralurges Bunge	1500	2600	1100
Astragalus parvulus Bornm.	1586	3630	2044
Astragalus patrius Maassoumi	1400	3400	2000
Astragalus paucifoliolatus Podlech	1225	2539	1314
Astragalus pauperiflorus Bornm.	1600	3550	1950
Astragalus pauxillis Maassoumi & F.Ghahremani	1850	2650	800
Astragalus pellitus Bunge	720	2300	1580
Astragalus penetratus Maassoumi	1800	3200	1400
Astragalus pentanthus Boiss.	1000	2500	1500
Astragalus perdurans Podl.	2100	3950	1850
Astragalus persicus (DC.) Fisch. & C.A. Mey.	1600	2513	913
Astragalus piranshahricus Maassoumi & Podl.	1105	2327	1222
Astragalus plagiophacos Maassoumi & Podlech	2200	3900	1700
Astragalus platysematus Bunge	1600	3800	2200
Astragalus plebejus Boiss.	1800	3650	1850
Astragalus podosphaerus Boiss. & Housskn.	2200	3340	1140
Astragalus porphyrophysa Bornm. & Gauba	670	2070	1400
Astragalus pseudocyclophyllus Rech.f.	1200	2500	1300
Astragalus pseudoibicinus Maassoumi & Podlech	1500	2800	1300
Astragalus pseudoindurascens Sirj. & Rech. f.	1200	2100	900
Astragalus pseudopersicus Maassoumi & Podlech	1695	2850	1155
Astragalus pseudorobustus Podlech & Maassoumi	1375	2400	1025
Astragalus pseudoshebarensis Podlech	1500	2500	1000
Astragalus psilostylus Bunge	1663	2620	957
Astragalus ptychophyllus Boiss. in Kotschy	1500	3000	1500
Astragalus raswendicus Hausskn. & Bornm.	1570	2600	1030
Astragalus recognitus Fisch.	1120	2600	1480
Astragalus remotiflorus Boiss.	1600	3600	2000
Astragalus remotijugus Boiss. & Hohen. in Boiss. Diagn. Pl. Or. Nov. Ser. 1	1250	2700	1450
Astragalus renzianus Podlech	1300	3000	1700
Astragalus repentinus Ekici & Podlech	1000	2500	1500
Astragalus reuterianus Boiss.	1100	2580	1480
Astragalus rhabdophorus Bornm.	1300	2600	1300
Astragalus rhodosemius Boiss. & Hausskn.	1200	3700	2500
Astragalus rollovii Grossh	1360	2300	940
Astragalus rosellus Sirj. & Rech.f.	1500	3000	1500
Astragalus rubriflorus Bunge	1700	2600	900
Astragalus rubrocalycinus Maassoumi & Podl.	1075	2700	1625
Astragalus rubrostriatus Bunge	1450	2300	850
Astragalus rudimentus Maassoumi	2000	3900	1900

Astragalus rufescens Freyn	2350	3850	1500
Astragalus ruscifolius Boiss.	1120	2300	1180
Astragalus saccatus Boiss.	1600	2514	914
Astragalus sahendi Fisch.	2500	3600	1100
Astragalus saremii Maassoumi	1000	1870	870
Astragalus savellanicus Podlech	1400	3600	2200
Astragalus scapiger Ranjbar & Maassoumi	1250	2400	1150
Astragalus schmidii Podl.	933	2300	1367
Astragalus sciureus Boiss. & Hohen. in Boiss.	1300	3000	1700
Astragalus sclerocladus Bunge	1636	2550	914
Astragalus semiromensis Podlech & Maassoumi	1500	2725	1225
Astragalus senilis Bornm.	1200	2900	1700
Astragalus shahbazanicus Podlech	1008	2500	1492
Astragalus sitiens Bunge	500	1893	1393
Astragalus sojakii Podl.	1604	3000	1396
Astragalus spachianus Boiss. & Buhse	1200	3300	2100
Astragalus speciosus Boiss. & Hohen.	1800	3400	1600
Astragalus sphaeranthus Boiss.	2162	3800	1638
Astragalus stenolepis Fisch.	1200	2600	1400
Astragalus stenostegius Boiss. & Hausskn.	2100	3950	1850
Astragalus straussii Bornm.	1250	2800	1550
Astragalus subalpinus Boiss. Buhse	1800	3500	1700
Astragalus submitis Boiss. & Hohen.	500	2750	2250
Astragalus subsecundus Boiss. & Hohen.	1700	3600	1900
Astragalus susianus Boiss.	1210	3355	2145
Astragalus sympileicarpus Rech.f.	932	2000	1068
Astragalus tabrizianus Fisch.	1133	2900	1767
Astragalus talimansurensis Sirj. & Rech.f.	219	1500	1281
Astragalus tarumensis Sirj. & Rech.f.	781	3200	2419
Astragalus teheranicus Boiss & Hohen. In Boiss.	920	2700	1780
Astragalus tenellus Bunge	1839	2700	861
Astragalus tenuiramosus Podlech & Zarre	65	2300	2235
Astragalus tenuiscapus Freyn & Bornm.	2460	3915	1455
Astragalus touranicus Freitag & Podl.	1200	3500	2300
Astragalus trachyacanthos Fischer	950	3200	2250
Astragalus tricholobus DC.	1110	2600	1490
Astragalus turgidus Podlech	2700	3900	1200
Astragalus vanillae Boiss.	819	2500	1681
Astragalus vegetus Bunge	1009	3000	1991
Astragalus vereskensis Maassoumi & Podl.	200	2750	2550
Astragalus xiphidiopsis Bornm.	1300	2450	1150
Astragalus yazdii (Vassilcz.) Podlech & Maassoumi	2503	4000	1497
Astragalus yushensis T. Sabaii	500	2500	2000
Astragalus zoshkensis Ghahremaninejad	1700	3000	1300
Astrodaucus persicus (Boiss.) Drude in Engler & Prantl	550	2750	2200
Asyneuma multicaule (Boiss.) Rech. f. Schiman-Czeina	2100	3300	1200

Atraphaxis aucheri Jaub. & Spach	300	1225	925
Azilia eryngioides (Pau) Hedge & Lamond	400	2400	2000
Ballota platyloma Rech. f.	400	2750	2350
Bellevalia decolorans Bornm.	1000	2693	1693
Bellevalia shirazana Parsa	2085	3020	935
Biarum platyspathum Bornm.	895	2000	1105
Biarum straussii Engl.	800	2450	1650
Bromus frigidus Boiss. & Hausskn.	2700	3800	1100
Brossardia papyracea Boiss.	1700	2600	900
Bufonia enervis Boiss.	1400	3042	1642
Bufonia koelzii Rech. f.	1900	3300	1400
Bufonia kotschyana Boiss.	1400	3200	1800
Bufonia macrocarpa Ser. in DC.	1300	3300	2000
Bunium luristanicum Rech. f.	1200	2450	1250
Bunium wolffii Kljuykov	980	2500	1520
Bupleurum flexile Bornm. ex Gauba	1200	2700	1500
Bupleurum ghahremanii Mozaffarian	1850	2950	1100
Caccinia kotschyi Boiss.	888	2500	1612
Caccinia strigosa Boiss.	630	2440	1810
Calligonum bungei Boiss.	570	1616	1046
Calligonum denticulatum Bunge ex Boiss.	403	1829	1426
Calligonum persicum (Boiss. & Buhse) Boiss.	200	2700	2500
Calligonum schizopterum Rech.f. & Schiman-Czeika	450	1449	999
Campanula candida DC.	1334	2650	1316
Campanula humillima DC.	1200	3684.69	2484.69
Campanula kermanica (Rech.f.	1020	2713	1693
Campanula kurdistanica Advay & Maroofi	1800	3000	1200
Campanula lourica Boiss.	1500	3300	1800
Campanula luristanica Freyn	2000	2800	800
Campanula persepolitana Ky. in Boiss.	1340	3000	1660
Centaurea albonitens Turrill	1500	2780	1280
Centaurea amadanensis Schultz-Bip.	1200	2500	1300
Centaurea aucheri Wagenitz	1300	2780	1480
Centaurea aziziana Rech.f.	1070	2100	1030
Centaurea congesta Wagenitz	1200	3000	1800
Centaurea gabrielae (Bornm.) Wagenitz	1000	1870	870
Centaurea galactochroa Rech.f.	1100	2250	1150
Centaurea gaubae (Bornm.) Wagenitz	1346	2800	1454
Centaurea gilanica Bornm.	1300	2695.06	1395.06
Centaurea hyrcanica Bornm.	400	2750	2350
Centaurea imperialis Hausskn. ex Bornm.	1100	2160	1060
Centaurea incanescens (DC.) Sch. Bip.	1204.61	2820	1615.39
Centaurea intricata Boiss.	100	1966.52	1866.52
Centaurea irritans Wagenitz	979.15	2000	1020.85
Centaurea ispahanica Boiss.	1223	3300	2077
Centaurea kandavanensis Wagenitz	270	2696.33	2426.33

Centaurea leuzeoides (Jaub. & Spech) Walp.	1210	2589	1379
Centaurea luristanica Rech.f.	900	2150	1250
Centaurea microlonchoides Boiss.	1202.19	2161.33	959.14
Centaurea persica Boiss.	1550	3000	1450
Centaurea sintenisiana Gand.	400	2220	1820
Centaurea sosnovskyi Grossh.	550	2670	2120
Centaurea urvillei DC.	700	2450	1750
Centaurea ustulata DC.	1263.19	3000	1736.81
Centaurea xeranthemoides Rech.f.	1467.35	2700	1232.65
Centaurea zuvandica (SOSN.) SOSN.	900	2780	1880
Cephalaria juncea Boiss.	1465	3100	1635
Cephalorrhynchus brassicifolius (Boiss.) Tuisl	1500	2730	1230
Cephalorrhynchus gorganicus (Rech.f. & Esfand.) Tuisl	1900	2700	800
Cephalorrhynchus kossinskyi (Krasch.) Krip.	1074	2500	1426
Cephalorrhynchus microcephalus (DC.) Schchian	563	2733	2170
Cerasus brachypetala Boiss.	2100	3600	1500
Cerasus chorassanica Pojark.	1134	3000	1866
Chaenorhinum grossecostatum Speta	2192	4000	1808
Chaerophyllum khorassanicum Czern. ex Schischk.	1400	3300	1900
Chaerophyllum nivale Hedge & Lamond	3200	4100	900
Chesneya kotschyi Boiss.	77	2500	2423
Cicer spiroceras Jaub. & Spach	1347	3800	2453
Cicer stapfianum Rech. f.	2900	3800	900
Cicer subaphyllum Boiss.	1750	2850	1100
Cicer tragacanthoides Jaub. & Spach	2700	3800	1100
Cirsium bracteosum DC.	1389.68	2339.49	949.81
Cirsium lappaceum M. B.	2000	3400	1400
Cirsium spectabile DC.	1700	3000	1300
Cistanche eremodoxa Bornm.	1200	2046	846
Clastopus erubescens Hausskn.	2400	3300	900
Clastopus vestitus (Desv.) Boiss.	1830	3352.05	1522.05
Cleome foliolosa DC.	1100	2287	1187
Colchicum varians (Freyn & Bornm.) Czernjak.	1300	2850	1550
Colchicum wendelboi K. Persson	850	2951	2101
Colpodium violaceum (Boiss.) Griseb.	3200	4000	800
Colutea persica Boiss.	1000	3500	2500
Colutea porphyrogramma Rech. f.	730	2000	1270
Colutea uniflora C. Back in Stapf	300	1250	950
Consolida linarioides (Boiss.) Munz	1600	2700	1100
Consolida teheranica (Boiss.) Rech. f.	300	2800	2500
Convolvulus argyracanthus Rech.f.	419	1900	1481
Convolvulus cephalophorus Boiss.	21	1000	979
Convolvulus eremophilus Boiss. et Buhse	750	1803	1053
Convolvulus gonocladus Boiss.	15	1492	1477
Convolvulus oxysepalus Boiss.	260	2700	2440
Convolvulus schirazianus Boiss.	1000	2900	1900

Convolvulus stapfii Rech.f.	450	1789	1339
Convolvulus turrillianus Parsa	160	2300	2140
Convolvulus urosepalus Pau	2518	3600	1082
Cotoneaster assadii Khatamsaz	1040	2250	1210
Cotoneaster esfandiarii Khatamsaz	2500	3400	900
Cotoneaster persicus Pojark.	1000	3300	2300
Cousinia adenosticta Bornm.	2200	3500	1300
Cousinia aggregata DC.	1100	2600	1500
Cousinia akredii Bornm. & Gauba	1500	2782.81	1282.81
Cousinia alexeenkoana Bornm.	1250	2550	1300
Cousinia amplissima (Boiss.) Boiss.	1000	2523.23	1523.23
Cousinia antonowii C. Winkl.	247	2170.27	1923.27
Cousinia arakensis Attar & Djavadi	1635	2500	865
Cousinia araneosa DC.	1641.34	3700	2058.66
Cousinia archibaldii Rech.f.	1800	3600	1800
Cousinia arctotidifolia Bunge	885.29	2107.73	1222.44
Cousinia assyriaca Jaub. & Spech	1026.4	2500	1473.6
Cousinia bachtiarica Boiss. & Hausskn.	2301.67	3419.53	1117.86
Cousinia barbeyi C.Winkl.	1100	2400	1300
Cousinia belangeri DC.	976.9	2000	1023.1
Cousinia calcitrapa Boiss.	1459.01	3000	1540.99
Cousinia calocephala Jaub. & Spech	1031	3207	2176
Cousinia calolepis Boiss.	1500	2500	1000
Cousinia chaetocephala Kult.	1154.19	2000	845.81
Cousinia chamaepeuce Boiss.	2100	3252.79	1152.79
Cousinia chlorosphaera Bornm.	1459	3400	1941
Cousinia chrysacantha Jaub. & Spech	900	2169.3	1269.3
Cousinia commutata Bunge	1400	3400	2000
Cousinia concinna Boiss. & Hausskn.	1100	3000	1900
Cousinia concolor Bunge	1446.88	2300	853.12
Cousinia crispa Jaub. & Spech	2200	3800	1600
Cousinia cylindracea Boiss.	1200	2962.75	1762.75
Cousinia decipiens Boiss. & Hohen.	1200	2810	1610
Cousinia denaensis Attar & Djavadi	1810	3170	1360
Cousinia edmondsonii Rech.f.	1750	2810	1060
Cousinia ekbatanensis Bornm.	1830	2962.75	1132.75
Cousinia elata Boiss. & Buhse	277	3000	2723
Cousinia erinacea Jaub. & Spach	247.96	1545.27	1297.31
Cousinia eriobasis Bunge	1700	2600	900
Cousinia eryngioides Boiss.	900	2250	1350
Cousinia esfandiarii Rech.f. & Aell.	750	2426.31	1676.31
Cousinia fabrorum Rech.f.	1056	2300	1244
Cousinia firuzkuhensis Rech.f.	1800	2800	1000
Cousinia freynii Bornm.	1000	2213.7	1213.7
Cousinia gabrielae Bornm.	1600	2700	1100
Cousinia gatchsaranica Mehregan	1460	2800	1340

Cousinia gaubae Bornm.	1400	2700.04	1300.04
Cousinia gedrosiaca Bornm.&Gauba	1100	2700	1600
Cousinia gilanica Bornm.	2000	3100	1100
Cousinia glaucopsis Bornm. & Rech.f.	1302.05	2400	1097.95
Cousinia gmelini C. Winkl.	2600	3400	800
Cousinia gracilis Boiss.	2300	3100	800
Cousinia grandis C. A. Mey.	1250	2700	1450
Cousinia harazensis Rech.f.	1850	3600	1750
Cousinia heliantha Bunge	1030.08	2193.82	1163.74
Cousinia hergtiana Bornm.	1890	2700	810
Cousinia hypoleuca Boiss.	1300	2900	1600
Cousinia hypopolia Bornm.& Sint.	700	2260.43	1560.43
Cousinia irritans Rech.f.	1900	3650	1750
Cousinia kandavanensis Attar	1263	2733	1470
Cousinia komarowii (O. Kuntze) C. Winkl.	879.15	1850	970.85
Cousinia kornhuberi Heimerl	1700	3300	1600
Cousinia kotschyi Boiss.	1100	3300	2200
Cousinia lepida Bunge ex Boiss.	880.85	1750	869.15
Cousinia longifolia C. Winkl. & Bornm.	2394.7	3690.23	1295.53
Cousinia lurorum (Bornm.) Bornm.	1200	2750	1550
Cousinia maassoumii Assadi	1400	2350	950
Cousinia macrocephala C. A. Mey.	614	2664	2050
Cousinia meshhedensis Bornm. & Rech.f.	1300	2880	1580
Cousinia neurocentra Bunge	1000	2300	1300
Cousinia noeana Boiss.	1490	2673.3	1183.3
Cousinia onopordioides Ledeb.	944	2881	1937
Cousinia oreodoxa Bornm. & Sint.	1000	2801.93	1801.93
Cousinia orthoclada Hausskn. & Bornm.	2100	2900	800
Cousinia pergamacea	1200	2300	1100
Cousinia pinarocephala boiss	1800	3090	1290
Cousinia piptocephala Bunge	947.2	2625.44	1678.24
Cousinia pterocaulos (C. A. Mey.) Rech.f.	1500	3350	1850
Cousinia pugionifera Jaub. & Spech	1551.21	2548.91	997.7
Cousinia rechingerae Bornm.	464.14	1300	835.86
Cousinia recurvata DC.	1800	3000	1200
Cousinia sagittata	1285	2970	1685
Cousinia seidlitzii Bunge	1000	1979.92	979.92
Cousinia shahvarica Rech.f.	1750	3400	1650
Cousinia sicigera C. Winkl. & Bornm.	2700	4150	1450
Cousinia silyboides	1300	2600	1300
Cousinia smirnowii Trautv	1350	3340	1990
Cousinia sphaerocephala Jaub. & Spech	2200	3300	1100
Cousinia stahliana Bornm. & Gauba	300	2500	2200
Cousinia straussii Hausskn. & Winkl. ex Winkl.	1433	2371.35	938.35
Cousinia tabriziana Bunge	1000	1860.15	860.15
Cousinia tenuifolia C. A. Mey.	1272.72	2250	977.28

Cousinia trachylepis Bunge	993.6	2000	1006.4
Cousinia turcomanica C. Winkl.	1100	2250	1150
Cousinia urumiensis Bornm.	1000	2400	1400
Cousinia verbascifolia Bunge	284	2500	2216
Cousinia xiphiolepis Boiss.	2113.37	3500	1386.63
Crepis asadbarensis Bornm. ex Rech.f.	2250	3600	1350
Crepis ciliata C. Koch	600	2800	2200
Crepis elbrusensis Boiss.	2800	3900	1100
Crepis elymaitica Bornm.	2400	3467	1067
Crepis gaubae Bornm.	1360	2200	840
Crepis heterotricha DC.	3000	4100	1100
Crepis khorassanica Boiss.	1500	2500	1000
Crepis papposissima Babcock	2500	3500	1000
Crepis quercifolia Bornm. & Gauba	600	1754	1154
Crepis sahendi Boiss. & Buhse	2500	3400	900
Crepis straussii Bornm.	570	2343	1773
Crepis willemetioides Boiss.	50	2900	2850
Crocus gilanicus Mathew	1560	2412	852
Crucianella gilanica Trin.	1400	3500	2100
Crucianella platyphylla Ehrend. & Schonb.-Tem.	1000	2500	1500
Cyclotrichium depauperatum (Bunge) Manden. & Scheng.	910	2700	1790
Cyclotrichium haussknechtii (Bunge) Manden. & Scheng.	1500	2300	800
Cyclotrichium straussii (Bornm.) Rech.f.	1130	2400	1270
Daucus littoralis Smith in Sibth. & Smith	-25	1370	1395
Delphinium aquilegifolium (Boiss.) Bornm.	1200	3000	1800
Delphinium elbursense Rech. f.	1200	3155.19	1955.19
Delphinium lalesaricum Iranshahr	2650	3453.69	803.69
Delphinium lanigerum Boiss. & Hohen.	1500	3600	2100
Delphinium saniculifolium Boiss.	1800	3550	1750
Delphinium tuberosum Auch. ex Boiss.	1000	2900	1900
Delphinium ursinum Rech. f.	870	3100	2230
Demavendia pastinacifolia (Boiss. & Hausskn.) Pimenov	1000	2600	1600
Deyeuxia parsana Bor	2300	3350	1050
Dianthus agrostolepis Rech. f.	420	2000	1580
Dianthus austroiranicus Lemperg in Rech.f.	200	2600	2400
Dianthus diversifolius Assadi	1550	2900	1350
Dianthus erythrocoleus Boiss.	2300	4100	1800
Dianthus hyrcanicus Rech. f.	450	2250	1800
Dianthus macranthoides Hausskn. ex Bornm.	200	2700	2500
Dianthus subaphyllus (Lemperg) Rech. f.	97	2700	2603
Dianthus szowitsianus Boiss.	965	2700	1735
Dianthus tabrisianus Bienert ex Boiss.	1020	2338	1318
Diceratella canescens (Boiss.) Boiss.	70	1200	1130
Dicyclophora persica Boiss.	45	2150	2105
Didymophysa aucheri Boiss.	3200	4800	1600
Dielsiocharis kotschyi (Boiss.) O. E. Schulz.	2000	4100	2100

Dionysia archibaldii Wendelbo	2250	4150	1900
Dionysia aretioides (Lehm.)Boiss.	600	3200	2600
Dionysia bryoides Boiss.	1700	3220	1520
Dionysia caespitosa (Duby) Boiss.	2100	3300	1200
Dionysia diapensiifolia Boiss.	1000	2700	1700
Dionysia gaubae Bornm.	1100	2430	1330
Dionysia haussknechtii Bornm. & Strauss	2100	3200	1100
Dionysia iranica Jamzad	1500	2350	850
Dionysia lamingtonii Stapf	1700	3200	1500
Dionysia leucotricha Bornm.	1200	2900	1700
Dionysia oreodoxa Bornm.	2000	3400	1400
Dionysia revoluta Boiss.	1600	3700	2100
Dionysia sawyeri (Watt)Wendelbo	1460	2900	1440
Dionysia termeana Wendelbo	2680	3500	820
Dionysia zagrica Grey-Wilson	1500	2850	1350
Diplotaenia cachrydifolia Boiss.	2200	3100	900
Dorema ammoniacum D. Don	1000	3250	2250
Dorema aucheri Boiss.	1700	2550	850
Doronicum bracteatum Edmondson	2248	3300	1052
Doronicum wendelboi Edmondson	1513.47	2600	1086.53
Draba pulchella Willd. ex DC.	3200	4000	800
Dracocephalum aucheri Boiss.	3350	4400	1050
Dracocephalum ghahremanii Jamzad	2200	3000	800
Dracocephalum kotschyi Boiss.	1290	3400	2110
Dracocephalum polychaetum Bornm.	2900	4000	1100
Dracocephalum surmandinum Rech. f.	3000	3900	900
Ducrosia assadii Alava	1300	2700	1400
Echinophora cinerea (Boiss.) Hedge & Lamond	2000	3050	1050
Echinophora platyloba DC.	1200	3700	2500
Echinops austro-iranicus Mozaff.	650	1460	810
Echinops bakhtiaricus Rech.f.	459.26	1320	860.74
Echinops cephalotes DC.	900	2450	1550
Echinops ceratophorus Boiss.	1520	2780	1260
Echinops chorassanicus Bunge	800	2700	1900
Echinops cyanocephalus Boiss.	1100	3000	1900
Echinops dichrous Boiss. & Hausskh.	100	2000	1900
Echinops ecbatanus Bornm.	1370	2962.75	1592.75
Echinops elbursensis Rech.f.	1950	3260	1310
Echinops elymaiticus Bornm.	1750	2962.75	1212.75
Echinops farsicus Rech. F	950	2300	1350
Echinops gedrosiacus Bornm.ÿÿÿÿ ÿ	600	1656.2	1056.2
Echinops glanduloso-punctatus Rech.f.	852.44	1670.74	818.3
Echinops haussknechtii Boiss.	600	2520.52	1920.52
Echinops heteromorphus Bunge	1043.78	1900	856.22
Echinops ilicifolius Bunge	1000	2025.9	1025.9
Echinops jesdianus Boiss.	1800	2700	900

Echinops keredjensis Rech.f.	1139	2500	1361
Echinops koelzii Rech.f.	400	3000	2600
Echinops kotschyi Boiss.	2119.17	3200	1080.83
Echinops lalesarensis Bornm.	1900	3000	1100
Echinops longipeticillatus Mozaff. & Ghahr.	100	1500	1400
Echinops macrophyllus Boiss. & Hausskn.	70	2600	2530
Echinops mosulensis Rech.f.	527	2600	2073
Echinops persepolitanus Rech.f.	940	2100	1160
Echinops polygamus Bunge	1000	2100	1100
Echinops robustus Bunge	997.49	2000	1002.51
Echinops sabzevarensis Mozaff.	1150	2000	850
Echinops shulabadensis Mozaff.	1000	1850	850
Echinops sojakii Rech . F.	1000	1900	900
Echinops tenuisectus Rech.f.	1000	3000	2000
Echinops viscidulus Mozaff.	1430	3200	1770
Elaeosticta nodosa (Boiss.) Boiss.	1250	3100	1850
Elburzia fenestrata (Boiss.) Hedge	1820	3000	1180
Epipactis rechingeri Renz	750	2200	1450
Erigeron hyrcanicus Bornm. & Vierh.	2700	4300	1600
Eriocycla ghafooriana Akhani	550	1600	1050
Eriocycla olivieri (Boiss.) Wolff	750	3000	2250
Eritrichium gracillimum Rech. f.	550	3000	2450
Erysimum caespitosum DC.	1800	4300	2500
Erysimum elbrusense Boiss.	1800	3700	1900
Erysimum nanum Boiss. & Hohen. in Boiss.	1900	4000	2100
Erysimum nasturtioides Boiss. & Hausskn.	2800	3800	1000
Euphorbia connata Boiss. in DC.	1210	2098	888
Euphorbia decipiens Boiss. & Buhse	1000	3100	2100
Euphorbia erythradenia Boiss.	1760	3900	2140
Euphorbia hebecarpa Boiss.	3000	3800	800
Euphorbia iranshahri Pahlevani	1878	3000	1122
Euphorbia mazandaranica Pahlevani	110	1470.82	1360.82
Euphorbia plebeia Boiss.	2000	2816.46	816.46
Euphorbia teheranica Boiss. in DC.	1200	2300	1100
Euphrasia juzepczukii Deniss.	2100	4200	2100
Ferula alliacea Boiss.	1550	2500	950
Ferula behboudiana (Rech.f. & Esfand.) Chamberlain	300	1800	1500
Ferula flabelliloba Rech. f. & Aell.	1700	2550	850
Ferula hezarlalehzarica Ajani	2400	3300	900
Ferula hirtella Boiss.	800	2100	1300
Ferula macrocolea Boiss.	570	2500	1930
Ferula microcolea (Boiss.) Boiss.	1600	3000	1400
Ferula persica Willd.	1300	2820	1520
Ferula serpentinica Rech.f.	1700	2700	1000
Ferula sharifii Rech. f. & Esfand.	1120	2000	880
Ferula stenocarpa Boiss. & Hausskn. in Boiss.	200	2300	2100

Ferula tabasensis Rech. f.	850	1950	1100
Ferulago angulata (schlecht.) Boiss.	800	3000	2200
Ferulago carduchorum Boiss. & Haisskn.	2200	3990	1790
Ferulago contracta Boiss. & Hausskn.	1700	3100	1400
Fibigia multicaulis (Boiss. & Hohen.) Boiss.	2000	3400	1400
Fibigia umbellata (Boiss.) Boiss.	1900	3900	2000
Fortuynia garcinii (Burm.) Shuttlew.	10	1519	1509
Fritillaria chlorantha Hausskn. & Bornm.	1300	2864.63	1564.63
Fritillaria kotschyana Herbert	800	3300	2500
Fritillaria olivieri Baker	1600	3560	1960
Fritillaria straussii Bornm.	1509	2700	1191
Fritillaria zagrica Stapf	1500	3032	1532
Gagea iranica Zarrei & Zarre	438	1435	997
Gagea uliginosa Siehe & Pascher	3000	3800	800
Gagea wendelboi Rech. f.	1000	2508	1508
Gaillonia eriantha Jaub. & Spach	1347	2600	1253
Galium aucheri Boiss.	3000	4300	1300
Galium decumbens (Ehrend.) Ehrend. & Schonb.-Tem.	1500	3700	2200
Galium delicatulum Boiss. & Hohen.	2300	4000	1700
Galium diploprion Boiss. & Hohen. in Boiss.	2000	3400	1400
Galium problematicum (Ehrend.) Ehrend. & Schonb.-Tem.	1800	2900	1100
Galium pseudokurdicum (Ehrend.) Sch”nb.-Tem.	1609.86	3900	2290.14
Galium schoenbeck-Temesyae Ehrend.	2400	3400	1000
Geranium persicum Sch”nbeck-Temesy	1404.31	2800	1395.69
Geum iranicum Khatamsaz	1800	3000	1200
Gladiolus persicus Boiss.	1000	3200	2200
Glaucium contortuplicatum Boiss.	300	2600	2300
Graellsia integrifolia (Rech.f.) Rech.f.	1800	2745	945
Graellsia saxifragifolia (DC.) Boiss. ssp. longistyla Poulter	1700	3500	1800
Graellsia stylosa (Boiss. & Hohen.) Poulter	1400	3200	1800
Grantia discoidea Bunge ex Boiss.	425	1313	888
Gypsophila acantholimoides Bornm.	2300	3300	1000
Gypsophila caricifolia Boiss.	1700	2800	1100
Gypsophila elymaitica Mozaffarian	700	1500	800
Gypsophila iranica Barkoudah	1600	3550	1950
Gypsophila lurorum Rech.f.	1200	2300	1100
Gypsophila melampoda Bienert ex Boiss.	150	1714	1564
Gypsophila persica Barkoudah	1070	2700	1630
Gypsophila polyclada Fenzl ex Boiss.	1500	2300	800
Gypsophila pseudomelampoda Gauba & Rech. f. in Rech. f.	1000	2200	1200
Gypsophila rupestris Mozaffarian	1600	2500	900
Gypsophila xanthochlora Rech. f.	1050	2300	1250
Halimocnemis azarbaijanensis Assadi	218	1200	982
Halimocnemis mamamensis (Bge.) Assadi	300	1854	1554
Haplophyllum canaliculatum Boiss.	110	2200	2090
Haplophyllum furfuraceum Bunge ex Boiss.	700	1950	1250

Haplophyllum glaberrimum Bunge ex Boiss.	790	1917	1127
Haplophyllum lissonotum C.C.Townsend	1650	2523	873
Haplophyllum rubro-tinctum C. Townsend	990	2300	1310
Haplophyllum stapfianum Hand.-Mzt.	427	1862	1435
Haplophyllum virgatum Spach	300	2200	1900
Haplophyllum viridulum Sojak	700	1971	1271
Haussknechtia elymaitica Boiss.	1700	2500	800
Hedysarum callithrix Bunge ex Boiss.	1350	2900	1550
Hedysarum criniferum Boiss.	1581	2993	1412
Helianthemum assadii Ghahremaninejad & Gholamian	20	1436	1416
Helichrysum artemisioides Boiis. & Hausskn.	1477	3430	1953
Helichrysum davisianum Rech.f.	2360	3510	1150
Helichrysum globiferum Boiss.	790	2590	1800
Helichrysum leucocephalum Boiss.	520	2650	2130
Helichrysum oligocephalum DC.	1600	3600	2000
Helichrysum oocephalum Boiss.	220	2720	2500
Helichrysum psychrophilum Boiss.	2700	4000	1300
Heliocarya monandra Bunge	1124	2000	876
Heliotropium agdense Bunge	180	1950	1770
Heliotropium aucheri	830	2302	1472
Heliotropium denticulatum Boiss. et Hausskn. in Boiss.	900	1930	1030
Heliotropium esfandiarii Akhani & Riedl	830	1950	1120
Heliotropium samoliflorum Bunge	854	2318	1464
Heracleum anisactis Boiss. & Hohen.	2200	3500	1300
Heracleum gorganicum Rech. f.	1500	2500	1000
Heracleum rechingeri Manden.	1250	2950	1700
Hertia angustifolia (DC.) O. Kuntze	1120	3250	2130
Hesperis nivalis Boiss. & Hausskn.	2180	3149.04	969.04
Hieracium azerbaijanense Lack	1191	2400	1209
Hymenocrater incanus Bunge	1150	2650	1500
Hymenocrater oxyodontus Rech. f.	1430	2260	830
Hymenocrater platystegius Rech. f.	850	2600	1750
Hymenocrater yazdianus Rech. f.	2200	3440.05	1240.05
Hyoscyamus kotschyanus pojark.	1700	3000	1300
Hyoscyamus kurdicus Bornm.	1800	3000	1200
Hyoscyamus malekianus Parsa	1900	3800	1900
Hyoscyamus tenuicaulis Schonbeck-Temesy	1	2400	2399
Hypericum dogonbadanicum Assadi	1000	1900	900
Iranecio elbrusensis (Boiss.) B. Nord	2150	3386.1	1236.1
Iranecio oligolepis (Boiss.) B. Nord.	3000	3800	800
Iranecio paucilobus (DC.) B. Nord.	1300	3550	2250
Iris barnumiae Baker & Foster	2000	3600	1600
Iris meda Stapf	1400	2900	1500
Isatis campylocarpa Boiss.	1480	2501	1021
Isatis gaubae Bornm.	570	2700	2130
Isatis koeiei Rech.f.	700	1900	1200

Isatis raphanifolia Boiss.	90	2379	2289
Isatis rugulosa Bunge ex Boiss.	947	1900	953
Isatis zarrei Al-Shehbaz	1800	2800	1000
Johrenia ramosissima Mozaff.	150	1700	1550
Johreniopsis scoparia (Boiss.) Pimenov	2300	3200	900
Johreniopsis stricticaulis (Rech.f.) M. Pimen.	1010	1900	890
Jurinea bungei Boiss.	1500	2500	1000
Jurinea catharinae Iljin.	800	2185.74	1385.74
Jurinea eriobasis DC.	2000	2800	800
Jurinea heterophylla (Jaub. & Spech) Borss.	898.51	2500	1601.49
Jurinea inuloides Boiss. & hausskn	1500	2400	900
Jurinea leptoloba DC.	1350	2334	984
Jurinea meda Bornm.	2200	4100	1900
Jurinea monocephala Aitch. & Hemsl.	1200	2800	1600
Jurinea radians Boiss.	997	2000	1003
Jurinea stenocalathia Rech.f.	1000	2300	1300
Jurinella frigida (Boiss.) Wagenitz	3300	4200	900
Jurinella microcephala (Boiss.) Wagenitz	2100	3900	1800
Kalakia marginata (Boiss.) Alava	600	2500	1900
Karvandarina aphylla Rech. f.	297	1594	1297
Klasea viciifolia (Boiss. & Hausskn.) L. Martins	1713	2742	1029
Lactuca azerbaijanica Rech.f.	1044	1884	840
Lactuca polyclada Boiss.	2405.85	3300	894.15
Lagochilus alutaceus Bunge	1050	2430	1380
Lagochilus aucheri Boiss.	1000	3120	2120
Lagochilus kotschyanus Boiss.	1000	3100	2100
Lagochilus lasiocalyx (Stapf) Jamzad	1500	2700	1200
Lagochilus macracanthus Fisch. & C.A. Mey. in Schrenk	900	3000	2100
Laser rechingeri Akhani	770	2100	1330
Launaea acanthodes (Boiss.) O. Kuntze	550	3000	2450
Launaea peistocarpa (Boiss.) Rech.f.	1490	2798	1308
Lavandula sublepidota Rech. f.	120	1700	1580
Lepechiniella persica (Boiss.) H. Riedl	3000	4000	1000
Lepechiniella wendelboi H. Riedl in Wendelbo	2000	4100	2100
Leucopoa pseudosclerophylla (Krivot.) Bor	2100	3042	942
Leutea cupularis (Boiss.) M. Pimen.	1800	3700	1900
Leutea gracillima M. Pimen.	750	2000	1250
Leutea nematoloba (Rech.f.) M. Pimen.	1000	2400	1400
Leutea petiolaris (DC.) Pimenov	1000	3350	2350
Leutea polyscias (Boiss.) M. Pimen.	200	1650	1450
Leutea rechingeri (Leute) Pimenov	2300	3300	1000
Ligularia persica Boiss.	2300	3500	1200
Linaria azerbaijanensis Hamdi & Assadi	1050	2900	1850
Linaria elymaitica (Boiss.) Kuprian.	1744	3200	1456
Linaria golestanensis Hamdi & Assadi	670	1827	1157
Linaria karajensis Hamdi & Assadi	1700	3200	1500

Linaria khalkhalensis Hamdi & Assadi	1500	2500	1000
Linaria lineolata Boiss.	1300	3400	2100
Linaria michauxii Chav.	889	2510	1621
Linaria nurensis Miller	1800	3100	1300
Linaria remotiflora Patzak	2012.4	3235	1222.6
Linaria shahroudensis Hamdi & Assadi	2300	3700	1400
Lindelofia kandavanensis Bornm. & Gauba	1304	2900	1596
Linum persicum Ky. ex Boiss.	1400	3113	1713
Malabaila kotschyi Boiss.	320	2200	1880
Malabaila porphyrodiscus Stapf & Wettst.	1100	2600	1500
Marrubium cordatum N b lek	2800	3600	800
Matthiola dumulosa Boiss. & Buhse	948	2000	1052
Matthiola ovatifolia (Boiss.) Boiss.	900	2800	1900
Matthiola revoluta Bunge ex Boiss.	70	2500	2430
Mentha mozaffarianii Jamzad	500	2000	1500
Michauxia stenophylla Boiss. & Hausskn.	330	1610	1280
Micrantha multicaulis (Boiss.) F. Dvo k	2100	3350	1250
Micromeria hedgei Rech. f.	650	2000	1350
Minuartia acuminata Turrill	1800	3200	1400
Minuartia glandulosa (Boiss. & A. Huet) Bornm.	1400	3500	2100
Minuartia lineata Bornm.	2600	3700	1100
Minuartia litwinowii Schischk.	1800	3600	1800
Minuartia sublineata Rech. f	1650	3300	1650
Muscari pseudomuscari (Boiss. & Buhse) Wendelbo	251	2200	1949
Myopordon hyrcanum (Bornm.) Wagenitz	3000	3900	900
Myopordon persicum Boiss.	3300	4100	800
Myosotis anomala H.Riedl	33	2450	2417
Nanorrhinum campyloceras (Rech. F. & Esfand.) Naanaie	40	1673	1633
Nanorrhinum chasmophyticum (Wendelbo) Naanaie	2250	3300	1050
Nanorrhinum khuzestanicum Naanaie	100	2166	2066
Nectaroscordum koelzii Wendelbo	1500	2800	1300
Nepeta archibaldii Rech. f.	2300	4140	1840
Nepeta assurgens Hausskn. & Bornm.	1700	3000	1300
Nepeta bakhtiarica Rech.f.	1200	2700	1500
Nepeta binaloudensis Jamzad	1560	3000	1440
Nepeta bokhonica Jamzad	1800	2700	900
Nepeta bornmuelleri Hausskn. & Bornm.	1680	3400	1720
Nepeta cephalotes Boiss.	930	2150	1220
Nepeta chionophila Boiss. & Hausskn.	2440	3437.04	997.04
Nepeta crassifolia Boiss. & Buhse	1200	3450	2250
Nepeta crispa Willd.	2100	4140	2040
Nepeta denudata Benth. in DC.	1150	2600	1450
Nepeta depauperata Benth. in DC.	1500	3500	2000
Nepeta dschuparensis Bornm.	2200	3850	1650
Nepeta elymaitica Bornm.	2000	3500	1500
Nepeta eremokosmos Rech.f.	1100	2800	1700

Nepeta gloeocephala Rech.f.	1500	2700	1200
Nepeta hormozganica Jamzad	300	1600	1300
Nepeta kotschyi Boiss.	1080	3300	2220
Nepeta lasiocephala Benth.	2300	4100	1800
Nepeta laxiflora Benth.	1400	3000	1600
Nepeta macrosiphon Boiss.	1800	3600	1800
Nepeta menthoides Boiss. Buhse	2024.18	3304.9	1280.72
Nepeta natanzensis Jamzad	2300	4200	1900
Nepeta oxyodonta Boiss.	1500	3300	1800
Nepeta pogonosperma Jamzad & Assadi	2600	3600	1000
Nepeta prostrata Benth.	1150	2600	1450
Nepeta racemosa Lam.	2000	3700	1700
Nepeta rivularis Bornm.	3000	3800	800
Nepeta schiraziana Boiss.	1500	3000	1500
Nepeta sessilifolia Bunge	2000	4000	2000
Nepeta straussii Hausskn. & Bornm.	1400	2850	1450
Nonea anchusoides Boiss. & Buhse	1305	3750	2445
Nonea iranica Falatoury & Pakravan	734	2100	1366
Nonea persica Boiss.	1000	3000	2000
Onobrychis alborzensis Ranjbar & Hajmoradi	1300	2207	907
Onobrychis aucheri Boiss.	1150	2100	950
Onobrychis gaubae Bornm.	1350	2400	1050
Onobrychis iranensis Amirabadizadeh & Ghanavati	913	2100	1187
Onobrychis mazanderanica Rech.f.	900	2400	1500
Onobrychis melanotricha Boiss.	800	3200	2400
Onobrychis psoraleifolia Boiss.	1313	2500	1187
Onobrychis scrobiculata Boiss.	1000	2500	1500
Onopordon caramanicum (Bornm.) Bornm.	700	2760.9	2060.9
Onosma bilabiata Boiss. & Buhse	1300	3500	2200
Onosma chrysochaetum Bornm.	1650	3050	1400
Onosma demavendica H.Riedl	1500	2950	1450
Onosma iranshahrii Ghahreman & Atter	1800	2600	800
Onosma kilouyense Boiss. & Hausskn	1500	3500	2000
Onosma kotschyi Boiss.	1220	3100	1880
Onosma pachypoda Boiss.	1050	2540	1490
Onosma platyphylla H.Riedl	1250	3400	2150
Onosma stenosiphon	3000	4000	1000
Onosma straussii (Riedl) Khatamsaz	120	2350	2230
Opsicarpium insignis Mozaff.	1420	2800	1380
Oreophysa microphylla (Jaub. & Spach) Browicz	1300	2100	800
Ornithogalum pycnanthum Wendelbo	2400	3200	800
Orobanche pulchra Gilli	1220	3400	2180
Otostegia michauxii Briq.	824.9	1700	875.1
Oxytropis bicornis Vassilcz	1100	2450	1350
Oxytropis binaludensis Vassilcz.	1600	3700	2100
Oxytropis chrysocarpa Boiss.	1900	3000	1100

Oxytropis cinerea Vassilcz.	1900	3300	1400
Oxytropis hypsophila Bunge & Boiss.	1200	3000	1800
Oxytropis Iranica Vassilcz.	2240	3850	1610
Oxytropis javaherdehi Maassoumi	1800	2700	900
Oxytropis karjaginii Grossh.	2500	3400	900
Oxytropis kermanica Freyn & Bornm	2700	4100	1400
Oxytropis kuchanensis Vassilcz.	1100	2863	1763
Oxytropis neorechingeriana Vassilcz.	1550	2800	1250
Oxytropis persica Boiss.	2500	3500	1000
Oxytropis rechingeri Vassilcz.	1100	2024	924
Oxytropis szovitsii Boiss. & Buhse	200	3000	2800
Papaver armeniacum (L.) DC	2179.51	3200	1020.49
Papaver persicum Lindl.	1400	2250	850
Papaver tenuifolium Boiss. & Hohen. ex Boiss.	200	2200	2000
Paracaryum cyclhymenium (Boiss.)H.Riedl	700	2250	1550
Paracaryum luristanicum Nab.	350	2031	1681
Paracaryum modestum Boiss. & Hausskn. ex Boiss.	200	2700	2500
Paracaryum persicum (Boiss.) Boiss.	700	2768	2068
Paracaryum pygmaeum (Rech.f.) Heller in D. Heller & C.C. Heyn	2900	3900	1000
Paraquilegia caespitosa	3500	4800	1300
Parlatoria rostrata Boiss.	1600	2700	1100
Paronychia bungei Boiss.	400	2600	2200
Paronychia caespitosa Stapf	1250	2500	1250
Pentanema flexuosum (Boiss. & Hausskn.) Rech.f.	1700	3000	1300
Pentanema multicaule Boiss.	2100	3750	1650
Pentanema pulicariiforme (DC.) Rech.f.	1466	3528	2062
Phagnalon persicum Boiss.	1700	3400	1700
Phlomis anisodonta Boiss.	950	3300	2350
Phlomis aucheri Boiss.	1200	2700	1500
Phlomis elliptica Benth.	700	2850	2150
Phlomis pachyphylla Rech.f.	450	1806	1356
Phlomis persica Boiss.	0	2800	2800
Phlomoides adenantha Jaub. & Spach	250	2900	2650
Phlomoides azerbaijanica Rech.f.	850	2300	1450
Phlomoides hyoscyamoides Boiss. & Buhse	940	2100	1160
Phlomoides lanata Jamzad	1735	2550	815
Phlomoides pulvinaris Jaub. & Spach	1250	2500	1250
Phuopsis stylosa Benth. & Hook.f	200	2640	2440
Physogeton acanthophyllus Jaub. & Spach	313	1900	1587
Physogeton occultus (Bge.) Assadi	742	1752	1010
Physoptychis gnaphalodes Boiss.	3200	4000	800
Pimpinella deverroides (Boiss.) Boiss.	1500	3500	2000
Pimpinella dichotoma (Boiss. et Hausskn.) Wolff in Engler	1500	2750	1250
Pimpinella gedrosiaca Bornm.	2000	3000	1000
Pimpinella khayyamii Mozaff.	1400	2500	1100
Pimpinella khorasanica Engstrand.	500	1850	1350

Pimpinella tragioides (Boiss.) Benth. & Hook.f. ex Drude	1150	2400	1250
Piptatherum molinioides Boiss.	1872.46	2750	877.54
Platychaete aucheri (Boiss.) Boiss.	16	1800	1784
Platychaete mucronifolia (Boiss.) Boiss.	129	1859	1730
Platychaete velutina Boiss. & Hausskn.	67	911	844
Polygala platyptera Bornm & Gauba	-28	2600	2628
Polygonum aridum Boiss. & Hausskn. in Boiss.	1700	3048	1348
Polygonum dumosum Boiss.	1650	3700	2050
Polygonum hyrcanicum Rech.f.	4	1900	1896
Polygonum salicornioides Jaub. & Spach	800	2950	2150
Polygonum spinosum H. Gross	2400	3900	1500
Polylophium involucratum (Pall.) Boiss.	1010	2810	1800
Postia bombycina Boiss. & Hausskn.	73	1602	1529
Postia puberula Boiss. & Hausskn.	697	2200	1503
Potentilla argyroloma Boiss. & Hohen.	1800	4200	2400
Potentilla aucheriana Th. Wolf	2200	4200	2000
Potentilla elvendensis Boiss. et Hohen.	1922.68	3183.36	1260.68
Potentilla farsistanica Browicz	1211	2202	991
Potentilla flaccida Th. Wolf	2600	4000	1400
Potentilla iranica (Rech.f.) Schiman-Czeika	1500	2500	1000
Potentilla lignosa Willd. ex D. F. K. Schltdl	2000	3150	1150
Potentilla nuda Boiss.	2200	3900	1700
Potentilla nurensis Boiss. & Hausskn.	1650	3350	1700
Potentilla pannosa Boiss. & Hausskn	1650	3000	1350
Potentilla polyschista Boiss.	3300	4479.93	1179.93
Potentilla porphyrantha Juz.	3300	4150	850
Potentilla poteriifolia Boiss.	2000	3500	1500
Prangos cheilanthifolia Boiss.	1000	2600	1600
Prangos crossoptera Herrnst. & Heyn	1200	2400	1200
Prangos tuberculata Boiss. & Hausskn.	1600	3000	1400
Primula gaubaeana Bornm.	679	2800	2121
Pseudocamelina aphragmodes (Boiss.) N. Busch	1800	2816.46	1016.46
Pseudocamelina camelinae (Boiss.) N.Busch	1600	2600	1000
Pseudocamelina glaucophylla (DC.) N. Busch	1000	2846.96	1846.96
Pseudofortuynia esfandiarii Hedge	1500	2430	930
Pseudofortuynia leucoclada (Boiss.) Khosravi	1470	3600	2130
Pseudotrachydium kotschyi (Boiss.) Pimenov & Kljuykov	1950	3900	1950
Pseudotrachydium pauciradiatum (Boiss. & Hohen.) Pimenov & Kljuykov	1900	3650	1750
Psychrogeton persicus (Boiss.) Grierson	2200	3828	1628
Pterocephalus lignosus Freyn & Bornm.	1350	2737	1387
Pterocephalus persicus Boiss.	1600	3100	1500
Pycnocycla acanthorhipsis Rech. f.	685	1600	915
Pycnocycla bashagardiana Mozaffarian	20	1150	1130
Pyrus glabra Boiss.	1200	3000	1800
Pyrus kandevanica Ghahreman	950	2330	1380
Pyrus mazanderanica Schonbeck-Temesy	1400	2400	1000

Quercus brantii Lindl.	1270	2319	1049
Ranunculus amblyolobus Boiss. & Hohen. in Boiss.	2000	3300	1300
Ranunculus aucheri Boiss.	1200	3100	1900
Ranunculus bulbilliferus Boiss. & Hohen.	2100	3000	900
Ranunculus crymophilus Boiss. & Hohen.	3100	3900	800
Ranunculus elbursensis Boiss.	1500	3202.02	1702.02
Ranunculus elymaiticus Boiss. & Hausskn.	2200	4200	2000
Ranunculus eriorrhizus Boiss. & Buhse	2700	4350	1650
Ranunculus papyrocarpus Rech. f.	1530	3400	1870
Ranunculus sahendicus Boiss. & Buhse	1502	2600	1098
Ranunculus sojakii Iranshahr & Rech. f.	2600	3400	800
Ranunculus straussii Bornm.	2300	3392.2	1092.2
Ranunculus trichocarpus Boiss.	1700	3800	2100
Reseda buhseana Mull.-Arg.	1170	2396	1226
Reseda bungei Boiss.	900	1900	1000
Reseda macrobotrys Boiss.	1081	2052	971
Rhabdosciadium aucheri Boiss.	2000	3500	1500
Rhabdosciadium petiolare Boiss. & Hausskn.	1650	3050	1400
Rhamnus cornifolia Boiss. & Hohen.	1700	3700	2000
Rheum kordestanicum Taheri & Assadi	1600	2400	800
Rindera bungei (Boiss.) Gurke in Engler & Prantl	800	2500	1700
Rochelia mirheydari Reidl & Esfandiari	350	1641	1291
Rubia albicaulis Boiss.	1300	2804	1504
Rubia pauciflora Boiss.	1800	3350	1550
Rumex elbursensis Boiss.	1500	3416.12	1916.12
Rumex ephedroides Bornm.	250	2026	1776
Salix firouzkuhensis Maassoumi	1730	2900	1170
Salsola persica Bunge ex Boiss.	800	2000	1200
Salsola yazdiana Assadi	700	1793	1093
Salvia aristata Aucher ex Benth. in DC.	1180	2900	1720
Salvia chorassanica Bunge	1550	3000	1450
Salvia eremophila Boiss.	130	2500	2370
Salvia hypoleuca Benth. in DC.	800	3000	2200
Salvia jamzadii Mozaffarian	1150	2350	1200
Salvia lachnocalyx Hedge	2020.73	3000	979.27
Salvia oligophylla Auch. ex Benth. in DC.	280	2000	1720
Salvia persepolitana Boiss.	180	2000	1820
Salvia sahendica Boiss. & Buhse	850	2600	1750
Salvia sclareopsis Bornm. ex Hedge	300	2550	2250
Salvia sharifii Rech.f. & Esfand.	100	2500	2400
Salvia urmiensis Bunge	1500	2500	1000
Saponaria bodeana Boiss.	1000	2600	1600
Satureja bachtiarica Bunge	1500	3000	1500
Satureja edmondi Briquet	1370	3950	2580
Satureja isophylla Rech.f.	900	3300	2400
Satureja sahendica Bornm.	1300	2950	1650

Saxifraga ramsarica Jamzad	2500	3800	1300
Saxifraga wendelboi Sch”nb.-Tem.	1900	2900	1000
Saxifrage iranica Bornm.	2800	4200	1400
Scabiosa schimperiana Boiss. & Buhse	300	1500	1200
Scilla gorganica Speta	211	1500	1289
Scilla greilhuberi Speta	80	1500	1420
Scilla khorassanica Meikle	976	2800	1824
Sclerochorton haussknechtii Boiss.	2734.37	3900	1165.63
Sclerorhachis leptoclada Rech.f.	200	1916	1716
Sclerorhachis platyrachis (Boiss.) Podl ex Rech.f.	990	2200	1210
Scorzonera calyculata Boiss.	250	3000	2750
Scorzonera grossheimii Lipsch. & Vassilcz	1800	3700	1900
Scorzonera intricata Boiss.	1700	3800	2100
Scorzonera ispahanica Boiss.	1303	2976	1673
Scorzonera kandavanica Rech.f.	600	2445	1845
Scorzonera luristanica Rech.f.	1171	2466	1295
Scorzonera microcalathia (Rech.f.) Rech.f.	552	2253	1701
Scorzonera mucida Rech.f.	750	2800	2050
Scorzonera persica Boiss. & Buhse	2000	3200	1200
Scorzonera perspolitana Boiss.	1000	2846	1846
Scorzonera renzii Rech.f.	1315	2600	1285
Scorzonera rupicola Hausskn.	1787	3235	1448
Scorzonera stenocephala Boiss.	2400	3666.8	1266.8
Scrophularia atroglandulosa Grau	2200	3100	900
Scrophularia crassicaulis Boiss.	2200	3500	1300
Scrophularia crassiuscula Grau	1300	3300	2000
Scrophularia elbursensis Bornm.	1000	3200	2200
Scrophularia farinosa Boiss.	1104	2700	1596
Scrophularia frigida Boiss.	1400	3900	2500
Scrophularia gaubae Bornm.	500	2070	1570
Scrophularia glauca Decne. ex Benth. in DC.	573	2200	1627
Scrophularia gorganica Rech. f.	1900	3700	1800
Scrophularia megalantha Rech.f.	40	2400	2360
Scrophularia oxysepala Boiss.	1500	2971	1471
Scrophularia rechingeri Grau	1065	2000	935
Scrophularia rostrata Boiss. & Buhse	28	2300	2272
Scrophularia schiraziana Attar & Hatami	650	2226	1576
Scrophularia subaphylla Boiss.	1800	3990	2190
Scutellaria bornmuelleri Hausskn. ex Bornm.	600	1660	1060
Scutellaria farsistanica Rech.f.	1700	2750	1050
Scutellaria glechomoides Boiss.	3400	4400	1000
Scutellaria multicaulis Boiss.	1100	4000	2900
Scutellaria nepetifolia Benth.	1295	3300	2005
Scutellaria persica Bornm.	1450	2500	1050
Scutellaria pinnatifida A. Ham.	1800	3500	1700
Scutellaria xylorrhiza Bornm.	1600	2400	800

Sedum callichroum Boiss.	1300	3000	1700
Sedum elburzense Akhiani & Assadi	1500	2500	1000
Sedum kotschyanum Boiss.	2100	4000	1900
Semenovia dichotoma (Boiss.) Manden.	2800	3900	1100
Semenovia frigida (Boiss.) Hausskn.	2400	3900	1500
Semenovia suffruticosa (Freyn & Bornm.) Manden.	2300	3600	1300
Semenovia trajioides (Boiss.) Manden.	1500	3550	2050
Sempervivum atropatanum Parnell	1350	2800	1450
Sempervivum iranicum Bornm. & Gauba	1110	3000	1890
Senecio lipskyi Lomak.	1540	3400	1860
Senecio vulcanicus Boiss.	3300	4100	800
Serratula haussknechtii Boiss.	2100	3340	1240
Serratula viciifolia Boiss. & Hausskn.	1600	3000	1400
Silene albescens Boiss.	1315	3000	1685
Silene avromana Boiss. & Hausskn.	1500	3450	1950
Silene daenensis Melzh.	3000	4100	1100
Silene elymaitica Bornm.	1670	3350	1680
Silene erysimifolia Stapf	1350	2600	1250
Silene farsistanica Melzh.	1800	3000	1200
Silene ferdowsii Joharchi	668	1532	864
Silene gertraudiae Melzh.	1150	2230	1080
Silene goniocaula Boiss.	2400	3200	800
Silene gynodioica Ghaz.	1150	3500	2350
Silene lucida Chowdhuri	2000	3000	1000
Silene meyeri Fenzl ex Boiss. & Buhse	1200	3000	1800
Silene nurensis Boiss. & Hausskn.	3000	4200	1200
Silene palinotricha Fenzl ex Boiss.	1400	3000	1600
Silene persica Boiss.	2400	3500	1100
Silene pseudaucheriana Melzh.	1090	1920	830
Silene sojakii Melzh.	1000	2780	1780
Stachys acerosa Boiss.	1500	3500	2000
Stachys asterocalyx Rech. f.	1255	3170	1915
Stachys aucheri Benth.	1700	2900	1200
Stachys ixodes Boiss. & Hausskn. ex Boiss.	1710	3000	1290
Stachys kermanshahensis Rech.f.	500	2200	1700
Stachys koelzii Rech.f.	2300	3500	1200
Stachys laxa Boiss. & Buhse	500	2810	2310
Stachys obtusicrena Boiss.	1900	4000	2100
Stachys persepolitana Boiss.	800	2750	1950
Stachys pilifera Benth.	1660	3300	1640
Stachys subaphylla Rech.f.	600	1400	800
Stachys veroniciformis Rech.f.	1100	3200	2100
Stenotaenia nudicaulis Boiss.	1800	3252.79	1452.79
Sterigmostemum longistylum (Boiss.) Bornm.	1260	2200	940
Stipa atriseta Stapf ex Bor	1700	3800	2100
Stipa haussknechtii Boiss.	1950	3200	1250

Straussiella purpurea (Bge.) Hausskn.	1500	2550	1050
Tanacetum dumosum Boiss.	2100	3459.61	1359.61
Tanacetum hololeucum (Bornm.) Podl.	1200	3700	2500
Tanacetum khorassanicum (Krasch.) Parsa	1200	3200	2000
Tanacetum lingulatum (Boiss.) Bornm.	1219	2726	1507
Tanacetum persicum (Boiss.) Mozaff.	1700	3800	2100
Tanacetum tenuisectum (Boiss.) Podl.	1300	3300	2000
Tanacetum walteri (C. Winkl.) Tzvel.	1637	2900	1263
Taraxacum azerbaijanicum Soest	1200	2000	800
Taraxacum iranicum Soest	1988	2906	918
Taraxacum koelzii Soest	1780	3083	1303
Taraxacum kotschyi Soest	1640	2800	1160
Taraxacum neo-spurium Soest	2600	3660	1060
Taraxacum rechingeri Soest	1500	2750	1250
Taraxacum roseum Bornm	1900	3586	1686
Taraxacum ruberuliforme Soest	1357	3165	1808
Telephium eriglaucum Williama	1550	2350	800
Tetrataenium lasiopetalum (Boiss.) Manden.	1500	4000	2500
Tetrataenium nephrophyllum (Leute) Manden.	1700	3000	1300
Teucrium macrum Boiss. & Hausskn. ex Boiss.	1800	3000	1200
Teucrium persicum Boiss.	80	1900	1820
Thecocarpus meifolius Boiss.	1500	3200	1700
Thlaspi stenocarpum (Boiss.) Hedge	2350	3600	1250
Thymus carmanicus Jalas	2000	3600	1600
Thymus daenensis Celak.	1035	3200	2165
Thymus persicus (Ronniger ex Rech.f.) Jalas	1900	2900	1000
Thymus pubescens Boiss. & Kotschy ex Celak.	1200	3600	2400
Trachydium depressum Boiss.	3000	3900	900
Trachydium kotschyi (Boiss.) Boiss.	2000	3900	1900
Trachydium pauciradiatum (Boiss. & Hohen.) Rech. f.	2400	3650	1250
Tragopogon acanthocarpus Boiss.	1300	3690	2390
Tragopogon caricifolius Boiss.	1000	3361	2361
Tragopogon gongylorrhizus Rech.f.	31	900	869
Tragopogon jezdianus Boiss. & Buhse	1300	3352.05	2052.05
Tragopogon kotschyi Boiss.	1200	3800	2600
Tragopogon porphyrocephalus Rech.f.	1281	2650	1369
Tragopogon rezaiyensis Rech.f.	1380	3400	2020
Trichodesma aucheri DC.	1428	3027	1599
Trifolium radicosum Boiss. & Hohen.	2800	3800	1000
Trigonella disperma Bornm. ex Vassilcz.	1029	2700	1671
Trigonella elliptica Boiss.	732	2150	1418
Trigonella persica Boiss.	33	2321	2288
Trigonella stenocarpa Rech. f.	1130	2150	1020
Trigonella teheranica Bornm.	1500	2600	1100
Trigonosciadium brachytaenium (Boiss.) Alava	1650	2600	950
Trisetum bungei Boiss.	1000	2700	1700

Tulipa montana Lindl.	250	3150	2900
Tulipa ulophylla Wendelbo	600	2500	1900
Ulmus boissieri Graudz	364	2619	2255
Ungernia flava Boiss. & Hausskn. in Boiss.	1416	2381	965
Verbascum aucheri (Boiss.) Hub.-Mor.	1070	2800	1730
Verbascum bornmuellerianum Hub.- Mor.	1313.67	2790.67	1477
Verbascum carmanicum (Bornm.) Hub.-Mor.	2448.22	3400	951.78
Verbascum farsistanicum (Murb.) Hub.- Mor	1000	2400	1400
Verbascum gabrieliae (Bronm.) Hub.-Mor.	2000	3146	1146
Verbascum hasarense Freyn & Bornm. in Freyn	2412	3601	1189
Verbascum intricatum (Benth.) O. Kuntze	1500	3600	2100
Verbascum kermanense Hub.-Mor.	1700	3124	1424
Verbascum lyprocarpum (Murb.) Hub.-Mor.	1273	2509	1236
Verbascum scoparium Mozaffarian	500	2000	1500
Verbascum straussii (Bornm.) Hub.- Mor	1570	2500	930
Verbascum sublobatum Murb.	600	2100	1500
Veronica acrotheca Bornm. & Gauba	1480	2400	920
Veronica aucheri Boiss.	2000	4800	2800
Veronica farinosa Hausskn.	1282	3000	1718
Veronica fragilis Boiss. & Hausskn.	1800	3200	1400
Veronica francispetae M. A. Fischer	-18	1200	1218
Veronica kurdica Benth.	2700	3750	1050
Veronica mazanderanae Wendelbo	70	2400	2330
Veronica mirabilis Wendelbo	2900	3700	800
Veronica paederotae Boiss.	3500	4300	800
Veronica rechingeri M. A. Fischer	1800	3400	1600
Veronica rubrifolia Boiss.	1800	3400	1600
Vicia ciceroidea Boiss.	2563.48	3600.71	1037.23
Vicia kotschyana Boiss.	2400	4110	1710
Vicia persica Boiss.	800	3000	2200
Vicia sojakii Chrtkova-Zertova	2000	3600	1600
Viola pachyrrhiza Boiss. & Hohen.	1500	3200	1700
Viola spathulata Willd.	800	3150	2350
Zeravschania aucheri (Boiss.) Pimenov	1300	3300	2000
Zerdana anchonioides Boiss.	2500	4100	1600
Zeugandra iranica P.H.Davis	1020	2154	1134
Zhumeria majdae Rech.f. & Wendelbo	250	2000	1750
Zosima radians Boiss. & Hohen.	1200	2500	1300