A History of Mammal Research in Europe

2

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Contents

Abstract

A review is given on the historical development of mammal research in Europe. The term Mammalia was coined by Carolus Linnaeus in 1758 for animals bearing mammae. While he named 77 species, a current list counts 320+ species for Europe. Thirty-five journals specialized on mammals have been issued since 1926, about 22 of which are currently being published. Regional mammal congresses have been organized since 1926, European-wide ones since 1960. Mammal Societies have been founded in Germany (1926), The Netherlands (1952), the United Kingdom (1954), France (1954), Czechoslovakia (1958), Italy (1983), Lithuania (1989), Russia (1992), Ukraine (1993), and Spain (2000), among others. Local faunas and handbooks have been published in many different countries over the last 250 years, culminating in the present *Handbook of the Mammals of Europe* and in the *Handbook of the Mammals of the World*.

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Keywords

Mammal research · History · Theriology · Taxonomy · Nomenclature · Europe

Introduction

Mammalogy is a branch of zoology dealing with mammals. The term blends Mammalia (i.e., mammals) and -logy (from Ancient Greek logos: a principle of knowledge, a reason, or a study). The hairy animals with a chain of three bones in the middle ear, a single bone in the lower jaw which articulates with the squamosal bone, the left aortic arch of the fourth pharyngeal arch, and with cheek-teeth bearing several roots, were known to early naturalists as Theria (from therion, Greek for a wild beast) or Quadrupedia (a combination from quadri, to mean four, and pes for hand, both Latin; i.e., quadrupeds or four-handed). The term Mammalia was coined by Linnaeus in the 10th edition of Systema Naturae (1758), to denote "these and no other animals [which] have mammae [mammata]" (Schiebinger 1993). Mamma (plural is mammae) is a Latin term designating the milk-secreting organs of females and translates either as breast or teat. The term mammalogy (also mammology) therefore literally means "a study of breasts/teats" and not of breast-bearing animals (Schiebinger 1993). The term mastology, which is in use in the Portuguese-speaking World (e.g., Brazil), has identical connotations, meaning a study of mammary glands. Another term was coined by Pallas (1811), a Russian naturalist of German origin, namely, Lactantia (i.e., alluding to breast-feeding).

Mammalogy explores every aspect of structure, function, and natural history of mammals and incorporates diverse aspects of management of wild populations. Usually, mammalogy focuses on free-living mammals, both extant and fossil, but leaves domesticated forms to veterinary medicine and animal husbandry. Scientists who study mammals may be primarily interested in them per se or may utilize these animals as models to understand more general biological principles. Depending on this, students of mammals can identify themselves as mammalogists, or as ecologists, population biologist, behavioral scientists, physiologists, conservationists, morphologists, wildlife managers, paleontologists, evolutionary biologists, and so forth. In consequence, one can trace scientific papers dealing with mammals in a broad spectrum of periodicals, starting from journals which specialize on mammals, to periodicals covering nearly any field of biology.

The diversity and complexity pose problems also to students of the history of mammalogy. We therefore restricted ourselves to the activities focusing on delimitation of mammalian species and documenting mammal faunas. In its narrow sense, these are the fields of taxonomy and zoological nomenclature. These two fields together with descriptive morphology and rudimentary zoogeography formed the beginnings of modern mammalogy.

Europe as a Starting Point

The formal establishment of zoological nomenclature by the Swede Carolus Linnaeus (1707–1778) can be regarded as the starting point of systematic mammal research in Europe (Linnaeus 1758). His work, however, was based on numerous earlier publications by uncounted authors, such as Gessner and Forer (1563), which are not further treated here. Linnaeus named 77 European mammal species (see Table 1), most of which are still valid. The study of mammal taxonomy continues until today. Reasons are the changing techniques such as the study of chromosomes and DNA sequences which allow deeper insight into the speciation process, in different views on delimitation of species, but also the study of the last remaining unexplored spaces in Europe.

Most early researchers dealing with mammals came from Europe. The term mammalogy was introduced (as French mammologie) by a French zoologist Anselme-Gaëtan Desmarest (1784–1838) in 1820. In comparison with ornithology, which was in usage already in the sixteenth century, the term mammalogy emerged relatively late and was also hesitantly applied during the nineteenth century when ornithology was already widely used. In the early twentieth century, mammalogy was still only occasionally used in French

Table 1 Preliminary list of recognized mammal species known to occur in Europe as defined by Hackländer and Zachos (this volume) with authors, year, and source. Note that this list is not identical with the eventual list of species chapters in this handbook.

Primates
Macaca sylvanus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:25
Homo sapiens Linnaeus, 1758. Syst. Nat., 10th ed. 1:20
Lagomorpha
Lepus capensis Linnaeus, 1758. Syst. Nat., 10th ed. 1:58
Lepus castroviejoi Palacios, 1977. Donana, Acta Vertebrata 1976, 3(2):205
Lepus corsicanus de Winton, 1898. Ann. Mag. Nat. Hist. ser. 7, 1:155
Lepus europaeus Pallas, 1778. Nova. Spec. Quad. Glir. Ord. p. 30
Lepus granatensis Rosenhauer, 1856. Die Thiere Andalusiens 3
Lepus timidus Linnaeus, 1758. Syst. Nat., 10th ed. 1:57
Oryctolagus cuniculus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:58
Sylvilagus floridanus (J. A. Allen, 1890). Bull. Amer. Mus. Nat. Hist. 3:159
Soricomorpha/Eulipotyphla
Atelerix algirus (Lereboullet, 1842). Mem. Soc. Hist. Nat. Strasbourg, 3(2), art. QQ:4
Erinaceus concolor Martin, 1838. Proc. Zool. Soc. London 1837:103(1838)
Erinaceus europaeus Linnaeus, 1758. Syst. Nat., 10th ed. 1:52
Erinaceus roumanicus Barrett-Hamilton, 1900. Ann. Mag. Nat. Hist. ser. 7, 5:365
Hemiechinus auritus (Gmelin, 1770). Nova Comm. Acad. Sci. Petropoli 14:519
Crocidura canariensis Hutterer, López-Jurado & Vogel, 1987. J. Nat. Hist. 21:1354
Crocidura gueldenstaedtii (Pallas, 1811). Zoogr. Rosso-Asiat. 1:132
Crocidura leucodon (Hermann, 1780). In Zimmermann, Geogr. Gesch. Mensch. Vierf. Thiere 2:382
Crocidura pachyura (Küster, H.C., 1835). Isis von Oken 28:77[75–78]
Crocidura russula (Hermann, 1780). In Zimmermann, Geogr. Gesch. Mensch. Vierf. Thiere 2:382
Crocidura sicula Miller, 1900. Proc. Biol. Soc. Wash. 14:41
Crocidura suaveolens (Pallas, 1811). Zoogr. Rosso-Asiat. 1:133
Crocidura zimmermanni Wettstein, 1953. Z. Säugetierk. 17:21
Diplomesodon pulchellum Lichtenstein, 1823. Eversmann, Reise von Orenburg nach Buchara, p. 124
Suncus etruscus (Savi, 1822). Nuovo Giorn. De Letterati, Pisa 1:60
Neomys anomalus Cabrera, 1907. Ann. Mag. Nat. Hist. ser. 7,20:214
Neomys milleri Mottaz, 1907. Mém. Soc. Zool. France 20:22
Neomys fodiens (Pennant, 1771). Synopsis Quadrupeds p. 308
Neomys teres Miller, 1908. Ann. Mag. nat. Hist. 1:68
Sorex alpinus Schinz, 1837. Neue Denkschr. Allgem. Schweiz. Gesell. Naturwiss. Neuchatel 1:13
Sorex antinorii Bonaparte, 1840. Iconogr. Faun. Ital. 1:29
Sorex araneus Linnaeus, 1758. Syst. Nat., 10th ed. 1:53
Sorex averini Zubko, 1937. Kharkov A. Gorsky-State Univ., Proc. Zool.-Bot. Inst. 4:300
Sorex caecutiens Laxmann, 1788. Nova Acta Acad. Sci. Petropoli 1785, 3:285 (1788)
Sorex coronatus Millet, 1828. Fauna de Main-et-Loire I, p. 18
Sorex granarius Miller, 1910. Ann. Mag. Nat. Hist. ser. 8,6:458
Sorex isodon Turov, 1924. C. R. Acad. Asci. Paris, p. 111
Sorex minutus Linnaeus, 1766. Syst. Nat. 12th ed. 1:73
Sorex minutissimus Zimmermann, 1780. Geogr. Gesch. 2:385
Sorex raddei Satunin, 1895. Arch. Naturgesch. 1:109
Sorex samniticus Altobello, 1926. Bol. Inst. Zool. Univ. Roma 3:102
Sorex satunini Ognev, 1922. Ann. Mus. Zool. Acad. St. Pétersb. 22:331
Sorex tundrensis Merriam, 1900. Proc. Wash. Acad. Sci., 2: 16
Sorex volnuchini Ognev, 1922. Ann. Mus. Zool. Acad. St. Pétersb. 22:322

(continued)

Table 1 (continued)

Desmana moschata (Linnaeus, 1758). Syst. Nat., 10th ed. 1:59
Galemys pyrenaicus (E. Geoffroy St. Hilaire, 1811). Ann. Mus. Hist. Nat. Paris 17:193
Talpa aquitania Nicolas, Martínez-Vargas & Hugot, 2017. Mammalia 81:641
Talpa caeca Savi, 1822. Nuovo Giorn. de Letterati Pisa 1:265
Talpa caucasica Satunin, 1908. Mitt. Kaukasus Museum 4:5
Talpa europaea Linnaeus, 1758. Syst. Nat., 10th ed. 1:52
Talpa levantis Thomas, 1906. Ann. Mag. Nat. Hist. ser. 17:416
Talpa martinorum Kryštufek, Nedyalkov, Astrin & Hutterer, 2018. Bonn. zool. Bulletin 67:45
Talpa occidentalis Cabrera, 1907. Ann. Mag. Nat. Hist. ser. 7, 20:212
Talpa romana Thomas, 1902. Ann. Mag. Nat. Hist. ser. 7, 10:516
Talpa stankovici V. Martino & E. Martino, 1931. J. Mammal. 12:53
Chiroptera
Rousettus aegyptiacus (E. Geoffroy, 1810). Ann. Mus. Natn. Hist. Nat. Paris 15:96
Rhinolophus blasii Peters, 1867. Monatsber. K. Preuss. Akad. Wiss. Berlin 1866:17
Rhinolophus euryale Blasius, 1853. Arch. Naturgesch. 19(1):49
Rhinolophus ferrumequinum (Schreber, 1774). Die Säugethiere 1:174, pl.62
Rhinolophus hipposideros (Bechstein, 1800). In Pennant, Allgemeine Uebersicht Vierfüss. Thiere 2:629
Rhinolophus mehelyi Matschie, 1901. S.B. Ges. Naturf. Berlin, p. 225
Tadarida teniotis (Rafinesque, 1814). Précis. Som., p. 12
Eptesicus bottae Peters, 1869. Monatsber. K. Preuss. Akad. Wiss. Berlin 1869:406
Eptesicus anatolicus Felten, 1971. Senckenbergiana biol. 52:371
Eptesicus isabellinus (Temminck, 1840). Monogr. Mammalogie 2:205, pl. 52, f.1,2
Eptesicus nilssoni (Keyserling & Blasius, 1839). Arch. Naturgesch. 5(1):315
Eptesicus serotinus (Schreber, 1774). Die Säugethiere 1:167
Nyctalus azoreum (Thomas, 1901). Ann. Mag. Nat. Hist. ser. 7, 8:34
Nyctalus lasiopterus (Schreber, 1780). In Zimmermann, Geogr. Gesch. Mensch. Vierf. Thiere 2:412
Nyctalus leisleri (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14, 46
Nyctalus noctula (Schreber, 1774). Die Säugethiere 1:166
Pipistrellus hanaki Hulva & Benda, 2004. Acta Chiropterlogica 6:193–217
Pipistrellus kuhlii (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14
Pipistrellus maderensis (Dobson, 1878). Cat. Chiroptera Brit. Museum: 231
Pipistrellus nathusii (Keyserling & Blasius, 1839). Arch. Naturgesch. 5(1):320
Pipistrellus pipistrellus (Schreber, 1774). Die Säugethiere 1:167
Pipistrellus pygmaeus (Leach, 1825). Zool. J. 1:559
Barbastella barbastellus (Schreber, 1774). Die Säugethiere 1:168
Plecotus auritus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:32
Plecotus austriacus (J. Fischer, 1829). Synopsis Mamm. p. 117
Plecotus begognae de Paz, 1994. Mammalia 58:423–432
Plecotus kolombatovici Đulić, 1980. Proc. 5th Internat. Bat. Res. Conf. (Wilson D E & Gardner A L eds), Texas Tech Press p. 159
Plecotus sardus Mucedda, Kiefer, Pidinchedda & Veith, 2002. Acta Chiropterol. 4:123
Plecotus teneriffae Barrett-Hamilton, 1907. Ann. Mag. Nat. Hist. ser. 7, 20: 520
Plecotus macrobullaris Kuzjakin, 1965. In Bobrinskij, Kuznetsov & Kuzyakin (Eds) Opredelitel mljeko-pitayushtshikh SSSR (p. 99). Moskva: Izd. Prosveshtshenije
Hypsugo savii (Bonaparte, 1837). Fauna Ital. 1, fasc. 20
Vespertilio murinus Linnaeus, 1758. Syst. Nat., 10th ed. 1:31
Myotis alcathoe Helversen & Heller, 2001. Naturwissenschaften 88:217
Myotis bechsteinii (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14, 30
Myotis brandtii (Eversmann, 1845). Bull. Soc. Nat. Moscow 18(1):505

(continued)

Table 1 (continued)

Myotis capaccinii (Bonaparte, 1837). Fauna Ital., 1 fasc. 20
Myotis crypticus Ruedi, Ibánez, Salicini, Juste & Puechmaille, 2019. Acta Chiropterol. 20:291
Myotis dasycneme (Boie, 1825). Isis Jena, p. 1200
Myotis daubentonii (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14
Myotis davidii (Peters, 1869). Mber. Preuss. Akad. Wiss. 1869:402
Myotis emarginatus (E. Geoffroy, 1806). Ann. Mus. Natn. Hist. Nat. Paris 8:198
Myotis escalerai Cabrera, 1904. Mem. Soc. Esp. Hist. Nat. 2(5):249–286
Myotis myotis (Borkhausen, 1797). Deutsche Fauna 1:80
Myotis mystacinus (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 15
Myotis nattereri (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14, 33
Myotis blythii (Tomes, 1857). Proc. Zool. Soc. 1857:53
Myotis punicus Felten, 1977. Senckenb. Biol. 58:1–44
Miniopterus schreibersii (Kuhl, 1817). Die Deutschen Fledermäuse, Hanau p. 14
Carnivora
Felis silvestris Schreber, 1777. Die Säugethiere 3(23):397
Lynx lynx (Linnaeus, 1758). Syst. Nat., 10th ed. 1:43
Lynx pardinus Temminck, 1827. Monogr. Mamm. 1:116
Genetta genetta (Linnaeus, 1758). Syst. Nat., 10th ed. 1:45
Herpestes ichneumon (Linnaeus, 1758). Syst. Nat., 10th ed. 1:43
Urva auropunctatus (Hodgson, 1836). J. Asiat. Soc. Bengal 5:235
Canis aureus Linnaeus, 1758. Syst. Nat., 10th ed. 1:40
Canis lupus Linnaeus, 1758. Syst. Nat., 10th ed. 1:39
Nyctereutes procyonoides (Gray, 1834). Illustr. Indian Zool. 2: pl.1
Vulpes lagopus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:40
Vulpes vulpes (Linnaeus, 1758). Syst. Nat., 10th ed. 1:40
Ursus arctos Linnaeus, 1758. Syst. Nat., 10th ed. 1:47
Ursus maritimus Phipps, 1774. Voyage Towards North Pole, p. 185
Odobenus rosmarus Linnaeus, 1758). Syst. Nat., 10th ed. 1:38
Cystophora cristata (Erxleben, 1777). Syst. Regni Anim. 1:590
Erignathus barbatus (Erxleben, 1777). Syst. Regni Anim. 1:590
Halichoerus gryphus (Fabricius, 1791). Skr. Nat. Selsk. Copenhagen 1(2):167
Monachus monachus (Hermann, 1779). Beschaft. Berlin Ges. Naturforsch. Fr. 4: 501, pls.12,13
Pagophilus groenlandicus (Erxleben, 1777). Syst. Regni Anim. 1:588
Phoca vitulina Linnaeus, 1758. Syst. Nat., 10th ed. 1:38
Pusa hispida (Schreber, 1775). Die Säugethiere 2(13): pl.86 (1775), text 3(17):312 (1776)
Pusa caspica (Gmelin, 1788). Syst. Nat., 13th ed. 1:64
Lutra lutra (Linnaeus, 1758). Syst. Nat., 10th ed. 1:45
Gulo gulo (Linnaeus, 1758). Syst. Nat., 10th ed. 1:45
Martes foina (Erxleben, 1777). Syst. Regni Anim. 1:458
Martes martes (Linnaeus, 1758). Syst. Nat., 10th ed. 1:46
Meles meles (Linnaeus, 1758). Syst. Nat., 10th ed. 1:48
Mustela erminea Linnaeus, 1758. Syst. Nat., 10th ed. 1:46
Mustela eversmannii Lesson, 1827. Manuel de Mammalogie p. 144
Mustela lutreola (Linnaeus, 1761). Fauna Suecica, 2nd ed., p. 5
Mustela nivalis Linnaeus, 1766. Syst. Nat., 12th ed. 1:69
Mustela putorius Linnaeus, 1758. Syst. Nat., 10th ed. 1:46
Neovison vison (Schreber, 1777). Die Säugethiere 3(19): pl.127B (1777), text 3(26):463 (1777)
Vormela peregusna (Güldenstädt, 1770). Nova Comm. Imp. Acad. Sci. Petropoli 14(1):441
Procyon lotor (Linnaeus, 1758). Syst. Nat., 10th ed. 1:48

(continued)

Table 1 (continued)

Nasua nasua (Linnaeus, 1766). Syst. Nat., 12th ed. 1:64
Terrestrial Cetartiodactyla
Sus scrofa Linnaeus, 1758. Syst. Nat., 10th ed. 1:49
Alces alces (Linnaeus, 1758). Syst. Nat., 10th ed. 1:66
Capreolus capreolus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:68
Capreolus pygargus (Pallas, 1771). Reise Prov. Russ. Reichs 1:453
Odocoileus virginianus (Zimmermann, 1780). Geogra. Gesch. Mensch. Vierf. Thiere 2:129
Rangifer tarandus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:67
Axis axis (Erxleben, 1777). Syst. Regn. Anim. 1:312
Cervus elaphus Linnaeus, 1758. Syst. Nat., 10th ed. 1:67
Cervus nippon Temminck, 1838. In von Siebold, Temminck & Schlegel, Fauna Japonica, Coup d'Oeil Faune Iles Sonde Emp. Japan, p. xxii
Dama dama (Linnaeus, 1758). Syst. Nat., 10th ed. 1:67
Hydropotes inermis Swinhoe, 1870. Athenaeum 2208:264
Muntiacus reevesi (Ogilby, 1839). Proc. zool. Soc. 1838:105
Bison bonasus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:71
Capra aegagrus Erxleben, 1777. Syst. Regn. Anim. 1:260
Capra hircus Linnaeus, 1758. Syst. Nat., 10th ed. 1:68
Capra ibex Linnaeus, 1758. Syst. Nat., 10th ed. 1:68
Capra pyrenaica Schinz, 1838. N. Denkschr. Schweiz. Ges. Natur. Wiss. 2:9
Capra caucasica Güldenstaedt et Pallas, 1783. Acta Acad. Sci. Petropoli, for 1779, 2:275
Ovibos moschatus (Zimmermann, 1780). Geogr. Gesch. Mensch. Vierf. Thiere 2:86
Ovis gmelini Blyth, 1841. Proc. Zool. Soc., 1840:69
Rupicapra carpatica Coutourier, 1938. Le Chamois: 369
Rupicapra ornata Neumann, 1899. Ann. Mus. Stor. Nat. Genova 20:347
Rupicapra parva Cabrera, 1911. Proc. Zool. Soc. 1910:999
Rupicapra pyrenaica Bonaparte, 1845. Cat. Meth. Mamm. Europe p. 17
Rupicapra rupicapra (Linnaeus, 1758). Syst. Nat., 10th ed. 1:68
Ammotragus lervia (Pallas, 1777). Spicilegia Zool. 12:12
Cetacea
Balaena mysticetus Linnaeus, 1758. Syst. Nat., 10th ed. 1:75
Eubalaena glacialis (Müller, 1776). Zool. Danicae Prodr. p. 7
Balaenoptera acutorostrata Lacépède, 1804. Hist. Nat. Cetacees p. 134
Balaenoptera bonaerensis Burmeister, 1867. Actas Soc. Paleo., Buenos Aires: 24
Balaenoptera borealis Lesson, 1828. Hist. Nat. Gen. Part. Mamm. Oiseaux 1:342
Balaenoptera edeni Anderson, 1879. Anat. Zool. Res., Yunnan:551, pl.44
Balaenoptera musculus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:76
Balaenoptera physalus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:75
Megaptera novaeangliae (Borowski, 1781). Gemein. Naturgesch. Thier. 2(1):21
Eschrichtius robustus (Lilljeborg, 1861). Forh. Skand. Naturf. Ottende Mode, Kopenhagen 1860, 8:602 (1861)
Delphinus delphis Linnaeus, 1758. Syst. Nat., 10th ed. 1:77
Feresa attenuata Gray, 1874. Ann. Mag. Nat. Hist. ser. 4, 14:238–239
Peponocephala electra Gray, 1846. Zoology of the voyage of H.M.S. Erebus and Terror, 1(Mammalia):48, pl.1, fig. 1, p. 35, pl.13
Globicephala macrorhynchus Gray, 1846. Zool. Voy. H.M.S. "Erebis" and "Terror" 1:33
Globicephala melas (Traill, 1809). Nicholson's J. Nat. Philos. Chem. Arts 22:81
Grampus griseus (G. Cuvier, 1812). Ann. Mus. Hist. Nat. Paris 19:13
Lagenodelphis hosei Fraser, 1956. Sarawak Mus. J., n.s. 8(7):496
Lagenorhynchus acutus (Gray, 1828). Spicil. Zool. 1:2

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Table 1 (continued)

Lagenorhynchus albirostris (Gray, 1846). Ann. Mag. Nat. Hist. ser. 1, 17:84
Orcinus orca (Linnaeus, 1758). Syst. Nat., 10th ed. 1:77
Pseudorca crassidens (Owen, 1846). Hist. Brit. Foss. Mamm. Birds p. 516, fig. 213
Sousa plumbea (G. Cuvier, 1829). Règne Anim. 1:288
Stenella clymene Gray, 1846. Zool. Voy. H.M.S. "Erebis" and "Terror" 1:39
Stenella coeruleoalba (Meyen, 1833). Nova Acta Acad. Caes. Nat. Curios. 16(2):609, pl.43
Stenella frontalis (G. Cuvier, 1829). Règne Anim. 1:288
Stenella longirostris (Gray, 1828). Spicil. Zool. 1:1
Steno bredanensis (G. Cuvier in Lesson, 1828). Hist. Nat. Gen. Part. Mamm. Oiseaux 1:206
Tursiops truncatus (Montagu, 1821). Mem. Wernerian Nat. Hist. Soc. 3:75, pl.3
Delphinapterus leucas (Pallas, 1776). Reise Prov. Russ. Reichs 3(1):85 (footnote)
Monodon monoceros Linnaeus, 1758. Syst. Nat., 10th ed. 1:75
Phocoena phocoena (Linnaeus, 1758). Syst. Nat., 10th ed. 1:77
Kogia breviceps (Blainville, 1838). Ann. fr. étrang. Anat. Physiol. 2:335–337
Kogia sima (Owen, 1866). Trans. Zool. Soc. London 6(1):30, pls.10–14
Physeter macrocephalus Linnaeus, 1758. Syst. Nat., 10th ed. 1:76
Hyperoodon ampullatus (Forster, 1770). In Kalm, Travels into N. Amer. 1:18
Mesoplodon bidens (Sowerby, 1804). Trans. Linn. Soc. Lond. 7:310
Mesoplodon densirostris (Blainville, 1817). Nouv. Dict. Hist. Nat., Nouv. Ed. 9:178
Mesoplodon europaeus (Gervais, 1855). Hist. Nat. Mammifères 2:320
Mesoplodon grayi Von Haast, 1876. Proc. Zool.Soc. Lond. 1876:9
Mesoplodon mirus True, 1913. Smithsonian Miscell. Collection 60(25):1
Ziphius cavirostris G. Cuvier, 1823. Rech. Oss. Foss., Nouv. Ed. 5(1):350
Rodentia
Sciurus anomalus Gmelin, 1778. In Linnaeus, Syst. Nat., 13th ed. 1:148
Sciurus carolinensis Gmelin, 1778. In Linnaeus, Syst. Nat., 13th ed. 1:148
Sciurus vulgaris Linnaeus, 1758. Syst. Nat., 10th ed. 1:63
Callosciurus erythraeus (Pallas, 1779). Nov. Sp. Quad. Gli. Ord.:377
Callosciurus finlaysonii (Horsefield, 1823). Zool. Res. Java 7:151
Atlantoxerus getulus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:64
Marmota bobak (Müller, 1776). Linné's Vollständ. Natursyst. Suppl. p. 40
Marmota marmota (Linnaeus, 1758). Syst. Nat., 10th ed. 1:60
Spermophilus citellus (Linnaeus, 1766). Syst. Nat., 12th ed. 1:80
Spermophilus fulvus (Lichtenstein, 1823). In Eversmann, Reise von Orenburg nach Buchara p. 119
Spermophilus major (Pallas, 1779). Nova Spec. Quad. Glir. Ord. p. 125
Spermophilus pygmaeus (Pallas, 1778). Nova Spec. Quad. Glir. Ord. p. 122
Spermophilus suslicus (Güldenstaedt, 1770). Nova Comm. Acad. Sci. Petropoli 14:389
Eutamias sibiricus (Laxmann, 1769). Sibirische Briefe, Göttingen p. 69
Tamias striatus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:64
Dryomys nitedula (Pallas, 1778). Nova Spec. Quad. Glir. Ord. p. 88
Eliomys quercinus (Linnaeus, 1766). Syst. Nat., 12th ed. 1:84
Muscardinus avellanarius (Linnaeus, 1758). Syst. Nat., 10th ed. 1:62
Myomimus roachi (Bate, 1937). Ann. Mag. Nat. Hist. ser. 10, 20:399
Glis glis (Linnaeus, 1766). Syst. Nat., 12th ed. 1(1):87
Castor canadensis Kuhl, 1820. Beitr. Zool. Vergl. Anat. 1:64
Castor fiber Linnaeus, 1758. Syst. Nat., 10th ed. 1:58
Allactaga major (Kerr, 1792). Anim. Kingd.:274
Dipus sagitta (Pallas, 1773). Reise 2:706
Stylodipus telum (Lichtenstein, 1823). In Eversmanns Reise:120

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Table 1 (continued)

Pygeretmus pumilio (Kerr, 1792). Anim. Kingd.:275
Scarturus elater (Lichtenstein, 1828). Abh. k. Akad. Wiss. Berlin:155
Sicista betulina (Pallas, 1779). Nova Spec. Quadr. Glir. Ord. p. 332
Sicista caucasica Vinogradov, 1925. Proc. zool. Soc.:548
Sicista kazbegica Sokolov, Baskevich & Kovalskaya, 1986. Zool. Zh., 65(6):949
Sicista kluchorica Sokolov, Kovalskaya & Baskevich, 1980. Gryzuny Severnovo Kavkaza:38
Sicista nordmanni (Keyserling and Blasius, 1840). Wirbelth. Europas:38
Sicista severzovi Ognev, 1935. Byulletin Nauchno-issled. Inst. Zool. Mosk. 2: 54
Sicista strandi (Formozov, 1931). Folia Zool. Hydrob. Riga 3:79.
Sicista subtilis (Pallas, 1773). Reise Prov. Russ. Reichs. 1(2):705
Sicista trizona (Frivaldszky, 1865). Termeszetrajzi Ftizetek, 5:103
Nannospalax leucodon (Nordmann, 1840). Demidoff Voy. 3:34
Nannospalax xanthodon (Nordmann, 1840). Demidoff Voy. 3:35
Spalax antiquus Mehely, 1909. A Földi Kutyák Fajai Budap.:175
Spalax arenarius Reshetnik, 1939. Reports Zool. Mus. Kiev 23:11
Spalax giganteus Nehring, 1898. Sitzber. Ges. Naturf. Frde Berlin p. 169
Spalax graecus Nehring, 1898. Zool. Anz. 21:479–481
Spalax istricus Mehely, 1909. A Földi Kutyák Fajai Budap.:186
Spalax microphthalmus Güldenstaedt, 1770. Nova Comm. Acad. Sci. Petropoli 14:1
Spalax zemni (Erxleben, 1777). Syst. Regni Anim. 1:370–371
Prometheomys schaposchnikowi Satunin, 1901. Zool. Anz. 24:574
Arvicola amphibius (Linnaeus, 1758). Syst. Nat., 10th ed. 1:61
Arvicola sapidus Miller, 1908. Ann. Mag. Nat. Hist. ser. 8, 1:195
Arvicola italicus Savi, 1839. Nuovo Giorn. de Lett., Pisa 37, 102:202
Chionomys gud (Satunin, 1909). Izv. Kaukas. Mus. 4:272
Chionomys nivalis (Martins, 1842). Rev. Zool. Paris p. 331
Chionomys roberti (Thomas, 1906). Ann. Mag. Nat. Hist. 17:418
Craseomys rufocanus (Sundevall, 1846). Ofv. K. Svenska Vet.-Akad. Forhandl. Stockholm 3:122
Dicrostonyx torquatus (Pallas, 1778). Nov. Spec. Quad. Gli. Ord.:77
Dinaromys bogdanovi (V. Martino & E. Martino, 1922). Ann. Mag. Nat. Hist. ser. 9, 9:413
Ellobius talpinus (Pallas, 1770). Nova Comm. Acad. Sci. Petropoli 14, 1:568
Lagurus lagurus (Pallas, 1773). Reise Prov. Russ. Reichs. 2:704
Lemmus lemmus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:59
Lemmus sibiricus (Kerr, 1792). Anim. Kingd.:241
Alexandromys middendorfii (Poljakov, 1881). Mem. Imp. Acad. Sci. St. Petersb. 39: appendix 2:70
Alexandromys oeconomus (Pallas, 1776). Reise Prov. Russ. Reichs. 3:693
Microtus agrestis (Linnaeus, 1761). Fauna Suecica, 2nd ed. p. 11
Microtus levernedii (Crespon, 1844). Faune Meridionale, 1:73
Microtus rozanius (Bocage, 1865). Mem. Ac. Real. Sci. de Lisboa, 3,2:7
Microtus arvalis (Pallas, 1778). Nova Spec. Quadr. Glir. Ord. p. 78
Microtus brachycercus (Lehmann, 1961). Zool. Anz. 167:223
Microtus cabrerae (Thomas, 1906). Ann. Mag. Nat. Hist. ser. 7, 17:576
Microtus daghestanicus (Shidlovsky, 1919). Tiflis Bull. Terr. Exper. Stat. 2:22
Microtus duodecimcostatus (Selys-Longchamps, 1839). Rev. Zool. Paris p. 8
Microtus felteni Malec & Storch, 1963. Senckenbergiana biol. 44:171
Microtus gerbei (Gerbe, 1879). Le Naturaliste 1:51
Microtus hartingi (Barrett-Hamilton, 1903). Ann. Mag. Nat. Hist. 11:307
Microtus levis Miller, 1908. Ann. Mag. Nat. Hist. ser. 8, 1:197
Microtus liechtensteini Wettstein, 1927. Anz. Akad. Wiss., Wien 20:2
Microtus lusitanicus (Gerbe, 1879). Rev. Mag. Zool. Paris ser. 3, 7:44

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Table 1 (continued)

Microtus majori Thomas, 1906. Ann. Mag. Nat. Hist., ser. 7, 17:419
Microtus multiplex (Fatio, 1905). Arch. Sci. Phys. Nat. Geneve, ser. 4, 19:193
Microtus nebrodensis (Mina-Palumbo, 1868). Ann. Agric. Sicil. 12:61
Microtus savii (de Selys-Longchamps, 1838). Rev. Zool. Paris p. 248
Microtus socialis (Pallas, 1773). Reise Prov. Russ. Reichs. 2:705
Microtus subterraneus (de Selys-Longchamps, 1836). Essai Monogr. sur les Campagnols des Env. de Liege, p. 10
Microtus tatricus (Kratochvíl, 1952). Acta Acad. Sci. Nat. Moravo-Siles. 24:155–194
Microtus thomasi (Barrett-Hamilton, 1903). Ann. Mag. Nat. Hist., Ser. 7, 11:306
Stenocranius gregalis (Pallas, 1779). Nov. Spec. Quad. Gli. Ord.:238
Clethrionomys glareolus (Schreber, 1780). Die Säugethiere 4: 680. See Kryštufek et al. (2019)
Clethrionomys rutilus (Pallas, 1779). Nova Spec. Quadr. Glir. Ord., p. 246
Myopus schisticolor (Lilljeborg, 1844). Ofv. K. Svenska Vet.-Akad. Forhandl. Stockholm I:33
Ondatra zibethicus (Linnaeus, 1766). Syst. Nat., 12th ed. 1:79
Allocricetulus eversmanni (Brandt, 1859). Mel. Biol. Acad. St. Pétersb.:210
Cricetus cricetus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:60
Mesocricetus brandti (Nehring, 1898). Zool.Anz. 21:331
Mesocricetus newtoni (Nehring, 1898). Zool. Anz. 21:329
Notocricetulus migratorius (Pallas, 1773). Reise Prov. Russ. Reichs. 2:703
Acomys cahirinus (É. Geoffroy, 1803). Cat. Mam. Mus. Natl. Hist. Nat., Paris:195
Apodemus agrarius (Pallas, 1771). Reise Prov. Russ. Reichs. 1:454
Apodemus alpicola Heinrich, 1952. J. Mammal. 33:260
Apodemus epimelas (Nehring, 1902). Sitz. Ber. Ges. Naturf. Fr. Berlin 1902:2
Apodemus flavicollis (Melchior, 1834). Dansk. Staat. Norg. Pattedyr, p. 99
Apodemus mystacinus (Danford & Alston, 1877). Proc. Zool. Soc. Lond. 1877:279
Apodemus sylvaticus (Linnaeus, 1758). Syst. Nat., 10th ed. 1:62
Apodemus uralensis (Pallas, 1811). Zoogr. Rosso-Asiat. 1:168
Apodemus witherbyi (Thomas, 1902). Ann. Mag. Nat. Hist., ser. 7, 10:490
Micromys minutus (Pallas, 1771). Reise Prov. Russ. Reichs. 1:454
Mus cypriacus Cucchi, Orth, Auffray, Renaud, Fabre, Catalan, Hadjisterkotis, Bonhomme, Vigne, 2006. Zootaxa 1241:1–36
Mus macedonicus Petrov & Ruzic, 1983. Proc. Fauna SR Serbia, Serbian Acad. Sci. and Arts, Belgrade 2:177
Mus musculus Linnaeus, 1758. Syst. Nat., 10th ed. 1:62
Mus spicilegus Petényi, 1882. Termeszetrajzi Fuzetek, Budapest 5:114
Mus spretus Lataste, 1883. Actes Soc. Linn. de Bordeaux, ser. 7, 4:27
Rattus norvegicus (Berkenhout, 1769). Outlines Nat. Hist. Great Britain and Ireland, 1:5
Rattus rattus (Linnaeus, 1758). Syst. Nat., 10th ed., 1:61
Meriones meridianus (Pallas, 1773). Reise Russ. Reichs 2:702
Meriones tamariscinus (Pallas, 1773). Reise Russ. Reichs 2:702
Meriones tristrami Thomas, 1892. Ann. Mag. Nat. Hist. 9:148
Hystrix cristata (Linnaeus, 1758). Syst. Nat., 10th ed., 1:56
Myocastor coypus (Molina, 1782). Sagg. Stor. Nat. Chile, p. 287
Diprotodontia
Macropus rufogriseus (Desmarest, 1817). Nouv. Dict. Hist. Nat., Nouv. Ed. 17:36

(e.g., Trouessart 1910) and English (e.g., Barrett-Hamilton 1913). At about that time (1919), the American Society of Mammalogists was founded along with the quarterly *Journal of Mammalogy* (Hoffmeister and Sterling 1994).

The first professional mammal society in Europe was founded in 1926 as Deutsche Gesellschaft für Säugetierkunde (German Society for Mammalian Biology) with its journal *Zeitschrift für Säugetierkunde* (since 2001 *Mammalian Biology*).

Mammals have been translated to German as Säugetiere (literary sucking animals) and the science devoted to their study received a name Säugetierkunde (Kunde is German for science). In 1936 the Natural History Museum in Paris started publishing the periodical *Mammalia* (now published by de Gruyter). In 1954 the Mammal Society was founded in the UK, with a periodical *Mammal Review* starting in 1970. Mammalogy has been avoided in all these attempts. The first professional mammal society in Europe to adopt the name mammalogy was seemingly the Mammalogical Section of the Natural History Society at the National Museum in Prague in 1958 (In Czech: *Mammaliologické sekce Přírodovědeckého sboru Společnosti Národního Musea*), together with the periodical of a similarly long name in 1959 (*Mammaliologické zprávy/Novitas mammaliologicae. Nová série/Series nova,* 1962 renamed as *Lynx (n.s.) Praha*). The name "mammaliologické" was difficult for pronunciation and several European languages gave priority to theriology. Czechs and Italians, for example, interchangeably used in the past, and still now both, mammalogy and theriology. Thus, the Italian Mammal Society (its official name in English) is called in Italian Associazione Teriologica Italiana and is issuing a periodical with the English title *Hystrix: Italian Journal of Mammalogy* since 1986.

The term theriology was more widely accepted in eastern Europe which was evident from the periodical *Acta Theriologica* (since 2015 *Mammal Research*) issued since 1954 by the Mammal Research Institute of the Polish Academy of Sciences (founded in 1952) and from the professional mammal society founded in the former Soviet Union under the name All Union Theriological Society. The Society involved 12 regional sections and after the collapse of the Soviet Union some of these sections continued their work as independent societies, for example, Russian Theriological Society (since 1992; the official name is Russian Theriological Society of the Russian Academy of Science), Ukrainian Theriological Society (1993), and Lithuanian Theriological Society (1989). The term mammalogy is not in use in these countries, and also the journals published by the societies avoid it: *Theriologia Ukrainica* (started in 1998 as *Proceedings of the Theriological School*), *Russian Journal of Theriology* (founded in 2002), and *Theriologia Lituanica* (not published continuously).

Other 27 mammalogical journals founded in Europe after the Second World War are listed in Table 2. There are more local leaflets or journals on bats and other organisms with a more local distribution.

Taxonomy

The discovery of about 320 indigenous and introduced mammal species (Table 1) in Europe took more than 250 years. We list 322 species, but the number of acknowledged species will differ depending on the underlying taxonomic philosophy and species concept(s). As already mentioned, the formal system of nomenclature was developed by C. Linnaeus. His basic works (Linnaeus 1758, 1761, 1766, 1768) listed and named 77 species of mammals from Europe, most of which are currently regarded as valid species. Further new European species of mammals were described by Berkenhout (1769), Laxmann (1769, 1788), Forster (1770), Gmelin (1770, 1778, 1788), Güldenstaedt (1770), Pallas (1769, 1770, 1771, 1773, 1775, 1776, 1777, 1778, 1779, 1811), Pennant (1771), Schreber (1774, 1775, 1777, 1780), Phipps (1774), Müller (1776), Erxleben (1777), Hermann (1779, 1780), Zimmermann (1780), Borowski (1781), Molina (1782), Güldenstaedt and Pallas (1783), Fabricius (1791), Kerr (1792), Borkhausen (1797), Bechstein (1800), Shaw (1801), Lacépède (1804), Sowerby (1804), E. Geoffroy (1803, 1806, 1810, 1811, 1818), Traill (1809), Cuvier (1812, 1823, 1829), Rafinesque (1814), Desmarest (1817), Blainville (1817, 1838, 1839), Kuhl (1817, 1820), Montagu (1821), Savi (1822, 1839), Horsefield (1823), Liechtenstein (1823, 1828), Boie (1825), Leach (1825), Gray (1812, 1828, 1834, 1846, 1874), Lesson (1827, 1828), Temminck (1827, 1838, 1840), Cuvier in Lesson (1828), Millet (1828), Fischer (1829), Meyen (1833), Melchior (1834), Küster (1835), Hodgson (1836), Sviridenko

Table 2 An overview of mammal journals published by European societies or institutions

Year	Journal name
1926–2000	*Zeitschrift für Säugetierkunde*, continued as (2001–present) *Mammalian Biology*
1936–present	*Mammalia*
1952–present	*Lutra*
1952–2001	*Säugetierkundliche Mitteilungen*
1954–2014	*Acta Theriologica*, continued as (2015–present) *Mammal Research*
1958–1961	*Mammaliologické zprávy/Novitas mammaliologicae. Nová série/Series nova*, continued as (1962–present) *Lynx, n.s.* (Praha)
1960–present	*Folia Primatologica*
+1961–1999	*Equus*
1963–2005	*Myotis*
1969–present	*Nyctalus*
1969–1994	*Investigations on Cetacea*
1970–present	*Mammal Review*
1970–2001	*Säugetierschutz*
1977–present	*Säugetierkundliche Informationen*
1978–2003?	*Przewalski Horse*
1981–1998?	*Eliomys* (Gent)
1984–2010?	*Arvicola*
1985–present	*Le Rhinolophe*
1986–present	*Hystrix: Italian Journal of Mammalogy*
1987–present	*Der Flattermann*
1988–present	*Galemys, Spanish Journal of Mammalogy*
1990–present	*Zoogdier*
1991–present	*MAUS*, Mitteilungen aus unserer Säugetierwelt
1993–present	*Journal of Mammalian Evolution*
1996–2000	*Folia Theriologica Estonica*
1996–2016	*Vespertilio*
1998–present	*Plecotus* et al.
1998–present	*Proceedings of the Theriological School*, continued as *Theriologia Ukrainica*
1999–present	*Acta Chiropterologica*
1999–present	*Mitteilungen für sächsische Säugetierfreunde*
2000–2002	*pro chiroptera*
2000–2007	*Studia Chiropterologica*
2000–2009	*Nietoperze*
2002–present	*Theriologia Lituanica*
2002–present	*Russian Journal of Theriology*

(1936), Sélys-Longchamps (1836, 1838, 1839), Bonaparte (1837, 1840, 1845), Martin (1838), Schinz (1837, 1838), Ogilby (1839), Keyserling and Blasius (1839, 1840), Lereboullet (1842), Nordmann (1840), Blyth (1841), Martins (1842), Lilljeborg (1844), Crespon (1844), Eversmann (1845), Owen (1846, 1866), Sundevall (1846), Blasius (1853), Gervais (1855), Rosenhauer (1856), Brandt (1859), Tomes (1857), Lilljeborg (1861), Bocage (1865), Frivaldszky (1865), Burmeister (1867), Peters (1867, 1869), Mina-Palumbo (1868), Swinhoe (1870), Von Haast (1876), Danford and Alston (1877, 1880), Anderson (1878), Dobson (1878), Gerbe (1879), Poljakov (1881), Petényi (1882), Lataste (1883), Monticelli (1885), Satunin (1895, 1901), Allen (1890), De Winton (1898), Nehring (1894, 1898, 1902), Neumann (1899), Merriam (1900), Miller (1900, 1908, 1910), Thomas (1892, 1901, 1902, 1906), Barrett-Hamilton (1900, 1903, 1907), Matschie (1901), Cabrera (1904, 1907, 1911), Fatio (1905), Bate (1906, 1937), Barrett-Hamilton (1907), Mottaz (1907), Miller (1908, 1910), Satunin (1908, 1909), Mehely (1909), True (1913), Shidlovsky (1919), Martino, V. &. E. (1922), Ognev (1922, 1924, 1935), Turov (1924), Vinogradov (1925), Altobello (1926), Formozov (1931), Martino, V. &. E. (1931), Kormos (1934), Kuzjakin (1935, 1965), Bate (1937), Zubko (1937), Coutourier (1938), Reshetnik (1939), Heinrich (1952), Kratochvíl (1952), Kratochvíl and Rosicky (1952), Wettstein (1927, 1953), Fraser (1956), Lehmann (1961, 1964), König (1962), Malec and Storch (1963), Ondrias (1966), Palacios (1977), Felten (1971, 1977), Djulic (1980), Sokolov, Kowalskaya and Baskevich (1980), Petrov and Ružić (1983), Sokolov, Baskevich and Kowalskaya (1986), Hutterer, López-Jurado, and Vogel (1987), de Paz (1994), Helversen and Heller (2001), Mucedda et al. (2002), Benda et al. (2004), Hulva and Benda (2004), Cucchi et al. (2006), Nicolas, Martínez-Vargas, and Hugot (2017), Kryštufek et al. (2018) and Ruedi et al. (2019). References are given in Table 2. Subspecific names, a possible source for further species names, are not listed here. More species will be

recognized after biogeographical studies have been finished, such as for voles (e.g., Jaarola and Searle 2002), or shrews (Amori and Castiglia 2018). See also Burgin et al. (2018) for a discussion of a recent species list and Genovesi et al. (2009) for a review of alien species.

In parallel with the discoveries of new species, mammalogists of the late eighteenth and nineteenth centuries also built up regional lists of species. Progress in cataloguing the mammal richness was not a steady accumulation of knowledge, but rather a series of ups and downs. The nineteenth-century European mammalogy reached its pinnacle in mid-century (1857) in The Natural History of Mammals of Germany and adjacent regions of Central Europe by the German Johann Heinrich Blasius (1809–1870). His work remained in high esteem for the rest of the century on the one hand, but also created an illusion that not much new could be expected in Europe on the other hand. European mammalogists, confronted with the European mammal fauna, which seemed not to be particularly challenging, and the challenges offered by overseas colonial possessions, chose the latter.

In the meantime, mammalogy in the New World progressed rapidly both conceptually and methodologically. Cuvier's concept of immutable species and varieties was replaced by polytypic species and subspecies. Study of variation emerged as the central topic in mammalogy which demanded clearer and more intelligible diagnostics of taxa. This could not be achieved without detailed descriptions of cranial and dental morphology, in addition to external appearance, and meticulous morphometrics for quantifying size and proportions. Above all, comparisons between taxa necessitated samples (hypodigms), not just individuals, and such demands could no longer be satisfied by taxidermic mounts. A whole series of conspecific individuals had to be sampled in the field, measured, prepared in a standardized way, and deposited in museum collections for further study. A museum voucher became a standard in taxonomic work. It consisted of a skin and skull with attached label containing detailed information on the locality, date of collecting, sex, standard external measurements, and relevant details on the habitat and observations made during dissection. The mammal collections were still small and scrappy in the 1880s and 1890s, and small mammals in particular were heavily underrepresented. At that time, Clinton Hart Merriam (1855–1942) at the United States Department of Agriculture (founded in 1885 and renamed in 1905 to Bureau of Biological Survey) started collecting small mammals using commercially available traps called the "Cyclone." The trap "was an affair of tin and wire springs, only about two inches square when collapsed, cheap in cost, and easily portable in quantity" (Osgood 1944). Simultaneously, the American mammalogists modified the way of skinning birds as museum vouchers, developed earlier on by ornithologists. Application of these two novelties enlarged mammal collection in the US Museums to proportions which at that time were unprecedented. Still in 1910, Edouard-Louis Trouessart (1842–1927) from the Natural History Museum in Paris wrote with amazement of the US collections in which common species were represented by series numbering up to 1200 museum vouchers (Denys et al. 2012).

In the 1890s Gerrit Smith Miller (1869–1956), at that time still employed at the Department of Agriculture (in 1898 he moved to the United States National Museum) transplanted to Europe "the methods and philosophy of the 'American School of Mammalogy', including the systematic study of large series of uniformly prepared small mammal specimens" (Dunnum and Cook 2012). In 1894, when Miller demonstrated at the British Museum new methods of field collecting small mammals using the "Cyclone" traps and processing the material as standard museum vouchers, European mammalogists were deeply impressed. The method was quickly adopted in various European countries, for example, France, Germany, and Russia.

European Mammal Collections

Europe has a long history of biological collections. Collections for scientific purposes (Genoways and Schlitter 1981) are younger and often are subject to change. Only larger collections run by public institutions have a chance to survive for longer periods. Table 3 lists some current collections where

Table 3 European mammal collections containing about 2,000 or more specimens of recent mammals

Institution	Number of specimens
Natural History Museum, London, UK	333,000
Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands	300,000
Zoological Museum of Moscow State University, Moscow, Russia	201,000
Mammal Research Institute, PAS, Bialowieza, Poland	190,000
Institute of Plant and Animal Ecology, Ural Branch of the Russian Academy of Sciences, Yekatarinburg, Russia	183,000
Museum für Naturkunde, Berlin, Germany	150,000
Koninklijk Museum vaar Midden-Africa, Tervuren, Belgium	135,000
Muséum National d'Histoire Naturelle, Paris, France	130,000
Naturhistorisches Museum, Vienna, Austria	125,000
Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany	120,000
Zoological Institute, St. Petersburg, Russia	100,000
Naturhistoriska Riksmuseet, Stockholm, Sweden	100,000
SNS, Forschungsinstitut Senckenberg, Frankfurt a.M., Germany	95,000
Finnish Museum of Natural History, Helsinki, Finland	60,000
Grant Museum of Zoology, University College London, London, UK	60,000
Staatliches Museum für Naturkunde, Stuttgart, Germany	51,000
Museum d'Historie Naturelle, Geneve, Switzerland	45,950
National Museum of Scotland, Edinburgh, UK	45,000
Hungarian Natural History Museum, Budapest, Hungary	44,276
Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium	42,000
Zoologische Staatssammlung, München, Germany	40,000
Natural History Museum of Denmark, Copenhagen, Denmark	40,000
Institute of Vertebrate Zoology, CAS, Brno, Czech Republic	40,000
Harrison Institute, Sevenoaks, UK	38,000
National Museum, Praha, Czech Republic	37,500
Department of Zoology, Charles University, Praha, Czech Republic	30,000
Biological Museum, Lund University, Sweden	30,000
Slovenian Museum of Natural History, Ljubljana, Slovenia	28,000
National Museum of Natural Sciences, Madrid, Spain	27,000
SNS, Museum für Tierkunde, Dresden, Germany	25,000
Zoologisches Museum, Hamburg, Germany	23,000
Museo Zoologico de La Specola, Firenze, Italy	22,330
SNS, Senckenberg Museum für Naturkunde, Görlitz, Germany	22,000
Landessammlungen für Naturkunde, Karlsruhe, Germany	21,000
National Museum of Natural Sciences, Kiev, Ukraine	20,300
Zoological Museum, Oulu, Finland (closed)	20,000
Biological Museum, Lund University, Sweden	18,700
Centrum für Naturkunde, Hamburg, Germany	17,000
Natural History Museum, Oslo, Norway	12,000
National Museum of Ireland, Dublin, Ireland	10,500
"Grigore Antipa" Museum of Natural History, Bucharest, Romania	10,000
Naturhistorisches Museum, Bern, Switzerland	10,000
Naturhistorisches Museum, Basel, Switzerland	9,500
Institute of Zoology, Academy of Sciences, Sofia, Bulgaria	8,400
Zoological Museum, University of Odesa, Odesa, Ukraine	8,000
Übersee-Museum Bremen, Germany	7,500
Department of Zoology, World Museum Liverpool, Liverpool, UK	7,000

(continued)

Table 3 (continued)

Institution	Number of specimens
Zoological Museum of the Kiev's State University, Kiev, Ukraine	7,000
Zoologisches Museum der Universitat Zürich, Zürich, Switzerland	7,000
Zoological Museum, University of Uzhgorod, Uzhgorod, Ukraine	6,513
National Museum of Natural History, Lvov, Ukraine	6,476
Laboratorium voor Algemende Dierkunde, Antwerpen, Belgium	6,000
Quex Museum, Birchington, UK	6,000
Museuo Civico di Storia Naturalle di Milano, Milano, Italy	5,700
Manchester Museum, Manchester, UK	5,367
Zoological Institute, Tartu University, Tartu, Estonia	5,344
Oxford University Museum, Oxford, UK	5,000
Zoologie der Sektion Biowissenschaften der Martin-Luther-Universitat, Halle, Germany	4,200
Estonian Museum of Natural History, Tallin, Estonia	4,100
All-Union Research Institute of Game Management and Fur Farming, Kirov, Russia	3,500
Museuo Civico di Storia Naturalle di Verona, Verona, Italy	3,500
Museo e Instituto de Zoologia Sistematica, Universa di Torino, Torino, Italy	3,500
Zoological Museum, University of Lvov, Ukraine	3,247
Zoological Museum, University of Dnepropetrovsk, Dnepropetrovsk, Ukraine	3,156
National Museum of Ireland, Dublin, Ireland	3,000
Museum of Evolution, Upsala, Sweden	2,000

Data obtained in March 2019. Numbers are estimates

mammals are kept for scientific studies and/or for public display. The listed mammal collections sum up to 3.2 million of specimens.

European Mammal Societies

After the First and Second World Wars, some national societies for the study and conservation of mammals were founded. One of the earliest ones was founded in Germany (1926), followed by The Netherlands (1952), France (1954), the United Kingdom (1954), Czechoslovakia (1958), Italy (1983), Lithuania (1989), Russia (1992), Ukraine (1993), and Spain (2000). Numerous local societies for the conservation of bats, dormice, hamsters, hedgehogs, large carnivores, otters, etc., were also founded in various European countries.

Mammal Congresses

Scientific congresses on mammalian topics have been held in Germany by the German Society of Mammalogist almost annually since 1926 (Hutterer 2001), in France by the French Society for the Protection of Mammals (13th Colloque International de Mammalogie in Banyuls, 1989), and certainly also by many other national societies. The European Mammal Foundation has held congresses since 1991 (Lisbon), the eighth one being organized in Warsaw in 2019. In 1960 and 1971, early meetings were held in Brno, Czechoslovakia. The International Theriological Congress was first organized in Moscow in 1974 and has been continued under the name International Mammalogical Congress since 2001 (Lidicker 2011).

Handbooks

Despite all the engagements in overseas explorations, several European countries printed mammal faunas of their territories already in the second half of the nineteenth century: UK (Lydekker 1896, Johnston 1903, Barrett-Hamilton 1910–1921, 1913), Germany (Blasius 1857), or Spain (Graells 1897). There was a need, however, for a comprehensive treatise at the continental scale to standardize taxonomy and nomenclature. In 1910, Trouessart, at that time appointed at the Mammals and Birds section of the National Museum of

Natural History in Paris (Denys et al. 2012), published the "Fauna of the Mammals of Europe" (Trouessart 1910). Shortly afterwards, an even more influential work followed, authored by Miller. Several mammalogists in London, Lord Lilford (Thomas Littleton Powys, 1833–1896), Oldfield Thomas (1858–1929), and Gerald Edwin Hamilton Barrett-Hamilton (1871–1914) put huge efforts in completing collections of European mammals which around 1910 contained 5000 museum vouchers, including 124 types. This material, along with 4000 vouchers held in Washington, and further 2500 museum specimens scattered across Europe, allowed Miller to produce a monographic treatise, a Catalogue of mammals of "Europe exclusive of Russia" on more than one thousand pages (Miller 1912). Miller recognized 314 "forms" (species and subspecies) in 69 genera. He himself examined museum vouchers of all these forms except six. Miller's Catalogue was much more than just a list of species. It contained detailed morphological descriptions, accompanied by craniodental measurements and drawings of skulls and dentition, produced by Amedeo John Engel Terzi (1872–1956). The quality of illustrations is such that they are still reproduced in textbooks of mammalogy. Furthermore, the Catalogue included dichotomous keys to families, genera, species and subspecies, and lists of all vouchers examined, together with localities and other details like sex, date, and collector. The Catalogue was a model for the most important contributions to European mammalogy (see Shamel et al. 1954) and served as the taxonomic standard well into the 1970s and 1980s. Even today, the Catalogue remains to be an invaluable nomenclatural source and a reference for morphological data. Contrary to Miller, Trouessart also considered marine mammals and covered Europe in its entirety, that is, as far as the Urals in the east and the Caucasus in the southeast. Despite the broader geographic and taxonomic scope, Trouessart's book counts only 266 pages (as compared to 1019 pages in Miller's Catalogue) which was a consequence of less detailed descriptions and lack of illustrations and identification keys. Miller's Catalogue prevailed because it allowed mammalogists a more secure classification of their vouchers and recognition of still unnamed taxa.

Miller in his Catalogue strictly adhered to Europe west of Russia, an evident consequence of the paucity of material from the East, both in general, and in particular in major museums of Central and West Europe. At about same time, the Russian mammologist Sergey I. Ognev (1886–1951) published "Fauna Mosquensis" which was supported by about 3000 museum vouchers (Bakloushinskaya et al. 2012). Despite such parallel trends in the West and the East, Miller's geographic scope proved remarkably persistent, being uniformly followed by subsequent authors well into the 1980s. This was not a matter of free choice, but of political reality in Europe during the twentieth century. In the same year that Miller published his Catalogue, a local conflict erupted in the Balkans, mammalogically the least known region in Europe. The skirmish soon became known as the First Balkan War. It was followed in 1913 by a brief Second Balkan War and in 1914 by the Third Balkan War which escaped control and developed into World War I. When the Great War, as it was called at the time, ended, the political map of Europe had been redrawn. The continent was instable, insecure, impoverished, and ideologically divided. Miller's border became a reality and West and East Europe took their own courses in mammalogy with not much collaboration. The environment therefore did not encourage mammal research and not many syntheses on mammals were published on either side of the border between the two wars.

Mammals were treated in handbooks at different levels. Mammals of the Palaearctic Region were covered by Ellerman and Morrison-Scott (1957, 1966) and Corbet (1978, 1984), and European mammals by Keyserling and Blasius (1840), Schmiedeknecht (1906), Trouessart (1910), Miller (1912), Hainard (1948, 1949), van den Brink (1955), Gaffrey (1961), Corbet (1966), König (1969), Curry-Lindahl (1975), Corbet and Ovenden (1980), Schilling et al. (1983), Bjärvall and Ullström (1986), Görner and Hackethal (1988), and Lange et al. (1994). Niethammer and Krapp (1978–2005) presented the first detailed handbook series, and Macdonald and Barrett (1993) provided an overview of British and European mammals. More recently Macdonald

Table 4 Some handbooks and faunal treatments of European mammals

Geographic region	Source
Austria	Rebel (1933), Spitzenberger (2001), and Stüber et al. (2014)
Belgium	Frechkop (1958)
Benelux	Saint Girons (1973)
British Islands	Millais (1904), Barrett-Hamilton (1910–1921), Thorburn (1920), Harrison Matthews (1952), Corbet and Southern (1964), Lawrence and Brown (1967), Arnold (1993), Harris et al. (1995), Macdonald and Tattersall (2001), and Harris and Yalden (2008)
Bulgaria	Markov (1957) and Peshev et al. (2004)
Czech Republic + Slovakia	Pelikán et al. (1979), Anděra (2000), Anděra and Horáček (1982), Anděra and Hanzal (1995, 1996), Anděra and Beneš (2001), and Anděra and Červený (2009)
Denmark	Baagoe and Jensen (2007)
Estland	Grevé (1909)
Estonia	Masing (1999)
Finland	Siivonen (1968, 1972)
France	Didier and Rode (1935), Rode and Didier (1946), Saint Girons (1973), Brosset (1974), and Fayard (1984)
Germany	Blasius (1857), Schäff (1911), Krumbiegel (1931), Mohr (1950), Haltenorth (1955), Angermann and Hackethal (1974), Herrmann (1991; Saarland), Borkenhagen (2011; Schleswig-Holstein), Hauer et al. (2009; Saxony), Görner (2009; Thuringia), Braun and Dieterlen (2003, 2005, Baden-Württemberg), and Grimmberger (2013)
Italy	Toschi (1965), Toschi and Lanza (1959), Spagnesi et al. (2000), and Spagnesi and De Marinis (2002)
Liechtenstein	von Lehmann (1963) and Broggi et al. (2011)
Lithuania	Balciauskas et al. (1999)
Macedonia	Kryštufek and Petkovski (2003)
Netherlands	Wijngaarden et al. (1971) and Broekhuizen et al. (1992)
Poland	Kowalski (1964), Pucek (1983), and Pucek and Raczynski (1983)
Romania	Murariu (2000), Popescu and Murariu (2001), and Murariu et al. (2016)
Slovakia	Krištofik and Danko (2012)
Slovenia	Kryštufek (1991)
Spain (Balearic Islands)	Alcover (1988)
Spain (mainland)	Graells (1897), Cabrera (1914), Vericad (1972), Gosàlbez i Noguera (1987), Rodríguez (1993), and Palomo and Gisbert (2002)
Switzerland	Baumann (1949), Rahm (1976), Hausser and Bourquin (1988), Hausser (1995), Marchesi et al. (2008), and Müller et al. (2010)
Yugoslavia (former)	Petrov (1992)

For books treating Russia and Far Eastern European countries, see text

(1995), Dietz et al. (2007), Temple and Terry (2007), Aulagnier et al. (2007), Grimmberger and Rudloff (2009), Twisk et al. (2010), and Dietz and Kiefer (2014; only bats) reviewed the status and distribution of European mammals. Mitchell-Jones et al. (1999) presented an atlas of European mammals as the result of an international cooperation. Temple and Cuttelod (2008) published a review of mammals of the Mediterranean area. Books treating mammals of mainly western Europe at a more local level are listed in Table 4. Wilson and Reeder (2005) and Wilson et al. (2009–2018) are modern checklists or handbooks which also include the European species.

The mammalogists of eastern Europe, which lived for the major part of the twentieth century within the borders of the Soviet Union (particularly Russia, Belarus, Ukraine, and Moldavia), published uncountable articles and books, often as part of wider geographical treatments. This includes a series of taxonomic compilations of various mammalian groups of Europe and

Palaearctic Asia, for example, of insectivores by Gureev (1979) and Zaytsev et al. (2014), a large number of works covering various rodents and lagomorphs which were summarized by Gromov and Erbajeva (1995), carnivorans and ungulates by Heptner and co-workers (e.g., Heptner and Sludskii 1992) which appeared in four volumes and so forth. There were several attempts to compile the entire mammal fauna of the Soviet Union under a single title, for example, by Bobrinskii et al. (1944 and reprinted editions), Gromov et al. (1963, in two volumes), Flint et al. (1965), and Pavlinov et al. (2002). The majority of publications during the Soviet period were in Russian and were therefore not accessible to the majority of mammologist working outside the Soviet Union. Because of their outstanding importance, some were translated into English and the best known in the West were seven volumes of the "Mammals of Eastern Europe and Northern Asia" (later volumes appeared under the title "Mammals of the USSR and Adjacent Countries") by Ognev published in the Soviet Union during 1928–1950 and released in English from 1962–1966 (Ognev 1962–1966; for references see Bakloushinskaya et al. 2012). Mammals are also covered in a large number of regional works. In the European part of Russia, Stroganov (1949) and Ivanter (2009) wrote about the mammals of Karelia, Estaf'ev (1994, 1998) of the extreme north-eastern European Russia, Vechkanov et al. (2004) about Mordovia, Kruskop (2002) about the Moscow area, Popov (1960) and Schlyakhtin et al. (2009) on the Volga region, Bol'shakov et al. (2000) of the Ural Mts, and so forth. Similarly, Serzhanin (1955 and reprinted editions) and Kozlo (2003) compiled knowledge on the mammals of Belarus, Dulitskiy (2001) about the Crimea, and Migulin (1938), Tatarinov (1956), Mezhzherin and Lashkova (2013), and Abelentsev with co-workers (in three volumes) about the Ukraine (zagorodniuk 2017).

The Discovery of Species

The cumulative number of acknowledged mammalian species in Europe has increased steadily ever since the 1758 Systema Naturae. The cumulative curve was the steepest before 1850, that is, during the period of most intensive naming of new species. Although the pace of new discoveries or descriptions slowed down after 1950, the curve is not yet asymptotic; hence, discoveries of new species are still likely. The curve reflects the development as perceived from the current state of knowledge (Fig. 1). As we already saw, the

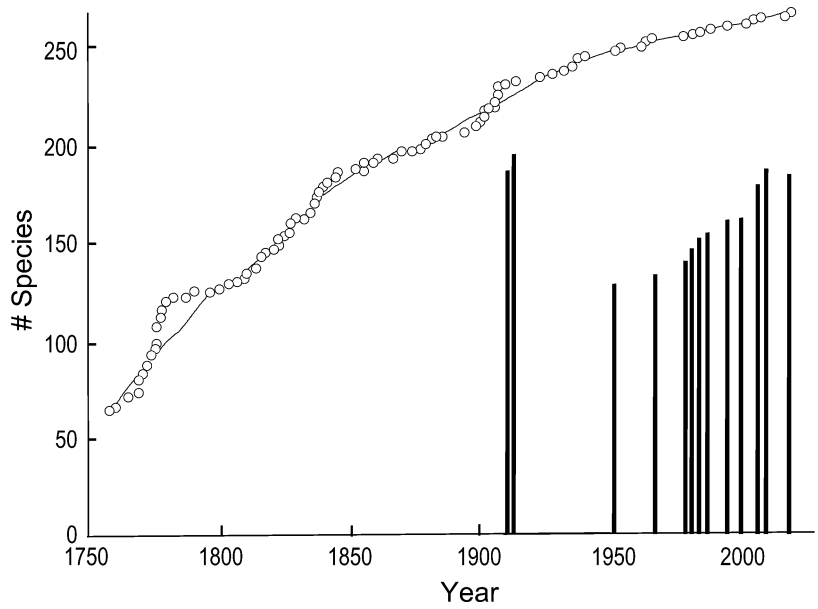

Fig. 1 Cumulative number of species of European mammals (dots) as recognized currently since the 1758 publication by Linnaeus. Note that the best-fit curve still does not reach the asymptote. Bars show variation in number of recognized species in Western Europe (i.e., Europe without Russia/Soviet Union) since the revisions of Trouessart (1910) and Miller (1912). Some species have been omitted to make different sources comparable

actual progress was much less directional, and therefore more erratic. In Western Europe, the number of recognized species was the highest in the early twentieth century but reached the lowest point in mid-century in a taxonomic revision by Ellerman and Morrison-Scott (1951). This work, which was at the time celebrated as "a magnificent synthesis … [which] has sweepingly arranged the mammals of Eurasia …" (Mayr 1963), is now denounced as representing a period of "taxonomic inertia" by some which underestimated the species richness, retarded the taxonomic progress in Europe, and in consequence affected biodiversity conservation policies (e.g., Gippoliti and Groves 2018). For a short treatment of different taxonomic philosophies, see Hackländer and Zachos (this volume). In the decades to follow Ellerman and Morrison-Scott (1951), the mammalogists were steadily adding "new" species (Table 1). In many cases they were arguing that taxa which already had valid names but were suppressed as junior synonyms do in fact represent full species. The new persuasive evidence frequently came from cytological laboratories, and later on from molecular evidence. That said, even in the light of new high-resolution molecular data, a large part of the disagreement over species delimitation and species numbers is due to fundamental differences in taxonomic philosophy, that is, which species concept one should follow.

Outlook

Today mammalogy is a complex science which is connected to a large set of other disciplines, such as physiology, cytology, ecology, population biology, behavior, conservation, morphology, paleontology, evolutionary biology, and so forth. Many of these fields were not even mentioned in the text. The basic disciplines however are taxonomy and evolution. Although a large amount of progress has been made in the recent past, we are still discovering and sorting species of mammals, also in Europe, attempting to put order into the mammal diversity that we find in nature.

References

Alcover JA (1988) Els mamífers de les Balears. Editorial Moll, Palma de Mallorca

Amori G, Castiglia R (2018) Mammal endemism in Italy: a review. Biogeogr J Integr Biogeogr 33:19–31

Anděra M (2000) Atlas of the mammals of the Czech Republic. A provisional version. Insectivores (Insectivora). Národni muzeum, Praha

Anděra M, Beneš B (2001) Atlas of the mammals of the Czech Republic. A provisional version. IV. Rodents (Rodentia). – Part 1. Hamsters (Cricetidae), voles (Arvicolidae), dormice (Gliridae). Národni muzeum, Praha

Anděra M, Červený J (2009) Large mammals in the Czech Republic. Distribution, history and protection. 1. Even-toed ungulates (Artiodactyla). Národní muzeum, Praha

Anděra M, Hanzal V (1995) Atlas of the mammals of the Czech Republic. A provisional version. I. Even-toed ungulates (Artiodactyla), lagomorphs (Lagomorpha). Národni muzeum, Praha

Anděra M, Hanzal V (1996) Atlas of the mammals of the Czech Republic. A provisional version. II. Carnivores (Carnivora). Národni muzeum, Praha

Anděra M, Horáček I (1982) Poznáváme nase savce. Mladà fronta, Praha

Angermann R, Hackethal H (1974) Säugetiere – Mammalia. In: Stresemann E (ed) Exkursionsfauna für die Gebiete der DDR und der BRD. Wirbeltiere. Volk und Wissen VEB, Berlin

Arnold HR (1993) Atlas of mammals in Britain. HMNS, London

Aulagnier S, Haffner P, Mitchell-Jones AJ, Moutou F, Zima J (2007) Mammifères d'Europe, d'Afrique du Nord et du Moyen-Orient. Delachaux & Niestle, Paris

Baagoe HJ, Jensen TS (2007) Dansk pattedyr Atlas. Nordisk Forlag A/S, Kobenhavn

Bakloushinskaya I, Bazykin GA, Kryukov AP, Kryukova EP (2012) Sergey Ivanovitch Ognev and the formation of theriology in Russia. Mammalia 76:375–382

Balciauskas L, Trakimas G, Juskaitis R, Ulevicius A, Balciauskiené L (1999) Atlas of Lithuanian mammals, amphibiens & reptiles, 2nd edn. Akstis Publications, Vilnius

Barrett-Hamilton GEH (1910–1921) A history of British mammals. Gurrney & Jackson, London

Barrett-Hamilton GEH (1913) A history of British mammals. Part XIV. Gurney and Jackson, London

Baumann F (1949) Die freilebenden Säugetiere der Schweiz. H Huber, Bern

Bjärvall A, Ullström S (1986) The mammals of Britain and Europe. Croom Helm, London/Sydney

Blasius JH (1857) Fauna der Wirbelthiere Deutschlands und der angrenzenden Länder von Mitteleuropa. I Vieweg & Sohn, Braunschweig

Bobrinskoy N, Kuznetzov B, Kuzyakin A (1944) Mammals of USSR. Sovietskaya Nauka, Moscow. (in Russian)

Bol'shakov VN, Berdyugin KI, Vasileva IA, Kuznetsova IA (2000) Mammals of Sverdlovsk Oblast. Ekaterinburg Press, Ekaterinburg. (in Russian)

Borkenhagen P (2011) Die Säugetiere Schleswig-Holsteins. Husum Druck- und Verlagsgesellschaft, Husum
Braun M, Dieterlen F (eds) (2003) Die Säugetiere Baden-Württembergs, vol 1. E Ulmer, Stuttgart
Braun M, Dieterlen F (eds) (2005) Die Säugetiere Baden-Württembergs, vol 2. E Ulmer, Stuttgart
Broekhuizen S, Hoekstra B, van Laar V, Smeenk C, Thissen JBM (1992) Atlas van de Nederlandse zoogdieren. Stichting Uitgeverij Koninklijke Nederlandse Natuurhistorische Vereniging, Arnheim
Broggi MF, Camenisch D, Fasel M, Güttinger R, Hoch S, Müller JP, Niederklopfer P, Staub R (2011) Die Säugetiere des Fürstentums Liechtenstein (Mammalia). Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg 36:5–200
Brosset A (1974) Mammifères sauvages de France et d'Europe de l'Ouest. Nathan
Burgin CJ, Coella JP, Kahn PL, Upham NS (2018) How many species of mammals are there? J Mammal 99:1–14
Cabrera A (1914) Fauna Ibérica. Mamíferos. Museo Nacional de Ciencias Naturales, Madrid
Corbet GB (1966) The terrestrial mammals of western Europe. G T Foulis & Co., London
Corbet GB (1978) The mammals of the Palaearctic Region: a taxonomic review. British Museum (Natural History) and Cornell University Press, London/Ithaca
Corbet GB (1984) The mammals of the Palaearctic Region: a taxonomic review. Supplement. British Museum (Natural History), London
Corbet GB, Ovenden D (1980) The mammals of Britain and Europe. Collins Sons & Co, London
Corbet GB, Southern HN (1964) The handbook of British mammals, 2nd edn. Blackwell Science, Oxford
Curry-Lindahl K (1975) Däggdjur i färg. Alla Europas arter. Almquist & Wiksell, Stockholm
Denys C, Callou C, Mellier B (2012) The contribution of Edouard-Louis Trouessart to mammalogy. Mammalia 76:355–364
Didier R, Rode P (1935) Les mammiféres de France. Société Nationalé d'Acclimatation de France, Paris
Dietz C, Helversen O, Nill D (2007) Handbuch der Fledermäuse Europas und Nordwestafrikas. Kosmos, Stuttgart
Dietz C, Kiefer A (2014) Die Fledermäuse Europas kennen, bestimmen schützen. Kosmos, Stuttgart
Dulitskiy AI (2001) Mammals of Crimea. Crimean Scientific and Pedagogical State Publisher, Simferopol. (in Russian)
Dunnum JL, Cook JA (2012) Gerrit Smith Miller: his influence on the enduring legacy of natural history collections. Mammalia 76:365–373
Ellerman JR, Morrison-Scott TCS (1951) Checklist of Palaearctic and Indian mammals 1758 to 1946. Trustees of the British Museum (Natural History), London
Ellerman J R, Morrison-Scott T C S. 1966. Checklist of Palaearctic and Indian mammals 1758 to 1946. 2nd edition. London: Trustees of the British Museum (Natural History)
Estaf'ev AA (ed) (1994) Fauna of the European north-eastern Russia. Mammals 1. Insectivores, bats, lagomorphs, rodents. Nauka, Sankt-Peterburg. (in Russian)
Estaf'ev AA (ed) (1998) Fauna of the European north-eastern Russia. Mammals 2. Cetaceans, carnivores, pinnipeds, artiodactyls. Nauka, Sankt-Peterburg. (in Russian)
Fayard A (1984) Atlas des mammifères sauvages de France. Société Francaise pour l'Étude et la Protection des Mammifères, Paris
Flint VE, Chugunov Yu D, Smirin VM (1965) Mammals of the USSR. Mysl, Moscow. (in Russian)
Frechkop S (1958) Faune de Belgique. Mammifères. Institut royal des Sciences naturelles de Belgique, Bruxelles
Gaffrey G (1961) Merkmale der wildlebenden Säugetiere Mitteleuropas. Akademische Verlagsgesellschaft, Leipzig
Genovesi P, Bacher S, Kobelt M, Pascal M, Scalera R (2009) Alien mammals of Europe. In: Nentwig W (ed) DAISIE, Handbook of Alien species in Europe. Springer, Dordrecht, pp 119–128
Genoways HH, Schlitter DA (1981) Collections of recent mammals of the World, exclusive of Canada and the United States. Ann Carnegie Museum 50:47–80
Gessner C, Forer C (1563) Thierbuch. Das ist ein kurtze beschreybung aller vierfüssigen Thieren/so auff der erde und in wassern wohnend/sampt irer waren konterfactur: alles zu nutz von gutem allen liebhabern der künsten/Artzeten/Maleren/Bildschnitzern/Weydleuten und Köchen/gestelt. Christoffel Froschower, Zürich
Gippoliti S, Groves CP (2018) Overlooked mammal diversity and conservation priorities in Italy: impacts of taxonomic neglect on a Biodiversity Hotspot in Europe. Zootaxa 4434(3):511
Görner M (ed) (2009) Atlas der Säugetiere Thüringens. Biologie, Lebensräume, Verbreitung, Gefährdung, Schutz. Arbeitsgruppe Artenschutz Thüringen, Jena
Görner M, Hackethal H (1988) Säugetiere Europas. Neumann Verlag, Leipzig/Radebeul
Gosàlbez i Noguera J (1988) Insectívors; rosegadors de Catalunya. Ketres Editora, Barcelona
Graells M de la Paz (1897) Fauna Mastodológica Ibérica. Mem Real Acad Cienc Exact Fís Natur Madrid 17:1–806, 22 pls, 2 maps
Grevé K (1909) Säugetiere Kur- Liv- Estlands. W Mellin, Riga
Grimmberger E (2013) Die Säugetiere Deutschlands: Beobachten und Bestimmen. Quelle & Meyer, Wiebelsheim
Grimmberger E, Rudloff K, Kern C (2009) Atlas der Säugetiere Europas, Nordafrikas und Vorderasiens. Natur und Tier-Verlag, Münster
Gromov IM, Erbajeva MA (1995) The mammals of Russia and adjacent territories. Lagomorphs and Rodents. Russian Academy of Sciences, Zoological Institute, St. Petersburg. (in Russian)
Gromov I M, Gureev A A, Novikov G A, Sokolov I I, Strelkov P P, Chapskij K K. (1963) Mammals in the Fauna of the USSR. Parts I and II. Moscow: Academy of Sciences of the USSR. (in Russian)

Gureev AA (1979) Fauna of the USSR. Mammals, IV/2, insectivores (Mammalia, Insectivora). Hedgehogs, moles and shrews (Erinaceidae, Talpidae, Soricidae). Nauka, Leningrad. (in Russian)

Hainard R (1948/49) Les mammifères sauvage d'Europe. I, II. Delachaux & Niestlé, Neuchâtel/Paris

Haltenorth T (1955) Mammalia. In: Döderlen L (ed) Bestimmungsbuch für deutsche Land- und Süßwassertiere. 2. erw. Auflage. Band 4, Wirbeltiere. R. Oldenburg, München

Harris S, Yalden DW (2008) Mammals of the British Isles: handbook, 4th edn. The Mammal Society, Southampton

Harris S, Morris P, Wray S, Yalden D (1995) A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. Joint Nature Conservation Committee, Peterborough

Harrison Matthews L (1952) British mammals. Collins, London

Hauer S, Ansorge U, Zöphel U (2009) Atlas der Säugetiere Sachsens. Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, Dresden

Hausser J (1995) Säugetiere der Schweiz. Verbreitung, Biologie, Ökologie. Birkhäuser, Basel/Boston/Berlin

Hausser J, Bourquin J-D (1988) Atlas der Säugetiere der Schweiz. Die Verbreitung von zwölf Säugetierarten in der Schweiz. Schweizerische Gesellschaft für Wildforschung, Lausanne

Heptner VG, Sludskii AA (1992) Mammals of the Soviet Union. Volume II, Part 2. Carnivora (Hyaenas and Cats). Smithsonian Institution Libraries and National Science Foundation, Springfield

Herrmann M (1991) Säugetiere im Saarland. Verbreitung, Gefährdung, Schutz. Schriftenreihe des Naturschutzbundes Saarland e.V, St. Wendel

Hoffmeister DF, Sterling KB (1994) Origin. In: Birney EC, Choate JR (eds) Seventy-five years of mammalogy (1919–1994). American Society of Mammalogy, pp 1–21

Hutterer R (2001) Berlin und die Deutsche Gesellschaft für Säugetierkunde. Bongo (Berlin) 31:97–120

Ivanter EV (2008) Mammals of Karelia. PetrGU, Petrozavodsk. (in Russian)

Jaarola M, Searle JB (2002) Phylogeography of field voles (*Microtus agrestis*) in Eurasia inferred from mitochondrial DNA sequences. Mol Ecol 11(12):2613–2621

Johnston H (1903) British mammals: an attempt to describe and illustrate the Mammalian Fauna of the British Islands from the commencement of the Pleistocene Period to the present day. Woburn Library, London

Keyserling AG, Blasius JH (1840) Die Wirbelthiere Europa's. Friedrich Viehweg & Sohn, Braunschweig

König C (1969) Wildlebende Säugetiere Europas. Chr. Belser, Stuttgart

Kowalski K (1964) Klucze do oznaczania kregowców Polski. Ssaki-Mammalia. Polska Akademia Nauk, Krakow

Kozlo PG (ed) (2003) Mammals. Belarus Encyclopedia (in Belarus)

Krištofík J, Danko Š (2012) Mammals of Slovakia: distribution, bionomy and protection. Veda, Bratislava. (in Slovak with English summary)

Krumbiegel I (1931) Mammalia. In: Schulze P (ed) Biologie der Tiere Deutschlands. Gebrueder Borntraeger, Berlin

Kryštufek B (1991) Mammals of Slovenia. Prirodoslovni muzej Slovenije, Ljubljana. (in Slovene with English summary)

Kryštufek B, Petkovski S (2003) Annotated checklist oft he mammals of the Republic of Macedonia. Bonner Zoologische Beiträge 51:229–254

Kryštufek B, Tesakov AS, Lebedev VS, Bannikova AA, Abramson GI, Shenbrot G (2019) Back to the future: the proper name for red-backed voles is *Clethrionomys* Tilesius and not *Myodes* Pallas. Mammalia, online 09 Aug 2019

Lange R, Twisk P, van Winden A, van Diepenbeek A (1994) Zoogdieren von West-Europa. KNNV-uitgeverij, Utrecht

Lawrence MJ, Brown RW (1967) Mammals of Britain. Their tracks, trails and signs. Blanford Press, London

Lidicker WZ Jr (2011) The International Federation of Mammalogists: what is it and what does it do? Therya 2(1):5–6

Linnaeus C (1758) Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Laurentii Salvii, Holmiae. Vol. Tomus I, Editio decima, reformata, pp i–ii, 1–824

Lydekker R (1896) A hand-book to the British Mammalia. Edward Llyod, London

Macdonald D (1995) Collins European mammals. Evolution and behavior. Harper Collins, London

Macdonald D, Barrett P (1993) Mammals of Britain & Europe. Collins Field Guide. Harper Collins, London

Macdonald D, Tattersall F (2001) Britain's mammals: The challenge for conservation. People's Trust for Endangered Species, London

Marchesi P, Blant M, Capt S (2008) Fauna Helvetica 22. Säugetiere der Schweiz. Bestimmungsschlüssel. CSCF & SGW, Neuchâtel

Markov G (1957) (Insect eating mammals of Bulgaria). Fauna Bulgarica 3. Bulgarian Academy of Science, Zoological Institute, Sofia

Masing M (1999) Taxonomy and status of wild mammals in Estonia. Sicista, Tartu

Mayr E (1963) Animal species and evolution. Harvard University Press, Cambridge, MA

Mezhzherin SV, Lashkova OI (2013) Mammals of Ukraine. Naukova Dumka, Kiev. (in Ukrainian)

Migulin OO (1938) Mammals of the Ukrainian SSR (Data on the fauna). Ukrainian SSR Academy of Sciences Press, Kiev. (in Ukrainian)

Millais JG (1904) The mammals of Great Britain and Ireland. Longmans Green & Co., London

Miller GS (1912) Catalogue of the mammals of western Europe (Europe exclusive of Russia) in the collection

of the British Museum. British Museum (Natural History), London
Mitchell-Jones AJ, Amori G, Bogdanowicz W, Kryštufek B, Reijnders PJH, Spitzenberger F, Stubbe M, Thissen JBM, Vohralík V, Zima J (eds) (1999) The atlas of European mammals. Poyser Natural History, London
Mohr E (1950) Die freilebenden Nagetiere Deutschlands und der Nachbarländer. G. Fischer, Jena
Müller JP, Jenny H, Lutz M, Mühletaler E, Briner T (2010) Die Säugetiere Graubündens, eine Übersicht. Desertina, Chur
Murariu D (2000) Fauna Romaniei. Mammalia. Vol. XVI Fasc. 1 Insectivora. Ed. Acad. Romane, Bucuresti
Murariu D, Chişamera G, Măntoiu DŞ, Pocora I (2016) Romanian Fauna. Mammalia, 16(3) Chiroptera. Romanian Academy, Bucharest. (in English)
Niethammer J, Krapp F (1978–1992) Handbuch der Säugetiere Europas, vol 1–6. Akademische Verlagsgesellschaft & AULA-Verlag, Wiesbaden
Ognev SI (1962–1966) Mammals of U. S. S. R. and adjacent countries, vols 1–7. Israel Program for Scientific, Jerusalem
Osgood WH (1944) Bibliographical memoire of Clinton Hart Merriam 1855–1942. Bibliogr Memoir Nat Acad Sci U S A 24:1–57
Palomo LJ, Gisbert J (eds) (2002) Atlas de los mamíferos terrestres de Espana. Dirección General de Conservación de la Naturaleza – SECEM-SECEMU, Madrid
Pavlinov IY, Kruskop SV, Varshavskij AA, Borisenko AV (2002) Terrestrial mammals of Russia. KMK, Moscow. (in Russian)
Pelikán J, Gaisler J, Rödl P (1979) Nasi savci. Albatros, Nakladatel
Peshev TH, Peshev DT, Popov VV (2004) The fauna of Bulgaria. 27. Mammalia. Edition Academia "Marin Drinov", Sofia
Petrov BM (1992) Mammals of Yugoslavia. Insectivores and rodents. Nat Hist Museum Belgrade (Supplementa Special Issues) 37:1–186
Popescu A, Murariu D (2001) Romania's Fauna, Mammalia16 (2), Rodentia. Bucureşti, Editura Academiei Române. (in Romanian)
Popov VA (1960) Mammals of the Volga-Kama region. Insectivores, bats, rodents. Academy of Sciences of the USSR, Kazan branch, Kazan. (in Russian)
Pucek Z (1983) Keys to vertebrates of Poland. Mammals. PWN-Polish Scientific Publishers, Warszawa
Puzek Z, Raczynski J (1983) Atlas rozmieszczenia ssaków W Plsce mapy. Polska Akademia Nauk, Zaklad Badania Ssakow. PWN-Polish Scientific Publishers, Warszawa
Rahm U (1976) Die Säugetiere der Schweiz. Veröffentlichungen aus dem Naturhistorischen Museum Basel 9:1–87
Rebel H (1933) Die freilebenden Säugetiere Österreichs als Prodromus einer heimischen Mammalienfauna. Österreichischer Bundesverlag für Unterricht, Wissenschaft und Kunst, Wien/Leipzig
Rode P, Didier R (1946) Atlas des mammifères de France. N. Boubée & Cie, Paris
Rodríguez JL (1993) Guía de campo de los mamíferos terrestres de Espana. Ediciones Omega, Barcelona
Saint Girons M-C (1973) Les mammifères de France et de Benelux (fauna marine exceptée). Doin, Paris
Schäff E (1911) Die wildlebenden Säugetiere Deutschlands. J. Neumann, Neudamm
Schiebinger L (1993) Nature's body: gender in the making of modern science. Beacon-Press, New Brunswick
Schilling D, Singer D, Diller H (1983) BLV Bestimmungsbuch Säugetiere. 181 Arten Europas. BLV, München
Schmiedeknecht O (1906) Die Wirbeltiere Europa's mit Berücksichtigung der Faunen von Vorderasien und Nordafrika. Fischer, Jena
Serzhanin IN (1955) Mammals of the Belarus Soviet Socialist Republic. Academy of Sciences of the Belarus Soviet Socialist Republic, Minsk. (in Russian)
Shamel HH, Miller AG, Schwarz E, Clark AH, Bartsch P, Jackson HHT, Wright AH, Howell AB, Rehn JAG, Miller GS Jr, Johnson DH (1954) Gerrit Smith Miller, Jr. J Mammal 35:317–344
Shlyakhtin GV, Il'in VY, Oparin ML, Beljachenko AV, Bystrakova NV, Ermakov OA, Zav'jalov EV, Zakharov KS, Kaybeleva EI, Koshkin VA, Kurmaeva NM, Luk'yanov SB, Mosolova EY, Oparina OS, Semikhatova SN, Smirnov DG, Sonin KA, Tabachishin VG, Titov SV, Filip'echev AO, Khuchraev SO, Yakushev NN (2009) Mammals of the Northern Lower-Volga region. Vol. I. Theriofauna composition. Saratov University Press, Saratov. (in Russian, English abstract)
Siivonen L (1968) Nordeuropas däggdjur. P. A. Norstedt & Söners, Stockholm
Siivonen L (1972) Suomen nisäkkäät 1. Helsingissä kustannus osakeyhtiö, Otavo
Spagnesi M, de Marinis AM (eds) (2002) Mammiferi d'Italia. Quaderni di Conservacione della Natura 14:1–309
Spagnesi M, Toso S, de Marinis A M (eds) (2000) Italian mammals. Ministerio dell'Ambiente: Servicio Conservazione della Natura and Istituto Nazionale per la Fauna Selvativa A Ghigi
Spitzenberger F (2001) Die Säugetierfauna Österreichs. Grüne Reihe des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Graz
Stroganov SU (1949) Key to the Mammals of Karelia. Karelian-Finnish State University, Petrozavodsk. (in Russian)
Stüber E, Lindner R, Jerabek M (2014) Die Säugetiere Salzburgs. Haus der Natur, Salzburg
Tatarinov KA (1956) Mammals of western parts of Ukraine. Academy of Sciences of the Ukrainian Soviet Republic, Kiev. (in Ukrainian)
Temple HJ, Cuttelod A (2008) The status and distribution of Mediterranean mammals. IUCN, Gland/Cambridge

Temple HJ, Terry A (2007) The status and distribution of European mammals. Office for Official Publications of the European Communities, Luxembourg

Thorburn A (1920) British mammals, vols I, II, London, Longmans, Green & Co

Toschi A (1965) Fauna d'Italia. Mammalia. Lagomorpha. Rodentia. Carnivora – Artiodactyla. Cetacea. Edizioni Calderini, Bologna

Toschi A, Lanza B (1959) Fauna d'Italia. Mammalia. Generalità, Insectivora. Chiroptera. Edizioni Calderini, Bologna

Trouessart E-L (1910) Faune des mammifères d'Europe. Friedländer & Sohn, Berlin

Twisk P, van Diepenbeeck A, Bekker JP (2010) Veldgids Europese zoogdieren. Zeist, KNNV Uitgeverij

van den Brink FH (1955) Zoogdierengids van Europa ten westen van 30° oosterlengte. Elsevier, Amsterdam/Bruxelles

van Wijngaarden A, van Laar V, Trommel MDM (1971) De verspreiding van de Nederlandse zoogdieren (Mammalia: Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Pinnipedia, Artiodactyla). Lutra 13:1–42 + 64 maps

Vechkanov VS, Kuznetsov VA, Al'ba LD, Ruchin AB (2004) Mammals of Mordovia. University of Mordovia, Saransk. (in Russian)

Vericad JR (1972) Estudio faunístico y biológico de los mamíferos del Pirineo. Publicaciones de Centro Pirenaico de Biologia experimental 4:7–232 + 56 photos

von Lehmann E (1963) Die Säugetiere des Fürstentums Liechtenstein. Jahrbuch des Historischen Vereins im Fürstentum Liechtenstein 62:159–362

Wilson DE, Reeder DA (eds) (2005) Mammal species of the World. A taxonomic and geographic reference, 3rd edn. The Johns Hopkins University Press, Baltimore

Wilson DE, Lacher TE, Mittermeier RA (eds) (2009-2019) Handbook of the mammals of the world, vols 1–8. Lynx Edicions, Barcelona

Zagorodniuk I (2017) Vaysl Abelentsev (1913–1980): Life in the world of science. Proceedings of the theriological school 15:167–174 (in Ukrainian)

Zaytsev MV, Voyta LL, Sheftel BI (2014) Mammals in the fauna of Russia and adjacent regions. Insectivores. Russian Academy of Sciences. Institute of Zoology, Sankt-Petersburg. (in Russian)