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Old and new records of turbellarians from the central areas of Spain

J. Gamo[1] & C. Noreña-Janssen[2]
[1]*Universidad de Alcalá de Henares, Departamento de Biología Animal. Alcalá de Henares (Madrid), Spain*
[2]*Museo Nacional de Ciencias Naturales, c/ José Gutierrez Abascal 2, Madrid 28006, Spain*

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Abstract

From the point of view of its biodiversity, the Iberian Peninsula is one of the most interesting areas. Its special geographical location and geological history have created a high degree of diversity within the invertebrates groups in general, and within the ecological group of the Turbellaria in particular. In the present work, old and new records of turbellarian species from the central areas of the Iberian Peninsula are presented. Data on their biology and distribution within the freshwater habitats, mainly limnic, are also provided. This study is mainly based on the project Fauna Iberica III.

Introduction

In February 1996, a study on the microturbellaria within the Iberian Peninsula was initiated, financed by the project 'Fauna Ibérica III'. The first phase of the investigation focused on the central areas of Spain. The main aims were: (1) to provide a complete list of species for this area, one of the best studied areas of the Iberian Peninsula (Farias et al., 1995; Gamo, 1987a,b,c; Gamo & Mayor, 1987; Gamo & Schwank, 1987); and (2) to complete the ecological data with respect to their distribution, seasonal occurrence, and habitats. Fifty-five localities within the provinces of Madrid, Guadalajara, Segovia, Toledo and Zaragoza were visited from February 1995 to April 1996. Selection of the localities was determined by the hydric level of the lotic and lentic environments. Most of the marshes, lagoons, ponds, springs and small rivers disappeared during droughts in recent years. Samples during 1995 were therefore taken in the shallow remaining areas of the reservoirs and in main rivers, where mainly the interstitial medium was studied. With good rainfall during the winter of 1995/96 most of the marshes re-appeared. Some of the previously absent species were found again, e.g. *Bothromesostoma personatum*, and new records completed the list of Turbellaria within the Iberian Peninsula.

In the present work, a total of 88 species are cited, of which 48 are old records, 20 new records, and 19 species are determined at the genus level only. A definitive description of the species listed at generic level will be provide in the near future.

Material and methods

The material obtained was collected mainly in the vegetated areas of the lotic and lentic environments by means of plankton nets of 125 and 250 μm, mounted in a circular frame (20 cm diameter) with a 1.8 m pole. For interstitial fauna, the Karaman–Chappuis method was used. In accordance with this method, a hole was made in the sandy or stony bottoms of the river banks. The depth of the hole created depended of the freatic level. The collected water was filtered through different sieves (250 and 125 μm). In order to obtain of a representative sample, 20–30 l were filtered.

Using plastic bottles, samples with live fauna were shipped to the laboratory, and processed under a stereomicroscope (10×, 20×, 50×). Information about the colour, presence or absence of glands and eyes, cilia, disposition of the reproductive organs, and measurements were obtained using stereo and compound microscopes (45×, 69×, 100×).

Specimens for histology were fixed in Bouin's fluid and blocked in paraplast wax. Sagittal and cross-sections (4 and 4.5 μm thick) were stained in Azan and

Heidenhein's haematoxylin and eosin, and mounted in DPX.

Taxonomical records

Table 1 shows the old and new records from the central areas of the Iberian Peninsula, as well as their seasonal occurrence and habitats (see also Table 2). For classification and determination of the species, the works of Luther (1955, 1960, 1963), Young (1970), Cannon (1986) and Gamo (1987a) were consulted.

Distribution

Microturbellaria in the central areas are preferentially distributed on the southern hillsides of the Guadarrama Mountain system and along the river Tajo basin.

In the north-east area of the river Tajo basin, the rivers Jarama, Tajuña, Henares, Torote and other rivers of minor order, form a fluvial net with the Tajo at freatic level. This area is characterized by numerous marshes, generally variable over time (Puebla de Beleña). During summer, these marshes and ponds tend to disappear. During springtime, in the marshes of Beleña, representatives of the genera *Castrada, Mesocastrada, Strongylostoma, Phaenocora, Rhynchomesostoma, Mesostoma, Bothromesostoma, Protoplanella* were captured. *Catenula lemnae, Microstomum lineare* and *Gyratrix hermaphroditus* were also collected.

South of Madrid (Arganda del Rey), a series of artificial lagoons and lakes are found that offer a new refuge for the invertebrate and vertebrate fauna of the area. In the vegetated banks of the 'graveras' representatives of the genera *Stenostomum, Castrella, Castrada* and *Rhynchomesostoma* were captured.

South-west of Madrid, some rivers of minor order flow into the Tajo river. These rivers emanate from the Toledo-hills and are characterized by the purity of their waters. Within the interstitial medium of these rivers, *Prorhynchus stagnalis* and *Macrostomum* sp. 1 were captured. In this region, also the lakes or lagoons known as 'navajos' are located: natural, shallow waterbodies of 20–30 m in diameter. These waterbodies have partially disappeared, in part due the dryness of the recent years, in part because they were used for agricultural irrigation of the adjacent areas. In some of these lagoons or in the adjacent ponds, individuals belonging to the genera *Gieysztoria* and *Castrada, Phaenocora, Mesostoma, Bothromesostoma* and *Olisthanella* were collected. Most of the species collected along the river Tajo basin were located in the described areas. The families with the widest distribution are, firstly, the F. Typhloplanidae; secondly, the F. Dalyellidae and, thirdly, the F. Stenostomidae.

The southern hillside of the Guadarrama Mountain system, is characterized by numerous reservoirs (Puertas viejas, Sequillo, Villar, Atazar, Santillana, Valmayor, San Juan, etc.), the majority of which are interconnected by canals. These reservoirs offer a refuge for species during dry periods and increase the opportunity for distribution through the canal system and the numerous decantations. During summer 1995, most of the species collected were found in the shallow areas of the reservoirs.

In autumn and spring, numerous temporary ponds can be found on this hillside. They are rich in detritus and offer a suitable habitat for turbellarians. The best represented families within these habitats were Typhloplanidae Dalyellidae.

On the northern hillside, which is less urbanized than the south side, no reservoirs are located and the rivers are less altered. The interstitial medium of these rivers yielded well: *Rhychoscolex simplex, Prorhynchus stagnalis, Geocentrophora spyrocephala* and *Bothrioplana semperi* were frequently found.

Next to the north side, a group of ponds and lagoons (Cantalejo, between the rivers Cega and Pirón) occur, that forms one of the most interesting marshes of the region due to its ecological features (mediterranean vegetation and substrate). In these lagoons species belonging to the genera *Stenostomum, Microdalyellia, Castrella, Castrada, Typhloplanella, Mesostoma* and *Olisthanella* were collected.

On the eastern hillside of the Guadarrama system, the province of Zaragoza (river Ebro basin), the best represented genera were *Castrada, Phaenocora* and *Mesostoma*, followed by *Microdalyellia, Macrostomum* and *Catenula*.

Seasonal occurrence and habitats

Table 2 summmarizes the data regarding seasonal occurrence and habitats of the microturbellarian species recorded in the present study. Most of the species were collected during the spring and autumn months.

Due to drought, clear differences were evident between the seasons of the years 1995 (extremely dry)

Table 1. List of species, (new records marked by an asterisk)

ORDER CATENULIDA	
A. Family Catenulidae	
1. Genus *Catenula*:	1. *Catenula lemnae* Duges, 1832
B. Family Stenostomidae	
2. Genus *Stenostomum*:	*2. *Stenostomum grabbskogense* Luther, 1960
	3. *Stenostomum leucops* (Duges, 1828) Schmidt, 1848
	4. *Stenostomum unicolor* Schmidt, 1848
	5. *Stenostomum* sp. 1
	6. *Stenostomum* sp. 2
	7. *Stenostomum* sp. 3
	8. *Stenostomum* sp. 4
3. Genus *Rhynchoscolex*:	*9. *Rhynchoscolex simplex* Leidy, 1851
ORDER MACROSTOMUM	
C. Family Macrostomidae	
4. Genus *Macrostomum*:	*10. *Macrostomum tuba* (Graff, 1882) Graff 1913
	11. *Macrostomum rostratum* (Papi, 1951) Papi, 1959
	12. *Macrostomum* sp. 1
	13. *Macrostomum* sp. 2
5. Genus *Promacrostomum:*	14. *Promacrostomum gieysztori* Papi, 1951
D. Family Microstomidae	
6. Genus *Microstomum*:	15. *Microstomum lineare* Oersted, 1843
ORDER LECITHOEPITHELIATA	
E. Family Prorhynchidae	
7. Genus *Prorhynchus*:	16. *Prorhynchus stagnalis* Schultze, 1851
8. Genus *Geocentrophora*:	*17. *Geocentrophora sphyrocephala* De Man, 1876
ORDER PROSERIATA	
F. Family Bothrioplanidae	
9. Genus *Bothrioplana*:	18. *Bothrioplana semperi* Braun, 1881
ORDER RHABDOCOELA	
Suborder Dalyellioida	
G. Family Dalyelliidae	
10. Genus *Dalyellia:*	19. *Dalyellia viridis* (Shaw, 1791) Graff 1904
11. Genus *Gieysztoria*:	*20. *Gieysztoria beltrani* (Gieysztor, 1931) Luther 1955
	21. *Gieysztoria cuspidata* (Schmidt 1861) Luther 1955
	22. *Gieysztoria diadema* (Hofsten, 1907) Luther 1955
	23. *Gieysztoria ornata* (Hofsten, 1907) Luther 1955
	24. *Gieysztoria rubra* (Fuhrmann, 1894) Luther 1955
	*25. *Gieysztoria (sibirica?* (Plotnikov, 1905) Luther 1955
	*26. *Gieysztoria subsalsa* Luther, 1955
12. Genus *Microdalyellia*:	7. *Microdalyellia armigera* (Schmidt, 1861) Gieysztor 1938
	28. *Microdalyellia fusca* (Fuhrmann, 1894) Ruebush & Hayes 1939
	29. *Microdalyellia kupelweiseri* (Meixner, 1915) R.& H. 1939
	*30. *Microdalyellia paucispinosa* (Sekera, 1888) R.& H. 1939
	31. *Microdalyellia rossi* (Graff, 1911) Gieysztor 1938
	32. *Microdalyellia schmidtii* (Graff, 1882) Gieysztor 1938
	33. *Microdalyellia tennessensis* Ruebush & Hayes 1939
	34. *Microdalyellia* sp. 1
13. Genus *Castrella*:	35. *Castrella truncata* (Abilgaard, 1789) Hofsten 1907
	*36. *Castrella (truncata?)* (Abildgaard, 1789) Hofsten 1907
	37. *Castrella (alba?*) Luther, 1955
H. Family Provorticidae	
14. Genus *Pilgramilla*:	38. *Pilgramilla sphagnorum* Sekera, 1911

Table 1. contd.

Suborder Typhloplanoida	
I. Family Typhloplanidae	
15. Genus *Castrada*:	39. *Castrada belennensis* Gamo & Schwank, 1987
	*40. *Castrada brevispina* Papi, 1959
	41. *Castrada (borealis borealis?* Steinböck, 1931)
	42. *Castrada cristatispina* Papi, 1954
	43. *Castrada infernalis* Papi, 1951
	*44. *Castrada lanceola* (Braun, 1885) Luther 1904
	45. *Castrada* sp. 1
	*46. *Castrada sphagnetorum* Luther, 1904
	*47. *Castrada* sp. 2
	*48. *Castrada (viridis*? Volz, 1898)
	49. *Castrada* sp. 3
	50. *Castrada* sp. 4
	51. *Castrada* sp. 5
	52. *Castrada* sp. 6
	53. *Castrada* sp. 7
	54. *Castrada* sp. 8
	55. *Castrada* sp. 9
16. Genus *Castradella*:	56. *Castradella gladiata* Schwank, 1980
17. Genus *Mesocastrada*:	57. *Mesocastrada fuhrmanni* Volz, 1898
	58. *Mesocastrada* sp. 1
16. Genus *Strongylostoma*:	59. *Strongylostoma radiatum* (Müller, 1774) Luther 1904
	*60. *Strongylostoma elongatum* Hofsten, 1907
	61. *Strongylostoma simplex* Meixner, 1915
19. Genus *Typhloplana*:	*62. *Typhloplana viridata* (Abildgaard, 1789) Luther 1904
20. Genus *Typloplanella*:	*63. *Typhloplanella halleziana* (Vejdovsky, 1880) Graff 1913
21. Genus *Tetracelis*:	64. *Tetracelis marmorosa* (Müller, 1774) Graff 1913
22. Genus *Phaenocora*:	65. *Phaenocora minima* Heitkamp, 1979
	66. *Phaenocora* (*typhlops*? (Vejdovsky, 1880) Graff 1913)
	67. *Phaenocora unipunctata* (örsted, 1843) Graff 1913
	68. *Phaenocora* sp. 1
23. Genus *Rhynchomesostoma*:	69. *Rhynchomesostoma rostratum* (Müller, 1774) Luther 1904
	70. *Rhynchomesostoma lutheri* Papi, 1963
	71. *Rhynchomesostoma* sp. 1
	72. *Rhynchomesostoma* sp. 2
24. Genus *Mesostoma*:	73. *Mesostoma ehrenbergi* (Focke, 1836) Graff 1882
	74. *Mesosotoma craci* Schmidt 1858
	75. *Mesosotoma lingua* (Abildgaard, 1789) Schmidt 1848
	76. *Mesostoma productum* (Schmidt, 1848) Graff, 1885
	77. *Mesostoma punctatum* Braun, 1885
	*78. *Mesosotoma (zariae* ? Mead & Kolada, 1981)
25. Genus *Bothromesostoma*:	79. *Bothromesostoma personatum* Braun, 1885
26. Genus *Opistomum*:	80. *Opistomum immigrans* Ax, 1956
	81. *Opistomum fuscum* Weise, 1942
	*82. *Opistomum pallidum* Schmidt, 1848
27. Genus *Protoplanella*:	*83. *Protoplanella simplex* Reisinger, 1924
28. Genus *Krumbachia*:	84. *Krumbachia subterranea* Reisinger, 1933
29. Genus *Olisthanella*:	85. *Olisthanella obtusa* (Schultze, 1851) Luther 1904
	86. *Olisthanella truncula* (Schmidt, 1859) Graff 1913
Suborder Kalyptorhynchia	
Section Eukalyptorhynchia	
Family Polycystidae	
30. Genus *Gyratrix*:	87. *Gyratrix hermaphroditus* Ehrenberg, 1831
31. Genus *Opisthocystis*:	88. *Opisthocystis goettei* (Bresslau, 1906) Graff 1913

Table 2. Seasonal occurrence and habitats

	Year												
	1995										1996		
Month	II	III	IV	V	VI	VII	VIII	IX	X	XI	II	III	IV
						Running waters							
		1					9			67		1	15
SR		2					17			75			75
		75											81
		78											87
					38					16		75	
C													
				30	5						33	36	69
D				67							41	50	
											70	75	
											80		
								11		19		15	9
I										20		18	12
													16
						Waterbodies							
		4					23	24		17			
R		24					31			77			
							85						
						5			6	17	27,80	32	32
SL						39			77		76,86	86	86
						46					78,32		67
						73					79,86		
	71	17,64,77	73	46		24	31		6,65	1	27,49,74,86	50,68	3,75
P	72	28,68,87							22,77	24	32,52,75,	51,74	36,77
		41,70							24,85	67	33,56,78	53,75	43,
		44,74							28		47,67,80	54,79	67,
		45,76							37		48,70,83	55,	69,
		44								24,			
M		45,								67,			
		70,											

The numbers correspond to the species in Table 1. (SR, small river; C, canal; D, ditches; I, interstitial; R, reservoir; SL, small lake; P, pond; M, marsh)

and 1996 (with abundant rainfall). Differences are most likely to be due to lack of appropriate habitat for the turbellarians rather than due to the seasons themselves. Most of the temporary and semipermanent ponds and lagoons disappeared during the preceding months. The low rainfall during 1995 was not sufficient to allow the appearance of many species, thus limiting species richness of the samples. Most of the species collected during that year were found in semipermanent ponds of the high areas of the mountain, in the shallow zones of the reservoirs (mainly *Microstomum lineare* and representatives of the family Dalyelliidae), and in the stagnant waters of rivers of minor order, canals and ditches.

The abundant rainfall in the last months of 1995 and first months of 1996 enabled the reappearance of the marshes and therefore of most of the species cited in this study. During years of a normal pluviometry, the presence of turbellarians can be expected from February to July within the central areas of the Iberian Peninsula, with a gradual substitution of the populations of the lentic environments (permanent, semipermanent or temporary).

As expected, the greatest abundance and species richness at all sample localities, were found in ponds and small lagoons with abundant marginal vegetation and detritus.

Within the lotic environments (of main and small rivers), the interstitial medium apparently forms an exclusive and excluding habitat. With respect to the turbellarians, it is often very difficult to decide whether the species present can be considered stygobiont (Schwank, 1986). The species collected were inhabitants of the three zones related to the interstitial medium: (1) phreatic zones, (2) stream bottoms and (3) the areas between phreatic zones and stream bottoms. Species belonging to the orders Catenulida (*Rhynchoscolex simplex*), Macrostomida (*Macrostomum* sp. 1), Lecithoepitheliata (*Prorhynchus stagnalis*, *Geocentrophora spyrocephala*) and Proseriata (*Bothrioplana semperi*) were captured in the phreatic biotops, but also in the surface waters of the stream bottoms. According to Schwank (1986), morphological criteria are secondary. Most of the subterranean turbellarians collected in the present study are small, colourless and blind, with the exception of *Macrostomum* sp. 1, that shows reduced ocular pigments.

All the organisms were found in clean, cold waters; rivers with a certain degree of contamination do not contain Turbellaria.

Another important factor influencing the presence of turbellarians is temperature. Extreme temperatures, below 4°C or above 25°C, result in the disappearance of microturbellaria. In the present study, we did not find turbellarians in regions characterized by very cold winters or very warm, dry summers. In these regions, ponds show an extremely short life (2–4 days), and temperatures can rise above 30°C. Very low temperatures result in the formation of icecover that impedes oxygen interchange across the air–water surface, reducing metabolic rates to levels often fatal. On the other hand, high temperatures reduce the concentration of dissolved oxygen in water and increase decomposition rates. Most of the ponds and turbellarian habitats showed temperatures between 6°C and 25°C, therefore the microturbellaria of the central areas of Spain are eurythermic or thermo-euryplastic.

Conclusions

The Guadarrama Mountain system apparently does not form a natural barrier for the distribution of genera, because representatives of the same families (mainly Typhloplanidae and Dalyellidae) were collected on both hillsides, but not above 1750 m (Morcuera Mountain Pass).

The cosmopolitanism nature of the turbellarian fauna is demonstrated, at least at the family level, and for some groups at genus level.

Three hypotheses may account for the cosmopolitan distribution of the turbellarians: (1) dispersion through migration of birds (Gamo, 1987a; Young & Young, 1976). (2) more numerous and extensive past distribution of Turbellaria, with current progressive reduction of the wet areas causing continuous reduction in the overall distribution of this group; (3) dispersion facilitated by the man-made canal system between the various rivers and reservoirs.

The family with the greatest distribution is Typhloplanidae. The genus *Castrada* is the best represented genus, collected in the majority of the sampling localities.

The genera *Mesostoma* and *Stenostomum* appear on the south and north hillsides of the Guadarrama Mountain. Also, representatives of both genera were found along the river Tajo basin, with the exception of the central area, where *Rhynchomesostoma* but not *Mesostoma* species were found. The genera *Phaenocora* and *Microdalyellia* are also widely distributed. *Phaenocora* spp. were found along the river Tajo basin and in some localities of the Guadarrama Mountain (Mountain Pass of Canencia, 1600 m). *Microdalyellia* spp. are distributed on both sides of the Guadarrama Mountains. *Microstomum* is one of the most widely distributed genera, being found along the river Tajo basin, but not in the north and east hillside of the Guadarrama.

The distribution of the genus *Catenula* is wide, but irregular. *Catenula* spp. do not appear on the north hillside of the Guadarrama nor in the central area of the river Tajo basin (decrease perhaps due to the drought?)

The genera *Castrella* and *Gieysztoria* apparently are concentrated within the river Tajo basin, how-

ever *Castrella truncata* was collected in the lagoons of Cantalejo (Province of Segovia).

The genus *Rhynchoscolex*, a characteristic representative of the interstitial fauna, was captured in the mountain springs of the province of Segovia (northern hillside of Guadarrama) and of the province of Toledo (south-west of Madrid). Its distribution is certainly among the widest, but limited to those areas free of contamination.

One of the most irregular distributions was presented by the genus *Macrostomum*. *Macrostomum* was collected in the hill-springs of Toledo, on the southern hillside of Guadarrama and in the ponds of the province of Zaragoza, two well separated regions.

The genus *Bothromesostoma* was collected in Beleña and in Toledo. The number of captured individuals in both areas was very high. This genus only appeared in the year 1996, a year with copious rainfall.

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