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CHROMOSOME NUMBERS OF SCARABAEIDAE  
(POLYPHAGA: COLEOPTERA)

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ABSTRACT

Chromosomal data on 209 species, representing 73 genera and 16 subfamilies of the family Scarabaeidae, are presented. The list contains the diploid number of chromosomes and chromosomal formulae along with a complete bibliography.

The family Scarabaeidae contains approximately 20,000 described species. Many of these species do considerable damage to cultivated crops. Other species are beneficial because they transport food material below the ground as a food supply for their progeny, where it acts as a manure in the soil.

The family Scarabaeidae is known cytologically by 209 species in 73 genera and 16 subfamilies (Table 1; numerical references are keyed to the literature cited). The family is conservative insofar as the chromosome number is concerned. The most common karyotype is  $9+Xyp$  male, in 84 species belonging to 14 subfamilies; 114 species have the  $Xyp$  male sex chromosome mechanism, whereas 161 species have 10 elements at metaphase of the first meiotic division.

The sequence of Smith (1953) regarding systematic arrangement of the taxa is followed. The chromosome numbers have been recorded from the originals. Correlations have been done with regard to the specific and generic nomenclature as well as systematic disposition of many species, and the errors in the originals have been pointed out as foot notes. The symbols and abbreviations used are as given by Smith (1953).

TABLE 1

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<b>PLEOCOMINAE</b>			
<i>Pleocoma crinita</i>	20s	$9+Xyp$	32
<i>P. dubitalis</i>	—	$9+Xyp$	32
<i>P. simi</i>	—	$9+Xyp$	32
<i>P. minor</i>	—	$9+Xyp$	32

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Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<b>TROGINAE</b>			
<i>Trox foveicollis</i>	20s	9 + Xyp	16; 32
<i>T. punctatus</i>	20s	9 + Xyp	16
<i>T. scaber</i>	20s	9 + Xyp	32
<i>T. spinulosus dentibius</i>	20s	9 + Xyp	32
<i>T. scutellaris</i>	20s	9 + Xyp	32
<i>T. monachus</i>	20s	9 + Xyp	32
<i>T. omacanthus</i> <sup>1</sup>	20s	9 + Xyp	36
<i>T. oricensis</i>	—	9 + Xyp	32
<i>T. granulatus</i>	20s	9 + Xyp	5
<i>Glareis</i> sp.	—	9 + Xyp	32
<b>GEOTRUPINAE</b>			
<i>Geotrupes balyi</i>	22s	? + Xy	24
<i>G. hypocrita</i>	22s	10 + Xy	27
<i>G. intermedius</i>	22s	11	19; 20
<i>G. mutator</i>	22s	—	26
<i>G. spiniger</i>	—	11	20
<i>G. splendidus</i>	22s	—	30
<i>G. stercorarius</i>	22s	11 <sub>11</sub>	26
<i>G. stercororus</i>	22s	11 <sub>11</sub>	26
<i>Bolboceras quadridens</i>	20s	9 + Xyp	40
<i>B. indicum</i>	20s	9 + Xyp	40
<i>Athyreus excavatus</i>	—	9 + Xyp	32
<b>ORPHNINAE</b>			
<i>Orphnus mysoriensis</i> <sup>2</sup>	20s	9 + Xyp	15
<i>O. impressus</i>	20s	9 + Xyp	40
<b>HYBOSORINAE</b>			
<i>Hybosorus orientalis</i>	20s	9 + Xyp	10; 40
<b>DYNAMOPINAE</b>			
<i>Dynamopus athleta</i>	22s	10 + Xyp	40
<b>CHIRONINAE</b>			
<i>Chiron digitatus</i>	20s	9 + Xy	10
<b>AEGIALLINAE</b>			
<i>Aegialia arenaria</i>	20s	10 <sub>11</sub>	26
<i>A. blanchardi</i>	—	9 + Xyp	32
<b>APHODIINAE</b>			
<i>Aphodius ater</i>	20s	—	26
<i>A. depressus</i>	20s	—	26
<i>A. distinctus</i>	20s	? + Xy	26; 30

<sup>1</sup>*Trox* sp. (Yadav & Pillai 1974).<sup>2</sup>Coprinae: Scarabaeini (ref. 15).

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<i>A. elevatus</i>	20s	—	27
<i>A. erraticus</i>	20s	9 + Xyp	24; 27; 30
<i>A. fimetarius</i>	20s	9 + Xy	24; 26
<i>A. foetens</i>	20s	10 <sub>II</sub>	26
<i>A. fossor</i>	20s	9 + Xy	26
<i>A. merdarius</i>	20s	9 + Xy	26
<i>A. haemorrhoidalis</i>	—	9 + Xy	26
<i>A. rufipus</i>	20s	9 + Xy	26
<i>A. rufus</i>	20s	10 <sub>II</sub>	26
<i>A. scrutator</i>	20s	9 + Xy	27
<i>A. subterraneus</i>	—	10 <sub>II</sub>	26
<i>A. moestus</i> <sup>3</sup>	22s	10 + Xyp	33
<i>Ataenius spretulus</i>	20s	—	24
<i>Psammodyus oregonesis</i>	—	9 + Xyp	32
COPRINAE			
<i>Gymnopleurus Koenigi</i> <sup>3a</sup>	—	9 + Xyp	4
<i>G. sinuatus</i>	18s	8 + X + Y	15; 21
<i>G. cyaneus</i>	20s	9 + Xyp	11
<i>Sisyphus schaefferi</i>	20s	9 + Xy	27
<i>Phanaeus vindex</i> <sup>4</sup>	12s	5 + 'XY'	8
	12s	5 + neoXY	29
<i>P. igneus</i>	12s	5 + 'XY'	8
<i>Heliocopris bucephalus</i>	20s	9 + XY	15
<i>Catharsius molossus</i>	20s	9 + Xyp	9; 15
		9 + XY	10
		9 + Xyp/Xyr	39
<i>C. sagax</i>	20s	9 + Xyp	15
<i>C. pithecius</i> <sup>5</sup>	20s	9 + Xyp	5; 9; 15; 39
<i>Catharsius</i> <sup>6</sup> sp.	20s	9 + Xyp	15
<i>Catharsius</i> sp.	20s	9 + Xyr	9
<i>Catharsius</i> sp.	18s	8 + Xyp	15
<i>Catharsius</i> sp.	20s	9 + Xyp	18
<i>Copris fricator</i>	21s	10 + XO	9
<i>C. lunaris</i>	20s	—	27
<i>C. tullius</i>	20s	—	30
<i>C. lugubris</i>	—	6 + Xyp	32a
<i>C. incertus</i>	—	6 + Xyp	32a
<i>C. hispanus cavolinii</i>	19s	—	19; 20
<i>Copris</i> sp.	14s	6 + Xyp	15

<sup>3a</sup>*G. koengii* (ref. 4).<sup>4</sup>*P. carnifex*.<sup>5</sup>2n = 18; n = 8 + XYp (ref. 42).<sup>5</sup>*C. pithecius* (ref. 15); Dynastinae (ref. 5).<sup>6</sup>*Catharsius* sp. near *sagax* (ref. 15).

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<i>Caccobius schreberi</i>	20s	9 + Xyp	27
<i>Onthophagus fracticornis</i>	20s	—	26
<i>O. amyntas</i>	20s	—	26
<i>O. furcatus</i>	20s	9 + Xy	27
<i>O. hecate</i>	—	9 + Xyp	24; 30
<i>O. illyricus</i>	—	9 + Xy	27
<i>O. andalusicus italicus</i>	20s	—	20
<i>O. taurus</i>	20s	9 + Xyp	26
<i>O. lemur</i>	20s	—	26; 27
<i>O. ovatus</i>	20s	—	27
<i>O. pennsylvanicus</i>	20s	9 + Xyp	30
<i>O. punctatus</i>	—s	10 <sub>II</sub>	26
<i>O. ruficapillus</i>	20s	9 + Xy	26
<i>O. vacca</i>	20s	—	26; 27
<i>O. verticicornis</i>	20s	—	27
<i>O. ramosellus</i>	20s	9 + Xyp	39
<i>O. catta</i>	20s	9 + Xyp	10; 15; 39
<i>O. bonasus</i>	20s	9 + Xyr	9
<i>O. quaestus</i>	20s	9 + Xyp	39
<i>O. dama</i>	20s	9 + Xyr	10
<i>O. mopsus</i>	20s	9 + Xyp	39
<i>O. crassus</i>	20s	9 + Xyp	39
<i>Onthophagus</i> “sp. I”	20s	9 + Xyp	15
<i>Onthophagus</i> “sp. II”	20s	9 + Xyp	15
<i>Onthophagus</i> “sp. III”	18s	8 + Xyp	15
<i>Onthophagus</i> “sp. IV”	18s	8 + Xyp	15
<i>Oniticellus fulvus</i>	—	10 <sub>II</sub>	27
<i>O. pallipes</i>	20s	9 + Xyp	42
<i>O. spinipes</i>	24s	11 + Xyp	42
<i>Onitis philemon</i>	20s	9 + Xyp	9; 39
<i>Chironitis furcifer</i>	20s	9 + Xy	20
<i>Canthon indigaceus</i>	—	8 + Xyp	32a
<i>Cathochilum hispidium</i>	—	8 + Xyp	32a
<i>C. histerodium</i>	—	8 + Xyp	32a
<i>C. oakleyi</i>	—	8 + Xyp	32a
<i>C. andyi</i>	—	8 + Xyp	32a
<i>Scarabaeus laticollis</i>	20s	9 + Xy	26
<i>S. sacer</i>	20s	9 + Xyp	20
<i>S. semipunctatus</i>	20s	9 + Xyp	20
<b>GLAPHYRINAE</b>			
<i>Lichnanthe rathvoni</i>	20s	9 + Xyp	32
<b>MELOLONTHINAE</b>			
<i>Serica sericea</i>	20s	9 + Xyp	23
<i>Serica sericea</i>	—	9 + Xyp	30

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<i>S. tristis</i>	20s	9 + Xyp	23
<i>S. falli</i>	—	9 + Xyp	32
<i>Aserica pilula</i>	—	9 + Xyp	37
<i>Aserica</i> <sup>7</sup> sp.	19s	9 + XO	37
<i>Autoserica</i> sp.	20s	9 + Xyp	9
<i>Autoserica</i> sp.	18s	8 + Xyp	6
Genus nr. <i>Autoserica</i> and <i>Neoserica</i>	20s	9 + Xyp	15
<i>Autoserica assamensis</i> <sup>8</sup>	30s	14 + Xy	5
<i>Diplotaxis</i> sp.	20s	9 + Xyp	24
<i>Diplotaxis obscura</i>	—	9 + Xyp	32
<i>D. sierrae</i>	—	9 + Xyp	32
<i>Phyllophaga anxia</i>	20s	—	32a
<i>P. drakii</i>	20s	—	30
<i>P. gracilis</i> <sup>9</sup>	20s	9 + Xy	22
	20o	—	22
<i>P. fusca</i> <sup>9</sup>	20s	9 + Xy	22
	20o	—	22
<i>P. delata</i> <sup>9</sup>	20s	9 + Xy	22
	20o	—	22
<i>P. tristis</i> <sup>9</sup>	20s	9 + Xy	22
	20o	—	22
<i>P. sp. crenulata</i> group	20o	—	24
<i>Ectinohoplia rufipes</i>	—	9 + Xyr	13
<i>Ophthalmoserica karafutoensis</i>	18s	9	13
<i>Hoplia communis</i>	—	10	13
<i>Schizonycha fuscescens</i>	20s	9 + Xyp	15
<i>S. ruficollis</i> <sup>10</sup>	20s	9 + Xyp	37
	22s	10 + Xyp	5
<i>Melolontha hippocastani</i>	—	9 + Xy	26
<i>Amphimallon solstitialis</i> <sup>11</sup>	20s	—	26
<i>Haplidia etrusca</i>	18s	8 + neoXY	20
<i>Apogonia nigricans</i> <sup>12</sup>	20s	9 + Xyp	10
	19s	9 + XO	15
<i>Apogonia</i> sp, nr. <i>nigricans</i>	19s	9 + XO	5
<i>A. unistraita</i>	20s	9 + Xy	14
<i>A. ferruginea</i>	19s	9 + XO	37
<i>Apogonia</i> sp.	21s	10 + XO	17; 18

<sup>7</sup>*Cephaloserica thompsoni* (Yadav & Pillai 1974).<sup>8</sup>*Autoserica assamensis* (ref. 5).<sup>9</sup>(*Lachnosterna*).<sup>10</sup>Linnaeus incorrectly cited as author (Yadav & Pillai 1974).<sup>11</sup>*Rhizotrogus solstitialis* (ref. 26).<sup>12</sup>Westwood incorrectly cited as author (ref. 10).

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<i>Apogonia</i> sp.	20s	9 + Xyp	14
<i>Holotricha serrata</i>	20s	9 + Xyp	37
<i>Holotricha longipennis</i> <sup>13</sup>	18s	8 + Xyp	7
<b>RUTELINAE</b>			
<i>Popillia japonica</i> <sup>14</sup>	18s	8 + Xy	43
<i>Mimela</i> sp.	20s	9 + Xyp	9
<i>Anomala rufocuprea</i>	18s	8 + Xy	43
	20s	10	13
<i>A. corpulenta</i>	18s	8 + Xy	43
<i>A. dorsalis</i>	20s	9 + Xyp	1; 2; 34
<i>A. bengalensis</i>	18s	8 + Xy	17; 18
<i>A. superflua</i>	20s	9 + Xyp	9
<i>A. polita</i> <sup>15</sup>	20s	9 + Xyp	34
<i>A. varicolor</i>	20s	9 + Xyp	34
<i>A. ruficapilla</i> <sup>16</sup>	20s	9 + Xyp	10; 34
<i>A. rufocuprea</i>	20s	10	13
<i>A. lucens</i>	20s	9 + Xyr	13
<i>A. cuprea</i>	20s	10	13
<i>A. vestigator</i>	20s	9 + Xyp	34
<i>Anomala</i> sp. <sup>17</sup>	20s	9 + Xyp	14
<i>Anomala</i> sp.	20s	9 + Xyp	10
<i>Anomala</i> sp.	20s	9 + Xyp	15
<i>Anomala</i> sp.	20s	9 + Xyp	7
<i>Peliodnota punctata</i> <sup>18</sup>	20s	9 + Xy	22
	20o	—	22
<i>Phyllopertha campestris</i> <sup>19</sup>	20s	9 + Xy	27
<i>Pocalta ursina</i>	20s	9 + Xy	30
<i>Cotalpa lanigera</i>	20s	9 + Xy	22
		9 + Xyp	30
	20o	—	22
<i>Adorrhinyptia</i> <sup>20</sup> sp.	16,18,20s	7,8,9 + Xyr	17; 18
<i>Adorrhinyptia dorsalis</i>	22s	10 + Xyp	35
<i>Adoretus limbatus</i>	22s	10 + Xyp	35
<i>A. incurvatus</i>	22s	10 + Xyp	35
<i>A. duvauceli</i>	22s	10 + Xyp	35
<i>A. lasiopygus</i>	22s	10 + Xyp	35

<sup>13</sup>*Holotricha longipennis* (ref. 7).<sup>14</sup>*Popillia* (Makino 1951); *Popillia* (ref. 20).<sup>15</sup>2n = 18, 8 + Xy (ref. 33a).<sup>16</sup>2n = 18, 8 + Xyp (ref. 33a); *A. ruficapilla* (ref. 10).<sup>17</sup>*Anomala* sp. near *bilobata* (ref. 14).<sup>18</sup>*Pelidonata* (ref. 14a).<sup>19</sup>*Blitopertha campestris* (ref. 27).<sup>20</sup>*Adorrhinyptia* (ref. 18; 37).

Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
<i>A. decanus</i>	—	10 + Xyp	35
<i>A. versutus</i> <sup>21</sup>	22s	10 + Xyp	10; 35
	—	11 + Xyp	3
<i>Adoretus</i> sp. (M-42)	—	10 + Xyp	35
<i>Adoretus</i> sp.	22s	10 + Xyp	9
<b>DYNASTINAE</b>			
<i>Oryctes nasicornis</i>	18s	8 + Xyp	26
		9 <sub>11</sub> + ss	28
<i>O. rhinoceros</i>	20s	9 + Xyp	5
<i>Ligyrodes relictus</i>	20s	9 + Xyp	32
<i>Orizabus cultripes</i>	—	8 + Xyp	32a
<i>Pentodon bispinifrons</i>	20s	9 + Xyp	9
<i>P. punctatus</i>	19s	9 + XO	19
<i>Pentodon</i> sp.	19s	9 + XO	9
<i>Eophileurus platypterus</i>	20s	9 + Xyp	38
<i>E. chinensis</i>	20s	10	13
<i>Phyllognathus dionysius</i>	20s	9 + Xyp	38
<i>P. silensis</i>	18s	8 + neoXY	20
<b>TRICHIINAE</b>			
<i>Trichius fasciatus</i> <sup>22</sup>	20s	9 + Xy	26; 27; 43
<i>T. zonatus</i>	—	9 + Xy	27
<i>T. succinctus</i>	20s	10	13
<i>Trichiotinus assimilis</i>	—	9 + Xyp	24; 30
<b>CETONIINAE</b>			
<i>Euphoria inda</i>	20s	9 + Xy	25
		9 + Xyp	24
<i>Potosia cuprea</i>	20s	9 + Xy	26; 27
<i>P. morio.</i>	—	9 + Xy	27
<i>Glycyphana fulvistemma</i>	20s	9 + Xy	43
<i>Cetonia aurata</i> <sup>22</sup>	20s	9 + Xy	26; 27
<i>Cetonia roelofsi</i>	20s	10	13
<i>Epicometis hirta</i>	20s	9 + Xy	26; 27
		9 + Xyp + ss	28
<i>E. squalida</i> Scop.	20s	9 + Xyp	20
<i>Oxythyrea funesta</i> <sup>22</sup>	20s	9 + Xy	26; 27
<i>Clinteria spilota</i>	20s	—	38
<i>Coenochilus trabecula</i>	—	9 + Xyp	38
<i>Cremastocheilus armatus</i>	20s	9 + Xyp	31; 32
<i>Rhomborrhina unicolor</i>	—	10	13
<i>R. polita</i>	—	10	13

<sup>21</sup>*A. verutus* (ref. 10).<sup>22</sup>The minute y chromosome was overlooked by Virkki (ref. 26).



Species with classification	Diploid number.	No. of autosomal bivalents and sex mechanism.	Reference
? SUBFAMILY			
<i>Allomyrina dichotoma</i>	—	9+Xyp	12

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#### LITERATURE NOTICES

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