CONTRIBUTION TO THE KNOWLEDGE OF THE ORTHOPTERAN FAUNA (CAELIFERA ET ENSIFERA, DERMAPTERA, MANTODEA AND BLATTARIA) OF THE MURES VALLEY

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Introduction

First records of Orthopteran fauna from Arad County respectively Arad City, were made in 1893 by SIMONKAI. In this publication 12 species are mentioned, which are: *Acrida ungarica, Calliptamus italicus, Forficula auricularia, Gomphocerippus rufus, Gryllotalpa gryllotalpa, Gryllus campestris, Locusta migratoria, Mantis religiosa, Oecanthus pellucens, Oedipoda caerulescens, Tettigonia viridissima* and *Tetrix subulata*. Last gradations on *Locusta migratoria* were reported in 1879 in eastern Hungary (Nagy, 1994). It is not known whether this impact would have any influence in the studied area. Other publications on wildlife Orthoptera appeared recently are Lőrinczi *et al.* (2011), Nagy & Szövényi (1998), Worschech (1998) and others. This study also aims to examine the Orthoptera species in terms of their ecology. Some of the species are bioindicators and therfore reflect the influence of human activity on environment.

Material and Methods

Study area

The studied area is located in the western part of Romania (Arad County), and extends along the Mures River from Lipova to Igris, at elevations ranging from 96 to 115 meters a.s.l. (see Fig.1 at page 5).

Sampling methods

For field studies the following equipments were used: entomological net (30cm diameter), a GPS/PDA (ASUS A636), a camera Pentax W90, collection containers with ethanol (50ml) and identification manuals. At the laboratory stage were used: a microscope, a binocular loupe, tweezers and identification manuals. The Orthoptera species inventory was achieved by combining multiple methods. The most applied method was individual capture with entomological net (30cm diameter). Other methods that have been applied in the studied area are: selectively capturing samples by hand, by listening to the males' stridulations, tree canopy shaking method and raising stones and logs. Remains to be noted that under these inventory methods can not be obtained quantitative data, just

qualitative. The Orthoptera species inventory of the study area occurred during the years 2011 and 2012 (Table 2) using the above methods.

Determination

The determination of Orthoptera species was performed using the following Identification Manuals: Kis (1960), Kis (1961), Kis (1976), Kis (1978a), Harz (1975), Bellmann (2006), Baur *et al.* (2006) and Kocárek *et al.* (2005).

Results and Discussion

During the study, 60 Orthoptera species were identified within 4 sites (26 Ensifera, 30 Caelifera, 2 Blattaria, 1 Dermaptera and 1 Mantodea) in the studied area (Table 1). Two of them are listed in Annex II and IV of the Habitat Directive. It is *Isophya stysi* Cejchan, 1957 and *Odontopodisma rubripes* Ramme, 1931 species who were not reported from the studied area until now. The presence of these species requires designation of special areas of conservation. At the same time there was present one endemic species too called *Odontopodisma acuminata* Kis, 1962.

Table 1. List of species inventoried during the study (Ensifera et Caelifera, Blattaria, Dermaptera, Mantodea); Nomenclature after: [Heller *et al.* (1998)].

Scientific name	Abbreviations
Ensifera	
Phaneroptera falcata (PODA, 1761)	Ph.fal
Phaneroptera nana FIEBER, 1853	Ph.nan
Leptophyes albovittata (KOLLAR, 1833)	L.alb
Leptophyes discoidalis (FRIVALDSKY, 1867)	L.dis
Isophya stysi CEJCHAN, 1957	I.sty
Poecilimon schmidtii (FIEBER, 1853)	P.sch
Polysarcus denticauda (CHARPENTIER, 1825)	P.den
Meconema thalassinum (DE GEER, 1773)	M.tha
Conocephalus fuscus (FABRICIUS, 1781)	C.fus
Ruspolia nitidula (SCOPOLI, 1786)	R.nit
Tettigonia viridissima LINNAEUS, 1758	T.vir
Decticus verrucivorus (LINNAEUS, 1758)	D.ver
Platycleis (Platycleis) affinis FIEBER, 1853	P.aff
Platycleis (Tessellana) veyseli KOCAK, 1984	P.vey
Metrioptera (Metrioptera) bicolor (PHILIPPI, 1830)	M.bic
Metrioptera (Metrioptera) roeselii (HAGENBACH, 1822)	M.roe
Pholidoptera fallax (FISCHER, 1853)	P.fal
Pholidoptera griseoaptera (DE GEER, 1773)	P.gri
Gryllotalpa gryllotalpa (LINNAEUS, 1758)	G.gry
Myrmecophilus acervorum (PANZER, [1799])	M.ace
Oecanthus pellucens (SCOPOLI, 1763)	O.pel

Pteronemobius heydenii (FISCHER, 1853)	P.hey
Gryllus campestris LINNAEUS, 1758	G.cam
Melanogryllus desertus (PALLAS, 1771)	M.des
Eumodicogryllus bordigalensis (LATREILLE, 1804)	E.bor
Modicogryllus frontalis (FIEBER, 1844)	M.fro
Caelifera	
Xya pfaendleri (HARZ, 1970)	X.pfa
Tetrix subulata (LINNAEUS, 1758)	T.sub
Tetrix tenuicornis SAHLBERG, 1893	T.ten
Calliptamus italicus (LINNAEUS, 1758)	C.ita
Pseudopodisma nagyi GALVAGNI ET FONTANA, 1996	P.nag
Odontopodisma acuminata KIS, 1962	O.acu
Odontopodisma rubripes RAMME, 1931	O.rub
Odontopodisma sp.	O.spec.
Pezotettix giornae (ROSSI, 1794)	P.gio
Acrida ungarica (HERBST, 1786)	A.ung
Mecostethus parapleurus (HAGENBACH, 1822)	M.par
Aiolopus thalassinus (FABRICIUS, 1781)	A.tha
Oedipoda caerulescens (LINNAEUS, 1758)	O.cae
Oedaleus decorus (GERMAR, 1826)	O.dec
Chrysocraon dispar (GERMAR, [1834])	C.dis
Euthystira brachyptera (OCSKAY, 1826)	E.bra
Doiciostaurus brevicollis (EVERSMANN, 1848)	D.bre
Doiciostaurus maroccanus (THUNBERG, 1815)	D.mar
Stenobothrus crassipes (CHARPENTIER, 1825)	S.cra
Stenobothrus stigmaticus (RAMBUR, 1838)	S.sti
Omocestus haemorrhoidalis (CHARPENTIER, 1825)	O.hae
Omocestus rufipes (ZETTERSTEDT, 1821)	O.ruf
Gomphocerippus rufus (LINNAEUS, 1758)	G.ruf
Chorhippus oschei HELVERSEN, 1986	C.osc
Chorthippus biguttulus (LINNAEUS, 1758)	C.big
Chorthippus brunneus (THUNBERG, 1815)	C.bru
Chorthippus dorsatus (ZETTERSTEDT, 1821)	C.dor
Chorthippus mollis (CHARPENTIER, 1825)	C.mol
Chorthippus parallelus (ZETTERSTEDT, 1821)	C.par
Euchorthippus declivus (BRISOUT de Barneville, 1849)	E.dec
Dermaptera	
Forficula auricularia LINNAEUS, 1758	F.aur
Mantodea	
Mantis religiosa (LINNAEUS, 1758)	M.rel
Blattaria	
Ectobius erythronotus nigricans RAMME, 1923	E.ery
Phyllodromica megerlei (FIEBER, 1853)	P.meg

During the study period 4 sites were driven by chance once or twice that were inventoried for Orthoptera species with the following results: surface near Lipova at 01.11.2011 5 species found (Annex I), site near Felnac also at 01.11.2011, 8 species, near Igris (12.06.2012), 10 species, near Lipova (05.08.2012), 18 species (Colour plate Figure 14), near Frumuseni (06.08.2012) were 16 species, near Felnac (14.08.2012) 31 species, at Igris-island (18.08.2012) 6 species, near Igris (18.08.2012) 9 species, at the site near Frumuseni (21.08.2012) were found 16 species (Colour plate Figure 15) and last but not least in the other plots along the Mures Valley 15 species were found.

After analysing the data, we determined that the site which had the most favorable conditions for Orthopteran fauna was at Felnac (Colour plate Figure 16), which had the greatest diversity of species. On the Island near Igris (Colour plate Figure 17) an endemic species of national interest, *Odontopodisma acuminata* KIS, 1962, was found in August too (Colour plate Figure 19). The same species was found at Ceala Forest near Arad, along the road that crosses the forest between Airport and the III-th Ireland. Near Frumuseni several species were identified, among which one is rare in the Mures Valley, it is *Oedaleus decorus* (Germar, 1826), a specific species for sandy areas (Colour plate Figure 18). Another species *Xya pfaendleri* (HARZ, 1970) was found in 2 of 4 studied sites: Frumuseni and Igris.

In the study, some of the ecological aspects of orthoptera were examined, like humidity of the site, the way of life of the species, the associated substrate type and hemerobiotic degree of species.

Tables 3, 4 and 5 show the preferences of each species in terms of ecological characteristics. By analyzing these ecological characteristics of Ensifera the most species were xerophilous (7 species) followed by xero-mesophilous species (5). Concerning to the landscape structure most frequent of Ensifera was that pratinicol (14 species) followed by that deseti/pratinicol (6) and others. The substrate type of the species that are the most lived on was graminicol (7 species) followed by others. The species with an average tolerance of human disturbance were the most common with 15, followed by the sensitive species (8) and some others that show a high tolerance (3) (Table 2).

Among the Caelifera species, many of them were xerophilous (14), followed by mesophilous (6), hygrophyllous (4), xero-mesophilous (3), from mesophilous to hygrophyllous (2) and a single representative from hygrophyllous to xerophilous. The Caelifera's most common landscape structure was pratinicol (15), followed by deserti/pratinicol (8) and others. In terms of substrate type the most common species of Caelifera were graminicols (12), fewer terricols (4) and terri/graminicols (1). After analysing the hemerobiotic degree, most of the species had an average tolerance of human impact (14), some were less sensitive (13) and just a few had a high tolerance (3) (Table 3).

Table 2. Ecological characteristics of Ensifera species [Pisica & Iorgu (2006); Ingrisch & Köhler (1998)].

Taxon	Ecological characteristics			
Ensifera	Humidity	Landscape structure	Substrate type	Hem.
Ph.fal	xero-mesophilous	deserti/pratinicol	arbusticol	ome
Ph.nan	xero-mesophilous	deserti/pratinicol	arbusti/arboricol	ome
L.alb	meso-xerophilous	deserti/pratinicol	gramini/arbusticol	ome
L.dis	meso-xerophilous	deserti/pratinicol	graminicol	ome
I.sty	meso-xerophilous	pratinicol	gramini/arbusticol	om
P.sch	xerophilous	pratinicol	arbusticol	om
P.den	hygro-mesophilous	pratinicol	geocol-graminicol	ome
M.tha	mesophilous	silvicol	arboricol	ome
C.fus	hygro-mesophilous	ripi/pratinicol	graminicol	ome
R.nit	hygrophyllous-meso-xerophilous	pratinicol	gramini/arbusticol	om
T.vir	mesophil	prati/silvicol	arbusti/arboricol	ome
D.ver	xero-mesophilous	pratinicol	graminicol	ome
P.aff	hygrophyllous	pratinicol	graminicol	om
P.vey	xerophilous	pratinicol	graminicol	om
M.bic	xerophilous	pratinicol	graminicol	om
M.roe	hygrophyllous	pratinicol	graminicol	om
P.fal	meso-xerophilous	prati/silvicol	arbusticol	ome
P.gri	mesophilous	prati/silvicol	gramini/arbusticol	ome
G.gry	meso-hygrophyllous	ripi/pratinicol	geobiont-terricol	omep
M.ace	xero-mesophilous	pratinicol	terricol	om
O.pel	xerophilous	deserti/pratinicol	graminicol-arboricol	omep
P.hey	hygrophyllous	pratinicol	terricol	ome
G.cam	xero-mesophilous	deserti/pratinicol	terricol	ome
M.des	xerophilous	pratinicol	geobiont-terricol	omep
E.bor	xerophilous	pratinicol	geobiont-terricol	ome
M.fro	xerophilous	pratinicol	geobiont-terricol	ome

Abbreviations: Hem. – hemerobiotic degree, omep – oligo-meso-eu-polyhemerob, ome – oligo-meso-euhemerob, om – oligo-mesohemerob.

Table 3. Ecological characteristics of Caelifera species [Pisica & Iorgu (2006); Ingrisch & Köhler (1998)].

Taxon	Ecological characteristics			
Caelifera	Humidity	Landscape structure	Substrate type	Hem.
X.pfa	hygrophyllous	ripicol	geophil-geobiont	om
T.sub	hygrophyllous	pratinicol	terricol	ome
T.ten	xerophilous	pratinicol	terricol	ome
C.ita	xerophilous	deserti/pratinicol	terricol	om
P.nag	mesophilous	prati/silvicol	gramini/arbusticol	om
O.acu	mesophilous	prati/silvicol	arbusticol	ome
O.rub	mesophilous	prati/silvicol	arbusticol	om
Odontopodisma sp.	mesophilous	prati/silvicol	arbusticol	om
P.gio	xerophilous	deserti/pratinicol	gramini/arbusticol	ome
A.ung	xerophilous	deserti/pratinicol	graminicol	om
M.par	mesophilous-hygrophyllous	pratinicol	phitophil	om
A.tha	hygrophyllous	pratinicol	geophil-phitophil	ome
O.cae	xerophilous	deserticol	terricol	ome
O.dec	xerophilous	pratinicol	geophil	ome
C.dis	hygrophyllous	pratinicol	graminicol	om
E.bra	hygrophyllous - xerophilous	pratinicol	graminicol	om
D.bre	xerophilous	pratinicol	geophil-phitophil	ome
D.mar	xerophilous	pratinicol	geophil-phitophil	ome
S.cra	xerophilous	pratinicol	graminicol	ome
S.sti	xerophilous	pratinicol	terricol-graminicol	ome
O.hae	xerophilous	deserti/pratinicol	graminicol	om
O.ruf	xero-mesophilous	deserti/pratinicol	graminicol	ome
G.ruf	xero-mesophilous	prati/silvicol	gramini/arbusticol	om
C.osc	mesophilous-hygrophyllous	pratinicol	graminicol	ome
C.big	xero-mesophilous	deserti/pratinicol	graminicol	omep
C.bru	xerophilous	deserti/pratinicol	terri/graminicol	omep
C.dor	mesophilous	pratinicol	graminicol	om
C.mol	xerophilous	deserti/pratinicol	graminicol	om
C.par	mesophilous	pratinicol	graminicol	omep
E.dec	xerophilous	pratinicol	graminicol	ome

Abbreviations: Hem. – hemerobiotic degree, omep – oligo-meso-eu-polyhemerob, ome – oligo-meso-euhemerob, om – oligo-mesohemerob.

Table 4. Ecological characteristics of Dermaptera, Mantodea and Blattaria species [Pisica & Iorgu (2006); Ingrisch & Köhler (1998)].

Taxon	Ecological characteristics			
Dermaptera	Humidity	Landscape structure	Substrate type	Hem.
F.aur	mesophilous	campi/prati/silvi/deserticol	terri/gramini-arboricol	omep
Mantodea				
M.rel	xerophilous	deserti/pratinicol	gramini/arbusticol	ome
Blattaria				
E.ery	meso-xerophilous	silvi/pratinicol	terricol-arbusticol	omep
P.meg	meso-xerophilous	prati/silvicol	terri/graminicol	om

Abbreviations: Hem. – hemerobiotic degree, omep – oligo-meso-eu-polyhemerob, ome – oligo-meso-euhemerob, om – oligo-mesohemerob.

In the study area 22 xerophilous species were identified, followed by mesophilous (10), xero-mesophilous (8), hygrophyllous (7), meso-xerophilous (6), hygro-mesophilous (2), from mesophilous to hygrophyllous (2), meso-hygrophyllous (1), from hygrophyllous to mesophilous (1) and one from hygrophyllous to meso-xerophilous (Fig.1).

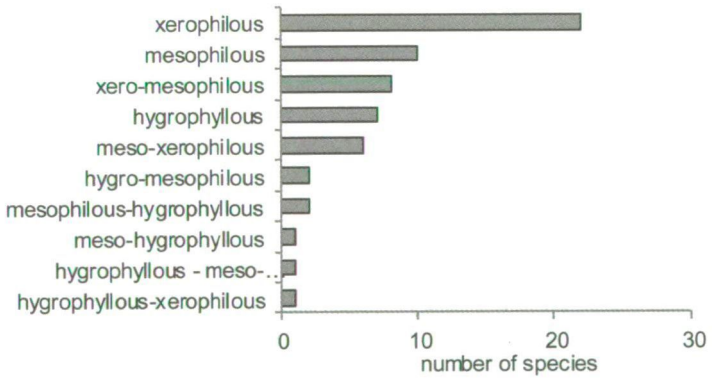

Figure 1. Preferences of species inventoried against moisture.

On the basis of landscape structure it could be observed that most species were pratinicols (29), deserti/pratinicols (15) followed by that prati/silvicols (9), ripi/pratinicols (2), silvi/pratinicols (1), ripicols (1), silvicols (1), deserticols (1) and campi/prati/silvi/deserticols (1) (Fig. 2).

On the type of substrate preference most of the species were graminicols (19) (Fig.3), followed by gramini/arbusticols (7), terricols (7), arbusticols (4),

geophils-phitophils (3), arbusti/arboricols (2), geobiont-terricols (2), geophils (2), arboricols (1), graminicols-arboricols (1), terri/gramini-arboricols (1), terricols-arbusticols (1), geophils-geobionts (1), geocols-graminicols (1), terricols-graminicols (1), respectively terri/ graminicols (1).

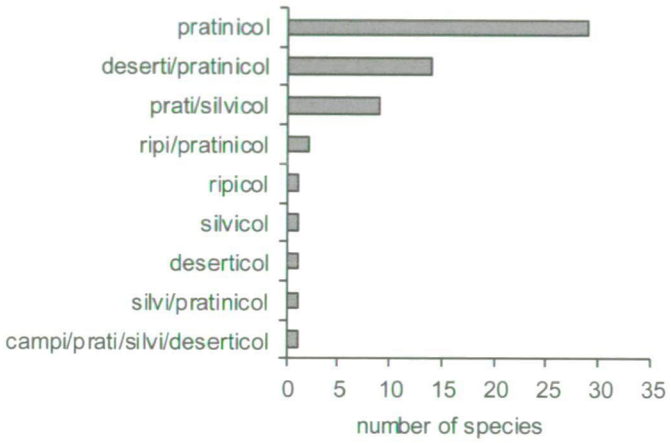

Figure 2. Preferred landscape structure of Ortoptera species of Mures Valley.

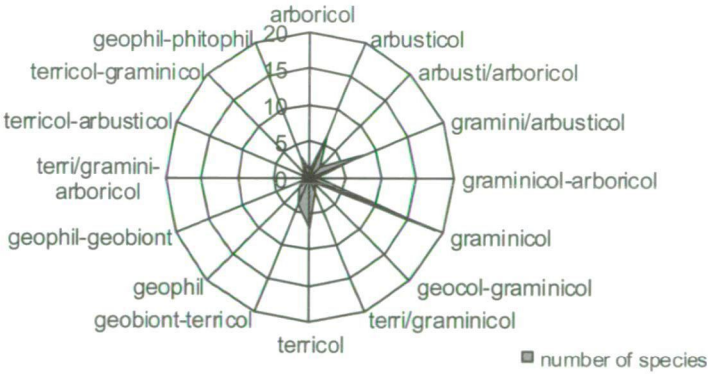

Figure 3. Diagram with prefered substrate type of Orthoptera species from Mures Valley.

Regarding the toplerance of anthropogenic influence (hemerobiotic degree) it was found that 22 species show a low tolerance, 30 species had only an average tolerance and 8 of them tolerate a very high anthropogenic influence (Fig.4).

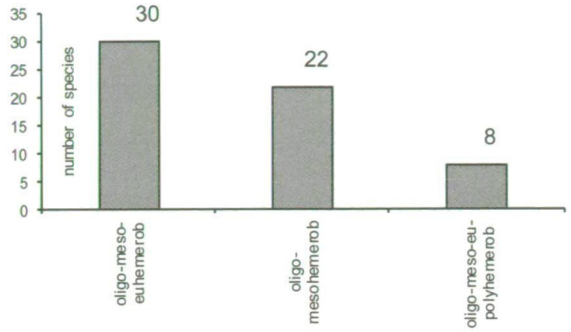

Figure 4. Diagram with hemerobiotic degree of Orthoptera species found on studied area.

Legislation

Among the species of Community interest two species were found (*Isophia stysi* Cejchan, 1957 and *Odontopodisma rubripes* Ramme, 1931), who are listed in Annex II and IV of the Habitat Directive and Annex 3 of OUG 57/2007. Neither species were reported until now at the NATURA 2000 site ROSCI0108. Conservation of these species requires the designation of special protection areas. Among the species of national interest just one strictly protected species (*Odontopodism acuminata* KIS, 1962) was found which is listed in Annex 4B of OUG 57/2007. Furthermore the species *Odontopodisma rubripes* Ramme, 1931 is listed in The IUCN Red List of Threatened Species too, as vulnerable. Because they are sensitive species with declining populations, it was necessary to implement protective measures throughout Europe by Habitat Directive: Annexe II and IV and nationally by OUG 57/2007 and OMMDD 1964/2007.

Conclusions and Recommandation

During the study several problems were mate that can cause the disappearance of sensitive species and their populations like *Isophya stysi* Cejhan, 1957, *Odontopodisma rubripes* RAMME, 1931, *Odontopodisma acuminata* KIS, 1962 and others. Problems like overgrazing, invasion by alian plants like *Amorpha fruticosa* L. along the River and other plant species, all over heap of rubbish, especially near the villages and last but not least the river pollution by garbage and other pollutants conducted from the households into the Mures. Another problem that seems to be majore impact especialy in the autumn is caused by a road inside the Ceala Forest, where especially the endemic species *Odontopodis-ma acuminata* Kis, 1962 is rund over by cars (Colour plate Figure 21). All the mentioned problems can cause massiv habitat degradations, fragmentation and loss through out to ireversible impact. To solve these problems

we need a management plan that will be strictly controlled while implementing protective measures, to stop the population decline of sensitive species, habitat deterioration and fragmentation.

One of the major problems was notified in several plots of the studied area is the state sequence field. For most species, extensiv grazing seems to have a very important role, because only in this way can be kept the areas open without scrubs and also other precious habitats. Also, follow preferences sensitive species that do not tolerate the troubles of domestic animals (overgrazing). In this respect remains to mention that the goal is to keep fully current of Orthoptera fauna. For *Isophya stysi* Cejhan, 1957 and *Odontopodisma rubripes* RAMME, 1931 be defined sites of Community interest by which to protect all populations. For endemic species like *Odontopodisma acuminata* Kis, 1962, measures are necessary be taken to preserve their habitats and also existing populations. In fact it would be important that all species and habitats of Community interest (listed in Annexes II and IV of the Habitat Directive), which are present in the studied area, would be reported later to the EU Commission.

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Annex I **Table 1:** Species found in the Mures Valley. 1: Lipova 01.11.11; 2: Lipova 05.08.12; 3:Felnac 01.11.11; 4: Felnac 14.08.12; 5: Igris 12.06.12; 6: Igris-island 18.08.12; 7: Igris 18.08.12; 8: Frumuseni 06.08.12; 9: Frumuseni 21.08.12; 10: other plots from Mures Valley

Species	1	2	3	4	5	6	7	8	9	10
Ph.fal										
Ph.nan				×		×				
L.alb					×					
L.dis							×			
I.sty										×
P.sch				×						
P.den										×
M.tha										×
C.fus		×		×			×			
R.nit		×							×	
T.vir	×	×		×	×	×		×		
D.ver										×
P.aff				×					×	
P.vey				×						
M.bic				×	×					
M.roe		×			×					
P.fal				×						
P.gri		×		×		×				
G.gry										×
M.ace										×
O.pel	×	×		×		×	×	×		
P.hey		×		×	×			×	×	
G.cam		×	×	×	×				×	

Species	1	2	3	4	5	6	7	8	9	10
M.des		×		×	×				×	
E.bor		×		×						
M.fro										×
X.pfa					×		×	×	×	
T.sub							×		×	
T.ten										×
C.ita		×		×				×	×	
P.nag										×
O.acu						×				
O.rub										×
O.spec.										×
P.gio	×			×		×	×	×	×	
A.ung		×		×				×	×	
M.par		×								
A.tha				×					×	
O.cae				×				×	×	
O.dec									×	
C.dis				×						
E.bra				×						
D.bre								×		
D.mar								×		
S.cra				×						
S.sti			×							
O.hae			×	×						
O.ruf			×	×				×		
G.ruf										×
C.osc				×						
C.big		×	×	×			×	×		
C.bru		×		×			×		×	
C.dor	×	×	×	×	×			×		
C.mol			×					×		
C.par	×	×		×	×			×	×	
E.dec		×		×			×	×	×	
F.aur			×							
M.rel				×						
E.ery										×
P.meg										×