Graellsia, 62(número extraordinario): 509-521 (2006)

A SURVEY OF AVAILABLE MOLECULAR MARKERS FOR VERTEBRATE SPECIES PRESENT IN COMUNIDAD DE MADRID

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ABSTRACT

In this paper I present a survey for molecular markers available for Vertebrate species inhabiting the Comunidad de Madrid, with the aim of being useful to researchers working on the characterization of animal biodiversity in this area.

Key words: Molecular markers, Vertebrate, Madrid.

RESUMEN

Estudio de los marcadores moleculares disponibles para las especies de vertebrados presentes en la Comunidad de Madrid

En este trabajo presento los resultados de una búsqueda en bases de datos de marcadores moleculares para especies de Vertebrados presentes en la Comunidad de Madrid, en la esperanza de que este trabajo pueda ser de utilidad para aquellos investigadores involucrados en la caracterización de biodiversidad animal en esta Comunidad.

Palabras clave: Marcadores moleculares, Vertebrados, Madrid.

Introduction

Today, molecular markers are a valuable tool for taxonomic and conservation studies allowing serious inferences in phylogeography, genetic structure of populations, conservation status, and so on (Bruford & Wayne, 1993; Tautz *et al*., 2003; Avise, 2004).

For this reason, I consider that a survey of available molecular markers for Vertebrate species inhabiting in Comunidad de Madrid in sequence databases could be interesting as a research tool for biodiversity present in this area, giving researchers an overview to molecular knowledge for the species under scrutiny, and contributing to define gaps that can be filled subsequently.

The present survey is realised with this in mind, searching in sequence databases for mitochondrial, nuclear, and microsatellite (frequently repeated, highly polymorphic short sequences) sequences for vertebrate species or genera present in Comunidad de Madrid.

This approach, however, can have relative value only, since new sequences in sequence databases become available almost every day, and could make data shown in this work rapidly obsolete. In this sense, I believe that incorporating these data into a new database in progress in the Museo Nacional de Ciencias Naturales, and their continued review, can increase the value of the work.

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Table 1.— Sequences in databases for fish present in Comunidad de Madrid.

Tabla 1.— Secuencias en las bases de datos para peces presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Ameiurus melas/ *Ictalurus melas*	13	12	1	0	85 sequences to the Genus (55753 sequences for *Ictalurus*) Many microsatellites
Barbus bocagei	28	25	3	0	733 sequences to the Genus 22 microsatellites
Barbus comizo	14	14	0	0	idem
Carassius auratus	745	yes	yes	21	790 sequences to the genus
Chondrostoma arcasii/ *Rutilus arcasii*	29	29	0	0	185 sequences to the genus (55 for *Rutilus*) 5 microsatellites for *R. rutilus*
Chondrostoma lemmingii/ *Rutilus lemmingii*	10	10	0	0	idem
Chondrostoma polylepis	4	4	0	0	idem
Cobitis calderoni	12	12	0	0	277 sequences to the Genus
Cobitis paludica	59	59	0	0	idem
Cyprinus carpio	11616	yes	yes	13	15 microsatelllites for *C.auratus* are conserved
Esox lucius	108	42	40	26	171 sequences to the genus
Gambusia holbrooki	4	4	0	0	71 sequences to the Genus 7 microsatllites for *G. affinis*. 3 described for *G. holbrooki* are not in GenBank
Gobio lozanoi/ *Gobio gobio*	58	44	14	0	67 sequences to the Genus
Lepomis gibbosus	11	8	3	0	215 sequences to the genus 9 microsatellites for *L. marginatus*, 1 for *L. macrochirus*
Micropterus salmoides	73	47	20	6	269 sequences to the genus. 11 microsatellites for *M. dolomieu*
Oncorhynchus mykiss	242135	yes	yes	967	246644 sequences to the Genus
Silurus glanis	21	3	2	16	42 sequences to the Genus
Salmo trutta	870	yes	yes	40	114040 sequences to the Genus
Squalius alburnoides/ *Tropidophoxinellus alburnoides*/ *Rutilus alburnoides*	67	67	0	0	149 sequences to the Genus (2 for *Tropidophoxinellus*) 6 microsatellites for *S. aradensis*
Squalius pyrenaicus/ *Leuciscus pyrenaicus*	47	47	0	0	idem. (633 for Leuciscus) 5 microsatellites for *L. idus* and 5 for *R. rutilus* that are conser ved in *L. idus*
Tinca tinca	38	7	30	1	

Table 2.— Sequences in databases for Amphibia present in Comunidad de Madrid.

Tabla 2.— Secuencias en las bases de datos para anfibios presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Alytes cisternasii	11	5	0	6	105 sequences to the Genus 11 microsatellites for *A. muletensis*
Alytes obstetricans	57	51	6	0	idem. Genome mitochondrial completed
Bufo bufo	60	34	10	16	1772 sequences to the Genus
Bufo calamita	54	35	1	18	idem
Discoglossus galganoi	78	77	1	0	Genome mitochondrial completed 204 sequences to the Genus
Discoglossus jeanneae	72	71	1	0	idem
Euproctus asper	15	13	2	0	22 sequences to the Genus
Hyla arborea	25	4	4	17	1147 sequences to the genus
Hyla meridionalis	11	3	8	0	idem
Pelobates cultripes	22	15	7	0	37 sequences to the Genus
Pelodytes punctatus	21	17	4	0	30 sequences to the Genus
Pleurodeles walt	134	81	53	0	225 sequences to the Genus
Rana iberica	15	7	8	0	2022 sequences to the Genus Microsatellites
Rana perezi	12	9	3	0	idem
Salamandra salamandra	188	172	5	11	226 secuences to the Genus
Triturus alpestris[1]	10	2	1	7	427 sequences to the Genus 64 Microsatellites
Triturus boscai[2]	6	6	0	0	idem
Triturus marmoratus	4	3	1	0	idem
Triturus pygmaeus	1	1	0	0	idem

([1]) Now *Mesotriton alpestris*. (2) Now *Lissotriton boscai.*

Methods

Each species present in Comunidad de Madrid has been searched for number of sequences, using the Taxonomy browser of the WEB page of NCBI (National Center for Biotechnology information USA) (http://www.ncbi.nlm.nih.gov/Taxonomy /taxonomyhome.html). This information has been edited, sorting them into mitochondrial and nuclear sequences and microsatellites when sequence number output is less than 200 sequences. Sequences available for the corresponding genera, with special focus in the presence of microsatellites, have also been analyed.

In cases with a sequence number output greater than 200, I search specifically for the presence of microsatellite using the *Entrez* option with a query: "Genus name + microsatellite".

In the case of Fish I took the distribution show in the *Atlas y Libro Rojo de los Peces continentales de España* (Doadrio, 2002) as the basis of the their presence in the region. For Amphibia, I followed Martínez-Solano & González Fernández (2003). In relation to Reptilia, I used the *Atlas y Libro Rojo de los Anfibios y Reptiles de España* (Pleguezuelos *et al*., 2002). In the case of Aves, I split the species present in Madrid into sedentary and migrants on the basis of the *Anuario Ornitológico de Madrid 2002* (De la Puente Nilsson *et al*., 2002), excluding species cited as accidental. For Mammals, I use the *Atlas de los mamíferos terrestres de España* (Palomo & Gisbert, 2002). For main synonymies I

Table 3.— Sequences in databases for Reptilia present in Comunidad de Madrid.

Tabla 3.— Secuencias en las bases de datos para repriles presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Acanthodactylus erithrurus	41	41	0	0	87 sequences to the Genus
Anguis fragilis	8	3	5	0	
Blanus cinereus	3	0	3	0	5 sequences to the Genus
Coluber hippocrepis[1]	3	3	0	0	60 sequences to the Genus
Coronella austriaca	29	6	1	22	39 sequences to the Genus
Coronella girondica	10	9	1	0	22 microsatellites for *C. austriaca*
Chalcides bedriagai	0	0	0	0	139 sequences to the genus
Chalcides striatus/ *Chalcides chalcides*	6	4	2	0	idem
Chrysemys scripta	8	0	8	0	95 sequences to the Genus
*Elaphe escalaris*2	0	0	0	0	94 sequences to the Genus 11 microsatellites for *E. obsoleta*
Emys orbicularis	127	93	34	0	130 sequences to the Genus
Iberolacerta cyreni/ *Lacerta monticola*	45	40	5	0	218 sequences to the Genus
Lacerta lepida	69	66	3	0	652 sequences to the Genus 9 microsatellites for *L. vivipara* and 12 for *L. viridis*
Lacerta schreiberi	36	32	4	0	idem
Macroprotodon cucullatus	25	23	2	0	109 sequences to the Genus
Mauremys leprosa	9	9	0	0	149 sequences to the Genus
Mauremys caspica	14	11	3	0	idem
Malpolon monspessulanus	13	10	3	0	16 sequences to the Genus
Natrix maura	21	20	1	0	155 sequences to the Genus 8 microsatellites for *N. tesse-llata*
Natrix natrix	70	68	2	0	idem
Podarcis hispanica	307	yes	yes	0	954 sequences to the Genus 9 microsatellites for *P. bocagei*, 9 for *P. muralis* and 4 for *P. erhardii*
Podarcis muralis	86	64	12	9	idem
Psammodromus algirus	46	42	4	0	48 sequences to the Genus
Psammodromus hispanicus	2	2	0	0	idem
Tarentola mauritanica	69	69	0	0	289 sequences to the Genus
Vipera latastei	2	2	0	0	352 sequences to the Genus 6 microsatellites for *V. berus*

([1]) Now *Haemorhois hippocrepis*. (2) Now *Rhinechis escalaris.*

groupped data for both entries (*Squalius pyrenaicus/Leuciscus pyrenaicus*). The data are current to November 16, 2005

Results

Fishes

Fishes species in Comunidad de Madrid are represented by a large number of molecular markers (Table 1). This result is logical if we consider that nine of twenty present species are exotic and with high economic value. Despite having a good number of sequences for *Cobitis*, no microsatellites has been described. Similarly, the absence of microsatellites for *Gobio* is remarkable. The taxonomic status of some species has been revised in recent years. In these cases, the search for the different synonymies shows a large number of molecular markers available. Additionally, a recent study (Larno *et al*., 2005) characterizes new microsatellite markers for *Leuciscus* that are probably useful in other species (Barinova *et al*., 2004).

Amphibia

The 19 species present in Madrid are well represented in the GenBank (Table 2) except for *Triturus boscai*, *Triturus pygmaeus* and *Triturus marmoratus*, represented by 6, 1 and 4 sequences respectively and *Hyla meridionalis*, represented by 11 sequences. However, the Genus *Triturus* and *Hyla* are represented by a high number of sequences and among them they are numerous microsatellites that could be useful. All of the genera are well represented, with microsatellites described for *Alytes*, *Bufo*, *Hyla*, *Rana*, *Salamandra* and *Triturus*. In particular, microsatellites are described for *Alytes cisternasii*, *Bufo bufo*, *Bufo calamita*, *Hyla arborea*, *Salamandra salamandra* and *Triturus alpestris*.

Sequences are available from specimens sampled within the Comunidad de Madrid for *Alytes cisternasii*, *Alytes obstetricans*, *Discoglossus jeanneae* and *Salamandra salamandra* which may help in population studies.

Reptilia

Most species present in Comunidad de Madrid are well represented by sequences in databases (Table 3), except *Chalcides bedriagai* and *Elaphe escalaris*, and less so, *Blanus cinereus*, *Coluber hippocrepis*, *Psammodromus hispanicus* and *Vipera latastei*. However, they are many available sequences for the corresponding Genus except for *Blanus*.

With respect to microsatellites, a short number has been described for these species and genera. Only for *Coronella austriaca* and *Podarcis muralis* do we have microsatellites in GenBank, and at Genus level, microsatellites has been characterized for *Elaphe*, *Lacerta*, *Natrix, Podarcis* and *Vipera*. I believe that a supplementary effort in order to determine microsatellites for the Reptilia inhabiting the Comunidad de Madrid is necessary.

Aves

They are a large number of molecular markers for Aves, both sedentary (Table 4) and migrants (Table 5), that allow population, biogeographic and kinship studies. However, the number of markers is small for some genera. For this reason, it is necessary to implement the characterization of a larger number of molecular markers. For instance, there are no DNA markers for *Melanocorypha* among the sedentary group and other genera show a small number of markers (less than 10), including:

Sedentary:

Aegypius	*Lullula*	*Pyrrhocorax*
Amandava	*Miliaria*	*Remiz*
Bubulcus	*Oenanthe*	*Saxicola*
Egretta	*Petronia*	*Tachybaptus*
Elanus	*Phoenicurus*	*Tetrax*
Garrulus	*Ptyonoprogne*	*Upupa*

Migrants:

Calandrella	*Jinx*	*Pluvialis*
Delichon	*Lymnocryptes*	*Recurvirostra*
Gelochelidon	*Oenanthe*	*Saxicola*
Himantopus	*Philomachus*	*Scolopax*
Ixobrychus	*Phoenicurus*	*Tichodroma*

On the other hand, there are microsatellites available for the following genera: *Accipiter, Aegithalos, Alectoris, Anas, Aquila, Athene, Bubo, Buteo, Callipepla, Cettia, Columba, Corvus, Dendrocopos, Emberiza, Falco, Fringilla, Gyps, Hieraaetus, Larus, Loxia, Luscinia, Otis, Parus, Passer Phasianus, Phylloscopus, Pica, Podiceps, Prunella, Ptynoprogne, Saxicola* and *Strix* within the sedentary group, and for genera: *Acrocephalus, Anas,*

Table 4.— Sequences in database for sedentary Aves present in Comunidad de Madrid.

Tabla 4.— Secuencias en bases de datos para aves sedentarias presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Accipiter gentilis	50	13	13	24	113 sequences to the Genus
Accipiter nisus	12	3	9	0	idem. 24 microsatellites for *A. gentilis*
Actitis hypoleucos	10	7	3	0	24 sequences to the genus
Aegithalos caudatus	16	10	5	1	21 sequences to the Genus
Aegypius monachus	5	4	1	0	
Alauda arvensis	12	6	6	0	
Alcedo atthis	8	3	5	0	14 sequences to the Genus
Alectoris rufa	91	32	36	23	316 sequences to the Genus
Amandava amandava	2	2	0	0	7 sequences to the Genus
Anas clypeata	11	6	5	0	1879 sequences to the Genus. Microsatellites for *A. platyrynchos*
Anas platyrynchos	1111	yes	yes	More than 300	idem
Anas strepera	66	28	38	0	idem
Anthus spinoletta	3	1	2	0	32 sequences to the Genus
Aquila adalberti	22	4	0	18	208 sequences to the Genus 8 microsatellites for *A. heliaca*
Aquila chrysaetos	30	18	12	0	idem
Asio otus	22	17	5	0	37 sequences to the Genus
Athene noctua	9	9	0	0	17 sequences to the Genus. 7 microsatellites for *A. cunicularia*
Aythya ferina	1	1	0	0	18 sequences to the Genus
Bubo bubo	48	28	13	7	95 sequences to the genus
Bubulcus ibis	4	3	1	0	
Burhinus oedicnemus	1	1	0	0	12 sequences to the Genus
Buteo buteo	123	65	2	56	Genome mitochondrial completed. 265 sequences to the Genus
Callipepla californica	19	11	1	7	35 sequences to the Genus. Exotic
Carduelis cannabina	1	1	0	0	78 sequences to the Genus
Carduelis carduelis	6	5	1	0	idem
Carduelis chloris	19	15	4	0	idem
Certhia brachydactyla	1	1	0	0	15 sequences to the Genus
Cettia cetti	6	6	0	0	31 sequences to the Genus. 12 microsatellites for *C. diphone*
Cinclus cinclus	37	31	6	0	42 sequences to the Genus
Circus aeruginosus	9	5	4	0	20 sequences to the genus
Circus cyaneus	4	4	0	0	idem
Cisticola jundicis	2	2	0	0	11 sequences to the Genus
Coccothraustes coccothraustes	6	3	3	0	10sequenceas to the Genus
Columba livia	318	yes	yes	18	459 sequences to the Genus
Columba oenas	1	1	0	0	idem. Microsatellites for *C. livia*
Columba palumbus	29	19	10	0	idem
Corvus corax	282	yes	yes	1	439 sequences to the Genus
Corvus corone	17	8	9	0	idem. 1 microsatellite for *C. corax*
Corvus monedula	6	1	5	0	idem
Cyanopica cooki	8	8	0	0	73 sequences to the Genus
Cyanopica cyanus	65	62	3	0	idem
Dendrocopos major	276	yes	yes	0	296 sequences to the Genus. 3 microsatellites for *D. leucopterus* and 6 for *D. leucotos*
Dendrocopos minor	0	0	0	0	idem
Egretta garzetta	2	1	1	0	8 sequences to the Genus
Elanus caeruleus	0	0	0	0	3 sequences to the Genus
Emberiza cioides	4	4	0	0	117 sequences to the Genus. 26 microsatellites for *E. citrinella* and 7 for *E. schoeniclus*

Table 4.— Cont.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Emberiza cirlus	2	2	0	0	idem
Erithacus rubecula	79	68	11	0	
Falco peregrinus	180	108	43	29	Genome mitochondrial Completed. 328 sequences to the Genus. 28 microsatellites for *F. peregrinus*, 8 for *F. rusticulos* and 2 for *F. punctatus*
Falco tinnunculus	24	13	11	0	idem
Fringilla coelebs	87	70	16	1	121 sequences to the Genus 1 satellite
Fulica atra	3	2	1	0	11 sequences to the Genus
Galerida cristata	13	11	2	0	24 sequences to the Genus
Galerida theklae	9	7	2	0	idem
Gallinula chloropus	13	2	11	0	
Garrulus glandarius	1	1	0	0	4 sequences to the Genus
Gyps fulvus	19	7	2	10	39 sequences to the Genus
Hieraaetus fasciatus	52	12	5	35	91 sequences to the Genus
Lanius excubitor	16	13	3	0	132 sequences to the Genus
Lanius meridionalis	38	35	3	0	idem
Larus ridibundus	22	9	13	0	710 sequences to the genus. 7 microsatellites for *L. novaehollandiae*
Loxia curvirostra	43	39	4	0	58 sequences to the Genus. 7 microsatellites for *L. scotica*
Lullula arborea	2	2	0	0	
Luscinia svecica	302	yes	yes	2	310 sequences to the genus
Melanocorypha calandra	0	0	0	0	
Miliaria calandra	8	8	0	0	
Milvus milvus	46	46	0	0	137 sequences to the genus
Monticola solitarius	4	3	1	0	21 sequences to the genus
Motacilla alba	494	yes	yes	0	1629 sequences to the Genus
Motacilla cinerea	27	23	4	0	idem
Myiopsitta monachus	11	10	1	0	Exotic
Oenanthe leucura	0	0	0	0	2 sequences to the Genus
Otis tarda	220	yes	yes	8	
Parus ater	7	5	2	0	1283 sequences to the Genus. Microsatellites for *P. major* (23), *P. monticolus* (12) and *P. caeruleus* (12)
Parus caeruleus	268	yes	yes	12	idem
Parus cristatus	1	1	0	0	idem
Parus major	405	yes	yes	23	idem
Passer domesticus	76	20	46	10	129 sequences to the Genus
Passer hispaniolensis	4	4	0	0	idem. Microsatellites for *P. domesticus*
Passer montanus	29	18	11	0	idem
Petronia petronia	5	2	3	0	8 sequences to the Genus
Phasianus colchicus	67	13	53	1	78 sequences to the Genus. Exotic
Phoenicurus ochrurus	0	0	0	0	5 sequences to the Genus
Phylloscopus collybita	18	14	4	0	365 sequences to the Genus. 8 microsatellites for *P. occipitalis*, 2 for *P. trochilus* and 10 for *P. iijimae*
Phylloscopus ibericus	0	0	0	0	idem
Pica pica	50	39	7	4	60 sequences to the Genus
Picus viridis	3	2	1	0	14 sequences to the Genus
Porphyrio porphyrio	2	0	2	0	15 sequences to the Genus
Podiceps cristatus	2	0	2	0	36 sequences to the Genus. 7 microsatellites for *P. grisegena*
Podiceps nigricollis	1	1	0	0	idem
Prunella collaris	16	0	7	9	38 sequences to the Genus
Prunella modularis	11	4	7	0	idem. 9 microsatellites for *P. collaris*
Pterocles alchata	0	0	0	0	98 sequences to the Genus

Table 4.— End.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Pterocles orientalis	1	0	1	0	idem
Ptyonoprogne rupestris	2	2	0	0	5 sequences to the Genus. 1 microsatellite for *P. fuligula*
Pyrrhocorax pyrrhocorax	4	2	2	0	6 sequences to the Genus
Rallus aquaticus	3	3	0	0	12 sequences to the Genus
Regulus ignicapillus	4	4	0	0	54 sequences to the Genus
Regulus regulus	24	24	0	0	idem
Remiz pendulinus	7	2	5	0	
Saxicola torquata	2	2	0	0	8 sequences to the Genus. 1 microsatellite for *S. rubertra*
Serinus citrinella	1	1	0	0	73 sequences to the Genus
Serinus serinus	5	5	0	0	idem
Sitta europaea	287	yes	yes	0	392 sequences to the Genus
Strix aluco	328	yes	yes	0	417 sequences to the Genus. 7 microsatellites for *S. occidentalis*
Sturnus unicolor	0	0	0	0	32 sequences to the Genus
Sylvia melanocephala	5	5	0	0	54 sequences to the Genus
Sylvia undata	1	1	0	0	idem
Tachybapthus ruficollis	1	1	0	0	
Tetrax tetrax	6	4	2	0	
Troglodytes troglodytes	149	146	3	0	190 sequences to the Genus
Turdus merula	8	3	5	0	197 sequences to the Genus
Turdus philomelos	6	4	2	0	idem
Turdus viscivorus	1	0	1	0	idem
Tyto alba	34	24	10	0	59 sequences to the Genus
Upupa epops	7	4	3	0	
Vanellus vanellus	3	2	1	0	11 sequences to the Genus

Anser, Ardea, Calidris, Charadrius, Clamator, Corvus, Coturnix, Cuculus, Emberiza, Falco, Ficedula, Gallinago, Grus, Hirundo, Larus, Locustella Luscinia, Merops, Muscicapa, Otus, Phalacrocorax, Phylloscopus, Philomachus Phyrrula, Riparia, Saxicola and *Sterna* among the migratory group.

It is necessary to remark the absence of microsatellites for *Turdus* and *Ciconia*, and the presence of only one microsatellite sequence for *Corvus*. The case of *Philomachus* is also interesting. In this genus, the nine sequences available are microsatellites.

Mammals

Mammals are well represented by sequences in databases except for the endangered species *Galemys pyrenaicus* with only four sequences deposited in GenBank.

In respect to the microsatellites, the number of sequences is large, except for *Barbastella*, *Elyomis*, *Genetta*, *Hypsugo*, *Neomys*, *Pipistrellus*, *Suncus* and *Talpa*, with no microsatellites characterized.

Conclusions

The species and genera without molecular data deserve a particular effort for the characterization of molecular markers. In particular, I think that is necessary to invest in the obtention of more sequences from the endangered *Galemys pyrenaicus*, and to obtain sequences for underrepresented avian genera, such as *Elanus*, *Aegypius*, *Melanocorypha*, *Lymnocryptes* and others.

On the other hand, it is also necessary to characterize microsatellites for genera with no sequences available, considering the current importance of these markers (Bruford & Wayne, 1993), and in particular, a major effort in the characterization of microsatellites in reptiles and fish should be undertaken.

Table 5.— Sequences in databases for migrant Aves present in Comunidad de Madrid.

Tabla 5.— Secuencias en bases de datos para aves migrantes presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Acrocephalus arundinaceus	71	6	53	12	294 sequences to the Genus. 67 microsatellites for *A. sechellensis,* 3 for *A. paludicola* and 1 for *A. orientalis*
Acrocephalus schoenubaenus	10	10	0	0	idem
Acrocephalus scirpaceus	12	12	0	0	idem
Anas acuta	11	8	3	0	1879 sequences to the genus. Microsatellites for *A. platyrynchos*
Anas crecca	9	5	4	0	idem
Anas penelope	63	23	40	0	idem
Anas querquedula	5	5	0	0	idem
Anser anser	82	12	70	0	325 sequences to the Genus. 47 microsatellites para *A. cygnoides* and 2 for *A. albifrons*
Anthus campestris	1	1	0	0	32 sequences to the Genus
Anthus pratensis	9	6	3	0	idem
Anthus trivialis	5	2	3	0	idem
Apus apus	17	14	3	0	37 sequences to the Genus
Apus pallidus	0	0	0	0	idem
Ardea cinerea	5	2	3	0	76 sequences to the Genus. 60 microsatélites for *A. herodias*
Ardea purpurea	1	1	0	0	idem
Asio flammeus	15	12	3	0	37 sequences to the Genus
Aythya fuligula	2	1	1	0	18 sequences to the Genus
Aythya nycora	1	1	0	0	idem
Calandrella brachydactyla	0	0	0	0	4 sequences to the Genus
Calidris alpina	43	41	2	0	341 sequences to the Genus. 3 microsatellites for *C. canutus*
Calidris ferruginea	2	2	0	0	idem
Calidris minuta	0	0	0	0	idem
Caprimulgus europeus	3	2	1	0	15 sequences to the Genus
Caprimulgus ruficollis	0	0	0	0	idem
Carduelis spinus	3	3	0	0	78 sequences to the Genus
Charadrius dubius	1	0	1	0	183 sequences to the Genus. 66 microsatellites for *C. alexandrinus*
Charadrius hiatiluca	0	0	0	0	idem
Chlidonias hybridus	3	3	0	0	10 sequence to the Genus
Chlidonias niger	4	4	0	0	idem
Ciconia ciconia	7	5	2	0	Genome mitochondrial completed. 74 sequences to the Genus
Ciconia nigra	15	10	5	0	idem
Circaetus gallicus	8	5	3	0	19 sequences to the Genus
Circus pygargus	0	0	0	0	20 sequences to the genus
Clamator glandarius	10	3	0	7	13 sequences to the Genus
Coracias garrulus	5	4	1	0	24 sequences to the Genus
Corvus frugileus	7	4	3	0	439 sequences to the Genus. 1 micosatellite for *C. corax*. Genome mitochondrial completed
Coturnix coturnix	294	yes	yes	0	648 sequences to the genus. 115 microsatellites for *C. japonica*
Cuculus canorus	45	32	6	7	63 sequences to the Genus
Delichon urbica	3	2	1	0	8 sequences to the Genus
Emberiza citrinella	39	6	7	26	117 sequences to the Genus. 26 microsatellites for *E. citrinella* and 7 for *E. schoeniclus*
Emberiza hortelana	0	0	0	0	idem
Emberiza schoeniclus	37	23	7	7	idem
Falco columbarius	14	4	10	0	328 sequences to the Genus. 28 microsatellites for *F. peregrinus*, 8 for *F. rusticulos* and 2 for *F. punctatus*

Table 5. Cont.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Falco eleanorae	0	0	0	0	idem
Falco naumanni	1	1	0	0	idem
Falco subbuteo	3	3	0	0	idem
Ficedula hypoleuca	164	60	81	23	350 sequences to the genus. Other microsatellites
Fringilla montifrigilla	23	16	7	0	121 sequences to the Genus
Gallinago gallinago	7	3	4	0	118 sequences to the Genus. Microsatellites for *G. media*
Gelochelidon nilotica	1	1	0	0	
Grus grus	11	6	5	0	349 sequences to the Genus. 35 microsatellites for *G. americana*, 7 for *G. japonensis,* 1 for *G. paradisea* and 1 for *G. canadiensis*
Hieraaetus pennatus	11	7	4	0	91 sequences to the Genus
Himantopus himantopus	1	0	1	0	4 sequences to the Genus.
Hippolais polyglotta	4	4	0	0	27 sequences to the Genus
Hirundo daurica	0	0	0	0	89 sequences to the Genus. Microsatellites for *H. rustica*
Hirundo rustica	45	14	15	16	idem
Ixobrychus minutus	0	0	0	0	5 sequences to the Genus
Jynx torquilla	4	3	1	0	
Lanius collurio	9	4	5	0	132 sequences to the Genus
Lanius senator	6	6	0	0	idem
Larus cachinnans	57	57	0	0	710 sequences to the Genus. 7 microsatellites for *L. novaehollandiae*
Larus fuscus	72	62	10	0	idem
Larus melanocephalus	4	4	0	0	idem
Limosa limosa	4	4	0	0	27 sequences to the *Genus*
Locustella luscinoides	3	3	0	0	63 sequences to the Genus. 7 microsatellites for *L. pyeri*
Locustella naevia	7	7	0	0	idem
Luscinia megarhynchos	0	0	0	0	310 sequences to the Genus. 2 microsatellites for *L. svecica*
Lymnocryptes minimus	1	1	0	0	
Merops apiaster	20	0	0	20	30 sequences to the Genus
Milvus migrans	91	87	4	0	137 sequences to the Genus
Monticola saxatalis	0	0	0	0	21 sequences to the Genus
Motacilla flava	885	yes	yes	0	1629 sequences to the Genus
Muscicapa striata	23	5	15	3	37 sequences to the Genus
Neophron percnopterus	33	31	2	0	
Numenius arquata	2	2	0	0	13 sequences to the Genus
Nycticorax nycticorax	13	8	5	0	
Oenanthe hispanica	0	0	0	0	2 sequences to the Genus
Oenanthe oenanthe	1	1	0	0	idem
Oriolus oriolus	3	0	3	0	15 sequences to the Genus
Otus scops	10	6	4	0	118 sequences to the Genus. 18 microsatellites for *O. elegans*
Pandion haliaetus	16	8	8	0	
Pernis apivorus	7	7	0	0	38 sequences to the Genus
Phalacrocorax carbo	38	27	4	7	112 sequences to the Genus
Philomachus pugnax	9	0	0	9	
Phoenicurus phoenicurus	2	2	0	0	5 sequences to the Genus
Phylloscopus bonelli	5	5	0	0	365 sequences to the genus. 8 microsatellites for *P. occipitalis*, 2 for *P. trochilus* and 10 for *P. iijimae*
Phylloscopus trochilus	28	10	16	2	idem
Platalea leucorodia	0	0	0	0	267 sequences to the Genus
Pluvialis apricaria	0	0	0	0	7 sequences to the Genus
Pyrrhula pyrrhula	10	8	0	2	14 sequences to the Genus
Recurvirostra avosetta	4	2	2	0	8 sequences to the Genus
Riparia riparia	3	2	1	0	11 sequences to the Genus. 1 microsatellite for *R.cincta*
Saxicola rubertra	1	0	0	1	8 sequences to the Genus

Table 5. End.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Scolopax rusticola	2	2	0	0	9 sequences to the Genus
Sterna hirundo	10	6	4	0	120 sequences to the Genus. 4 microsatellites for *S. dougallii*
Streptopelia decaocto	7	6	1	0	94 sequences to the Genus
Streptopelia turtur	7	6	1	0	idem
Sturnus vulgaris	28	14	14	0	32 sequences to the Genus
Sylvia atricapilla	12	6	6	0	54 sequences to the Genus
Sylvia borin	8	5	3	0	idem
Sylvia cantillans	3	3	0	0	idem
Silvia communis	1	1	0	0	idem
Sylvia conspicillata	1	1	0	0	idem
Sylvia hortensis	1	1	0	0	idem
Tachymarptis melba/ Apus melba	11	8	3	0	See *Apus*
Tadorna tadorna	9	7	2	0	22 sequences to the Genus
Tichodroma muraria	1	0	1	0	
Tringa erythropus	9	7	2	0	113 sequences to the Genus
Tringa glareola	11	9	2	0	idem
Tringa nebularia	10	8	2	0	idem
Tringa ochropus	11	8	3	0	idem
Tringa totanus	20	16	4	0	idem
Turdus ialicus	0	0	0	0	197 sequences to the Genus
Turdus pilaris	0	0	0	0	idem
Turdus torquatus	0	0	0	0	idem

ACKNOWLEDGMENTS

Thanks to L. M. Carrascal, I. Doadrio, M. García París and J. E. Gónzalez for their commentaries and suggest. This work is partially supported by Comunidad de Madrid grant GR/AMB/0750/2004.

References

AVISE, J. C., 2004. *Molecular Markers, Natural History and Evolution*. Second Edition. Sinauer. Sunderland. 341 pp.

BARINOVA, A., YADRENKINA, E., NAKAJIMA, M. & TANIGUCHI, N., 2004. Identification and characterization of microsatellite molecular markers developed in *Leuciscus idus* and Siberian Roach *Rutilus rutilus*. *Molecular Ecology Notes*, 4: 86-88.

BRUFORD, M. W. & WAYNE, R. K., 1993. Microsatellites and their application to population genetic studies. *Current Opinion in genetics and Development*, 3: 939-943.

DE LA PUENTE, J., PÉREZ-TRIS, J. & BERMEJO, A., (eds.). 2003. *Anuario Ornitológico de Madrid 2002*. SEO Monticola. Madrid. 207 pp.

DOADRIO, I., (ed.). 2002. *Atlas y Libro Rojo de los Peces Continentales de España*. Ministerio de Medio Ambiente. Madrid. 233 pp.

LARNO, V., LAUNEY, S., DEVAUX, A. & LAROCHE, J., 2005. Isolation and Characterization of microsatellite loci from chub *Leuciscus cephalus* (Pisces: Cyprinidae). *Molecular Ecology Notes*, 5: 752-754.

MARTÍNEZ-SOLANO, I. Y GONZÁLEZ FERNÁNDEZ, J. E., 2003. La Colección de Anfibios de Madrid del Museo Nacional de Ciencias Naturales y su utilidad en conservación. *Graellsia,* 59: 105-128.

PALOMO, L. J. & GISBERT, J., (eds.). 2002. *Atlas de los Mamíferos terrestres de España*. Ministerio de Medio Ambiente. Madrid. 563 pp.

PLEGUEZUELOS, J. M., MÁRQUEZ, R. & LIZANA, M., (eds.). 2002. *Atlas y Libro Rojo de los Anfibios y Reptiles de España*. Ministerio de Medio Ambiente. Madrid. 587 pp.

TAUTZ, D., ARCTANDER, P., MUNELLI, A., THOMAS, R. H. & VOGLER, A. P., 2004. A plea for DNA Taxonomy. *Trends in Ecology and Evolution*, 18: 70-74.

Note in Proof:

Since the submission of this work and the proof corrections, and with respect to Aves, 4 microsatellites have been described for the genus *Porphyrio* and 16 for the species *Nycticorax nycticorax*. Many mitochondrial sequences have been published for the genus *Scolopax*. In the Reptilia, more sequences have been described for the genus *Blanus*, and 6 microsatellites have been described for *Mauremys*. Finally, many microsatellites have been described in the mammalian genus *Mustela*.

Table 6.— Sequences in database for mammals present in Comunidad de Madrid.

Tabla 6.— Secuencias en bases de datos para mamíferos presentes en la Comunidad de Madrid.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Apodemus sylvaticus	372	yes	yes	21	1190 sequences to the Genus Several microsatellites
Arvicola sapidus	1	0	1	0	58 sequences to the Genus. 21 microsatellites for *A. terrestris*
Barbastella barbastellus	36	36	0	0	40 sequences to the genus
Capra pyrenaica	38	31	7	0	3740 sequences to the Genus. 55 microsatellites for *C. hircus*
Capreolus capreolus	358	yes	yes	16	383 sequences to the genus
Cervus dama	30	6	16	8	859sequences to the Genus. 125 microsatellites
Cervus elaphus	405	yes	yes	82	idem
Crocidura russula	310	yes	yes	23	595 sequences to the Genus. 8 microsatellites for *C. suaveolens*. Genome mitochondrial completed
Eliomys quercinus	7	2	5	0	11 sequences to the Genus
Eptesicus serotinus	18	9	9	0	80 sequences to the Genus. 9 microsatellites for *E. fuscus*
Erinaceus europaeus	185	96	77	12	303 sequences to the Genus.
Felis silvestris	54	28	26	0	6313 sequences to the genus. 548 microsatellites
Galemys pyrenaicus	4	1	3	0	
Genetta genetta	27	22	5	0	125 sequences to the Genus
Hypsugo savii	18	18	0	0	20 sequences to the Genus
Lepus granatensis	104	51	53	0	1168 sequences to the Genus. 8 microsatellites for *L. saxatilis* and 6 for *L. europaeus*
Lutra lutra	118	81	10	27	130 sequences to the genus
Lynx pardinus	29	26	3	0	226 sequences to the Genus 6 microsatellites for *L. canadiensis* and 35 for *L. rufus.*
Martes foina	29	13	11	5	442 sequences to the Genus. 27 microsatellites
Meles meles	216	yes	yes	130	
Microtus cabrerae	34	2	32	0	1615 sequences to the Genus. 8 microsatellites for *M. oeconomus* and 8 for *M. montebelli*
Microtus duodecimcostatus	4	2	2	0	idem
Microtus lusitanicus	6	2	4	0	idem
Microtus nivalis/ *Chionomys nivalis*	21	11	10	0	Idem (7 sequences to *Chionomys*)
Miniopterus schreibersii	123	110	8	5	171 sequences to the Genus
Mus musculus	8093572	yes	yes	more than 600	8099741 sequences to the Genus.
Mustela nivalis	55	48	5	2	585 sequences to the genus. 81 microsatellites
Mustela putorius	102	36	65	1	Idem
Mustela vison	206	yes	yes	63	idem
Myotis bechsteini	10	10	0	0	711 sequences to the Genus. 41 microsatellites for *M. myotis*
Myotis blythii	14	14	0	0	idem
Myotis daubentoni	42	17	25	0	idem
Myotis emarginatus	6	6	0	0	idem
Myotis myotis	168	30	97	41	idem
Myotis mystacinus	33	33	0	0	idem
Myotis nattereri	6	6	0	0	idem
Neomys anomalus	10	9	1	0	26 sequences to the Genus
Nyctalus lasiopterus	6	6	0	0	68 sequences to the Genus. 10 microsatellites to *N. noctula*
Nyctalus leisleri	8	8	0	0	idem
Nyctalus noctula	36	24	2	10	idem

Table 6. End.

Species	Sequences	Mitochondrial sequences	Nuclear sequences	Microsatellites	Remarks
Oryctolagus cuniculus	738692	yes	yes	More than 400	738795 sequences to the genus
Ovis gmelini	0	0	0	0	392342 sequences to the Genus. Many microsatellites
Pipistrellus kuhli	27	17	10	0	212 sequences to the Genus
Pipistrellus nathusii	13	13	0	0	idem
Pipistrellus pipistrellus	78	72	6	0	idem
Plecotus auritus	88	77	5	6	509 sequences to the Genus
Plecotus austriacus	54	54	0	0	Idem. Microsatellites for *P. auritus*
Rhinolophus euryale	1	1	0	0	1605 sequences to the Genus. Microsatellites for *R. ferrumequinum* and 14 for *R. hipposideros*
Rhinolophus ferrumequinum	1453	yes	yes	33	idem
Rhinolophus hipposideros	17	3	0	14	idem
Rhinolophus mehelyi	0	0	0	0	idem
Sciurus vulgaris	105	68	11	26	305 sequences to the Genus
Sorex granarius	2	2	0	0	662684 sequences to the Genus. 3 microsatellites for *S. cacutiens*, 3 for *S. unguiculatus* and 20 for *S. araneus*
Sorex minutus	75	75	0	0	idem
Suncus etruscus	2	2	0	0	62 sequences to the Genus
Sus scrofa	1113105	yes	yes	More than 2000	1113336 sequences to the Genus.
Tadarida teniotis	1	1	0	0	269 sequences to the Genus. 9 microsatellites for *T. brasiliensis*
Talpa occidentalis	2	1	1	0	45 sequences to the Genus
Vulpes vulpes	159	94	41	24	209 sequences to the Genus