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ANALYSIS AND COMPARISON OF WORLD BIRD LISTS

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Dedicated to my dear friend and colleague Professor Dr. Michael WINK on his 70th birth day. I would like to dedicate this work also to my professor Nihat ŞİŞLİ.

Dünya Kuş Listelerinin Analizi ve Karşılaştırılması

Özet

Beş önemli dünya kuş listesi analiz edilmiş ve karşılaştırılmıştır. Dünya kuş türü sayıları Boyd et al. ve CornelUniversity 'nin sonuçları, Clements et al.'ın değerleri ile aynı olduğu için, ilk iki liste burada analiz edilmeyecektir. HBW'nin dünya kuş türü sayısal değerleri, Passeres (P) grubunda 6 648, Nonpasseres(NP) grubunda 4 478 olmak üzere toplam 11 135 tür ile en yüksektir. Dünya kuş türü sayısı Gill et al.'e göre toplam 10 714 iken (P grubunda 6 380 ve NP grubunda 4 334 tür), Clements et al. 'e göre toplam 10 930'dur(P için 6 518 ve NP için 4 412 tür). HBW'nin NP-grubu dünya kuş listesinde Sarothruridae, Bucorvidae ve Psittaculidae gibi kuş aileleri verilmemişken, hem Clements et al., hem de Gill et al. dünya kuş listelerinde verilmiştir. P grubunda Cettiidae, Erythrocercidae ve Hyliidae adlı kuş aileleri Gill et al'da belirtilirken, Clements et al. ve HBW 'nin dünya kuş listelerinde yer almamaktadır. DTichodromidae ve Icteriidae adlı kuş aileleri HBW'nin dünya kuş listesinde bulunmazken, diğer iki listede verilmiştir. Platylophidae ailesi Gill et al.'de yokken diğer iki listede bulunmaktadır. Oxyruncidae ailesi HBW'nin dünya kuş listesinde mevcut iken, diğer iki dünya kuş türleri listesinde bulunmamaktadır. Sylvidae ailesi, Gill's et al.'ın dünya kuş listesinde Sylvidae ve Paradoxornithidae ailelerine bölünmüştür. Gill's'in dünya kuş listesinde Pellorneidae ailesi, Pellorneidae ve Alcippeidae aileleri olarak yer almıştır.

Anahtar Kelimeler: dünya kuş türleri listeleri, kuş türleri, kuş alttürleri, kuş aileleri.

Analysis and Comparison of World Bird Lists

Abstract

Five important world bird lists were analyzed and compared. Since the Boyd et al. and Cornell University world bird counts are identical to Clement's et al. values, the first two are not evaluated here. The analysis of HBW's world bird count has in the highest values, showing 6,648 for Passeres (P) and 4,487 for Nonpasseres (NP), totaling 11,135. The world bird count values according to Gill et. al. totals 10,714 (i.e., P 6,380 and for NP 4,334) whereas Clements's et al. states total of 10,930(for P 6,518 and for NP 4,412). It was also found that in the NP some bird families, (such as Sarothruridae, Bucorvidae and Psittaculidae) are not listed HBW's World Bird List, while they are listed both in Clement's and Gill's World Bird List. The families Cettiidae, Erythrocercidae, and Hyliidae (in P), are given in Gill's World Bird List, but not in Clement's and HBW's. The families Tichodromidae and Icteriidae are not included in HBW's World Bird List, but are included in the others. The family Platylophidae is not included in Gill's World Bird List, but is included in the others. The family Oxyruncidae is included in HBW's World Bird List, but not in the others. The family Sylvidae has been split into two families namely, in Gill's List, Sylvidae and Paradoxornithidae, in Gill's World Bird List. The family Paradoxornithidae is not listed both in Clement's or and in HBW's. The family Pellorneidae was listed in Gill's World Bird List as two families (i.e.,Pellorneidae and Alcippeidae).

Keywords: world bird lists, bird species, bird subspecies, bird families.

1.INTRODUCTION

Sharpe's World Bird List (1899-1909) played an important role in ornithology. Since this first bird list of the world, new species or subspecies were constantly added. Sharpe was in some ways the last to continue the tradition of Linnaeus. He took a narrow, typological view and treated each taxon described as a binomial, regardless of its similarity to another taxon; thus, by his own estimate, the number of bird species known on earth in 1909 was 18,939. What is a species, and what is it not? Ernst Mayr (1942) formulated the biological species concept in which reproductive isolation was the main criterion for dividing birds into different species. Finding a species definition that applies to all organisms remains a challenge, as Mayr (1996) has already pointed out. For ornithology, Mayr's (1996) species concept remains an important foundation. He formulated, "A species is a group of natural populations whose individuals reproduce sexually by mating." Furthermore, according to (Mayr 1942), reproductive isolation was the decisive criterion for the delimitation of species in birds: According to this, "species are groups of actual (or potential) interbreeding populations that are reproductively isolated from other such groups in nature." Eighty years later, the species concept is still a frequently discussed topic in ornithology. When a population can be consistently distinguished by one or more unique characters, it is considered a monophyletic terminal taxon (a monotypic unit with a single lineage). According to the phylogenetic species concept, which is increasingly used, all subspecies that represent disjunct populations (e.g., on islands, in valleys, or on mountain tops) are terminal taxa and thus species. Speciation among birders today is exciting and dynamic; there is not yet a panacea for it (Winker, 2021). Linnaean binomial/binary naming of animals or birds has the great advantage that Latin names of bird species or subspecies are valid for all languages, although bird names vary according to national languages (Kiziroğlu, 2015; 2021; Wink, 2017). The problem of subspecies was also pointed out by (Mayr and Aschlock, 1991; Wink, 2021a).

The number of world bird species or subspecies can fluctuate from year to year, as new species or subspecies are constantly being added. This is evident when comparing the IOC world bird checklists of (Gill et al., 2020; 2021a; 2021b). Similarly, the world bird lists of Clement's et al. (2019; 2021) also differ.

The number of world bird species or subspecies according to the five world bird checklists studied or analyzed in this paper differs in (Gill et al., 2021a; HBW, 2019; Boyd, 2019/2020 and Cornell of Orntihology, 2020). Since the last two world bird lists are identical to the data of Clement et al., (2019), they are not

separately considered here. Since the systematic differences and the structure of these checklists still exist, the penultimate lists are considered and evaluated in this work.

2. MATERIALS AND METHODS

The data for this study were based on the following world bird lists (Table 1): (Clements, et al., 2019; Boyd, 2019/2020; Cornell of Ornithology, 2020; Gill et al., 2021a and HBW, 2019). World lists Boyd (2019/2020) and Cornell of Ornithology (2020) are largely identical to Clements (2019), as well as to each other. Therefore, these two (i.e., Boyd, 2019/2020 and Cornell of Ornithology, 2020) are considered together with world list (Clements et al., 2019). As a result, data from three world lists (research groups) (i.e., Clements et al., (2019); Gill et al., (2021a) and HBW (2019) are evaluated in this study (Table 1). Research group HBW (2019) did include numbers of family and species levels (not subspecies level) in their world bird lists, as summarized in Table 1. World bird lists are analyzed and evaluated with respect to families, number of species within families and, where possible, subspecies, as they were presented in various world bird lists by different research groups. For comparison purposes, the order of

families from different world bird checklists was also compiled and included as an example in the families with the highest numbers of species in Tables 2 and 4.

3. RESULTS

3.1. The Nonpasseres (NP) Group

The numbers of world bird families, species and subspecies from the evaluated world bird lists within Nonpasseres (NP) group showed some important differences. For example, the number of families in HBW (2019) is 105, which is lower than Gill et al. (2021a) and Clements et al. (2019) both of is with 108 families (Table 1).

Table 1. Numbers of main word bird groups by Families, Species and Subspecies levels according to three research groups.

Main World Bird groups	Number of Families			Number of Species		Number of Subspecies		
	[13]	[11]	[15]	[13]	[11]	[15]	[13]	[11]
Nonpassares(NP)	108	108	105	4,334	4,415	4,487	6,824	6,704
Passeres (P)	141	144	138	6,380	6,549	6,648	13,696	13,286
Total (NP+N)	249	252	243	10,714	10,964	11,135	20,520	19,990

The total number of species in the first six bird families, each with more than 200 bird species, accounts for more than one-third of the number of species in the NP group (Table 2).

Table 2. In the group of nonpasseres (NP), the families and the number of species within each family according to three different researcher group / world bird lists (In the second column, only the names of the families with at least 50 or more species are listed. The last column gives the rank order of each family (based on species number each family has).

No	World bird families with more than 50 species each	Number of bird species according to world birdlists*			The number of extra species when any two given world bird lists were compared.						Rank**		
		[13]	[11]	[15]	[13]vs[11]		[13]vs[15]		[11]vs[15]		[13]	[11]	[15]
01	Psittacidae	173	181	394		8		221		213	108	107	105
02	Trochilidae	349	361	368		12		19		7	29	21	29
03	Columbidae	348	344	369	4			21		25	16	27	20
04	Accipitridae	250	256	249		6	1		7		78	78	79
05	Picidae	234	236	254		2		20		18	102	102	100
06	Strigidae	216	230	227		14		11	3		80	80	75
07	Psittaculidae	189	192	-		3	189		192		107	108	-
08	Phasianidae	180	184	188		4		8		4	13	13	10
09	Anatidae	174	174	172	0	0	2		2		8	8	13
10	Rallidae	158	152	168	6			10		16	32	30	33
11	Cuculidae	147	149	150		2		3		1	21	24	31
12	Alcedinidae	118	114	120	4			2		6	90	90	91
13	Apodidae	112	113	96		1	16		17		27	20	28
14	Laridae	97	102	100		5		3	2		55	52	71
15	Caprimulgidae	98	97	98	1		0	0		1	23	17	25
16	Scolopacidae	96	98	96		2	0	0	2		49	49	67
17	Procellariidae	96	99	98		3		2	1		64	63	44
18	Ardeidae	68	72	69		4		1	3		73	70	47
19	Charadriidae	67	68	71		1		4		3	44	43	62
20	Falconidae	66	66	66	0	0	0	0	0	0	104	104	102
21	Bucerotidae	59	59	62	0	0		3		3	87	87	83
22	Cracidae	54	56	56		2		2	0	0	10	10	7
Total within 22 families		3,349	3,403	3,471	15	69	208	330	229	297			

* Researcher groups / World bird lists [13]=Clements et al., 2019; [11]=Gill et al.,2021a and [15]=HBW, 2019**=Rank order of each family in three different world lists (based on the species number within each family in such that the family with the highest species number received the highest rank number).

I presented Nonpasseres (NP) world bird families into two groups and analyzed them accordingly in Table 3. The first family group (i.e., N1) covers the families that have at least 50 species within each family. The number of families within N1 group is only 20%, yet it includes more than 77% of the NP bird species (i.e., more than 77.0 %) are included within only 20 % of the NP families (Table 3).

Table 3. In the group of Nonpasseres (NP), number of families, number of species, and number of subspecies according to three different world bird lists / research groups) (percentages are given in *italics* within parenthesis).

Family group**	Number of **Families** [according to research groups]*			Number of **Species** (and percentages) [according to research groups]*			Number of **Subspecies** [according to research groups]*	
	[13]	[11]	[15]	[13]	[11]	[15]	[13]	[11]
N_1	22 (20)	22 (20)	21 (20)	3,349 (77.3)	3,403 (77.1)	3,471 (77.4)	5,262 (77.1)	5,182 (77.3)
N2	86 (80)	86 (80)	84 (80)	985 (22.7)	1,012 (22.9)	1,016 (22.6)	1,562 (22.9)	1,522 (22.7)
Total	108 (100)	108 (100)	105 (100)	4,334 (100)	4,415 (100)	4,487 (100)	6,824 (100)	6,704 (100)

* Researcher groups / World bird lists: [13]=Clements et al., 2019; [11]=Gill et al.,2021a and [15]=HBW, 2019;
** N_1 = Families with at least 50 species (or at least 50 subspecies); N2: Families with less than 50 species (or less than 50 subspecies).

The second group (i.e., N2) includes the families that have less than 50 species within each family The number of NP families within N2 group is quite high (i.e., 80%), yet it includes only about 22% of the NP bird species (Table 3). According to Clements et al. (2019) and Gill et al. (2021a), total number of subspecies within each of the N1 and N2 groups show similar trends in their frequency as they are in family and species level (Table 3).
According to data based on three different world bird lists (i.e., in Clements et al.2019), Gill et al.(2021a) and HBW (2019), the numbers of bird species within a given family do not agree with each other, with exception of only two families, Falconidae (Table 2). For Falconidae family all three world lists have the same (66) species (Table 2).

3.1. The Passeriformes (P) Group

The number of families of P group is also different in different world bird lists. There are 141 bird families according to Clements et al.(2019) , 144 according to Gill et al.(2021a) and 138 according to HBW (2019), in the corresponding world bird lists. There is also no agreement in the number of P-group world bird families between the mentioned world bird lists (Table 1).
The total number of bird species within the first six families (Table 4), each of which consist of more than 200 bird species, accounts for more than one-third of the number of species in the P group. The world bird families of group P according to the different world bird lists, which have more than 47/49/54 bird species, are distributed as follows according to the world bird lists: according to Clements et al.(2019) (total species number 6,380) there are 5,452(85.5%), according to Gill et al.(2021a) (total species number 6,549) 5,567 (85.0%) and according to HBW (2019) (total species number 6,648) 5,746 (86.4%) (see Table 4 and 5).
According to data based on three different world bird lists [i.e., in Clements et al.(2019); Gill et al.(2021a) and HBW (2019)], the numbers of bird species within a given family do not agree

with each other, with exception of only two families, Grallariidae and Pipridae (Table 4). For Grallariidae family all three world lists have the same 55 species, and for Pipridae family all three have 53 species (Table 4).

Table 4. In the group of Passeres (P), the families and the number of species within each family according to three different researcher group / world bird lists. (In the second column, only the names of the families with at least 47 or more species are listed. The last column gives the rank order of each family (based on species number each family has).

	World bird (P) families, each with more than 47 species	Number of bird species according to world bird lists*			The number of extra species when any two given world bird lists were compared.						Ranks**		
		[13]	[11]	[15]	[13] vs[11]		[13] vs [15]		[11] vs [15]		[13]	[11]	[15]
01	Tyrannidae	422	437	450		15		28		13	18	14	17
02	Thraupidae	377	383	408		6		31		25	143	144	140
03	Muscicapidae	323	332	336		9		13		4	106	115	102
04	Furnariidae	304	315	331		11		27		16	13	7	13
05	Thamnophilidae	227	238	242		11		15		4	7	8	7
06	Fringillidae	226	230	228		4		2	2		127	128	125
07	Meliphagidae	187	191	183		4	4		8		24	23	24
08	Turdidae	170	172	181		2		11		9	105	114	101
09	Cisticolidae	155	163	161		8		6	2		76	92	75
10	Pycnonotidae	149	158	158		9		9	0	0	83	78	82
11	Leiothrichidae	146	133	148	13			2		15	91	99	90
12	Nectariniidae	143	145	183		2		40		38	116	119	116
13	Estrildidae	139	141	141		2		2	0	0	122	122	121
14	Zosteropidae	136	141	139		5		3	2		88	95	87
15	Passerellidae	131	138	147		7		16		9	131	132	129
16	Corvidae	129	133	131		4		2	2		59	57	55
17	Sturnidae	123	123	129	0	0		6		6	103	112	99
18	Ploceidae	118	117	125	1			7		8	121	121	120
19	Parulidae	110	119	122		9		12		3	140	141	133
20	Icteridae	105	109	115		4		10		6	139	140	132
21	Monarchidae	100	102	109		2		9		7	54	56	52
22	Alaudidae	97	99	92		2	5		7		72	77	71
23	Campephagidae	89	93	99		4		10		6	31	44	40
24	Hirundinidae	89	88	89	1		0	0		1	82	79	81
25	Troglodytidae	85	88	93		3		8		5	99	106	95
26	Phylloscopidae	77	80	79		3		2	1		84	87	83
27	Sylviidae	68	34	69	34			1		35	87	93	86
28	Motacillidae	66	69	66		3	0	0	3		126	126	124
29	Cotingidae	65	66	67		1		2		1	15	15	15
30	Acanthizidae	65	66	65		1	0	0	1		27	26	26
31	Paridae	63	64	61		1	2		3		70	73	69
32	Vireonidae	63	64	65		1		2		1	39	52	39
33	Locustellidae	62	66	64		4		2	2		78	89	78
34	Rhinocryptidae	60	65	60		5	0	0	5		11	12	11
35	Pellorneidae	59	62	64		3		5		2	90	97	89
36	Acrocephalidae	59	62	60		3		1	2		77	88	76
37	Pachycephalidae	57	64	52		7	5		12		40	50	37
38	Grallariidae	55	55	55	0	0	0	0	0	0	10	10	10
39	Rhipiduridae	53	53	65	0	0		12		12	50	55	49
40	Pipridae	53	53	53	0	0	0	0	0	0	14	16	14
41	Timaliidae	52	54	54		2		2	0	0	89	96	88

42	Malaconotidae	50	50	48	0	0	2		2		49	37	48
43	Petroicidae	49	50	53		1		4		3	64	62	66
44	Cardinalidae	49	53	52		4		3	1		142	143	139
45	Dicaeidae	47	49	54		2		7		5	115	118	115
	Total within 45 families	5,452	5,567	5,746	49	164	18	312	55	234			

* Researcher groups / World bird lists [13]=Clements et al., 2019; [11]=Gill et al.,2021a and [15]=HBW, 2019**Rank order of each family in three different world lists (based on the species number within each family, in such that the family with the highest species number received the highest rank order number).

I have divided the passeres bird families of the world into two groups and analyzed them accordingly in Table 5. The first family group (i.e., N1) includes the families that have at least 50 species in each family. The number of P families within the N1 group is 32%, 31%, and 33% in different world bird checklists (Table 5), yet families within N1 group include more than 85% of the P bird species. On the other hand, while the number of P families within the N2 group consist of more than 67%, only at most 22.6% of the species are present in N2 group (Table 5).

Table 5. In the group of Passeres (P), number of families, number of species and number of subspecies according to three different world bird lists / research groups) (percentages are given in *italics* within parenthesis).

Family group**	Number of **Families** [according to research groups]*			Number of **Species** (and percentages)[according to research groups]*			Number of **Subspecies** [according to research groups]*	
	[13]	[11]	[15]	[13]	[11]	[15]	[13]	[11]
N1	45 *(32)*	45 *(31)*	45 *(33)*	5,452 *(85,5)*	5,567 *(85,0)*	5,746 *(86.4)*	11,732 *(85,7)*	11,216 *(84,4)*
N2	96 *(68)*	99 (69)	93 *(67)*	928 *(14,5)*	982 *(15,0)*	902 *(22.6)*	1,964 *(14,3)*	2,070 *(15,6)*
Total	141 *(100)*	144 *(100)*	138 *(100)*	6,380 *(100)*	6,549 *(100)*	6,648 *(100)*	13,696 *(100)*	13,286 *(100)*

* Researcher groups / World bird lists: [13]=Clements et al., 2019; [11]=Gill et al.,2021a and [15]=HBW, 2019.
** N1 = Families with at least 50 species (or at least 50 subspecies); N2: Families with less than 50 species (or less than 50 subspecies).

3.3. Analysis on the Number of Species Within Nonpasseres and Passeres Groups

The world bird families of the NP and P groups according to the different world bird lists show only few similarities. As can be seen from the tables, they show some differences in the total number of species and subspecies and their percentage distribution among the families, as well as the comparisons of the orders of the families according to the different world bird lists.

The certain differences are recorded in the number of subspecies according to different world bird checklists, for example, according to Clements et al. (2019); the number of subspecies is 6,824 for the NP group and 13,696 for the P group (see Table 1), which together reach the highest values of 20,520 subspecies. In contrast, according to Gill et al.(2021a), the number of subspecies is 6,704 for the NP group and 13,286 for the P group, which together reach 19,990 subspecies (see Table 1). The other relations can be seen in Tables 3 and 5. The world bird families with equal and unequal numbers of species based on three different world bird lists [i.e., Clements et al. (2019); Gill et al.(2021a) and HBW (2019)] are shown in Table 6. The number of families (within the NP group) with the same number of species is the same in all

three bird lists (i.e., 56, but the percentages are slightly different, ranging from 51.9 to 53.3%) (Table 6). On the other hand, the number of families (within the NP group) with unequal species numbers are 31 (28.7%), 32 (29.6%), and 40 (38.1%) according to Clements et al. (2019); Gill et al.(2021a) and HBW (2019), respectively. More details about the species numbers and their distribution among families can be found in Table 6.

Tab. 6. Number of families with identical (or equal) number of bird species by different world bird lists / research groups .

Main World Bird Groups*	Number of Families**	When World bird families in (1); (2) and (3) are compared jointly:		When the remaining World bird families are compared two by two:			Sum of Families
		Number of families with equal number of species	Number of families with unequal number of species	Number of families with equal number of species between (1) (2)	Number of families with equal number of species between (1) and (3)	Number of families with equal number of species between (2) and (3)	
		Number (*in %*)	Number (*in %*)	Number (*in %*)	Number (*in %*)	Number (*in %*)	
NP	108 [1]	56 (51.9)	31 (28.7)	16 (14.8)	5 (4.6)	-	108
	108 [2]	56 (51.9)	32 (29.6)	16 (14.8)	-	4 (3.7)	108
	105 [3]	56 (53,3)	40 (38.1)	-	5 (4.6)	4 (3.8)	105
P	141 [1]	65 (46.1)	45 (31.9)	22 (15.6)	9 (6.4)	-	141
	144 [2]	65 (45.1)	53 (36.8)	22 (15.3)	-	4 (2.8)	141
	138 [3]	65 (47.1)	60 (43.5)	-	9 (6.5)	4 (2.9)	138

* NP: Nonpasseres; P: Passares; ** The total number of world bird families according to: (1) = Clements et al., (2019); (2)= Gill et al., (2021a), (3)= HBW, 2019), respectively.

The number of families (within the P group) with the same number of species is the same in all three bird lists (i.e., 65, but the percentages are slightly different, ranging from 45.1 to 47.1%) (see Table 6). On the other hand, the number of families (within the P group) with unequal species numbers are 45 (31.9%), 53 (36.8%), and 60 (43.5%) according to Clements et al. (2019); Gill et al.(2021a) and HBW (2019) respectively. More details about the species numbers and their distribution among families can be found in Table 6.

The world bird families with equal and unequal numbers of species based on three different world bird lists [i.e., Clements et al. (2019); Gill et al.(2021a) and HBW (2019)] are shown in Table 6. The number of families (within the NP group) with the same number of species is the same in all three bird lists (i.e., 56, but the percentages are slightly different, ranging from 51.9 to 53.3%) (Table 6). On the other hand, the number of families (within the NP group) with unequal species numbers are 31 (28.7%), 32 (29.6%), and 40 (38.1%) according to Clements et al. (2019); Gill et al.(2021a) and HBW (2019), respectively. Further details on species numbers and their distribution among families can be found in Table 6. The number of families (within the P group) with the same number of species is the same in all three bird lists (i.e., 65, but the percentages are slightly different, ranging from 45.1 to 47.1%) (see Table 6). On the other hand, the number of families (within the P group) with unequal species numbers are 45 (31.9%), 53 (36.8%), and 60 (43.5%) according to Clements et al. (2019); Gill et al.(2021a) and HBW (2019), respectively. Further details on species numbers and their distribution among families can be found in Table 6. Comparing the rankings in the bird lists of different research groups [e.g., Clements et al. (2019); Gill et al.(2021a) and HBW (2019)], only a few families show similar (or nearly similar) rankings. Thus, even in Table 2 and 4 (which lists only 22 and 45 families of the NP and P groups, respectively), only a few families show close matches in their rankings in bird lists Clements et al. (2019); Gill et al.(2021a) and HBW (2019),

respectively (see Tables 2 and 4). Such inconsistencies between rankings based on data from different research groups suggest that a certain number of species have been added or deleted from many families, either by misidentification or classification. It is also worth noting that in the world bird lists of Gill et al.(2021a), 94 species are listed as extinct in the NP group and 56 in the P group.

3.4. Collective Analyses of Five Different World Bird Lists

Sharpe (1899-1909) played an important role in the advancement of ornithology, as he compiled the "first world bird list". Since this first world bird list, new species or subspecies have been constantly added to the world bird list. In 1909, Sharpe (1899-1909) estimated the number of bird species known on Earth to be 18,939, and of the 4,471 taxa listed in the World Bird List that are not passerine birds, 17% are considered to be in danger of extinction and another 11% are in danger of extinction (Wink, 2021b). Following Sharpe's works, numerous studies have been conducted for international or local world bird lists in different regions of the world (Kiziroğlu, 2015; 2021; Peters, 1931-1986; Del Hoyo, 1992-2013; Chesser et al., 2020). Likewise, new occurrences of some species in certain areas are continually being recorded (Adızel et al., 2017). World bird lists for bird watching were introduced as early as the 1930s. The major world bird lists such as Gill et al., (2021a and b); Peters (1931-1986); Del Hoyo (1992-2013); Dickinson et al., (1992-2013) and Lynx Edition (2017-2018) were widely known and very useful for ornithology. The BirdLife list evolved from regional world bird lists, as a standard HBW(2019) and Chesser et al.,(2020), but with a series of annual revisions by a small committee that reviewed new taxonomic proposals. The resulting list was evaluated and compiled by various authors. The HBW lists and the efforts of BirdLife, the Clements Institute, and Avibaselisten are currently being updated and improved for all bird species. With the proliferation of national field guides, world bird lists, and family monographs over the past 20 years, it has become common for authors to make their own taxonomic decisions rather than relying on a specific author as in the past. The latest version of the world bird lists of Gill et al., (2019); Gill et al., (2021a; 2021b) and Clements et al.2021) may even have some differences from the penultimate lists, some of which has been edited and evaluated here.

The world bird lists are basically based on a comprehensive ornithological synthesis developed in the last decades. But how could it happen that the number of species or subspecies in the different world bird lists as well as Clements et al., (2019); Gill et al., (2021a) and HBW (2019) show differences?

The important differences in the composition of the world bird families according to the different world bird lists are noted. Thus, the world bird families of the NP group as well as Bucorvidae and Sarothruridae are already listed in Clements et al., (2019) and Gill et al., (2021a), but not in HBW (2019), the two world bird families as well as The bird families Psittacidae and Psittaculidae are listed separately in Clements et al.,(2019) and Gill et a.,2021a), whereas in HBW (2019) they are listed only in the family Psittacidae (see Table 3). The number of parrot species listed by HBW (2019) in the world bird family Psittacidae is 394, making the family Psittacidae the highest number of species among the world bird families in the NP group (Table 3). In the P group, the families Cettiidae; Erythrocercidae and Hyliidae are listed in Gill et al., (2021a) but not in Clements et al., (2019) and in HBW (2019), and the families Tichodromidae and Icteriidae are listed in all other world bird lists except (HBW, 2019). The family Platylophidae is listed in all world bird lists except Gill et al., (2021a); the family Oxyruncidae is listed in Clements et al., (2019) but not in except Gill et al., (2021a) and HBW (2019). There are also differences in the composition of some bird families in the various world bird lists. For example, bird species listed under the family Scotocercidae in Clements et al.,

(2019) and HBW (2019) are listed under the family Cettiidae in Gill et al., (2021a), and only one species is mentioned in the family Scotocercidae. The family Sylvidae was divided into two families, Sylvidae and Paradoxornithidae, in Gill et al., (2021a). The family Paradoxornithidae is not listed in Clements et al., (2019) and HBW (2019). A similar subdivision is made for the family Pellorneidae in (Gill et al., 2021a). The family Pellorneidae was listed in Gill et al., (2021a) as Pellorneidae and Alcippeidae. The family Alcippeidae is not included in Clements et al., (2019) or HBW (2019). For the rest of the world bird families, different species numbers are given in the different world bird lists. Thus, with respect to identical species numbers according to the different world bird lists, there is agreement only in the NP group between 51.9-53.3% and in the P group between 45.1-47.1%, depending on the world bird list (see Table 6). The number of species according to HBW (2019) is 4,487 for NP group and 6,648 for P group, which is also slightly higher than according to Gill et al., (2021a) with 6,549 and 4,415 bird species. Few bird species number is registered according to Clements et al., (2019) with 4,334 for NP and with 6,380 for P group. Thus, HBW (2019) lists more species in their world bird list for NP and P group together with 11,135 species than Gill et al., (2021a) with 10,964 species and than Clements et al., (2019) with 10,714 species. Sharpe (1899-1909) had estimated 18,939 known bird species on Earth in 1909.

The IOC World Bird List Gill et al., (2021a) gives the species number of world birds as 158 species, which are considered extinct to date. Thus, its list includes 10,806 existing bird species divided into 40 orders, 252 families, and 2,353 genera. The 19,990 subspecies, their ranges and authors are also included. Thus, the number of new bird species is constantly increasing. It has been speculated that we will eventually have more than 18,000 bird species when all bird species are sequenced and reclassified [24]. According to Clements et al., (2019), the number of subspecies is 6,824 for the NP group and 13,696 for the P group, for a total of 20,520 subspecies; according to Gill et al., (2021a), it is 6,704 for the NP group and 13,286 for the P group, for a total of 19,990 subspecies. In HBW (2019), no number of subspecies is given. The number of species and subspecies in NP and P groups is 31,234 in Clements et al., (2019) and 30,926 in Gill et al., (2021a), so the total number of species and subspecies in Clements et al.,(2019) is 308 more than in (Gill et al., 2021a).

There are also differences in the species and subspecies numbers of some bird families between the various world bird lists: for example, in group NP of HBW (2019), the bird family Psittacidae is given as the most species-rich family with 394 species; in Clements et al., (2019) and Gill et al., (2021a), the family Trochilidae appears as the most species-rich family in the world bird lists with 349 and 360 species, respectively. In group P, the family Tyrannidae is listed as the most species-rich family in the world bird lists with 450 species according to HBW (2019), 422 species according to Clements et al., (2019), and 437 species according to (Gill et al., 2021a).

The family Picidae has 601 subspecies according to Gill et al., (2021a), while the family Columbidae has the highest number of subspecies in the NP group with 565 subspecies according to (Clements et al.,2019). The family Tyrannidae has 756 species according to Gill et al., (2021a) and 776 subspecies according to (Clements et al.,2019). Such discrepancies among the research groups (or world bird lists) indicate that certain number of taxonomic groups are added or deleted in many families, either by erroneous identification or classification. The next question to ask is. What are the reasons for these differences in the number of species between the different world bird lists in the different world bird families of the NP and P groups, respectively? To answer this important question, all research groups need to come together and possibly solve this problem by DNA analyses of the species.

4. CONCLUSION

There is no broad consensus among the numbers of world bird families, the numbers of species and subspecies of world bird groups in the world bird lists examined here. What could be the reason for this must be verified in principle by the DNA study of the world bird species. The differences between the numbers of the respective world bird families according to the different world bird lists vary between 243 and 252, so there is no agreement between the world bird lists. Comparing the numbers of world bird families, species and subspecies for the bird groups and the group of passerine and non-passerine birds according to the analyzed world bird lists, the differences can be seen in the Table 1. World bird lists are constantly being revised and reorganized, as shown by Chesser et al., (2020) for North American birds. A large number of collaborators from ornithological taxonomic research groups are required to study and reorganize the world bird lists. However, this is unlikely to happen in the foreseeable future, and it has also been pointed out that species-level taxonomy in birds is likely to remain unresolved for the years to come Winker (2021), even though ornithological research is now very dynamic and exciting (Winker, 2021). Support from molecular phylogeny can be used to build a taxonomic framework. However, it is not straightforward to systematize world bird species into an identical arrangement of the number of world bird species and an identical order of world bird families. Wink et al.,(2009) give the molecular phylogeny of the Strigiformes based on DNA sequences and mitochondrial cytochrome b and nuclear RAG-1 genes for 97 owl taxa from 15 of the larger genera. Performing such work requires a large investment of time, money, and effort. If such studies are carried out for the worldwide bird groups and taxa, it can only be recommended as a long-term solution by the joint work of ornithological institutions. According to Wink (2021a) and HBW (2019), the phylogenetic species concept (PSC) is used or adopted today as the most successful and widely used species concept. According to the PSC, the central criterion in HBW (2019) is diagnosability. In the work of HBW (2019) several criteria are used to delineate bird species, which were the basis for creating this new global assessment. In addition, DNA analyses play a very important role for PSC and lead to a constant expansion of the global list. For this reason, molecular research plays a key role in the taxonomy of avian relationships, as it is a generally accepted approach in other taxonomic studies. Genome sequencing will provide us with reliable systematics of birds in the foreseeable future; this could be the case as early as between 2022-2027 (Wink, 2021a and 2021b). Based on DNA and mitochondrial DNA analyses and variations, many genera and families have been divided to avoid para- and polyphyletic groupings. According to modern systematics (cladistics), all groupings must be monophyletic. This also explains the differences between the world birds lists discussed below (Wink, 2021b; Zink and Barrowclough, 2008 and Zhang et al. 2014). Scientific research on DNA sequencing methods will largely edit the DNA segments for the taxonomic levels of birds. In avian systematics, many inconsistencies in world bird lists can be resolved over time through comprehensive phylogenetic tree analysis of DNA. Thus, many-sided consortia have been working on the various bird families using sequencing methods (Barrowclough et al., 2016; Jarvis et al., 2014; Wink, 2018; 2021b; Wink et al., 2009; Winker 2021; Zhang et al., 2014 and Zink and Barrowclough, 2008).

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5. REFERENCES

Adızel O, Azizoğlu E, Kiziroğlu I (2017) A new bird species record for (*Oenanthe albonigra* Hume, 1872) Turkey: Hume's wheatear. Natural Science and Discovery 3(3): 37-44. http://natscidiscovery.com/index.php/nsd/article/view/56 [Distribution]

Barrowclough GF, Cracraft J, Klicka J, Zink RM (2016) How many kinds of birds are there and why Does It matter? PLOS ONE. 2016:11(11): e0166307. DOI: 10.1371/journal.pone.0166307.Birdguides.com https://www.birdguides.com/articles/ [Species records]

Boyd JH (2019/2020) III - TiF checklist, Version 3.10: July 27 2019 and updated February 29 2020.

Chesser RT, Billerman SM, Burns KJ, Cicero C, Dunn JL, Kratter AW, Lovette IJ, Mason NA, Rasmussen PC, Remsen JV, Stotz DF, Winker K (2020) Sixty-first Supplement to the AmericanOrnithological Society's Check-list of North American Birds. AmericanOrnithology.org. The Auk 137: 1-24. DOI: 10.1093/auk/ukaa030.

Clements JF, Schulenberg TS, Iliff MJ, Billerman SM, Fredericks TA, Sullivan BL & Wood CL (2019) The eBird/Clements Checklist of Birds of the World: v(2019) Downloaded from http:// www.birds. cornell.edu/clementschecklist/download/

Clements JF, Schulenberg TS, Iliff MJ, Billerman SM, Fredericks TA, Gerbracht JA, Lepage Sullivan DBL & Wood CL (2021) The eBird/Clements checklist of birds of the world: v2021. Downloaded from https://www.birds.cornell.edu/clementschecklist/download/

CornellLab of Ornithology (2020) Editions & Cornell Laboratory of Ornithology. 159 Sapsucker Woods Rd Ithaca, New York.14850.

Del Hoyo Josep (ed.), Elliott A (ed.), Sargatal J (ed.) (vol. 1–7) & Christie, DA (ed.) (vol. 8–16). (1992–2013) Handbook of the Birds of the World. Lynx Edicions.http://www.hbw.com/ [Species records]

Dickinson EC & Remsen JV eds. (2013) The Howard and Moore Complete Checklist of the Birds of the World. 4th edition. Vol 1. Non-passerines. Aves Press, Eastbourne, UK. Facebook Global Rare Bird Alert.

https://www.facebook.com/groups/GlobalRBA/ [Species records]

Gill F, Donsker D, Rasmussen P. (Eds) (2020) IOC World Bird List (v10.2). Tersiger.com.Western Palearctic Bird News.http://www.tarsiger.com/news/index.php?sp=wp&lang=eng(Species records) Xeno-canto.org https://xeno-cantoorg(Species records).

Gill F, Donsker D, Rasmussen P (Eds) (2021a) IOC World Bird List (v 11.1). Doi 10.14344/IOC.ML.11.1.

Gill F, Donsker D, Rasmussen P(Eds) (2021b) IOC World Bird List (v 11.2). Doi 10.14344/IOC.ML.11.2. http://www.worldbirdnames.org/

HBW and BirdLife International (2019) Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 4. Available at: http://datazone. birdlife.org/ userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_v4_Dec19.zip

Jarvis E D et al. (2014) Whole-genome analyses resolve early branches in the tree of life of modern birds. *Science 346:* 1320-1331.

Kiziroğlu İ (2015) Türkiye Kuşları Cep Kitabı.The Pocket Book for Birds of Türkiye. English and Türkish. Sarıyıldız Ofset, Ankara, 577pp.

Kiziroğlu İ (2021) Kuşlar.Birds.Haydi Kuşları Gözlemeye.Kuban Mat.,Ankara, 321 pp.

Lynx edition (2017-2018) First Country Reports. http://www.hbw.com/news/first-country-reports [Species records]

Mayr E (1942) Systematics and the Origin of Species. Columbia University Press, New York.

Mayr E (1996) What is a species, and what is not? Philos. Sci. 63(2): 262–277.

Mayr E & Ashlock PD (1991) Principles of Systematic Zoology. 2nd edition. McGraw-Hill, New York.

Peters JL (1931–1986) Check-list of Birds of the World. Vols. 1–15+ Index. Museum of Zoology, Harvard University Press, Cambridge, Massachusetts. datazone/info/taxonomy (download May 2014).

Sharpe RB (1899–1909) A Hand-list of the Genera and Species of Birds. Vols. 1–5. Trustees of the British Museum (Natural History), London.

Wink M (2017) Wissenschaft für alle: Citizen Science, in der Biologie-Schwerpunkt Ornithologie. Heidelberger Jahrbücher Online 2017; Bd.2:Artikel 7; 107-120.

Wink M (2018) Aktuelle Ergebnisse aus Genomanalysen: Ein neuer Stammbaum der Vögel. Der Falke 65(September 2018): 8-15.

Wink M (2021a) Ornithologie für Einsteiger und Fortgeschrittene. 2. Aufl. Springer Spektrum.

Wink M (2021b) DNA analyses have revolutionized studies on the taxonomy and evolution in birds. Book Chapter Template. IntechOpen (in press).

Wink M, El Sayed A-A, Gürth H S & Gonzales J (2009) Molecular Phylogeny of Owls (Strigiformes) Inferred from DNA Sequences of the Mitochondrial Cytochrome b and the Nuclear RAG-1 gene. Ardea 97(4): 581-591. https://doi.org/10.5253/078.097.0425.591.

Winker K (2021) An overview of speciation and species limits in birds American Ornithology.org. Ornithologie 138: 1-27.

Zink RM & Barrowclough GF (2008) Mitochondrial DNA under siege in avian phylogeography. Molecular Ecology 17: 2107-212.

Zhang G et al. (2014) Comparative genomics reveals insight into avian genome evolution. Science 346: 1311-1320.