



## The entomological diversity of Pokémon

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Pocket Monsters or as they are better known, Pokémon, are playable monsters which first appeared in the 1990's as a video game in Japan, but soon expanded worldwide. They are still very successful with numerous games, a TV series, comic books, movies, toys and collectibles, additionally to the trading card game and video games. Most recently the release of Pokémon GO, an augmented reality game for smartphones, meant that Pokémon became as popular as never before. The game launched in 2016 and almost 21 million users downloaded it in the very first week in the United States alone (Dorwald et al., 2017).

The games and TV series take place in regions inhabited by humans and Pokémon. Each Pokémon lives in a specific environment (forests, caves, deserts, mountains, fields, seas, beaches, mangroves, rivers, and marshes). The humans try to catch Pokémon with Pokéballs, a device that fits even the largest Pokémon but that is still small enough to be placed into a pocket, hence the name Pocket Monster (Whitehill et al., 2016). After Pokémon have been caught, they are put to fight against each other, just like in the real world, in which humans (unfortunately) let cockerels, crickets, or dogs fight (Marrow, 1995; Jacobs, 2011;

Gibson, 2005). The origin of Pokémon goes back to the role-playing game created by Satoshi Tajiri and released by Nintendo for the Game Boy (Kent, 2001). Tajiri was not only a game developer, but like many Japanese adults, grew up catching insects as a child. He wanted to design a game so that every child in Japan could play and let their critters fight, even if they lived in areas which are too densely populated to find insects in the wild. This resulted in the 151 Pokémon in the first versions of the game ("first generation"), with each version adding more Pokémon.

Today, there are 807 Pokémon (seventh generation). Almost all are based on real organisms (mostly animals, but many plants as well), while some depict mythological creatures or objects (e.g., stones, keys). Each Pokémon belongs to one or two of the following 18 types: Normal, Fire, Fighting, Water, Flying, Grass, Poison, Electric, Ground, Psychic, Rock, Ice, Bug, Dragon, Ghost, Dark, Steel, and Fairy (Bulbapedia, 2018). All Pokémon in the game are oviparous, which means they all lay eggs; probably because the creator was fond of insects or just for practical reasons.

Certain Pokémon also evolve; however, this kind of evolution is not the same as the

biological concept of evolution. In Pokémon evolution is largely synonymous to metamorphosis, such as when a caterpillar turns into a butterfly. As this is the core concept of the game, almost all Pokémon evolve, not only the insects, but also mammals, rocks, and mythological creatures. Usually, they evolve with a complete or incomplete metamorphosis: either they just grow larger, or their look differs significantly between the adult and the young stages.

Insects are the largest group of organisms on earth (Zhang, 2011). There are more than one million described species of insects, of a total of 1.8 million known organisms (Zhang, 2011). They occupy all terrestrial environments (forests, fields, under the soil surface, and in the air) and freshwater; some are even found in the ocean. Additionally, they show a wide range of morphological and behavioral adaptations. This biodiversity is not reflected in the Pokémon world. In the present Generation VII, only 77 of the 807 Pokémon are “Bug type”: about 9.5% of all Pokémon. The aim of this work is to describe the entomological diversity of Pokémon based on taxonomic criteria of the classification of real insects.

## METHODOLOGY

The Pokédex was the source of primary information on Pokémon (Pokémon Website, 2018). The criteria to identify insects are either based on the type (Bug type) or morphology (resembles a real insect). Afterwards, the insect Pokémon were classified to the lowest possible taxonomic level (family, genus, or species) according to their real world counterparts. This classification of the Pokémon allowed the

comparison of their biological data (such as ecological or morphological traits; Bulbapedia, 2018) with the current knowledge of real insects. The information of the biology of real insects is largely based on Borror et al. (1981).

## RESULTS

Not all Bug types are insects; many of them represent other arthropods, like spiders, while some are from other invertebrate groups (Table 1). Also, five insect Pokémon do not belong to the Bug type (*e.g.*, Trapinch (#328) is a Ground type; Table 2). In total, insects represent only 62 of the 807 Pokémon. In comparison, the vertebrate groups are overly well-represented by birds (61), mammals (232), reptiles (57), amphibians (23), and fishes (39) (Table 3).

Eleven insect orders are represented in the Pokémon world, namely Blattodea (with 1 Pokémon), Coleoptera (11), Diptera (3), Hemiptera (7), Hymenoptera (6), Lepidoptera (22), Mantodea (4), Neuroptera (3), Odonata (2), Orthoptera (2), Phasmatodea (1). They are listed below in systematic order.

### **Order: Odonata**

#### **Families: Libellulidae and Aeshnidae**

Genera: *Erythrodiplax* and *Anax*

*Yanma* (#193) evolves to *Yanmega* (#469).

*Yanma* is a large, red dragonfly Pokémon. Like all dragonflies and damselflies, it lives near the water and hunts other insects for food. *Yanma* is territorial and prefers wooded and swampy areas. Based on its appearance, it belongs to the dragonfly family Libellulidae, and further to the genus *Erythrodiplax* Brauer, 1868.

**Table 1.** List of the 20 Pokémon that are Bug type, but are not insects. Mostly, they belong to other groups within the phylum Arthropoda.

Pokédex #	Name	Type	Subphylum	Class	Order	Family, Genus, Species
167	Spinarak	Bug / Poison	Chelicerata	Arachnida	Aranae	Theridiidae, <i>Theridion grallator</i> (happy-face spider)
168	Ariados	Bug / Poison	Chelicerata	Arachnida	Aranae	Salticidae, jumping spider
213	Shuckle	Bug / Rock	n/a	n/a	n/a	possibly an endolithic fungi
347	Anorith	Rock / Bug	n/a	Dinocaridida	Radiodonta	<i>Anomalocaris</i>
348	Armaldo	Rock / Bug	n/a	Dinocaridida	Radiodonta	<i>Anomalocaris</i>
451	Skorupi	Poison / Bug	Chelicerata	Arachnida	Scorpiones	generalized scorpion
543	Venipede	Bug / Poison	Crustacea	Malacostraca	Isopoda	woodlouse
544	Whirlipede	Bug / Poison	Crustacea	Malacostraca	Isopoda	woodlouse
545	Scolipede	Bug / Poison	Myriapoda	Chilopoda	n/a	centipede
557	Dwebble	Bug / Rock	Crustacea	Malacostraca	Decapoda	hermit crab
558	Crustle	Bug / Rock	Crustacea	Malacostraca	Decapoda	hermit crab
595	Joltik	Bug / Electric	Chelicerata	Arachnida	Ixodida	tick
596	Galvantula	Bug / Electric	Chelicerata	Arachnida	Aranae	Theraphosidae, tarantula
616	Shelmet	Bug	Conchifera	Cephalopoda	Nautilida	nautilus
617	Accelgor	Bug	Conchifera	Cephalopoda	Nautilida	nautilus
649	Genesect	Bug / Steel	n/a	n/a	n/a	man-made insectoid creature
751	Dewpider	Water / Bug	Chelicerata	Arachnida	Aranae	Dictynidae, <i>Argyroneta aquatica</i> (diving bell spider)
752	Araquanid	Water / Bug	Chelicerata	Arachnida	Aranae	Dictynidae, <i>Argyroneta aquatica</i> (diving bell spider)
767	Wimpod	Bug / Water	Crustacea	Malacostraca	Isopoda	isopod
768	Golisopod	Bug / Water	Crustacea	Malacostraca	Isopoda	isopod

Yanmega on the other hand is a large, dark green Pokémon. It is actually a different real-world species. Not only the colors are different, but also the morphology, like the appendages on the tip of the tail. Based on this, it belongs to the dragonfly family Aeshnidae, and to the genus *Anax* Leach, 1815. One could argue that it is based on *Meganeura* Martynov, 1932, a very large (wingspan up to 70 cm) but extinct dragonfly genus from the Carboniferous Period. However, the size alone should not be the indicator to classify the species, as many insectoid species are larger in the Pokémon world compared to the real world.

**Order: Mantodea**

**Family: Mantidae**

*Scyther* (#123) evolves to *Scizor* (#212, incl. *Mega-Scizor*).

Scyther is a bipedal, insectoid Pokémon. It is green with cream joints between its three body segments, one pair of wings and two large, white scythes as forearms. Scyther camouflages itself by its green color. Based on its appearance, it is classified as a praying mantis (or possibly a mantidfly).

Scizor is also a bipedal, insectoid Pokémon. It is primarily red with grey, retractable forewings. Scizor's arms end in large, round pincers. It appears to be based on a praying mantis, maybe with some references to flying red ants and wasp-mimicking mantidflies.

Although Scizor evolves from Scyther, they are very different and would actually be two different real-world species. Not only are the colors different, but also the morphology: the arms end in either scythes or pincers; Scyther has one pair of wings, Scizor has two.

**Table 2.** Taxonomic classification of the insect Pokémon (Arthropoda: Hexapoda: Insecta). All images are official artwork from *Pokémon* games (obtained from Bulbapedia, 2018). An asterisk (\*) denotes Pokémon that are not Bug type.










Pokédex #	Name	Figure	Type	Order	Family
10	Caterpie		Bug	Lepidoptera	Papilionidae
11	Metapod		Bug	Lepidoptera	Papilionidae
12	Butterfree		Bug / Flying	Lepidoptera	Papilionidae
13	Weedle		Bug / Poison	Hymenoptera	Tenthredinidae
14	Kakuna		Bug / Poison	Hymenoptera	Tenthredinidae
15	Beedrill		Bug / Poison	Hymenoptera	Tenthredinidae
46	Paras		Bug / Grass	Hemiptera	Cicadidae
47	Parasect		Bug / Grass	Hemiptera	Cicadidae
48	Venonat		Bug / Poison	Lepidoptera	Geometridae

Table 2. (cont.)











Pokédex #	Name	Figure	Type	Order	Family
49	Venomoth		Bug / Poison	Lepidoptera	Arctiidae
123	Scyther		Bug / Flying	Mantodea	Mantidae
127	Pinsir		Bug / Flying	Coleoptera	Lucanidae
165	Ledyba		Bug / Flying	Coleoptera	Coccinellidae
166	Ledian		Bug / Flying	Coleoptera	Coccinellidae
193	Yanma		Bug / Flying	Odonata	Libellulidae
204	Pinenco		Bug	Lepidoptera	Psychidae
205	Forretress		Bug / Steel	Lepidoptera	Psychidae
212	Scizor		Bug / Steel	Mantodea	Mantidae
214	Heracross		Bug / Fighting	Coleoptera	Scarabaeidae

Table 2. (cont.)











Pokédex #	Name	Figure	Type	Order	Family
265	Wurmple		Bug	Lepidoptera	Nymphalidae, Saturniidae
266	Silcoon		Bug	Lepidoptera	Nymphalidae
267	Beautifly		Bug / Flying	Lepidoptera	Nymphalidae
268	Cascoon		Bug	Lepidoptera	Saturniidae
269	Dustox		Bug / Poison	Lepidoptera	Saturniidae
283	Surskit		Bug / Poison	Hemiptera	Gerridae
284	Masquerain		Bug / Flying	Hemiptera	Fulgoridae
290	Nincada		Bug / Ground	Hemiptera	Cicadidae
291	Ninjask		Bug / Flying	Hemiptera	Cicadidae
292	Shedinja		Bug / Ghost	Hemiptera	Cicadidae

Table 2. (cont.)




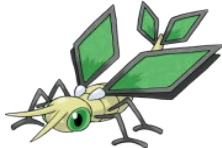






Pokédex #	Name	Figure	Type	Order	Family
313	Volbeat		Bug	Coleoptera	Lampyridae
314	Illumise		Bug	Coleoptera	Lampyridae
328	Trapinch *		Ground	Neuroptera	Myrmeleontidae
329	Vibrava *		Ground / Dragon	Neuroptera	Myrmeleontidae
330	Flygon *		Ground / Dragon	Neuroptera	Myrmeleontidae
401	Kricketot		Bug	Orthoptera	Grillidae
402	Kricketune		Bug	Orthoptera	Grillidae
412	Burmy		Bug	Lepidoptera	Psychidae
413	Wormadam		Bug / Grass / Ground / Steel	Lepidoptera	Psychidae
414	Mothim		Bug / Flying	Lepidoptera	Psychidae

Table 2. (cont.)














Pokédex #	Name	Figure	Type	Order	Family
415	Combee		Bug / Flying	Hymenoptera	Apidae
416	Vespiqueen		Bug / Flying	Hymenoptera	Apidae
469	Yanmega		Bug / Flying	Odonata	Aeshnidae
540	Sewaddle		Bug / Grass	Lepidoptera	Tortricidae
541	Swadloon		Bug / Grass	Lepidoptera	Hesperiidae
542	Leavanny		Bug / Grass	Phasmatodea	Phylliidae
588	Karrablast		Bug	Coleoptera	Elateridae
589	Escavalier		Bug / Steel	Coleoptera	Elateridae
632	Durant		Bug / Steel	Hymenoptera	Formicidae
636	Larvesta		Bug / Fire	Lepidoptera	Saturniidae



Table 2. (cont.)

Pokédex #	Name	Figure	Type	Order	Family
637	Volcarona		Bug / Fire	Lepidoptera	Saturniidae
664	Scatterbug		Bug	Lepidoptera	Riodinidae
665	Spewpa		Bug	Lepidoptera	Riodinidae
666	Vivillon		Bug / Flying	Lepidoptera	Riodinidae
736	Grubbin		Bug	Coleoptera	Lucanidae
737	Charjabug		Bug / Electric	Coleoptera	Lucanidae
738	Vikavolt		Bug / Electric	Coleoptera	Lucanidae
742	Cutiefly		Bug / Fairy	Diptera	Bombyliidae
743	Ribombee		Bug / Fairy	Diptera	Bombyliidae
753	Fomantis *		Grass	Mantodea	Mantidae

**Table 2.** (cont.)

Pokédex #	Name	Figure	Type	Order	Family
754	Lurantis *		Grass	Mantodea	Mantidae
794	Buzzwole		Bug / Fighting	Diptera	Culicidae
795	Pheromosa		Bug / Fighting	Blattodea	n/a

**Table 3.** Comparison between the diversity of Pokémon “species” and their respective representatives in the natural world (Zhang, 2011).

Pokémon		Nature	
Group	# of “species”	Group	# of species
Insects	62 (13.1%)	Insects	1,020,007 (66.0%)
Birds	61 (12.9%)	Birds	9,990 (0.9%)
Mammals	232 (48.9%)	Mammals	5,750 (0.5%)
Reptiles	57 (12.0%)	Reptiles	9,413 (0.9%)
Amphibians	23 (4.9%)	Amphibians	7,694 (0.7%)
Fishes	39 (8.2%)	Fishes	31,958 (2.9%)

foes (and prey). It also disguises itself as a Bug Pokémon for self-defense. Lurantis is likely based on the orchid mantis as well as the orchid flower itself, as it is impossible to say where the flower ends and the insect starts. Orchid mantises mimic parts of a flower, by making their legs look like flower petals. Well camouflaged, they can wait for their prey, which will visit the flower for nectar.

*Fomantis (#753) evolves to Lurantis (#754).*

Fomantis is a plant-like and, at the same time, an insect-like Pokémon. Its main body is pink, with green hair, green tufts on the head, and green leaves as a collar. Fomantis is somewhat bipedal and is likely based on the orchid mantis *Hymenopus coronatus* Olivier, 1792 (Fig. 1), which is known for being able to mimic the orchid flower, along with the orchid itself.

Lurantis is also plant- and insect-like. It is pink, white, and green. Lurantis looks and smells like a flower, to attract and then attack

### Order: Blattodea

*Pheromosa (#795).*

Pheromosa is a bipedal anthropomorphic Pokémon. It has a rather slender build and is mostly white. Pheromosa originates from the Ultra Desert dimension in Ultra Space. Pheromosa is based on generic cockroaches just after they have molted (Fig. 2); during this stage, the animals are pale and vulnerable until their exoskeleton hardens and darkens.



**Figure 1.** Adult male of *Hymenopus coronatus*. Credit: Sander van der Wel (2010), Wikimedia Commons.

**Order: Orthoptera**  
**Family: Gryllidae**

*Kricketot (#401) evolves to Kricketune (#402).*

Kricketot is a bipedal, bug-like Pokémon. It has a red body with some black and white markings. By shaking its head and rubbing its antennae together, it can create a sound that it uses to communicate. Based on its appearance, it is a cricket.

Kricketune is also a bipedal Pokémon with an insectoid appearance, also primarily red with some black and tan colored markings. It can produce sound by rubbing its arms on the abdomen. Kricketune appears to be based on crickets due to their sound-producing ability, but it somewhat resembles a violin beetle.

Both Kricketot and Kricketune are depicted with only 4 limbs, whereas insects are largely defined by having exactly six legs.



**Figure 2.** A freshly-molted cockroach (family Blattidae), leaving its exuvia behind. Credit: Donald Hobern (2010), Wikimedia Commons.

**Order: Hemiptera**  
**Families: Gerridae and Fulgoridae**

*Surskit (#283) evolves to Masquerain (#284).*

Surskit is a blue insectoid Pokémon with some pink markings. It produces some sort of syrup, which is exuded as a defense mechanism or to attract prey. This Pokémon can also secrete oil from the tips of its feet, which enables it to walk on water as though skating. Surskit usually inhabits ponds, rivers, and similar wetlands, where it feeds on microscopic, aquatic organisms. This Pokémon is based on water striders. However, a water strider does not ooze syrup and neither does it need oil to walk on water; it can walk on water due to the natural surface tension.

Masquerain is a light blue Pokémon with two pairs of wings. On either side of its head is a large antenna that resembles an angry eye. These eyespots are used by many real-life moths and lantern-flies to confuse and

intimidate would-be predators. Masquerain is in fact based on a lantern-fly.

Both “species”, water striders and lantern-flies, are only distantly related, belonging to two different families within the “true bugs” (Hemiptera).

### Family: Cicadidae

*Nincada* (#290) evolves to *Ninjask* (#291) and then to *Shedinja* (#292).

Nincada is a small, whitish, insectoid Pokémon. The claws are used to carve the roots of tree and absorb water and nutrients. Nincada builds underground nests by the roots of trees. It is based on a cicada nymph, which lives underneath the soil surface. However, a cicada nymph usually does not have fully developed wings. Instead, they have short wing stubs which eventually will become fully functional wings – as usual amongst hemimetabolous insects.

Ninjask is a small, cicada-like Pokémon with two pairs of wings. Its body is mostly black with some yellow and grey markings. Ninjask is a very fast Pokémon and it can seem invisible due to its high speed. It is based on an adult cicada, with the colors somewhat resembling *Neotibicen dorsatus* (Say, 1825) (Fig. 3).

Shedinja is a brown and grey insectoid Pokémon. A hole between its wings reveals that its body is completely hollow and dark, as it possesses no internal organs. It is based on the shed husk (exuvia) that cicadas and other hemimetabolous insects leave behind when they molt.



**Figure 3.** Adult female of *Neotibicen dorsatus*, the bush cicada. Credit: Yakkam255 (2015), Wikimedia Commons.

*Paras* (#046) evolves to *Parasect* (#047).

Paras is an orange insectoid Pokémon with an ovoid body. On the top it has two little red and yellow mushrooms known as *tōchūkasō*. The mushrooms can be removed at any time, and grow from spores that are doused on this Pokémon’s back at its birth by the mushroom on its mother's back. *Tōchūkasō* is an endoparasitoid that replaces the host tissue and can affect the behavior of its insect host. The base insect is based on a cicada nymph. The real-world *tōchūkasō* live on hepialid caterpillars in Tibet. However, there are many

more species of entomopathogenic fungi in the world, most notable the genus *Cordyceps* (L.) Fr. (1818).

Parasect is an orange, insectoid Pokémon that has been completely overtaken by the tōchūkasō mushroom. The adult insect has been drained of nutrients and is now under the control of the fully-grown tōchūkasō. Parasect can thrive in dank forests with a suitable amount of humidity for growing fungi. The base insect is a deformed version of what is probably a cicada nymph, the parasitic mushroom having caused a form of neoteny, when the adults look like a juvenile form.

**Order: Neuroptera**  
**Family: Myrmeleontidae**

*Trapinch (#328) evolves to Vibrava (#329) and then to Flygon (#330).*

Trapinch is an orange, insectoid Pokémon. This Pokémon lives in arid deserts, where it builds its nest in a bowl-shaped pit dug in sand. It sits in its nest and waits for prey to stumble inside. Once inside, the prey cannot climb back out. It is based on the larval stage of the antlion, which lives in conical sandy pits before maturing into winged adults.

Vibrava is a dragonfly-like Pokémon. Vibrava's wings are not fully developed, so it is unable to fly very far. However, it is able to create vibrations and ultrasonic waves with its wings, causing its prey to faint. Vibrava is a saprotroph – it spits stomach acid to melt its prey before consumption. Vibrava is based on the adult stage of an antlion. Adult antlions and dragonflies look from a distance quite similar

and are therefore often mistaken for each other.

Flygon is a desert-dwelling insectoid dragon with a green body and one pair of wings. Its wings make a “singing” sound when they are flapped. It uses this unique ability to attract prey, stranding them before it attacks. It is based on the winged, adult stage of the antlion.

**Order: Coleoptera**  
**Family: Lucanidae**

*Pinsir (#127, incl. Mega-Pinsir).*

Pinsir is a bipedal beetle-like Pokémon with a brown body and a large pair of grey, spiky pincers on top of its head. Pinsir is based on a stag beetle.

*Grubbin (#736) evolves to Charjabug (#737) and then to Vikavolt (#738).*

Grubbin is a small insectoid Pokémon. It has a white body with three nubs on either side resembling simple legs. Grubbin typically lives underground. It uses its jaw as a weapon, a tool for burrowing, and for extracting sap from trees. Grubbin appears to be based on a larval beetle, also known as “grubs”.

Charjabug is a small cubic Pokémon resembling an insect-like battery. Its body consists of three square segments with two brown stubs on each side. It generates and stores electricity in its body by digesting food. This energy is stored in an electric sac. Charjabug appears to be based on a cocooned bug and a battery. It may also be based on the denkimushi (*Monema flavescens* Walker, 1855), a caterpillar in Japan that, when touched, can



give a sting that is said to feel like an electric shock (Fig. 4).

Vikavolt is a beetle-like Pokémon with a large pair of mandibles. It produces electricity with an organ in its abdomen, and fires powerful electric beams from its huge jaws. Vikavolt appears to be based on a stag beetle. Its straight, scissor-like mandibles resemble those of *Lucanus hayashii* Nagai, 2000.



**Figure 4.** Larva of *Monema flavescens*. Credit: Pan et al. (2013), Wikimedia Commons.

#### **Family: Coccinellidae**

*Ledyba* (#165) evolves to *Ledian* (#166).

Ledyba is a red ladybird-like Pokémon with five black spots on its back. Female Ledyba have shorter antennae than male Ledyba. Ledyba is a very social Pokémon, e.g. in the winter they gather together to keep each other warm. Ledyba is probably based on the five-point ladybird *Coccinella quinquepunctata* Linnaeus, 1758 due to its color and/or on the harlequin ladybird *Harmonia axyridis* (Pallas, 1773), which clusters together in the winter.

Ledian is a large red bipedal ladybird-like Pokémon. Female Ledian's antennae are

shorter than the males'. Ledian sleeps in forests during daytime inside a big leaf.

#### **Family: Scarabaeidae**

*Heracross* (#214, incl. *Mega-Heracross*).

Heracross is a bipedal beetle-like Pokémon with a blue exoskeleton. The prolonged horn on its forehead ends in a cross-shaped (males) or heart-shape (females) structure. Heracross is most likely based on the Japanese rhinoceros beetle *Allomyrina dichotoma* Linnaeus, 1771 (Fig. 5).



**Figure 5.** Adult male of *Allomyrina dichotoma*. Credit: Lsardonkey (2016), Wikimedia Commons.

#### **Family: Lampyridae**

*Volbeat* (#313) and *Illumise* (#314).

Volbeat is a bipedal firefly-like Pokémon. Its body is black with some blue, yellow, and red portions. It has a spherical yellow tail, which glows to communicate and draws geometric patterns in the sky while in a swarm. This is a male only Pokémon "species"; Illumise is its female counterpart. Volbeat lives in forests near clean ponds and is attracted by the sweet aroma given off by Illumise. It is based on a firefly like its counterpart Illumise. Its

appearance may be based on a greaser, a subculture from the 1950's.

Illumise is a bipedal firefly-like Pokémon. It is black and blue with some yellow markings. This is a female only Pokémon "species"; Volbeat is its male counterpart. It is a nocturnal Pokémon that lives in forests. Illumise does not seem to share its coloring with any particular species. Illumise may be based on flappers, a 1920's women's style. Its mating behavior only slightly resembles the behavior of real-world fireflies, in which females use light signals to attract mates.

**Family: Elateridae**

*Karrablast (#588) evolves to Escavalier (#589).*

Karrablast is a round bipedal Pokémon with a yellow and blue body. When it senses danger, it spews an acidic liquid from its mouth. It targets another Pokémon, Shelmet, so it can evolve. It resides in forests and fields, and it often hides in trees or grass if threatened. Karrablast may be based on a Japanese snail-eating beetle due to its preference for attacking Shelmet, a snail-like Pokémon.

Escavalier is an insectoid Pokémon wearing a knight's helmet. Its tough armor protects its entire body. It flies around at high speed, jabbing foes with its lances. Escavalier is probably based on the *Drilus* Olivier, 1790 genus, with references to a jousting knight. *Drilus* larvae are known for eating snails and stealing their shells, explaining why it attacks Shelmet and takes its shell to evolve into Karrablast.

**Order: Hymenoptera**  
**Family: Tenthredinidae**

*Weedle (#013) evolves to Kakuna (#014) and then to Beedrill (#015, incl. Mega-Beedrill).*

Weedle is a small larval Pokémon with a body ranging in color from yellow to reddish-brown. It has a conical venomous stinger on its head and a barbed one on its tail to fend off enemies. Weedle can be found in forests and usually hides in grass, bushes, and under the leaves it eats. Weedle appears to be based on the larva of a wasp or hornet, although these real-world larvae usually don't have defense strategies. The only larvae which feed directly off leaves are those of sawflies.

Kakuna is a yellow cocoon-like Pokémon. Kakuna remains virtually immobile and waits for its "evolution" to happen, often hanging from tree branches by long strands of silk. Although Kakuna is the pupa stage of a Hymenoptera, it showcases a silky cocoon, a feature usually found in Lepidoptera and only some Hymenoptera, like sawflies.

Beedrill is a bipedal, wasp-like Pokémon. Its forelegs are tipped with long, conical stingers. It stands on its other two legs, which are long, segmented, and insectoid in shape. Beedrill has two pairs of rounded, veined wings, and another stinger on its yellow-and-black striped abdomen. By its color pattern, Beedrill looks like a vespid wasp, but due to the previous stages of this Pokémon species, it must be based on *Tenthredo scrophulariae* Linnaeus, 1758, the figwort sawfly.

### Family: Apidae

*Combee (#415) evolves to Vespiquen (#416, female).*

Combee is a small insectoid Pokémon that resembles three social bees inside three hexagonal pieces of honeycomb stuck together; the top two have wings. Female Combee have a red spot on the forehead. Male Combee are not known to evolve into or from any other Pokémon. The sex ratio of Combee is 87.5% male and 12.5% female. Combee can fly with its two wings as long as the top two bees coordinate their flapping. They gather honey, sleep, or protect the queen. Combee is based on a mix of bees and their larvae living in honeycombs. (Bees arrange their honeycombs in a vertical manner, whereas wasps arrange them horizontally.)

In the hive of the real-world honey bee (*Apis mellifera* Linnaeus, 1758), there is usually one queen bee and up to 40,000 female workers. So, the sex ratio of Combee does not reflect the ratio of female (workers) and male (drones) honey bees, but of the reproductive bees, the drones and the fertile queens. The larger number of drones is needed, since each queen will often mate with 10–15 males before she starts a new hive. Usually, drones can make up to 5% of the bees in a hive.

Vespiquen is a bipedal bee-like Pokémon with a yellow and black striped abdomen resembling an elegant ballroom gown. Underneath the expansive abdomen are honeycomb-like cells that serve as a nest for baby Combee. Vespiquen is a female-only Pokémon “species”. Vespiquen is the queen of a Combee hive, controlling it and protecting it,

as well as giving birth to young Combee. The horizontal honeycombs hints that this “species” is a wasp rather than a bee.

### Family: Formicidae

*Durant (#632).*

Durant is an ant-like Pokémon with a grey body and six black legs. It is territorial, lives in colonies and digs underground mazes. Durant grows steel armor to protect itself from predators. Durant is based on an ant, possibly the Argentine ant (*Linepithema humile* Mayr, 1868), due to the jaw and their invasive behavior.

### Order: Lepidoptera

#### Family: Papilionidae

*Caterpie (#010) evolves to Metapod (#011) and then to Butterfree (#012).*

Caterpie is a green caterpillar-like Pokémon. It has yellow ring-shaped markings down the sides of its body and bright red “antenna” (osmeterium) on its head, which releases a foul odor to repel predators. The appearance of Caterpie helps to startle predators; Caterpie is probably based on *Papilio xuthus* Linnaeus, 1767, the Asian swallowtail (Fig. 6). The osmeterium is a unique feature of swallowtails. Caterpie will shed its skin many times before finally cocooning itself in thick silk. Its primary diet are plants.

Metapod is a green chrysalis Pokémon. Its crescent shape is based upon a Swallowtail chrysalis with a large nose-like protrusion and side protrusions resembling a Polydamas



Swallowtail or Pipevine Swallowtail chrysalis (genus *Battus* Scopoli, 1777).

Butterfree is a butterfly Pokémon with a purple body and large, white wings, somewhat resembling a black-veined white *Aporia crataegi* (Linnaeus, 1758). Although it is supposed to be a butterfly, it lacks the proboscis, which is typical of Lepidoptera, and presents teeth instead. Additionally, the body does not consist of the typical three segments of insects. Therefore, each stage seems to be based on a different species.



**Figure 6.** Larva of *Papilio xuthus*, with everted orange osmeterium. Credit: Alpsdake (2011), Wikimedia Commons.

#### Families: Geometridae and Arctiidae

*Venonat* (#048) evolves to *Venomoth* (#049).

Venonat has a round body covered in purple fur, which can release poison. It feeds on small insects, the only Lepidoptera caterpillar which is known to feed on prey instead of leaves belong the genus *Eupethecia Grote*, 1882 (Geometridae). However, Venonat does not resemble a caterpillar in general body shape or numbers of legs.

Venomoth is a moth-like Pokémon with a light purple body and interestingly two small

mandibles. It has two pairs of wings, which are covered in dust-like, purple scales, although the color varies depending on their toxic capability. Dark scales are poisonous, while lighter scales can cause paralysis. These scales are released when Venomoth flutters its wings. The general appearance resembles species belonging to the Actiidae.

There is no cocoon stage for this species it is doubtful whether both stages were based on the same real-life species.

#### Family: Riodinidae

*Scatterbug* (#664) evolves to *Spewpa* (#665) and then to *Vivillon* (#666).

Scatterbug is a small caterpillar Pokémon with a grey body. If threatened by a bird Pokémon, it can spew a powder that paralyzes on contact. Similarly, the large white butterfly *Pieris brassicae* (Linnaeus, 1758) is known to throw up a fluid of semi-digested cabbage, which contains compounds that smell and taste unpleasant to predators, such as birds.

Spewpa is a small insectoid Pokémon with a grey body covered by white furry material. In order to defend itself, Spewpa will bristle its “fur” to threaten predators or spray powder at them. Spewpa is based on a generic pupa of a moth or butterfly, probably a silkworm cocoon.

Vivillon is a butterfly-like Pokémon with wings that come in a large variety of patterns, depending in which climate it lives or rather, in which real-world region the player is. There is a total of 20 patterns known. It would be interesting to know whether they evolved due to allopatric speciation or if it is a case of mimicry.

### **Family: Psychidae**

*Pineco (#204) evolves to Forretress (#205).*

Pineco is a pine cone-like Pokémon without visible limbs. It is based on a bagworm, the caterpillar stage of psychid Lepidoptera. Bagworms cover themselves with a case (the bag) made of surrounding material. This Pokémon uses tree bark and thus resembles a pine cone.

Forretress is a large spherical Pokémon, also without any visible limbs. It lives in forests, attaching itself immovably to tree trunks. Forretress is also based on a bagworm.

Different bagworm species are adapted to their environment, to the plants they eat, and to the materials available for producing their case. Therefore, Pineco and Forretress are actually based on two different species, as they both are caterpillars. There is no adult stage for this Pokémon.

*Burmy (#412) evolves to Wormadam (#413, female) or Mothim (#414, male).*

Burmy is a small pupa-shaped Pokémon with a black body and six stubby legs. It is based on a bagworm pupa, which will metamorphose into a winged moth if male, or wingless moth if female. Burmy can change its “cloak” (case) depending on the environment it last battled.

Wormadam is a black bagworm-like Pokémon with a cloak of leaves, sand, or building insulation. Its cloak depends on Burmy’s cloak when it evolved, and so does its type (Grass, Ground or Steel). It is a female-only “species”, with Mothim as its male counterpart. Female psychid moth either don’t have wings at

all or have only small wing stubs that don’t develop fully.

Mothim is a moth-like Pokémon with two pairs of legs and two pairs of wings, one larger than the other. Mothim is a nomadic nocturnal Pokémon, searching for honey and nectar. Instead of gathering honey on its own, it raids the hives of Combee. It is a male-only “species”, with Wormadam as its female counterpart.

### **Family: Nymphalidae**

*Wurmple (#265) evolves to Silcoon (#266) and then to Beautifly (#267).*

Wurmple is a small caterpillar-like Pokémon with a mostly red body and many spikes on the top of its body. It can spit a white silk that turns gooey when exposed to air. Spikes or hairy appendages are common amongst nymphalid caterpillars. Also, it has five pairs of legs, whereas insects are known to have only three pairs of legs. However, many lepidopteran caterpillars have additionally “prolegs” (small fleshy stub-like structures) to help them move.

Silcoon is a cocoon-like Pokémon which is completely covered by white silk. Silcoon also uses the silk to attach itself to tree branches. Nymphalid cocoons are usually not woolly or hairy, but smooth.

Beautifly is a butterfly-like Pokémon with two pairs of wings. Beautifly has a long and curled black proboscis that it uses to drain body fluids from its prey. In the real world, Lepidoptera usually drink the nectar of flowers. One of the few exceptions are the species of the genus *Calyptra* Ochseneimer, 1816, which pierce skin of animals and drink blood.

**Family: Saturniidae**

*Wurmple (#265) evolves to Cascoon (#268) and then to Dustox (#269).*

The caterpillar stage of this species is morphologically identical to the caterpillar stage of the “species” above: Wurmple. It appears that Wurmple can evolve in two forms: due to mimicry, sympatric speciation or are there morphological or biological characters, which have not been notices yet?

Cascoon is a round cocoon-like Pokémon covered in purple silk. Saturniid cocoons are usually covered in silk.

Dustox is a moth-like Pokémon. It has a purple body, two pairs of tattered green wings, and – just like Beautifly – two pairs of legs. Dustox is nocturnal and is instinctively drawn to light. Clearly, this is a moth. Some of the markings on its wings resemble typical markings of noctuid moths, but the big “fake eye” is typical of saturniids.

*Larvesta (#636) evolves to Volcarona (#367).*

Larvesta is a fuzzy caterpillar-like Pokémon. It has five red horns on the sides of its head, which it can use to spit fire as a defensive tactic to deter predators. Larvesta is based on a saturniid caterpillar.

Volcarona is a large moth-like Pokémon with four small feet and three pairs of wings. It releases fiery scales from its wings. Just like Larvesta, Volcarona is based on a saturniid moth, likely the Atlas moth *Attacus atlas* (Linnaeus, 1758).

**Order: Diptera****Family: Bombyliidae**

*Cutiefly (#742) evolves to Ribombee (#743).*

Cutiefly is a tiny Pokémon with large wings. Cutiefly appears to be based on the bee fly, specifically the species *Anastoechus nitidulus* (Fabricius, 1794) (Fig. 7).

Ribombee is a tiny insectoid Pokémon with a large head, slightly smaller body, and thin arms and legs. It is covered in fluffy yellow hair. Two wings nearly as large as its body sprout from its back. The wings are clear with three brown loop designs near the base. Its four thin limbs have bulbous hands or feet. Ribombee uses its fluffy hair to hold the pollen it collects from flowers. It is based on a bee fly.



**Figure 7.** Adult of *Anastoechus nitidulus*. Credit: karakotokako (2007), image retrieved from <https://karakoto.exblog.jp/>.

**Family: Culicidae**

*Buzzwole (#794).*

Buzzwole is a bipedal anthropomorphic Pokémon. It has four legs and two pairs of orange translucent wings. It uses its proboscis

to stab and then drink “energy” off its enemies/prey. Buzzwole originates from the Ultra Desert dimension in Ultra Space. It is based on a mosquito and may specifically derive inspiration from *Aedes albopictus* (Skuse, 1894), which is an invasive species worldwide.

**Mixed Orders: Lepidoptera and Phasmatodea**

**Families: Tortricidae, Hesperiiidae, and Phylliidae**

*Sewaddle* (#540) evolves to *Swadloon* (#541) and then to *Leavanny* (#542).

Sewaddle is a caterpillar-like Pokémon with a green body with three pairs of legs. It makes leafy “clothes” using chewed-up leaves and a thread-like substance it produces from its mouth. The leafy hood helps Sewaddle to hide from enemies. Sewaddle appears to be based on the caterpillar of the silver-spotted skipper *Epargyreus clarus* (Cramer, 1775), which produce silk and fold leaves over themselves for shelter (Fig. 8).

Swadloon is a round yellow Pokémon inside of a cloak of leaves. It lives on the forest ground and feeds on fallen leaves. Swadloon appears to be based on the chrysalis of *Epargyreus clarus*. *Epargyreus clarus* fold leaves over themselves for shelter as they age and, when cocooning, eventually use silk to stick the leaves together and form its chrysalis.

Leavanny is a bipedal, insectoid Pokémon with a yellow and green body with leaf-like limbs. It lives in forests and uses its cutters and sticky silk it produces to create leafy “clothing”. It also warms its eggs with fermenting fallen leaves. Leavanny has the features of several insects. Primarily it appears to be a bipedal leaf-

insect (Phylliidae). Its general body structure is also similar to that of *Choeradodis* Serville, 1831 mantises, which also have laterally expanded thoraxes and abdomens.



**Figure 8.** Larva of *Epargyreus clarus*. Credit: Seth Ausubel (2013), image retrieved from <https://bugguide.net/>.

**DISCUSSION**

Only 11 insect orders (out of 30) are represented in the Pokémon world. Possible more, as differentiation of insect Pokémon and non-insect Pokémon are sometimes difficult. The main reason is, that many insect Pokémon are not depicted as a typical insect with its segmented body, the six legs, and two pairs of wings<sup>1</sup>. Many are depicted as bipedal (e.g., #401 Krickatot) or even in an anthropomorphic way (e.g., #795 Pheromosa). Also, insectoid Pokémon typically have only four limbs (instead of six). Many insectoid Pokémon also have fewer wings than insects (except for #637 Volcarona, which has more). Therefore, the definition of what is an insect Pokémon is debatable.

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<sup>1</sup> Not all insects have two pairs of wings, though. For instance, the Diptera (flies) have only one, while the Siphonaptera (fleas) have none.

One clue is to look at the types each Pokémon belongs to. However, from the circa 80 Bug-type Pokémon, only about 60 are insects. The others belong to other arthropods groups, like Chelicerata, Crustacea, and Myriapoda. This is not surprising, as often creepy crawlies (basically everything that is small with legs) are all addressed as “bugs”. In fact, only member of the insect order Hemiptera are called “true bugs”.

Interestingly, Prado & Almeida (2017) have included Pokémon on their insect list, which are doubtful: #251 Celebi, #247 Pupitar, and #206 Dunsparce. None of them are considered insects here. Celebi may resemble a bipedal somewhat anthropomorphic insectoid, but nothing of the lifestyle or beyond the vague appearance gives a clue to an insect. Similarly, #247 Pupitar, might look like a pupa of an insect. However, both its “larval” stage (#256 Larvitar) and its final stage (#248 Tyranitar) resemble a dinosaur or some sort of dragon. Only the hint of “pupa” in its name, links Pupitar to an insect. Lastly, #206 Dunsparce was classified as a Hymenoptera by Prado & Almeida (2017). It may look somewhat like an insect, even showing two pairs of wings (and no legs at all). Dunsparce, however, is based on a mythical “snake-like animal” called Tsuchinoko, also known as “bachi hebi” (or “bee snake”). Finally, Prado & Almeida (2017) have classified #212 Scizor as “unknown”, but here it is treated as a praying mantis (Mantodea). Similarly, those authors have classified #284 Masquerain as a Lepidoptera, but here we treat it as a true bug (Hemiptera).

Lastly, #649 Genesect resembles somewhat an ant covered by steel. However, according to

the Pokédex (Pokémon Website, 2018), it is a man-made machine.

Compared to the vertebrates (birds, mammals, reptiles, amphibians, and fishes), many more insects live on earth (66,000 described species to about 1 million, respectively; Zhang, 2011). This ratio is, however, not represented in the Pokémon world (Table 3), most likely due to the fact that the majority of people prefer (cute and cuddly) furry animals over creepy insects, even though butterflies and dragonflies are regarded as beautiful.

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