How Many Animal Species are there in Austria? Update after 20 Years

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Geiser (1998) estimated that 45 870 animal species occur in Austria. The number combines summation of published species lists with extrapolation from species numbers in groups where knowledge is insufficient. An update after 20 years is justified by the increase in quantity and quality of evaluated species lists, resulting from various research activities. This includes better-consolidated species numbers from Germany, which were used as the basis for extrapolation. The new and better-verified outcome of animal species reported for Austria is 54 125. Insects alone account for 40 000 species. This increase by 18 % or 8 255 species is first and foremost due to an improved level of scientific knowledge. The influence of taxonomic revisions is negligible, as some species were split while others were synonymized.
There are a considerable number of species for which only few individuals have been recorded in Austria. Some of them are known only by single specimens preserved in museum collections. Others have not been recorded in Austria for more than 50 years. Some of these species are, indeed, extremely rare, but often the lack of records is simply an indication of the difficulty to observe, catch and identify certain species. The numbers of these species have increased in the past two decades due to specialist investigations (mostly involved in specific projects).
Bear in mind that the increase in species numbers recorded in Austria masks a serious problem:
Although the species number has seemingly been magnified, it does not mean that pressure on biodiversity has decreased. To the contrary – biomass is shrinking. The biomass of insects has diminished by 75 % during the past decades, even in protected habitats. This decline comes with serious side effects, including impacts on the reproduction of birds and bats, and on the pollination of plants, to name but a few (Hallmann et al. 2017). Therefore, it is necessary to consider that this seemingly encouraging number of animal species in Austria only reflects a status which includes an increasing number of endangered species.

Geiser E., 2018: Wie viele Tierarten leben in Österreich? Aktualisierung nach 20 Jahren.
1998 publizierte Geiser erstmalig eine Artenzahl für Tiere Österreichs. Die damalige Zahl von 45 870 beruhte auf direkter Auswertung von publizierten Artenlisten, ergänzt mit Hochrechnungen bei Tiergruppen, für die noch keine Artenlisten vorlagen. In den letzten 20 Jahren wurden im Rahmen mehrerer großer Projekte aktuelle und genauer recherchierte Artenlisten erstellt, sodass eine Aktualisierung dieser Artenzahl geboten erscheint. Diese Listen wurden nun ausgewertet und abermals durch Hochrechnungen ergänzt, wobei deren Basis, die Artenzahlen in Deutschland, ebenfalls inzwischen deutlich verbessert wurde. In Summe ergibt das nun 54 125 Tierarten für Österreich, wobei die Insekten allein bereits 40 000 Arten stellen.
Diese Erhöhung um 8 255 Arten bzw. um 18 % ist hauptsächlich auf eine genauere Erforschung der österreichischen Fauna zurückzuführen. Dabei ist der Einfluss der taxonomischen Revision vernachlässigbar, einige Arten wurden zwar aufgesplittet, aber dafür andere synonymisiert.
Von einer beträchtlichen Anzahl von Tierarten sind nur wenige Individuen in Österreich nachgewiesen. Von manchen existiert nur ein einziges Belegexemplar in einer Museumssammlung. Ebenso gibt es von vielen Arten seit mindestens 50 Jahren keine neuen Nachweise. Dabei handelt es sich allerdings meist um Arten, die immer schon selten waren und auch um solche, die schwierig zu beobachten, zu fangen und sehr schwer zu bestimmen sind. Durch die intensiven Recherchen der Spezialisten einzelner Tiergruppen (die meist auch in die aktuellen Projekte eingebundenen sind) wurden nun mehr von diesen Arten nachgewiesen.
Diese neue hohe Artenzahl verdeckt allerdings ein ernstes Problem:

Obwohl sich die Artenzahl scheinbar vergrößert hat, nimmt die Biomasse vieler Tierarten ab. Die Biomasse der Insekten ist nachweislich um 75 % zurückgegangen, und zwar in verschiedenen und auch in geschützten Habitaten. Dadurch wird ein Domino-Effekt ausgelöst, der sich auch auf die Reproduktion von zahlreichen Vogel- und Fledermausarten und auf die Bestäubung von Blütenpflanzen auswirkt. Die erfreulich hohe Artenzahl für Österreich bezeichnet daher einen Status, der zahlreiche vom Aussterben bedrohte Arten mit einschließt.

Keywords: Species numbers, checklists of animals, Austria, endangered species, biodiversity.

Introduction

Before 1998 it was assumed that the number of animal species in Austria was 30 000 (GEPP 1983, GRABHERR 1994). In part thanks to her cooperation with the comprehensive Evertebrata database ZOODAT in Linz, now ZOBODAT [https://www.zobodat.at/], the author knew that more than 30 000 insect species were recorded for Austria, thus the overall number of animal species had to be considerably higher. After expert literature research and consultation of experts, the species number of 45 870 was published (GEISER 1998) and has since been widely used.

Over the past 20 years, various research activities have led to more precise species numbers. The Academy of Sciences started their new series *Checklists of the Fauna of Austria*. The aim of the project *ABOL – Austrian Barcode of Life* is to gain genetic barcodes of all animal and plant species in Austria, which has promoted a lot of systematic research and species listing activity. The third edition of the FAA (*Fauna Aquatica Austriaca*) was published in December 2017. The Environment Agency of Austria (Umweltbundesamt) published detailed studies, i.e. Red Lists of several animal groups and a comprehensive study about endemism in Austria (RABITSCH & ESSL 2009). To estimate the percentage of species that are threatened or endemic, it is necessary to ascertain the total number of species of the studied group, which was also published there by the experts.

Thus, there is a much greater abundance of data with much better precision available today compared with the situation in 1998. Since these data are scattered across literature, websites and sometimes experts' private lists, the present paper compiles them here now as the result of very many research activities.

Material and Methods

Main Data Sources

Checklists of the Fauna of Austria

Biosystematics and Ecology Series, edited by the Austrian Academy of Sciences. Vol.1 was published in 2004, since then 8 further checklists have been published until December 2017 (See details in chapter: Literature).

FAA: Fauna Aquatica Austriaca

A Comprehensive Species Inventory of Austrian Aquatic Organisms with Ecological Notes. 3rd edition published in December 2017, on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW).
[http://www.ecoprof.at/index.php/faunaaquaticaaustriaca.html].

Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. 923 pp.
Edited in 2009 by Rabitsch & Essl on behalf of the Environment Agency Austria.

Red Lists with detailed lists of all animal species of the studied groups:
Rote Listen gefährdeter Tiere Österreichs. Checklisten, Gefährdungsanalysen, Handlungsbedarf.
Edited by P. Zulka (2005–2009) on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW).
Further comprehensive studies with complete species lists for separate animal groups like Huemer (2013): Lepidoptera, or Zuna-Kratky et al. (2017): Saltatoria.

ABOL – Austrian Barcode of Life [https://www.abol.ac.at/].
Experts for separate groups offered me great support, answering my questions, compiling their own data and sharing their detailed species lists with me.

Another very helpful source was the series:
Entomofauna Germanica.
From there, I mainly used the comprehensive list in Entomofauna Germanica No. 6 (Klausnitzer 2003).

Extrapolation

For all groups where species lists or at least reliable numbers of species were available, these numbers were used directly. But there are some animal groups for which we do not have sufficient knowledge regarding the number of species occurring in Austria. For these groups, species numbers for Austria were extrapolated from species numbers from Germany.

A comparison of species numbers in Germany and Austria in well studied animal groups consistently reveals higher numbers in Austria by 10 % to 30 %. A similar result was obtained by Schwarz (2014) in comparisons of hymenopteran families.

Reflecting the mean ratio of species numbers in Germany and Austria, the following formula was used to estimate species numbers in animal groups with insufficient knowledge:

$$GE_{sp} \times 1.2 = AU_{sp}$$

GE_{sp}: number of species in Germany
AU_{sp}: number of species in Austria

Of course this formula can only be applied in animal groups without marine species!

The same formula was used in Geiser (1998), but the factor 1.2 remains the same irrespective of whether older or newer species numbers are compared. Higher numbers in Austria seem paradoxical because the area of Germany is 4.2 times larger than the area of Austria, and the results thus seemingly contradict the species-area relationship.

However, there are several reasons why Austrian species numbers are higher than numbers in Germany.

- Austria has a much more diverse landscape. It is structured topographically on a smaller scale generally, and especially in the Alps. The Alps in Germany are only a small part of the Northern Calcareous Alps in southernmost Bavaria. The Austrian alpine regions differ in geology, soil, rocks, minerals, microclimate, exposition, amount of precipitation and glacial history. The massifs are often isolated, the valleys and lowlands impede dispersal of most species living in high alpine habitats.

- Apart from the alpine regions, Austria contains Pannonian lowlands in the northeast and the Illyrian region in the southeast.
- The area of Austria is situated in lower degrees of latitude which usually results in increased species numbers.

Remarks on Classification

Despite a lot of changes in systematics during the last 20 years, almost the same classifications were applied as in GEISER (1998). This allows for better comparability, in many cases the numbers can be easily allocated to different classifications.

Species and Subspecies

Wherever data was sufficient, subspecies were treated as the units of biodiversity. Some subspecies are considered as species by some specialists and vice versa. In many cases numbers are not affected, since only a single subspecies of a species occurs in Austria.

Furthermore, the information whether subspecies are included in species numbers was not always available, since some lists lack remarks. Thus, the numbers in Table 1 sometimes refer only to species numbers, while sometimes including the subspecies level. This implies that total numbers are underrated if subspecies levels should be reflected, while only being slightly overrated if the species level is the lowest level of interest.

Species Delimitation

Species delimitation can sometimes be very difficult. Even in well studied taxa like the fish family Coregonidae, species delimitation is not unambiguous. It is likely that the Coregonidae are a typical example of evolution in progress and that the species are not completely delimited in reality.

Gastropoda species were mainly described by shell characters. Shell shape variation was often considered as the differential character system for species delimitation, and the extent of ecological variation was thus underrated. Similar problems occur in nearly all animal taxa. But taxonomic revisions are laborious, hence it will take a long time for further clarification.

Aliens

Another problem occurs with alien species. Most of the species which were introduced decades ago are now considered part of the Austrian fauna. But especially some newly introduced species like the lady beetle *Harmonia axyridis* or the moth *Cydalima perspectalis*, whose caterpillars feed on box tree, must be treated as a species in Austria because they ARE an (invasive) species in Austria. What is more, the total species number of a group often lacks information on whether some of the species are considered alien species. Therefore, they are included in most cases. The only exception is explained in comment c18.

Species Numbers

The problems explained above may cause some uncertainty regarding the seemingly exact numbers specified in Table 1. While uncertainty is much higher in understudied groups, the numbers actually change more frequently in well studied groups. Almost all experts told me a slightly higher number of species than the number published a few years ago by themselves or by colleagues. Therefore, sums calculated for the higher taxa were brought up to a round figure, so the final result is considered to be more realistic.

Results

Numbers of Species in Austria

Explanations for abbreviations used in Table 1:

1998 the number of species published in Geiser 1998

of species the currently proven or estimated number of species in Austria

c1, c2, … number of the comment for further explanation

FAA:
Moog, O. & Hartmann, A. (Eds.), 2017: Fauna Aquatica Austriaca, 3rd Edition. BMLFUW, Wien.

Checklist No. 1, 2, …
Checklisten der Fauna Österreichs, Biosystematics and Ecology Series. Österreichische Akademie der Wissenschaften, Wien.

Tab. 1: The numbers of species for the individual fauna groups in Austria. – Tab. 1: Die Artenzahlen der einzelnen Tiergruppen in Österreich.

Taxon	# 1998	# of species	Source	C
Protozoa	1200	> **1500**	E. Aescht (pers. communication, 02.02.2018)	
Testacea	232	317 (243 sp. + 74 ssp.)	Ortner (2017)	
Ciliophora	750	1033	Checklist No. 7: Aescht (2013)	
Porifera	> 6	**6**	FAA: Dröscher et al. (2017)	
Coelenterata	> 3	**> 3**	Mildner (1995)	
Plathelminthes	< 1050	**1100**		c1
Turbellaria	< 150	200	H. Sattmann (pers. communication, 01.02.2018)	
Monogenea		> 120	C. Hahn (pers. communication, 01.12.2017)	
Trematoda	< 450	400	H. Sattmann (pers. communication, 01.02.2018)	
Cestodes	< 450	300	H. Sattmann (pers. communication, 01.02.2018)	
Nemertini	2	**2**	Senz (1996)	
Nemathelminthes	610	**850**		
Rotifera	< 550	760	Jersabek (2009)	
Gastrotricha	< 10	< 30	Stresemann (1992)	
Nematomorpha	13	14	Schmidt-Rhaesa (2009)	
Acanthocephala	37	> 40	Kritscher (1985), Konecny (2009) , H. Sattmann (pers. communication, 01.02.2018)	c2
Nematoda	< 1500	**< 4000**	Stresemann (1992)	c3
Bryozoa	10	**14**	FAA: Wöss (2017)	
Mollusca	435	**537**		c4
Gastropoda	391	498	Reischütz & Reischütz (2007), with 105 limnic species included (FAA: Reischütz et al. 2017a)	
Bivalvia	44	39	FAA: Reischütz et al. (2017b)	
Annelida	> 282	**300**		
Polychaeta	3-4	3	FAA: Hörner et al. (2017)	

Tab. 1 continued – Fortsetzung

Taxon	# 1998	# of species	Source	C
Oligochaeta	> 250	260		
limnic species (without Echytraeidae and Lumbricidae)	106	89	FAA: Hörner et al. (2017)	
Enchytraeidae	100	100	Bauer (2009)	
Lumbricidae	60	60	Bauer (2009)	
Branchiobdellidae		6	FAA: Nesemann (2017)	
Hirudinea	28	39	FAA: Nesemann & Moog (2017)	
Kamptozoa	-	**1**	FAA: Sporka (2017)	
Linguatulida	2	**2**	Führer in litt. (11.12.2017) and Böckeler et. al. (2010)	c5
Tardigrada	63	**79**	Checklist No. 8: Dastych (2015)	
Crustacea	< 525	**530**	P. Dworschak (pers. communication, 01.02.2018)	c6
Anostraca, Notostraca, Laevicaudata, Spinicaudata	16	16	FAA: Hödl et al. (2017) and Checklist No. 6: (Eder 2012)	
Branchiopoda (Cladocera)		104	FAA: Gaviria et al. (2017)	
Amphipoda		17	FAA: Pöckl et al. (2017)	
Decapoda		9	FAA: Pöckl et al. (2017)	
Isopoda (limnic and terrestric)	73	77	FAA: Pöckl et al. (2017) (7 limnic species), Allspach (2009) (70 terrestrial species)	
Mysida		3	FAA: Wittmann (2017)	
Copepoda-Harpactoida	35	51	FAA: Gaviria & Fuchs (2017)	
Copepoda-Cyclopoida		59	FAA: Gaviria et al. (2017)	
Copepoda-Calanoida		16	FAA: Gaviria et al. (2017)	
Copepoda-Parasitica		6	FAA: Konecny (2017)	
Ostracoda		92	FAA: Gaviria (2017)	
Chelicerata		**4200**		
Araneae	1000	1035	Komposch (2009b) and Komposch in litt. (23.11.2017)	
Opiliones	58	65	Checklist No. 5: Komposch (2011) and Komposch in litt. (23.11.2017)	
Scorpiones	2	3	Komposch (2009a)	
Pseudoscorpiones	60	71	Checklist No. 5: Mahnert (2011) and C. Muster in litt. (26.01.2018)	
Palpigradi	2-3	2	Checklist No. 3: Christian (2008) and Christian in litt. (27.01.2018)	
Acari	> 1000	> 3000	M. Walzl (pers. communication 07.03.2018)	c7
Oribatei	559	623	Checklist No. 9: Krisper et al. (2017)	
Scutacaridae		117	Checklist No. 1: Ebermann (2004)	
Halacaridae		8	Checklist No. 6: Gerecke (2012)	
Hydrachnidia		247	Checklist No. 6: Gerecke (2012)	
Myriapoda	281	**330**		
Chilopoda		73	Szucsich in litt. 11.12.2017	

Tab. 1 continued – Fortsetzung

Taxon	# 1998	# of species	Source	C
Diplopoda		> 190	extrapolation	c8
Pauropoda		39	Szucsich in litt. 11.12.2017	
Symphyla		21	Szucsich in litt. 11.12.2017	
Insecta		**40010**		
Collembola	500	486	Checklist No. 3: Querner (2008) and Christian in litt. (27.01.2018)	
Protura	50	59	Checklist No. 5: Christian (2011) and Christian in litt. (27.01.2018)	
Diplura	20	22	Checklist No. 4: Christian (2009) and Christian in litt. (27.01.2018)	
Archaeognatha	20	21	Christian (2009)	
Zygentoma	5	6	Christian (2009)	
Ephemeroptera	111	119	FAA: Bauernfeind et al. (2017)	
Plecoptera	115	135	FAA: Graf et al. (2017)	
Odonata	81	78	FAA: Chovanec et al. (2017)	
Saltatoria	135	139	Zuna-Kratky et al: (2017)	
Mantodea		1	Rabitsch (2009a)	
Blattodea		11	Rabitsch (2009a)	
Dermaptera		8	Haas (2009)	
Psocoptera	110	> 100	Lienhard (2009) and extrapolation	c9
Phthiraptera	< 1000	900	estimation	c10
Thysanoptera	198	204	Strassen (2009)	
Auchenorrhyncha	600	700	Checklist No. 4: Holzinger (2009) Holzinger in litt. 08.11.2017	
Heteroptera	1000	920	Rabitsch (2016)	
Stenorrhyncha		840		
Aleyrodoidea		15	Rabitsch (2009b)	
Aphidoidea		> 500	Rabitsch (2009b)	
Coccoidea		180	Malumphy & Kahrer (2011) and extrapolation	c11
Phylloxeroidea		16	Rabitsch (2009b)	
Psylloidea		122	Rabitsch (2009b)	
Coleoptera	7500	8000	extrapolation	c12
Strepsiptera	> 9	15	estimation	c13
Hymenoptera	> 10 000	11200	extrapolation	c14
Trichoptera	300	315	FAA: Graf et al. (2017)	
Lepidoptera	4000	4090	4071 in Huemer (2013) and some additional records (Huemer in litt. 23.02.2018)	
Neuropterida	117	150	Aspöck H. in litt. (20.01.2018)	c15
Mecoptera	10	10	Gepp (2005)	
Siphonaptera	> 70	80	Rabitsch (2009b) and extrapolation	c16
Diptera	10 000	11500	extrapolation	c17
Vertebrata	626	**661**		
Cyclostomata	2	2	Zangl pers. communication 13.02.2018	
Pisces	60	84	Koblmüller & Zachos (2015) and Koblmüller pers. communication 01.12.2017	c18

Tab. 1 continued – Fortsetzung

Taxon	# 1998	# of species	Source	C
Amphibia	21	24	Schweiger (pers. communication, 30.01.2018)	
Reptilia	16	16	Schweiger (pers. communication, 30.01.2018)	
Aves	417	430	Birdlife Austria (Ranner (2017)	
Regular breeding birds	239	217	Birdlife Austria (Ranner 2017)	
passage migrants or vagrants	178	213	Birdlife Austria (Ranner 2017)	
Mammalia	110	**105**	Koblmüller & Zachos (2015) and Zachos pers. communication 07.11.2017	

Comments to Table 1

c1 Plathelminthes:

The numbers of species for all classes are estimations! The Turbellaria are very difficult to identify and not very well studied. The parasitic worms are well investigated only if they are relevant in human or veterinary medicine. The Monogenea were formerly considered as part of the Trematoda, but they are now treated as a separate class. The investigation of species which are parasites on fish gills has just started, and many more species are to be expected.

c2 Acanthocephala:

37 species are listed in Kritscher (1985). No changes of the species number in Austria have been recorded so far, even though a lot of research has been done on this group in parasitology and freshwater monitoring (Konecny 2009). 40 species in Austria may be a realistic minimum species number.

c3 Nematoda:

The number of Nematoda in Austria is unknown. In the first edition of Stresemann (1967), 1500 species of Nematoda were indicated; in Stresemann (1992), this number increased to 4000 species. Because of the marine species included there, the number of species in Austria is estimated to be less than 4000. Maybe there are a lot more. There are 20 000 species described worldwide, but it is estimated that there may be 1 million species (Eisendle & Hoschitz 2009).

c4 Mollusca:

Although molluscs are thoroughly investigated in Austria, the species number is uncertain because of systematic problems within some species groups (A. Eschner in litt. 07.12.2017)

c5 Linguatulida:

Linguatula serrata parasitizes in the small intestine of Canidae (mostly in dogs), but can also be found in cats and – rarely – in humans. *Reighardia sternae* parasitizes in the lungs of gulls.

c6 Crustacea:

Many crustacean taxa have been well studied in Austria by limnologists, these taxa amounting to 450 species. Because there are some additional, lesser known taxa, a total number of 530 species is estimated.

c7 Acari:

About 1200 mites are recorded for Austria, but there are many more species for sure. They are very difficult to identify, and some habitats are not yet explored. Every bird species can be a host to several specific mites on different parts of the body, and these mites are very poorly studied. Therefore, the 400 bird species in Austria may provide more than 1500 mite species. There is also a knowledge gap in other mite habitats and a lot of systematic clarification is necessary. It is not unrealistic to assume there are about 5000 mite species in Austria (M. Walzl pers. communication 07.03.2018).

c8 Diplopoda:

Nikolaus Szucsich provided me with his lists of Myriapoda he compiled for ABOL – The Austrian Barcode of Life. Only the number of Diplopoda species was calculated by comparison with the numbers of Myriapoda species in Germany (Tab. 2).

sp. in GE: number in Germany as indicated in Stresemann (1992)
sp. in AU: number in Austria as indicated in Szucsich in litt.

Tab. 2: Data for the calculation of the ratio necessary to calculate of the number of diplopod species in Austria. – Tab. 2: Datengrundlage für die Berechnung der Verhältniszahl, die man zur Berechnung der Anzahl der Diplopodenarten in Österreich benötigt.

	# sp. in GE	# sp. in AU	ratio AU /GE
Myriapoda		**330**	
Chilopoda	50	73	1.46
Diplopoda	125	**> 190**	**> 1.5**
Pauropoda	20	39	1.95
Symphyla	15	21	1.4

The average ratio value derived from Chilopoda, Pauropoda and Symphyla is 1.6, therefore the assumed ratio value of 1.5 for the Diplopods is rather a minimum.

c9 Psocoptera:

For the Psocoptera, reliable records for 75 species exist. But the Psocoptera of Austria are not well studied. In Germany 95 species and in Switzerland 101 species are recorded (Lienhard 2009). Therefore, it can be assumed that there are at least 100 species of Psocoptera in Austria.

c10 Phthiraptera:

In Entomofauna Germanica 6 (Klausnitzer 2003), 641 species are recorded for Germany. But the Phthiraptera parasitizing on mammals and birds are poorly studied. It can be assumed that each of the 100 mammal and 400 bird species in Austria is the host of several specific species of Phthiraptera. Therefore 900 species is a realistic number.

c11 Coccoidea:

According to Malumphy & Kahrer (2011), there are 80 species recorded in Austria, but 200 species in Hungary. They assume that there may be about 160 species in Austria. 145

species are listed in Germany (KLAUSNITZER 2003). Therefore 180 seems a realistic number.

c12 Coleoptera:

Although the beetles of Austria are well studied, especially in some provinces, there still exists no comprehensive list for the whole country. Even the number of 7500 (GEISER 1998) was a cautious estimation. About 200 Coleoptera species have been newly recorded in Austria since 1998 (published in the journals Koleopterologische Rundschau, in Beiträge zur Entomofaunistik and further in the journals of the local entomological workgroups). Records of overlooked species and aliens still go on.

In Germany, 6492 species of beetles are recorded (KLAUSNITZER 2003), and their number has also increased since.

Calculation:
6492 × 1.2 => 7790

For beetles the factor 1.25 is more adequate (derived by comparison with well-studied families in Austria and Germany):

6492 × 1.25 => 8115

Therefore 8000 is likely to be realistic for the number of Coleoptera species in Austria.

c13 Strepsiptera:

7 species are recorded in Austria until now (RABITSCH 2009b), and 15 species in Germany (KLAUSNITZER 2003). Usually there are more species in Austria, therefore 15 species is a very cautious estimation.

c14 Hymenoptera:

In his comprehensive study, SCHWARZ (2014) lists detailed numbers for each family of Hymenoptera in Austria and a total number of 6689 species. But he also notes that this number is far too low. When the species numbers of well-studied families in Germany are compared with well-studied families in Austria, the numbers are 10 % to 30 % higher in Austria. This confirms the factor 1.2 used for extrapolation.

9318 species are recorded for Germany (KLAUSNITZER 2003).

9318 × 1.2 => 11181

Thus, 11200 is likely to be realistic species number for Hymenoptera species in Austria.

c15 Neuropterida:

Currently 125 species of Neuropterida are definitely recorded in Austria, but more species are assumed – at least 140 species; 150 will be more realistic (ASPÖCK H. in litt. 20.01.2018).

c16 Siphonaptera:

RABITSCH (2009b) mentions 73 species for Austria, while 72 species are recorded in Germany (KLAUSNITZER 2003). There are certainly more species, therefore 80 species will be considered realistic.

c17 Diptera:

Some Diptera families are well investigated, particularly the groups with aquatic larvae. But there are also big knowledge gaps. The up-to-date species number in Germany is 9544 (Schumann 2010)

$$9544 \times 1.2 \Rightarrow 11453$$

Therefore, 11500 is a realistic species number for Diptera in Austria.

c18 Pisces:

This number does not refer to the many newly deliberately introduced fish species which can be found in Austrian waters.

Survey of the Species Numbers of Animals in Austria

In Table 3 the species numbers of the animal groups in Austria are added together.

Tab. 3: Comprehensive species numbers of animal groups in Austria. – Tab. 3: Zusammenfassung der Artenzahlen der einzelnen Tiergruppen Österreichs.

Animal group	species number	Animal group	species number
Protozoa	1500	Kamptozoa	1
Porifera	6	Linguatulida	2
Coelenterata	3	Tardigrada	79
Plathelminthes	1100	Crustacea	530
Nemertini	2	Chelicerata	4200
Nemathelminthes	850	Myriapoda	330
Nematoda	4000	Insecta	**40010**
Bryozoa	14	Vertebrata	661
Mollusca	537		
Annelida	300	**Total sum**	**54125**

According to this result, the number of animal species in Austria is increased by 8 255 species or 18 % compared with the species number of 45 870 published by Geiser in 1998.

The pie chart (Fig. 1) shows that about three quarters of all animal species in Austria are insects. Vertebrates contribute only 1 % to the species number of Austrian animals.

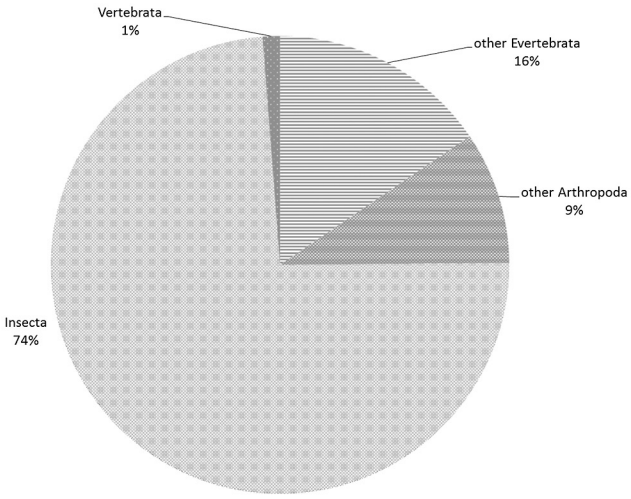

Fig. 1: Proportion of the species numbers of Insecta, other Arthropoda, other Evertebrata and Vertebrata in Austria. – Abb. 1: Verteilung der Artenzahlen auf Insekten, übrige Arthropoden, übrige Evertebrata und Vertebrata in Österreich.

Discussion

These results show an apparent increase of the animal species number from 45 870 to 54 125 or an increase of 18 % in the last 20 years. This increase is mainly due to enhanced knowledge and not due to decreasing ecological pressure or new species introductions to Austria. In 1998, many alien species were already established. The number of alien species introduced to and established in Austria since then can be estimated to a few hundred and is clearly not responsible for the augmentation by 8 255 species. The cited literature has more than doubled compared to GEISER (1998), which partly reflects the intense level of study on systematics and ecology of animals in Austria. Furthermore, many papers concerning detailed studies on a single animal group are not cited there.

The influence of taxonomic revisions is negligible. This applies to very few species only. Of course some species were split in the last 20 years, but other species were synonymized. Therefore, the effect of these revisions has been neutralized.

One must bear in mind that, for a considerable number of species counted in Table 1, we have records from only a few individuals. Some of them are known only by single specimens preserved in museum collections. The following examples are shown from the family of the leaf beetles (Coleopterea: Chrysomelidae):

Donacia sparganii: Only 4 specimens are known from Austria. They were collected in the Ettenau near Ostermiething, Upper Austria, by Fritz LEEDER, sometime between 1950 and 1970, and are now stored in the collection of the Haus der Natur museum in Salzburg.

Donacia tomentosa: only one specimen from Austria recorded after 1900 is known so far. It was collected in Biedermannsdorf, Lower Austria, in 1923 and is stored in the Natural History Museum of Vienna. Further eight specimens of this species from Austria are stored there, but with vague location records and apparently collected before 1900 (GEISER 2018).

These are two typical examples of rare species, which are highly specialised. *Donacia tomentosa* feeds on *Butomus umbellatus* (Monocotyledona: Alismatales) which is itself a rare plant in Austria. Furthermore, the imagines of these beetles are active only for a few weeks. This time period shifts every year and is difficult to predict. Moreover, they are difficult to catch.

From another leaf beetle only one record exists so far, although it may not be rare in Austria. The alien species *Luperomorpha xanthodera* (Chrysomelidae: Galerucinae: Alticini) was accidentally introduced to Europe in 2003 by market gardeners importing plants from Eastern Asia. The beetle has since been dispersed in private gardens where it feeds on typical garden plants. There are surely several 100 specimens living unrecognized in Austrian gardens, because this species is very small and jumps away very quickly when approached. Its unique record in Austria occurred because a coleopterologist recognized "a new beetle" in his garden and asked the author to determine the representative of Chrysomelidae. The author herself was alerted a year previously by a specialist of Alticini, who sent her an identification key for this species with the remark: this species will soon occur in Austria.

These are typical stories concerning rare species and every specialist knows many such examples from within his or her own group. For further details on these examples see GEISER & BERNHARD (2012), FAA: GEISER (2017) and GEISER (2018).

Some species added up in Table 1 where not recorded in Austria for more than 50 years. This applies especially to rare species whose detection is difficult.

A typical example is the snake *Vipera ursinii*, which lives (or at least used to) in the Pannonian area southeast of Vienna. It has not been observed since the fifties of the twentieth century. Nobody knows whether it still occurs there. Sampling or even observation is very difficult, so current evidence is missing (S. Schweiger, pers. communication, 30.01.2018).

Another example from the leaf beetle family Chrysomelidae: In the Natural History Museum of Vienna, 28 specimens of *Donacia brevitarsis* are stored. The youngest specimen was collected in 1933. No further confirmed records are known until now. But nor has anybody searched for this species in that area since then. Additionally, this species is very difficult to identify. There may well be more specimens unrecognized in beetle collections (Geiser 2016).

The examples of the leaf beetle species *Donacia tomentosa, Donacia brevitarsis* and *Luperomorpha xanthodera*, which are not included in the ÖAW Checklist No. 1 (Geiser 2004), illustrate that further research by specialists contributes to more species recorded in Austria. This applies also to the research activities triggered by the projects listed in the Chapter Main Data Source. Besides these major activities, there are many more activities by individual specialists, which all contribute to this increased species number.

On the other hand, the augmentation by 8 255 species masks a serious problem:

Although the species number has seemingly increased, the biomass is shrinking. It has been shown that the biomass of insects has diminished by 75 % not only in urban areas or intensively exploited farmland, but also in protected areas. This is alarming because the insects are the group with the highest species numbers. Their biomass decrease has many side effects, to mention here only the reproduction of birds and bats and the pollination of plants (Hallmann et al. 2017, BUND: Insektensterben 3/2018).

Therefore, it is necessary to keep in mind that this encouragingly high number of animal species in Austria only reflects a status which includes a lot of endangered species.

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Literature

Checklists of ÖAW

Checklists of the Fauna of Austria, edited by the Austrian Academy of Sciences (ÖAW: Österreichische Akademie der Wissenschaften, Wien):

No. 1, Geiser E., 2004: Chrysomelidae (Insecta: Coleoptera); Ebermann E.: Scutacaridae (Arachnida: Acari). Checklisten der Fauna Österreichs, No. 1, Biosystematics and Ecology Series, No. 22.

No. 2, Rabitsch W., 2005: Heteroptera (Insecta); Adlbauer K.: Cerambycidae (Insecta: Coleoptera). Checklisten der Fauna Österreichs, No. 2, Biosystematics and Ecology Series, No. 23.

No. 3, Querner P., 2008: Collembola (Insecta); Christian E.: Palpigradi (Arachnida); Gusenleitner J.: Vespidae (Insecta: Hymenoptera). Checklisten der Fauna Österreichs, No. 3, Biosystematics and Ecology Series, No. 24.

No. 4, Christian E., 2009: Diplura (Insecta); Schedl W.: Symphyta (Insecta); Holzinger W.: Auchenorrhyncha (Insecta). Checklisten der Fauna Österreichs, No. 4, Biosystematics and Ecology Series, No. 26.

No. 5, Christian E., 2011: Protura (Insecta); Komposch C.: Opiliones (Arachnida); Mahnert V.: Pseudoscorpiones (Arachnida); Vogtenhuber P.: Tipulidae (Insecta: Diptera). Checklisten der Fauna Österreichs, No. 5, Biosystematics and Ecology Series, No. 28.

No. 6, Eder E., 2012: Anostraca, Notostraca, Laevicaudata, Spinicaudata (Crustacea: Branchiopoda excl. Cladocera); Gusenleitner F. , Schwarz M. & Mazzucco K.: Apidae (Insecta: Hymenoptera); Gerecke R.: Halacaridae und Hydrachnidia (Arachnida: Acari). Checklisten der Fauna Österreichs, No. 6, Biosystematics and Ecology Series, No. 29.

No. 7, Aescht E., 2013: Ciliophora. Checklisten der Fauna Österreichs, No. 7, Biosystematics and Ecology Series, No. 30.

No. 8, Dastych H., 2015: Tardigrada; Holzinger E., Chovanec A. & Waringer J.: Odonata (Insecta). Checklisten der Fauna Österreichs, No. 8, Biosystematics and Ecology Series, No. 31.

No. 9, Steiner F.M., Ambach J., Glaser F., Wagner H.C., Müller J. & Schlick-Steiner B., 2017: Formicidae (Insecta: Hymenoptera); Krisper G., Schatz H. & Schuster R.: Oribatida (Arachnida: Acari). Checklisten der Fauna Österreichs, No. 9, Biosystematics and Ecology Series, No. 33.

FAA: Fauna Aquatica Austriaca

FAA: Fauna Aquatica Austriaca 2017, 3rd edition: A Comprehensive Species Inventory of Austrian Aquatic Organisms with Ecological Notes Compiled by the Institute of Hydrobiology and Aquatic Ecosystem Management (IHG), University of Natural Resources and Life Sciences, Vienna (BOKU) on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW). http://www.ecoprof.at/index.php/faunaaquaticaaustriaca.html [01.12.2017].

Bauernfeind E., Weichselbaumer P., Leitner P. & Moog O. , 2017: Ephemeroptera. FAA.

Chovanec A., Waringer J., Holzinger W.E., Moog O. & Janecek B., 2017: Odonata. FAA.

Dröscher I., Waringer J., Mildner J. & Mildner P., 2017: Spongillidae. FAA.

Gaviria S., 2017: Crustacea: Ostracoda. FAA.

Gaviria S., Forró L., Jersabek C.D. & Schabetsberger R., 2017: Crustacea: Branchiopoda (Cladocera). FAA.

Gaviria S. & Fuchs A., 2017: Crustacea: Copepoda: Harpacticoida. FAA.

Gaviria S., Fuchs A., Herzig A., Pospisil P. & Forró L., 2017: Crustacea: Copepoda: Cyclopoida. FAA.

Gaviria S., Herzig A. & Forró L., 2017: Crustacea: Copepoda: Calanoida. FAA.

Geiser E., 2017: Coleoptera: Chrysomelidae: Donaciinae. FAA.

Graf W., Grasser U. & Waringer J., 2017: Trichoptera. FAA.

Graf W., Grasser U. & Weinzierl A., 2017: Plecoptera. FAA.

Hödl W., Schernhammer T. & Eder E., 2017: Crustacea: Anostraca, Notostraca, „Conchostraca". FAA.

Hörner K., Moog O. & Sporka F., 2017: Polychaeta. FAA.

Hörner K., Sporka F. & Moog O., 2017: Oligochaeta. FAA.

Konecny R., 2017: Crustacea: Copepoda: Parasitica. FAA.

Nesemann H.F., 2017: Clitellata: Branchiobdellidae. FAA.

Nesemann H.F. & Moog O., 2017: Hirudinea. FAA.

Pöckl M., Borza P., Nesemann H.F. & Moog O., 2017: Crustacea: Amphipoda, Isopoda, Decapoda. FAA.

Reischütz A., Reischütz P.L., Moog O. & Nesemann H.F., 2017a: Mollusca: Gastropoda. FAA.

Reischütz A., Reischütz P.L., Moog O. & Nesemann H.F., 2017b: Mollusca: Bivalvia. FAA.

Sporka F., 2017: Kamptozoa (Entoprocta). FAA.

Wittmann K., 2017: Crustacea: Mysida. FAA.

Wöss E.R., 2017: Bryozoa. FAA.

Further References

ABOL – The Austrian Barcode of Life. https://www.abol.ac.at/ [26.03.2018].

Allspach A., 2009: Terrestrische Crustacea (Landasseln). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 398–404.

Bauer R., 2009: Annelida (Ringelwürmer). Enchytraeidae (Enchyträen). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 308–311.

Böckeler W., Richling I. & Sattmann H., 2010: Pentastomiden, Pentastomosen und ihre humanmedizinische Bedeutung. In: Aspöck H. (Hg.), Krank durch Arthropoden. Denisia 30, 411–426.

BUND: Insektensterben 3/2018. http://www.bund-rvso.de/insektensterben-quellen-studien-ursachen.html [04.04.2018].

Christian E., 2009: Insecta (Insekten). Apterygota (Ur-Insekten). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 546–584.

Eisendle U. & Hoschitz M., 2009: Nematoda (Fadenwürmer). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 379–381.

Geiser E., 1998: Wie viele Tierarten leben in Österreich? Erfassung, Hochrechnung und Abschätzung. Verh. Zool.-Bot. Ges. Ö. 135, 81–93.

Geiser E., 2016: Additions to the checklist of the Chrysomelidae of Austria (Coleoptera: Chrysomelidae). Koleopt. Rundschau 86, 229–230.

Geiser, E. 2018: Additions to the Checklist of the Chrysomelidae of Austria (II) (Coleoptera: Chrysomelidae). Koleopt. Rundschau 88, 211–215.

Geiser E. & Bernhard M., 2012: Der Flohkäfer *Luperomorpha xanthodera* (Fairmaire, 1888) (Alticinae, Chrysomelidae) - Erstnachweis für Österreich in einem Salzburger Garten. Newsletter d. Salzburger Entomolog. Arbeitsgem. 3–4/2012, 1–3.

Gepp J., 1983: Rote Listen gefährdeter Tiere Österreichs. 1. Fassung. BM f. Gesundh. u. Umweltsch., Wien.

Gepp J., 2005: Rote Liste der Mecoptera (Schnabelfliegen) Österreichs. In: Zulka P. (Hg.), Rote Listen gefährdeter Tiere Österreichs. Checklisten, Gefährdungsanalysen, Handlungsbedarf. BM f. L.u.F.,U.u.W., Böhlauverlag, Wien, Grüne Reihe 14(1), 309–312.

Grabherr G., 1994: Biodiversität und landschaftliche Vielfalt in Österreich. In: Morawetz W.: Ökologische Grundwerte in Österreich - Modell für Europa? Biosyst. Ecology Ser., Austrian Academy of Science, Supplement, 23–49.

Haas F., 2009: Dermaptera (Ohrwürmer). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 593–594.

Hallmann C.A., Sorg M., Jongejans E., Siepel H., Hofland H., Schwan H., Stenmans W., Müller A., Sumser H., Hörren T., Goulson D. & de Kroon H., 2017: More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLOS online [18.10.2017], https://doi.org/10.1371/journal.phone.0185809.

Huemer P., 2013: Die Schmetterlinge Österreichs (Lepidoptera). Systematische und Faunistische Checkliste. Studioh. 12, Tiroler Landesmus. Innsbruck, 304 pp.

Jersabek C., 2009: Rotifera (Rädertiere). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 299–307.

Klausnitzer B. (Hg.), 2003: Entomofauna Germanica 6. Entomolog. Nachr. u. Ber., Dresden. Beih. 8, 1–344.

Koblmüller S. & Zachos F., 2015: Biodiversität im Auge der Öffentlichkeit: DNA-Barcoding der heimischen Wirbeltierfauna – Probleme & Herausforderungen. Acta ZooBot Austria 152, 167–172.

Komposch C., 2009a: Skorpione (Scorpiones). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 496–500.

Komposch C., 2009b: Spinnen (Araneae). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 408–463.

Konecny R., 2009: Acanthocephala (Kratzwürmer). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, p. 298.

Kritscher E., 1985: Acanthocephala. Catalogus Faunae Austria IVd. Österr. Akad. Wiss., Wien.

Lienhard C., 2009: Psocopterea (Staubläuse). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 603–605.

Malumphy C. & Kahrer A., 2011: New data on the scale insects (Hemiptera: Coccoidea) of Vienna, including one invasive species new for Austria. Beitr. Entomofaunistik 12, 47–60.

Mildner P., 1995: Zum Erforschungsstand von „Niederen Tieren" in Kärnten. Carinthia II 185/105, 89–94.

Ortner B., 2017: Beschalte Amöben (Testaceen) und Zieralgen (Desmidiaceae) des Sphagnetums einiger österreichischer Moore. Beitr. z. Naturk. Oberösterreichs 24, 1–139.

Rabitsch W. & Essl F. (Hg.), 2009: Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 923 pp.

Rabitsch W., 2009a: Dictyoptera (Schabenverwandte). In: Rabitsch W. & Essl F. (Hg.)., Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 602–603.

Rabitsch W., 2009b: Insecta varia. In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 844–848.

Rabitsch W., 2016: Beitrag zur Kenntnis der Wanzenfauna Vorarlbergs (Insecta: Hemiptera: Heteroptera). Joannea Zool. 15, 127–159.

Ranner A., 2017: Artenliste der Vögel Österreichs. Informal list. Status: December 2017. © Avifaunistische Komm. v. BirdLife Österreich. 12 pp.

Reischütz A. & Reischütz P.L., 2007: Rote Liste der Weichtiere (Mollusca) Österreichs. In: Zulka P. (Hg.), Rote Listen gefährdeter Tiere Österreichs. Checklisten, Gefährdungsanalysen, Handlungsbedarf. BM f L.u.F.,U.u.W., Böhlauverlag, Wien, Grüne Reihe 14(2), 363–433.

Schmidt-Rhaesa A.,2009: Nematomorpha (Saitenwürmer). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 381–383.

Schumann H., 2010: Dritter Nachtrag zur Checkliste der Dipteren Deutschlands. Studia dipterologica 16(1–2), 7–27

Schwarz M., 2014: Bienen, Wespen, Ameisen – eine Übersicht über heimische Hautflügler (Hymenoptera) sowie praktische Tipps für angehende Hymenopterologen. Entomolog. Austriaca 21, 153–207.

Senz W., 1996: *Prostoma communopore* sp. n., eine neue Nemertine aus dem Grundwasser in Österreich (Nemertini: Hoplonemertini: Monostilifera). Ann. d. Naturhist. Mus. Wien, 98 B, 23–30.

Strassen R.Z., 2009: Thysanoptera (Fransenflügler). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 605–606.

Stresemann E., 1967: Exkursionsfauna von Deutschland. Wirbellose I. Volk und Wissen, Berlin.

Stresemann E., 1992: Exkursionsfauna von Deutschland. Wirbellose I. 8. Aufl., Volk und Wissen, Berlin.

Zicsi A. & Meyer E., 2009: Annelida (Ringelwürmer). Lumbricidae (Regenwürmer). In: Rabitsch W. & Essl F. (Hg.), Endemiten. Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwiss. V. f. Kärnten u. Umweltbundesamt GmbH, Klagenfurt u. Wien, 312–317.

ZOBODAT, https://www.zobodat.at/ [26.03.2018]

Zoologische Staatssammlung München, Diptera. http://www.zsm.mwn.de/sektion/diptera-home/ [12.03.2018]

Zuna-Kratky T., Landmann A., Illich I., Zechner L., Essl F., Lechner K., Ortner A., Weissmair W. & Wöss G., 2017: Die Heuschrecken Österreichs. Denisia 39, 880 pp.

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