

Group of organisms	Geographic range in the line of origin	Stratigraphic range Earth fossil record	Expected origin based on phylogenetic analysis	Biodiversity over time selection scale	Special characteristics	Present geographic range	Social idea?	Population size ranges	Genetic reproduction system	Castes	
Ants	[1] Origin in Pterophorid angiosperms [2] Ants first appeared in fossil record in parallel to growth of angiosperm habitat	[2][3] Boundary between early and late Cretaceous (100 Mya-rc)	[1] Cretaceous fossil record and angiospores preserved is at ~120 Ma. This is the earliest evidence of ant fossils from an earlier time. Ants (Cretaceous-angiospermic) were lineage still united, molecular clock dating 120-130 Mya	[2][3] High initial diversity already 100 mya. Cretaceous diversity increased rapidly after the Cretaceous/Tertiary (KT) boundary into Cenozoic	[4] Some ant species in Cretaceous include ants with other niches such as aphids and guard them or the honeyevel which aphids produce	[5] Worldwide- 8 biogeographic regions: Neotropic, Afrotropic, Nearctic, Malagasy, Palearctic, Indo-Malayan, Oceania, Australasia	In what way does such early diversity of ants (100 mya) in the fossil record correspond to material and angiosperm distribution at the time?	From just a few individuals to millions. Even seasonal changes affect some populations.	[7] Oviparous- winged females mate with males and lay eggs. Queen starts a colony. Egg hatched larvae	[8]Wide variety of morphological castes- workers, subterranean workers, queens and queens	
Spongiformae	[6] Spongiformae originated in Southeast Asia (Asia)	[2] Late Cretaceous-rc	[10][11] [15] Spongiformae subfamily of Vespoidea	[12] Considerable diversity in social behaviour	Intermediate position between isolated Eusocial and eusocial bivalve/monocarp. Because of this it is important for study of eusocial evolution in wasps [12]	[13] Spongiformae- East Asian tropics	[14] Social wasps are not closely related to ants and bees. Unlike bees, many eusocial wasps are omnivorous. How does eusociality evolution in wasps correspond with that in bees since they are both flying hymenoptera	[15] Spongiformae- from 10 to 32 individuals, small populations	[16] Spongiformae- central females lay the most eggs	[17] Spongiformae- queens and workers	
Polyadenidae + Vespoidea	[18] Polyadenidae + Vespoidea thought to originate in Laurasia	[2] Late Cretaceous-rc	[19][21] Vespoidea subfamilies Polyadenidae+Vespoidea	[20] About 4000 species today		[18] Polyadenidae+Vespoidea- widespread, cosmopolitan, temperate regions and tropics		Populations in the range from 20 to 40 or more individuals. Vespoidea numbers can reach >2000 individuals [2][22]	[22] Polyadenidae, Vespoidea- One female among several becomes queen which then lays eggs. Vespoidea- Single queen founds a colony	Polyadenidae- queens and workers. Vespoidea- that do not become dominant queen become workers. Vespoidea- queens and workers, morphologically indistinguishable [22]	
Bees	[24] Laurasia (most bees found in Baltic Amber) [25] Asia, Europe, Africa, Australia (Australia- Cretaceous origin) [26] North America (North America- Cretaceous origin) [27][28] Maldives, 80-74 Ma Cretaceous-rc Age= 50-55 Ma Paleocene/Eocene-rc		Primitive eusocial bees about 90 Ma, advanced eusocial bees about 69 Ma (Paleocene/Eocene-rc)[28]	[28] Diversified to use after Cretaceous		[28] Cosmopolitan (Europe, Asia, Africa, ...)		[30] Up to 50 000-60 000 individuals	[31] Queens, Queens start a colony after mating right with male	[29] Queens, drones and workers	
Emarginatae	[32] For east Asia, Sahalin Amber; oldest fossil?	[32] Middle Eocene-rc	[33] Family Emarginatae is part of the superfamily Chalcidoidea (parasitic wasps)	[34] Very diverse family containing about 3700 species	Eurytomidae are polyembryonic- multiple embryos develop from a single egg (multiple genetically identical offspring) [35]	Cosmopolitan		Today Eurytomidae are used to control pests like the European corn borer. They are also used to pollinate plants related to great numbers for example 1,250 adult individuals [36]	[36] Euphorinae	Reproductive lineages that develop into adult winged females and unfertilized eggs that become a sterile soldier caste. [36]	
Auchenorrhyncha + Cicadomorpha	[37] Truest and examples. Most basal species of Auchenorrhyncha are found in Baltic amber and some in Baltic amber	[38] Mid Cretaceous-rc	[39] Auchenorrhyncha belongs to Psylloidea which is a subfamily derived within Stenozyginae	[40] Major diversification during Cretaceous following angiosperm diversification	[41] The Auchenorrhyncha belongs (syntaxis with antiochid fungi) also present in ants and termites	[42] Australia	The presence of fungi gardening- did this symbiosis evolve independently in different groups? Or did it spread from ants to termites? Similar environmental conditions or fossils? The most recent common ancestor evolved around 60-65 mya ago in the Amazon basin [43]	[44] Colonies of 6-7 members	[45] Individual or a pair start to bore into wood and lay eggs. Ovipositor	One reproductive female system (no colony).卵生和孤雌生殖是通过在森林中产卵、产卵和孤雌生殖实现的。[44][45][47]	
Socidae	[46] France, probably all Eurasia	[48] 60 Ma Cenomanian-Turonian amber	[49] 127 Ma	[48] Holopeltis	[48] Character analysis reveals origin of this group is predominantly on Macrophyllales	N/A	Long paleo might seem for carboxinization unknown in living termites [46]	[48] Probably at lower possible value	Unknown	Unknown	
Histeridae	[50] Russia, cosmopolitan	[52] 127 Ma Chernovian Kogi- present	[49] 127 Ma	[51] Rare until Eocene	[52] Post in the present	Australia		Colonies are usually small but if the conditions are right they can breed to astonishing size of millions of individuals [52]	Primary status (male and female) male and star a colony. Female produces an egg mass [52]	[54] Queen, Reproductive status, Neotenic reproduces, workers, soldiers	
Estheriidae	Histeridae- Puzzling paleobiogeography. Eurasia, North America (USA), South America (Argentina) and Australia (Baltic Amber) and suggested origin of the group suggests the origin of the group was in South America. Today the family consists of three sister groups with about 1000 species. The sister group to the Histeridae is the Kateretidae. The Kateretidae is sister to the Estheriidae. Another sisterly clade to the Estheriidae is the Termitidae. This termite family is adapted to live in the soil. The Estheriidae is sister to the Termitidae which can be seen in their developed mechanism for dispersal. The Estheriidae are found in tropical rainforests as pests (they are widely distributed because of global wood trade). They are found in the tropical rainforest and in subtropical and temperate forests (Mediterranean, Histeridae and Kateretidae). The Estheriidae are found in Australia and New Zealand. Histeridae- Distribution in Eurasia. 5 fossil genera [53][54]	Histeridae- Wide paleobiogeographic distribution already in Cretaceous time suggest that distribution has been stable since then. Many species are found in subtropical and temperate regions. Many species are found in deserts and semideserts of North Africa, North America (USA) and Australia (Baltic Amber) and suggested origin of the group suggests the origin of the group was in South America. Today the family consists of three sister groups with about 1000 species. The sister group to the Histeridae is the Kateretidae. The Kateretidae is sister to the Estheriidae. Another sisterly clade to the Estheriidae is the Termitidae. This termite family is adapted to live in the soil. The Estheriidae is sister to the Termitidae which can be seen in their developed mechanism for dispersal. The Estheriidae are found in tropical rainforests as pests (they are widely distributed because of global wood trade). They are found in the tropical rainforest and in subtropical and temperate forests (Mediterranean, Histeridae and Kateretidae). The Estheriidae are found in Australia and New Zealand. Histeridae- Distribution in Eurasia. 5 fossil genera [53][54]	Histeridae- These termites forage for grass and can have a serious impact on grasslands and erosion of soil. Histeridae- Many species are found in subtropical and temperate regions. Many species are found in deserts and semideserts of North Africa, North America (USA) and Australia (Baltic Amber) and suggested origin of the group suggests the origin of the group was in South America. Today the family consists of three sister groups with about 1000 species. The sister group to the Histeridae is the Kateretidae. The Kateretidae is sister to the Estheriidae. Another sisterly clade to the Estheriidae is the Termitidae. This termite family is adapted to live in the soil. The Estheriidae is sister to the Termitidae which can be seen in their developed mechanism for dispersal. The Estheriidae are found in tropical rainforests as pests (they are widely distributed because of global wood trade). They are found in the tropical rainforest and in subtropical and temperate forests (Mediterranean, Histeridae and Kateretidae). The Estheriidae are found in Australia and New Zealand. Histeridae- Three sister genera: Anoplotermes- deserts and semideserts of North Africa, North America (USA) and Australia (Baltic Amber) and suggested origin of the group suggests the origin of the group was in South America. Today the family consists of three sister groups with about 1000 species. The sister group to the Histeridae is the Kateretidae. The Kateretidae is sister to the Estheriidae. Another sisterly clade to the Estheriidae is the Termitidae. This termite family is adapted to live in the soil. The Estheriidae is sister to the Termitidae which can be seen in their developed mechanism for dispersal. The Estheriidae are found in tropical rainforests as pests (they are widely distributed because of global wood trade). They are found in the tropical rainforest and in subtropical and temperate forests (Mediterranean, Histeridae and Kateretidae). The Estheriidae are found in Australia and New Zealand. Histeridae- One female, after breeding, reproductive males and females (males) increase. Termitidae- One female reproduces males and females (males) increase. Kateretidae- Queen, workers, soldiers, queens and workers. Kateretidae- Queen, workers, soldiers, queens and workers. Queen, workers, soldiers and workers (queens after nuptial flight, survive offspring, lay eggs to form a new colony) [55][56][57][58][59]	[52] Up to 300 soldiers (Hemiptera obsoletipennis)	Colon- highly mobile and independent clones. Parthenogenesis- reproduction without males and parthenogenesis [58]	Progress and morphological/developmental differences between esterines [57]					
Phaenothripidae (Phaenothripidae)	[58] Stable tropical and subtropical forest of Northern Europe (Baltic Amber)	[58] Phaenothripidae- Neogene (Miocene)-rc, Baltic amber	[59] Phaenothripidae- one of the most diverse families along with Psylloidae. This is consistent with the broad record for these two families (Cretaceous, Tertiary) [58]	[59] Major diversification in the early Cretaceous parallel to angiosperms	Aphids form galls in a host tissue in which the colony lives and feeds. That even use plant vascular systems for waste removal and absorption [58]	[60] c. 4000 species most come from temperate climate and most are rare in the tropics			[62] Up to 10 000 adults and larvae	[63] Hemipteroid, Oviposition- Single female, apterous, may fly. Queen may mate with multiple males, initiates the gall and lays eggs. Dated	Gall forming female, morphology and development of gall associated with gall formation [58][59]
Synaphidae (Synaphidae)	[65] Caribbean	[65] Miocene-rc	Gasterophilidae- second group. Synaphidae- Eusocially divided into two main groups [65]	Major diversification during Upper Miocene/Middle Pliocene c. 5-7 mya (corresponding with increase of Parasite cleaving) and a second onshore c. 4 mya [65]	Thrips also form galls which provide food and shelter for them	[67] Gall Thrips (Thysanoptera: Phaenothripidae)- Large subfamily. Thysanoptera contains 14 families, common in North temperate regions. Many species are found in subtropical and temperate Lepidoptera worldwide but particularly in warmer habitats and Phaenothripidae occurs worldwide.	[67] The size of the colony in Synaphidae regulae is in correlation with this size of the breeding female	[68] Tropical/West African, tropical reefs, intercoastal sponges	[69] Colonies of >300 individuals	[69] Oviparous- reproduction males confined by epipharynx to female eggs. Dated	One reproductive female, reproduction delayed until after eclosion?, developing ovaries [68]
Termitidae (Termitidae)	[70] Sub-Saharan Africa	[10] Miocene-rc, three extinct species found no older than miocene	Closely related species link with the suborder Hydroxyphaga (pogonomyrmecines, guineas diges and chinichines) [10]	Three extinct species- today Naked mole-rat and Damantid mole-rat are known [10]	Naked mole rats contain a special caste, the disperger. Individuals of this cast are large in size, have high amounts of stored energy and are sterile. They move well for the opportunity to escape. They have the ability to live entirely in the ground to live with the queen female. [10]	[104] East Africa	An extreme environmental condition the cause of eusociality in these insects? Why did the disperger caste evolve?	[105] Colonies of up to 80 individuals	[105] Vespertilio, live birth	one (nearly two) queen, handful of male reproduction and non-breeding workers [103]	
Homo/Hymenoptera	[106] Africa (Homo habita) [107]	[107] 2.1 Ma	[108] 3.95 Ma	Fossil African population thought to be small (around 10 000 breeding individuals). After leaving Africa rapid spread and diversification. Fossil hominid population in East Africa shows dramatic changes. Total population in year of 7.5 billion individuals [108]	Significant impact of the increasing human population on the environment [109]	Cosmopolitan	All the beginning of Homo/Hymenoptera the climate became warmer c. 2.5 million years ago and these conditions were ideal for the advent of agriculture which in turn influenced the rapid development of civilization [110][111][112]	[113] 27 individuals	clue to monogamy (recent shift from polygyny) [114]	no indications in Indian system. Indian caste system as a consequence of social and economic stratification [113]	

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