



## The ichthyological diversity of Pokémon

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*Pokémon*, or *Pocket Monsters*, was originally created for videogames, becoming a worldwide fever among kids and teenagers in the end of the 1990's and early 2000's. Currently, it is still a success, with numerous games, a TV series, comic books, movies, a Trading Card Game, toys and collectibles. Through its core products and vibrant merchandising, Pokémon took over the world, influencing pop culture wherever it landed. Despite losing some steam in the early 2010's, Pokémon is now back to its previous uproar with the release of *Pokémon GO*, an augmented reality (AR) game for smartphones. This game launched in 2016, with almost 21 million users downloading it in the very first week in the United States alone (Dorward et al., 2017). Thus, Pokémon is indubitably an icon in pop culture (Schlesinger, 1999a; Tobin, 2004).

The origin of Pokémon goes back to two role-playing video games (created by Satoshi Tajiri and released by *Nintendo* for the *Game Boy*; Kent, 2001): *Pokémon Green* and *Pokémon Red*, released in Japan in 1996. In the West, the Green version never saw the light of day, but the Red and Blue versions were released in

1998, selling together more than 10 million copies. Also in 1998, the Yellow version of the game was released, which has as its most distinct feature the possibility of having Pikachu (the most famous Pokémon) walking side by side with the player in the game. Pokémon Green, Red, Blue and Yellow are the so-called "first generation" of games in the franchise. Today, the Pokémon series is in its seventh generation, with 29 main games released, besides several spin-offs. The TV series, on the other hand, is in its sixth season, with more than 900 episodes.

The games and TV series take place in regions inhabited by many Pokémon and humans. The mission of the protagonist is to win competitions ("Pokémon battles") against gym leaders who are spread across different cities and regions. For each victory, the protagonist receives a gym badge; with eight badges, he/she is allowed to enter the Pokémon League to try and become the Champion.

For each generation, new Pokémon (and an entire new region) are introduced. In this way, the creatures have a homeland, although most

can appear in other regions as well (Schlesinger, 1999b; Whitehill et al., 2016). The seven main regions are: Kanto, Johto, Hoenn, Sinnoh, Unova, Kalos and Alola.

In every region, there are numbered routes that connect cities and landmarks and in which the protagonist travels, finding the monsters in their natural habitats and interacting with other characters. These routes comprise a great range of environments, such as forests, caves, deserts, mountains, fields, seas, beaches, underwater places, mangroves, rivers and marshes, which usually display a huge diversity of Pokémon.

In addition to winning the Pokémon League, the protagonist must complete the Pokédex, a digital encyclopedia of Pokémon. In other words, the trainer must catch all the Pokémon that live in that region, registering each capture in the Pokédex. Each Pokémon has a registry number and an entry text in the Pokédex. Pokémon are usually found in nature, and may be captured with a device called “Pokéball”. Pokéballs are small enough to fit in a pocket, hence the name “Pocket Monsters” (Whitehill et al., 2016).

### **NOT AS MONSTROUS AS WE THINK**

In the world depicted in the games, there are 801 Pokémon, belonging 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, 2017). Almost all Pokémon are based on animal species, some of them are based on plants or mythological creatures, and a few are based on objects. Curiously, all Pokémon are oviparous, which

means they all lay eggs (their development happens inside of an egg and outside of their mother’s body); of course, in the real natural world, this is a reproductive strategy of animals such as fishes, amphibians, reptiles, birds and many kinds of invertebrates (Blackburn, 1999). Moreover, Pokémon might “evolve”, usually meaning they undergo some cosmetic changes, become larger and gain new powers.

In the present work, the Pokémon world was approached by analogies with the real natural world, establishing parallels with actual animals.

A remarkable group of animals represented in Pokémon is the fishes. Fishes are the largest group of vertebrates, with more than 32,000 species inhabiting marine and freshwater environments, a number that roughly corresponds to half of all described vertebrates (Nelson et al., 2016). Showing ample morphological and behavioral variety and living in most of the aquatic ecosystems of the planet, fishes are well represented in the Pokémon world, therefore offering a great opportunity for establishing parallels between the two worlds. The creators of the games not only used the morphology of real animals as a source of inspiration for the monsters, but also their ecology and behavior.

Based on these obvious connections between real fishes and Pokémon, the aim of this work is to describe the ichthyological diversity found in Pokémon based on taxonomic criteria of the classification of real fishes. Ultimately, our goal is to offer useful material for both teaching and the popularization of science.

**Table 1.** Taxonomic classification of the fish Pokémon. Abbreviations: Ch = Chondrichthyes; Gn = Gnathostomata; Pe = Petromyzontomorphi; Pt = Petromyzontida; Os = Osteichthyes. All images obtained from The Official Pokémon Website (2016).



































Pokédex No.	Pokémon				Common Name	Species	Family	Order	Class	Super-class
	Name	Image	Type	Region						
116	Horsea		Water	Kanto	Seahorse	<i>Hippocampus</i> sp.	Syngnathidae	Syngnathiformes	Os	Gn
117	Seadra		Water	Kanto	Seahorse	<i>Hippocampus</i> sp.	Syngnathidae	Syngnathiformes	Os	Gn
118	Goldeen		Water	Kanto	Goldfish	<i>Carassius auratus</i> Linnaeus, 1758	Cyprinidae	Cypriniformes	Os	Gn
119	Seaking		Water	Kanto	Goldfish	<i>Carassius auratus</i> Linnaeus, 1758	Cyprinidae	Cypriniformes	Os	Gn
129	Magikarp		Water	Kanto	Common carp	<i>Cyprinus carpio</i> Linnaeus, 1758	Cyprinidae	Cypriniformes	Os	Gn
170	Chinchou		Water / Electric	Johto	Footballfish	<i>Himantolophus</i> sp.	Himantolophidae	Lophiiformes	Os	Gn
171	Lanturn		Water / Electric	Johto	Footballfish	<i>Himantolophus</i> sp.	Himantolophidae	Lophiiformes	Os	Gn
211	Qwilfish		Water / Poison	Johto	Porcupinefish	<i>Diodon</i> sp.	Diodontidae	Tetraodontiformes	Os	Gn
223	Remoraid		Water	Johto	Remora, Suckerfish	<i>Remora</i> sp.	Echeneidae	Carangiformes	Os	Gn
226	Mantine		Water / Flying	Johto	Manta ray	<i>Manta birostris</i> Walbaum, 1792	Myliobatidae	Myliobatiformes	Ch	Gn
230	Kingdra		Water / Dragon	Johto	Common seadragon	<i>Phyllopteryx taeniolatus</i> Lacepède 1804	Syngnathidae	Syngnathiformes	Os	Gn
318	Carvanha		Water / Dark	Hoenn	Red piranha	<i>Pygocentrus</i> sp.	Serrasalminidae	Characiformes	Os	Gn
319	Sharpedo		Water / Dark	Hoenn	Shark	—	—	Carcharhiniformes	Ch	Gn
339	Barboach		Water / Ground	Hoenn	Pond loach	<i>Misgurnus</i> sp.	Cobitidae	Cypriniformes	Os	Gn
340	Whiscash		Water / Ground	Hoenn	Catfish	<i>Silurus</i> sp.	Siluridae	Siluriformes	Os	Gn
349	Feebas		Water	Hoenn	Largemouth bass	<i>Micropterus salmoides</i> Lacepède, 1802	Centrarchidae	Perciformes	Os	Gn
350	Milotic		Water	Hoenn	Oarfish	<i>Regalecus</i> sp.	Regalecidae	Lampriformes	Os	Gn
367	Huntail		Water	Hoenn	Onejaw	<i>Monognathus</i> sp.	Monognathidae	Anguilliformes	Os	Gn
368	Gorebyss		Water	Hoenn	Snipe eel	—	Nemichthyidae	Anguilliformes	Os	Gn
369	Relicanth		Water / Rock	Hoenn	Coelacanth	<i>Latimeria</i> sp.	Latimeriidae	Coelacanthiformes	Os	Gn
370	Luvdisc		Water	Hoenn	Kissing gourami	<i>Helostoma temminckii</i> Cuvier, 1829	Helostomatidae	Anabantiformes	Os	Gn
456	Finneon		Water	Sinnoh	Freshwater butterflyfish	<i>Pantodon buchholzi</i> Peters, 1876	Pantodontidae	Osteoglossiformes	Os	Gn
457	Lumineon		Water	Sinnoh	Freshwater butterflyfish	<i>Pantodon buchholzi</i> Peters, 1876	Pantodontidae	Osteoglossiformes	Os	Gn
458	Mantyke		Water / Flying	Sinnoh	Manta ray	<i>Manta birostris</i> Walbaum, 1792	Myliobatidae	Myliobatiformes	Ch	Gn

Table 1. (cont.)

Pokédex No.	Pokémon				Common Name	Species	Family	Order	Class	Super-class
	Name	Image	Type	Region						
550	Basculin		Water	Unova	Piranha	—	Serrasalminidae	Characiformes	Os	Gn
594	Alomomola		Water	Unova	Sunfish	<i>Mola mola</i> Linnaeus, 1758	Molidae	Tetraodontiformes	Os	Gn
602	Tynamo		Electric	Unova	Sea lamprey	<i>Petromyzon marinus</i> Linnaeus, 1758	Petromyzontidae	Petromyzontiformes	Pt	Pe
603	Eeletrik		Electric	Unova	Sea lamprey	<i>Petromyzon marinus</i> Linnaeus, 1758	Petromyzontidae	Petromyzontiformes	Pt	Pe
604	Eelektross		Electric	Unova	Sea lamprey	<i>Petromyzon marinus</i> Linnaeus, 1758	Petromyzontidae	Petromyzontiformes	Pt	Pe
618	Stunfisk		Ground / Electric	Unova	Flatfish	—	—	Pleuronectiformes	Os	Gn
690	Skrelp		Poison / Water	Kalos	Common seadragon	<i>Phyllopteryx taeniolatus</i> Lacepède 1804	Syngnathidae	Syngnathiformes	Os	Gn
691	Dragalge		Poison / Dragon	Kalos	Leafy seadragon	<i>Phycodurus eques</i> Günther, 1865	Syngnathidae	Syngnathiformes	Os	Gn
746	Wishiwashi		Water	Alola	Pacific sardine	<i>Sardinops sagax</i> (Jenyns, 1842)	Clupeidae	Clupeiformes	Os	Gn
779	Bruxish		Water / Psychic	Alola	Reef triggerfish	<i>Rhinecanthus rectangulus</i> (Bloch & Schneider, 1801)	Balistidae	Tetraodontiformes	Os	Gn

### GOTTA CATCH 'EM FISHES!

The first step of our research was a search in the Pokédex (The Official Pokémon Website, 2016) for Pokémon which were related to fishes. The criterion used was the Pokémon's morphology (resemblance to real fishes). Afterwards, the "fish Pokémon" were classified to the lowest taxonomic level (preferably species, but when not possible, genus, family or even order).

This classification of the Pokémon allowed the comparison of biological data (such as ecological, ethological, morphological traits) from Bulbapedia (2017) with the current knowledge on real fishes (e.g., Nelson et al., 2016). Bulbapedia is a digital community-driven encyclopedia created in 2004 and is the most complete source regarding the pocket monsters.

The final step was a search in online scientific databases (*Fishbase*, Froese & Pauly,

2016; and *Catalog of Fishes*, Eschmeyer et al., 2016) in order to obtain the current and precise taxonomy and additional information on habitats, ecology etc. of the fish species.

In the present work, the taxonomic classification used was that proposed by Nelson et al. (2016), who consider the superclasses Petromyzontomorphi (which includes the class Petromyzontida, that is, the lampreys) and Gnathostomata (the jawed vertebrates). Gnathostomata, in turn, includes the classes Chondrichthyes (cartilaginous fishes) and Osteichthyes (bony fishes). Along with this classification, we used the classification proposed by the database ITIS (Integrated Taxonomic Information System, 2016) for comparison at all taxonomic levels. Following identification, the "fish Pokémon" were described regarding their taxonomic and ecological diversity.

## POCKET FISHES

As a result of our search, 34 fish Pokémon were identified (circa 4% of the total 801 Pokémon; Table 1) and allocated in two superclasses, three classes, eighteen orders, twenty families and twenty-two genera. Eighteen of the 34 fish Pokémon (circa 53%) could be identified to the species level (Table 2). The features of the real fishes which probably inspired the creation of the Pokémon and other relevant information are described below for each species. To enrich the comparisons, images of the Pokémon (obtained from the Pokédex of The Official Pokémon Website; [www.pokemon.com](http://www.pokemon.com)) and of the real fishes (illustrations by one of us, C.B.P. Eirado-Silva) follow the descriptions.

**Table 2.** Taxonomic diversity of the fish Pokémon.

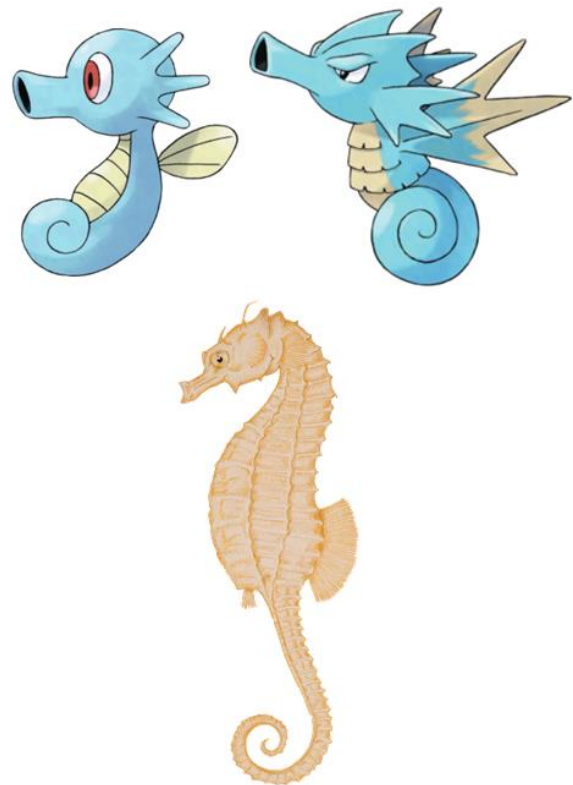
Taxon	n	%
Species	18	52.94
Genus	22	88.23
Family	20	94.12
Order	18	100
Class	3	100
Superclass	2	100

### Horsea and Seadra

**Species:** *Hippocampus* sp.; **Common name:** seahorse.

The Pokémon Horsea and Seadra (Fig. 1), which debuted in the first generation of the franchise, were based on seahorses. The long snout, ending in a toothless mouth (Foster & Vincent, 2004), the prehensile, curved tail (Rosa et al., 2006) and the salient abdomen are features of the real fishes present in these

Pokémon. Seahorses belong to the genus *Hippocampus*, presently composed of 54 species (Nelson et al., 2016). The males have a pouch in their bellies where up to 1,000 eggs are deposited by the females. In this pouch, the eggs are fertilized and incubated for a period ranging from 9 to 45 days (Foster & Vincent, 2004). Due to overfishing for medicinal and ornamental purposes, as well habitat destruction, about 33 species of seahorses are considered threatened (Rosa et al., 2007, Castro et al., 2008; Kasapoglu & Duzgunes, 2014).

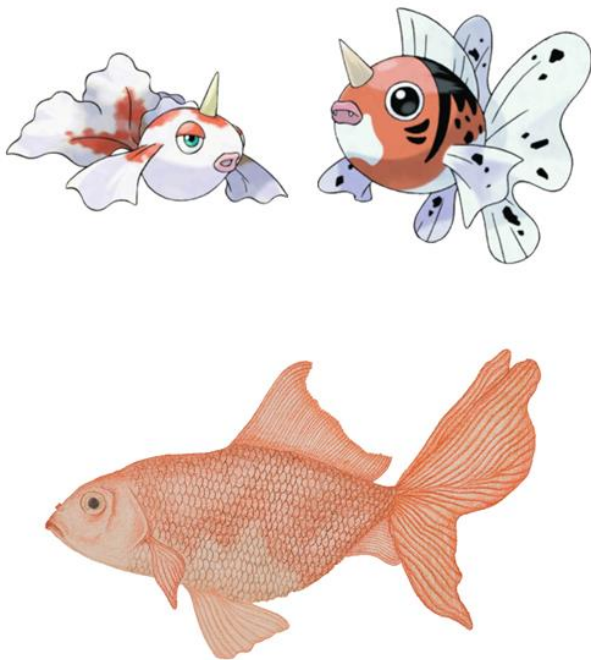


**Figure 1.** Horsea, Seadra and *Hippocampus* sp.

### Goldeen and Seaking

**Species:** *Carassius auratus*; **Common name:** goldfish.

Goldeen and Seaking (Fig. 2) were based on the goldfish. This species is one of the most common ornamental fishes worldwide (Soares et al., 2000; Moreira et al., 2011) and it is widely used in studies of physiology and reproduction due to its docile behavior and easy acclimatization to artificial conditions (Bittencourt et al., 2012; Braga et al., 2016). The resemblance between the goldfish and the Pokémon include morphological features, such as the orange/reddish color and the long merged fins, and the name “Goldeen”. The name Seaking, on the other hand, may be a reference to another common name of the species, “kinguio”, from the Japanese “kin-yu” (Ortega-Salas & Reyes-Bustamante, 2006).

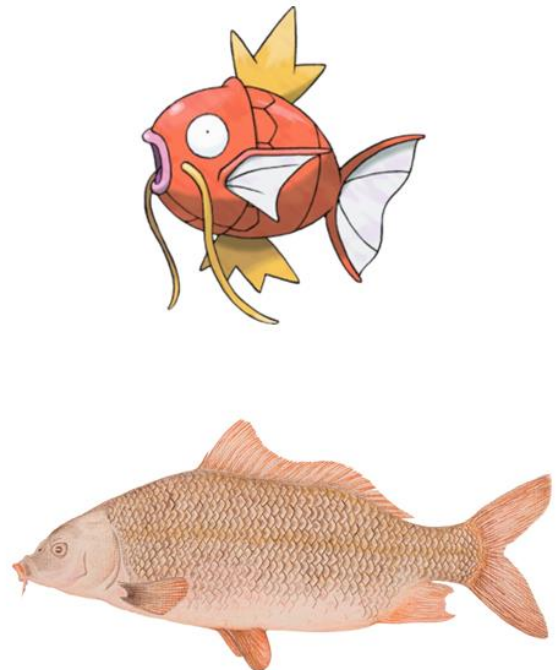


**Figure 2.** Goldeen, Seaking and *Carassius auratus*.

### Magikarp

**Species:** *Cyprinus carpio*; **Common name:** common carp.

Possibly the most famous fish Pokémon, Magikarp (Fig. 3) was based on a common carp, a species present in Europe, Africa and Asia, widely used in pisciculture due to its extremely easy acclimatization to many freshwater environments and the high nutritional value of its meat (Stoyanova et al., 2015; Mahboob et al., 2016; Voigt et al., 2016). In some regions of the planet, such as Brazil, the common carp is considered an invasive species, as it was inadvertently released in the wild and poses a threat to the native aquatic fauna (Smith et al., 2013; Contreras-MacBeath et al., 2014).



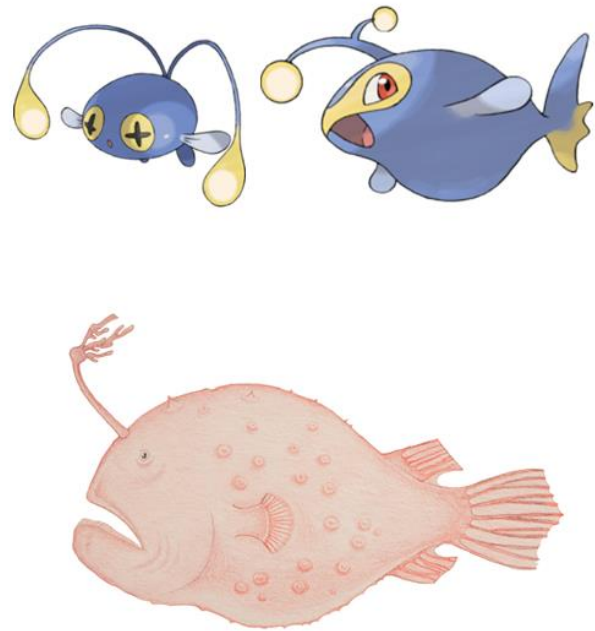
**Figure 3.** Magikarp and *Cyprinus carpio*.

The shared traits between the Pokémon and the real fish are many: the rounded mouth, the lips, the strong orange color and the presence of barbels (“whiskers”) (Nelson et al., 2016). In China, the common carp is praised as an animal linked to honor and strength, due of its ability to swim against the current; an ancient legend tells about carps that swim upstream, entering through a portal and transforming into dragons (Roberts, 2004). In Pokémon, Magikarp evolves into Gyarados, which resembles a typical Chinese dragon.

### Chinchou and Lanturn

**Species:** *Himantolophus* sp.; **Common name:** footballfish.

Chinchou and Lanturn (Fig. 4) were based on fishes of the genus *Himantolophus*, a group of deep-sea fishes found in almost all oceans living in depths up to 1,800 meters (Klepadlo et al., 2003; Kharin, 2006). These fishes are known as footballfishes, a reference to the shape of their bodies. Fishes of this genus have a special modification on their dorsal fin that displays bioluminescence (the ability to produce light through biological means; Pietsch, 2003), which is used to lure and capture prey (Quigley, 2014). Bioluminescence was the main inspiration for these Pokémon, which have luminous appendages and the Water and Electric types. The sexual dimorphism (difference between males and females) is extreme in these fishes: whilst females reach up to 47 cm of standard-length (that is, body length excluding the caudal fin), males do not even reach 4 cm (Jónsson & Pálsson, 1999; Arronte & Pietsch, 2007).



**Figure 4.** Chinchou, Lanturn and *Himantolophus* sp.

### Qwilfish

**Species:** *Diodon* sp.; **Common name:** porcupinefish.

Qwilfish (Fig. 5) was based on porcupinefishes, more likely those of the genus *Diodon*, which present coloring and spines most similar to this Pokémon. Besides the distinctive hard, sharp spines (Fujita et al., 1997), porcupinefishes have the ability to inflate as a strategy to drive off predators (Raymundo & Chiappa, 2000). As another form of defense, these fishes possess a powerful bacterial toxin in their skin and organs (Lucano-Ramírez et al., 2011; Ravi et al., 2016). Accordingly, Qwilfish has both Water and Poison types.

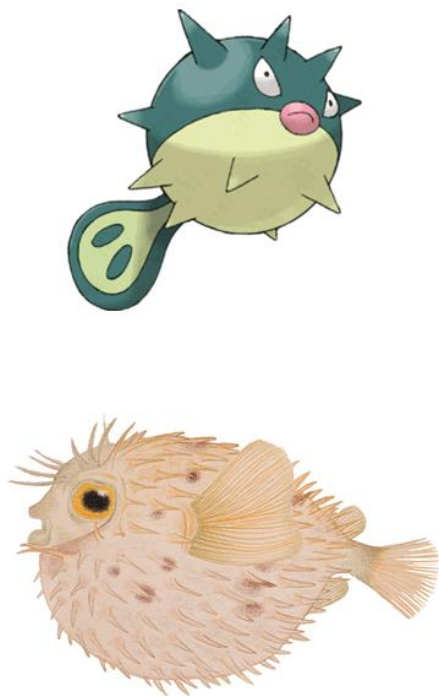


Figure 5. Qwilfish and *Diodon* sp.

### Remoraid

**Species:** *Remora* sp.; **Common names:** remora, suckerfish.

Remoraid was based on a remora (Fig. 6), a fish with a suction disc on its head that allows its adhesion to other animals such as turtles, whales, dolphins, sharks and manta rays (Fertl & Landry, 1999; Silva & Sazima, 2003; Friedman et al., 2013; Nelson et al., 2016). This feature allows the establishment of a commensalisc or mutualisc relationship of transportation, feeding and protection between the adherent species and its “ride” (Williams et al., 2003; Sazima & Grossman, 2006). The similarities also include the name of the Pokémon and the ecological relationship they have with other fish Pokémon: in the same way remoras keep ecological relationships with rays, Remoraid

does so with Mantyke and Mantine (Pokémon based on manta rays; see below).

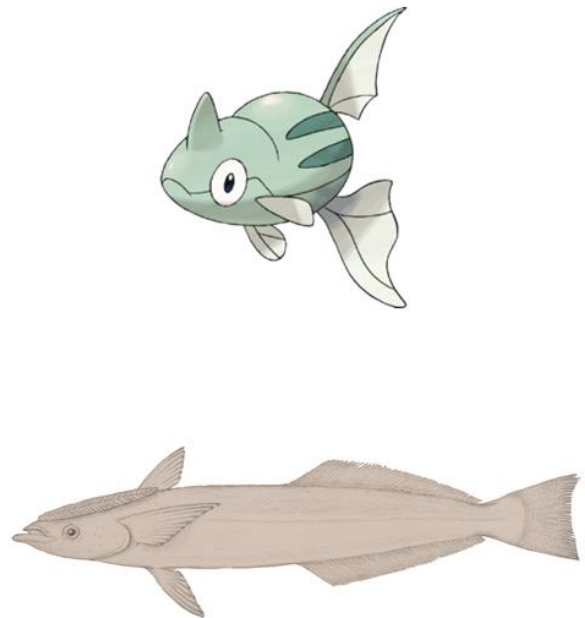


Figure 6. Remoraid and *Remora* sp.

### Mantyke and Mantine

**Species:** *Manta birostris*; **Common name:** manta ray.

The Pokémon Mantyke and its evolved form Mantine (Fig. 7) were probably based on manta rays of the species *Manta birostris*, which inhabits tropical oceans (Duffy & Abbot, 2003; Dewar et al., 2008) and can reach more than 6 meters of wingspan, being the largest species of ray in existence (Homma et al., 1999; Ari & Correia, 2008; Marshall et al., 2008; Luiz et al., 2009; Nelson et al., 2016). The similarities between the Pokémon and the real fish are: the body shape, the color pattern, the large and distinctive wingspan and even the names.





Figure 7. Mantine, Mantyke and *Manta birostris*.

### Kingdra and Skrelp

**Species:** *Phyllopteryx taeniolatus*; **Common name:** common seadragon.

Kingdra and Skrelp (Fig. 8) were based on the common seadragon. The resemblances between these Pokémon and the real fish species include the leaf-shaped fins that help the animals to camouflage themselves in the kelp “forests” they inhabit (Sanchez-Camara et al., 2006; Rossteuscher et al., 2008; Sanchez-Camara et al., 2011), and the long snout. Also, the secondary type of Kingdra is Dragon. Although both are based on the common seadragon, Kingdra and Skrelp are not in the same “evolutionary line” in the game.

Common seadragons, as the seahorses mentioned above, are of a particular interest to conservationists, because many species are

vulnerable due to overfishing, accidental capture and habitat destruction (Foster & Vincent, 2004; Martin-Smith & Vincent, 2006).



Figure 8. Kingdra, Skrelp and *Phyllopteryx taeniolatus*.

### Carvanha

**Species:** *Pygocentrus* sp.; **Common name:** red piranha.

Piranhas of the genus *Pygocentrus* possibly were the inspiration for the creation of Carvanha (Fig. 9), a Pokémon of voracious and dangerous habits. The main feature shared by the real fish and the Pokémon is the color pattern: bluish in the dorsal and lateral areas, and reddish in the ventral area (Piorski et al., 2005; Luz et al., 2015).

It is worthwhile pointing out that, despite what is shown in movies and other media, piranhas do not immediately devour their prey;

instead, they tear off small pieces, bit by bit, such as scales and fins (Trindade & Jucá-Chagas, 2008; Vital et al., 2011; Ferreira et al., 2014).



Figure 9. Carvanha and *Pygocentrus* sp.

### Sharpedo

**Order:** Carcharhiniformes; **Common name:** shark.

Sharpedo (Fig. 10), according to its morphological traits (elongated fins), was possibly based on sharks of the order Carcharhiniformes, the largest group of sharks, with 216 species in 8 families and 48 genera. Fishes in this order are common in all oceans, in both coastal and oceanic regions, and from the surface to great depths (Gomes et al., 2010). Several species of Carcharhiniformes are in the IUCN's (International Union for Conservation of Nature) endangered species list (a.k.a. "Red

List") due to overfishing, as their fins possess high commercial value (Cunningham-Day, 2001).

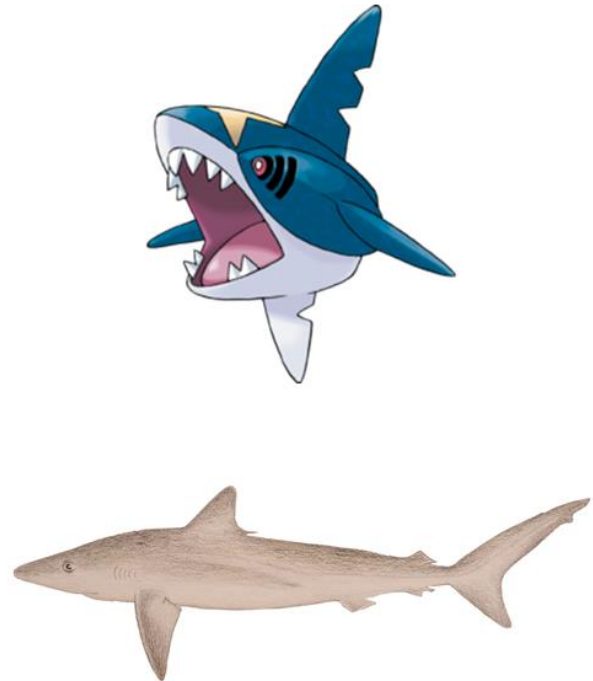


Figure 10. Sharpedo and a carcharhiniform shark.

### Barboach

**Species:** *Misgurnus* sp.; **Common name:** pond loach.

Barboach (Fig. 11) is likely based on fishes of the genus *Misgurnus*, natively found in East Asia (Nobile et al., 2017) but introduced in several countries (Gomes et al., 2011). These animals, like *M. anguillicaudatus* Cantor, 1842, are used as ornamental fishes and in folk medicine (Woo Jun et al., 2010; Urquhart & Koetsier, 2014). The shared similarities between the Pokémon and the pond loach include morphological features, such as the elongated body, oval fins and the presence of

barbels (Nelson et al., 2016). The resemblance also extends itself to behavior, such as the habit of burying in the mud (Zhou et al., 2009; Kitagawa et al., 2011) and using the barbels to feel the surroundings (Gao et al., 2014). The secondary type of Barboach, Ground, alongside the ability to feel vibrations in the substrate, seem to be a reference to the behavior of the real fishes.

(“*Namazun*”). In Japan, fishes of the genus *Silurus* are usually associated with this mythological creature and even the common name of these fishes in that country is “*namazu*” (Yuma et al., 1998; Malek et al., 2004). In addition, the physical traits of the *Silurus* catfishes also present in Whiscash are the long barbels (or “whiskers”, hence the name Whiscash) and the robust body (Kobayakawa, 1989; Kiyohara & Kitoh, 1994). In addition to the Water type, Whiscash is also Ground type, which is related to Namazu’s fantastic ability of creating earthquakes.

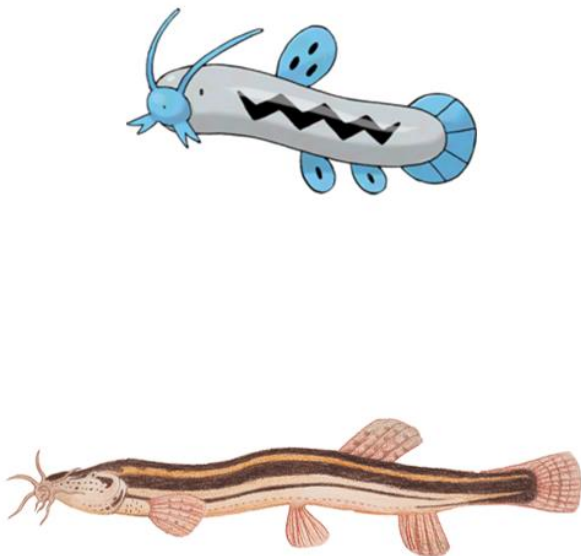


Figure 11. Barboach and *Misgurnus* sp.

### Whiscash

**Species:** *Silurus* sp.; **Common name:** catfish.

Whiscash (Fig. 12) was based on the Japanese mythological creature Namazu, a gigantic catfish that inhabits the underground realm and is capable of creating earthquakes (Ashkenazi, 2003). Namazu also names the Pokémon in the Japanese language

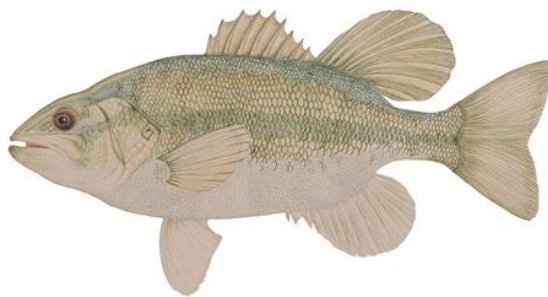


Figure 12. Whiscash and *Silurus* sp.

### Feebas

**Species:** *Micropterus salmoides*; **Common name:** largemouth bass.

The Pokémon Feebas (Fig. 13), a relatively weak fish (as its name implies), was possibly based on a largemouth bass, a freshwater fish native to North America (Hossain et al., 2013). The species was introduced in many countries and is often considered a threat to the native fauna (Welcomme, 1992; Hickley et al., 1994; Godinho et al., 1997; García-Berthou, 2002). Similarities between Feebas and the largemouth bass include the large, wide mouth and the brownish coloration, with darker areas (Brown et al., 2009).



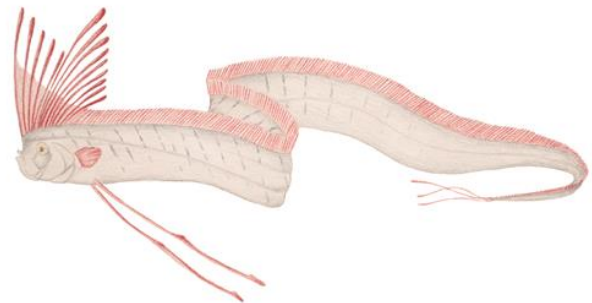
**Figure 13.** Feebas and *Micropterus salmoides*.

#### Milotic

**Species:** *Regalecus* sp.; **Common name:** oarfish.

Often praised as the most beautiful Pokémon of all (Bulbapedia, 2017), Milotic (Fig.

14) certainly lives up to its title. Their long reddish eyebrows were based on the first elongated rays of the dorsal fin of *Regalecus* species (Nelson et al., 2016), which also share the reddish color of the dorsal fin (Carrasco-Águila et al., 2014). Other similarities between the oarfish and the Pokémon are the elongated body (some oarfishes can grow larger than 3.5 m) and the spots scattered on the body (Chavez et al., 1985; Balart et al., 1999; Dulčić et al., 2009; Ruiz & Gosztanyi, 2010).



**Figure 14.** Milotic and *Regalecus* sp.

#### Huntail

**Species:** *Monognathus* sp.; **Common name:** onejaw.

Probably based on fishes of the genus *Monognathus*, which have a large mandible and a long dorsal fin (Nelson et al., 2016),

Huntail (Fig. 15) is one of the possible evolutionary results of the mollusk Pokémon Clamperl (the other possibility is Gorebyss; see below). According to Raju (1974), fishes of the genus *Monognathus* live in great depths and have a continuous dorsal fin that ends in an urostyle (“uro” comes from the Greek language and means “tail”, an element also present in the Pokémon’s name).

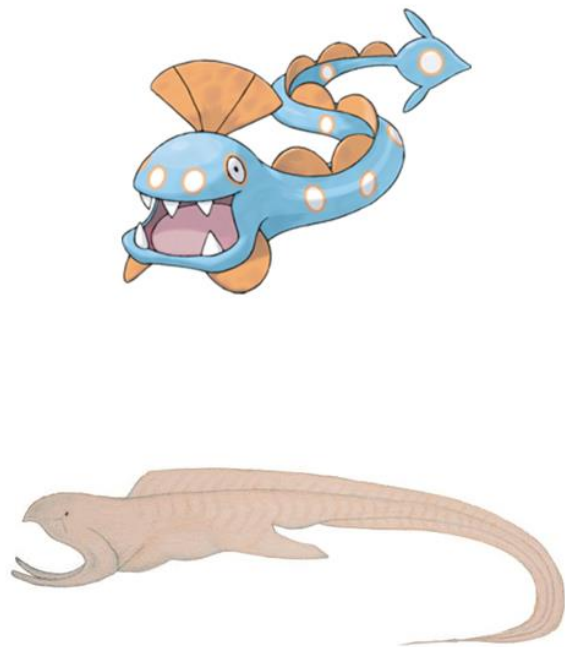


Figure 15. Huntail and *Monognathus* sp.

### Gorebyss

**Family:** Nemichthyidae; **Common name:** snipe eel.

The serpentine body and the thin beak-shaped jaw of Gorebyss (Fig. 16) are features of fishes belonging to the family Nemichthyidae (Nielsen & Smith, 1978). These fishes inhabit tropical and temperate oceans and can be

found in depths up to 4,000 meters, in the so-called “abyssal zone” (Cruz-Mena & Anglo, 2016). The Pokémon’s name may be a reference to such habitat.

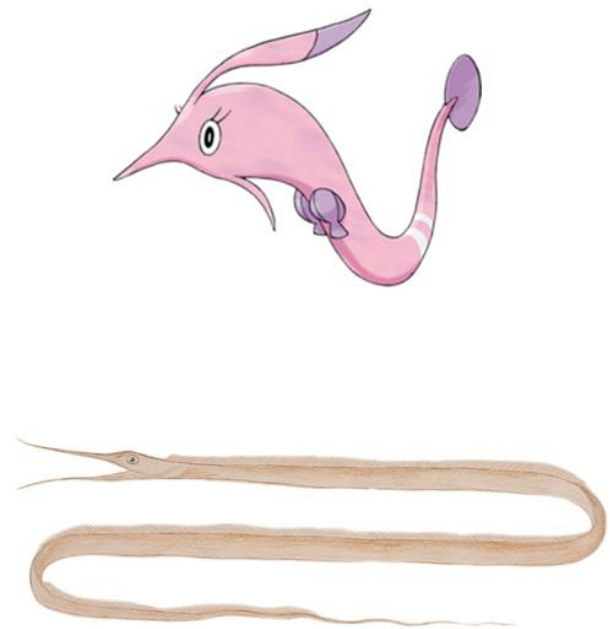


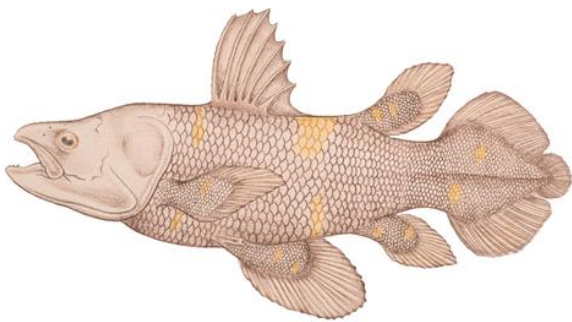
Figure 16. Gorebyss and a nemichthyid fish.

### Relicanth

**Species:** *Latimeria* sp.; **Common name:** coelacanth.

Relicanth (Fig. 17) was based on the coelacanth. The brown coloration, the lighter patches on the body (Benno et al., 2006) and the presence of paired lobed fins (Zardoya & Meyer, 1997) are traits of both the real fish and the Pokémon. It was believed that coelacanths went extinct in the Late Cretaceous, but they were rediscovered in 1938 in the depths off the coast of South Africa (Nikaido et al., 2011). Therefore, the only two living species *L.*

*chalumnae* Smith, 1939 and *L. menadoensis* Pouyaud et al., 1999 are known as "living fossils" (Zardoya & Meyer, 1997). Probably for this reason, Relicanth belongs to the Water and Rock types (the "fossil Pokémon" are all Rock-type).



**Figure 17.** Relicanth and *Latimeria* sp.

#### Luvdisc

**Species:** *Helostoma temminckii*; **Common name:** kissing gourami.

The silver-pinkish coloration, the peculiar mouth formed by strong lips and the habit of "kissing" other individuals of their species (which is actually a form of aggression!) are features of the kissing gourami (Sterba 1983; Sousa & Severi 2000; Sulaiman & Daud, 2002; Ferry et al., 2012) that are also seen in Luvdisc (Fig. 18). *Helostoma temminckii* is native to

Thailand, Indonesia, Java, Borneo, Sumatra and the Malay Peninsula (Axelrod et al., 1971), but due to its use as an ornamental fish and the irresponsible handling by fishkeepers, it has been introduced in other parts of the world (Magalhães, 2007).



**Figure 18.** Luvdisc and *Helostoma temminckii*.

#### Finneon and Lumineon

**Species:** *Pantodon buchholzi*; **Common name:** freshwater butterflyfish.

Finneon and Lumineon (Fig. 19) were probably based on the freshwater butterflyfish. Finneon has a caudal fin in the shape of a butterfly and Lumineon, like *Pantodon buchholzi*, has large pectoral fins (Nelson et al., 2016) resembling the wings of a butterfly (hence the popular name of the species). Butterflyfishes are found in West African lakes

(Greenwood & Thompson, 1960); their backs are olive-colored while their ventral side is silver, with black spots scattered throughout the body; their fins are pink with some purplish spots (Lévêque & Paugy, 1984). Both Pokémon have color patterns that resemble the freshwater butterflyfish.



Figure 19. Finneon, Lumineon and *Pantodon buchholzi*.

**Basculin**

**Family:** Serrasalimidae; **Common name:** piranha.

The two forms of the Pokémon Basculin (Fig. 20) seem to have been inspired on fishes from the Serrasalimidae family, such as piranhas. Basculin, like these fishes, has a tall body and conical teeth (Baumgartner et al., 2012). Piranhas are predators with strong jaws that inhabit some South American rivers.

Curiously, they are commonly caught by local subsistence fishing (Freeman et al., 2007).

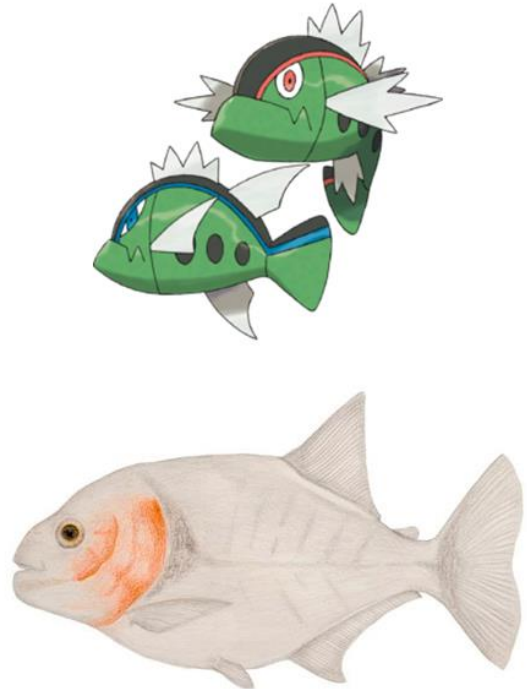


Figure 20. Basculin’s two forms and a serrasalimid fish.

**Alomomola**

**Species:** *Mola mola*; **Common name:** sunfish.

The very name of this Pokémon is evidence that it was inspired on *Mola mola*, the sunfish (Fig. 21). Moreover, Alomomola, just like the sunfish, has a circular body with no caudal fin (Pope et al., 2010). The sunfish is the largest and heaviest bony fish in the world, weighting more than 1,500 kg (Freesman & Noakes, 2002; Sims et al., 2009). They inhabit the Atlantic and Pacific Oceans, feeding mainly on zooplankton (Cartamil & Lowe, 2004; Potter & Howell, 2010).

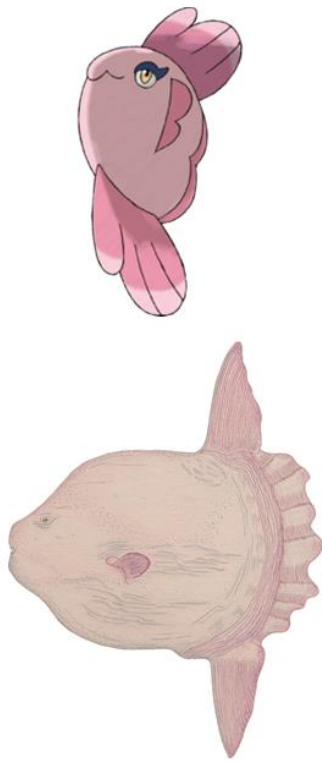


Figure 21. Alomomola and *Mola mola*.

### Tynamo, Eelektrik and Eelektross

**Species:** *Petromyzon marinus*; **Common name:** sea lamprey.

The evolutionary line Tynamo, Eelektrik and Eelektross (Fig. 22) was probably inspired by the life cycle of the sea lamprey, *Petromyzon marinus*: Tynamo represents a larval stage, Eelektrik a juvenile, and Eelektross an adult. As a larva, the sea lamprey inhabits freshwater environments and, after going through metamorphosis, the juvenile migrates to the ocean, where they start to develop hematophagous (“blood-sucking”) feeding habits (Youson, 1980; Silva et al., 2013). Eelektrik and Eelektross, like the sea lamprey, have a serpentine body and a circular suction cup-mouth with conical teeth. In addition, the yellow circles on the side of these Pokémon

resemble the gill slits of lampreys (which are of circular shape) or the marbled spots of *P. marinus* (Igoe et al., 2004).

It is worth mentioning that Eelektrik and Eelektross also seem to possess name and characteristics (Electric type and serpentine body with yellow spots) inspired by the electric eel (*Electrophorus electricus* Linnaeus, 1766), a fish capable of generating an electrical potential up to 600 volts, making it the greatest producer of bioelectricity in the animal kingdom (Catania, 2014). However, a remarkable characteristic of Eelektrik and Eelektross is the jawless mouth structure of the superclass Petromyzontomorphi species. The electric eel has a jaw and thus belongs to the superclass Gnathostomata (jawed vertebrates) (Gotter et al., 1998).



Figure 22. Tynamo, Eelektrik, Eelektross and *P. marinus*.



### Stunfisk

**Order:** Pleuronectiformes; **Common name:** flatfish.

Flattened and predominantly brown in color, Stunfisk (Fig. 23) appears to have been based on fishes of the order Pleuronectiformes. Popularly known as flatfishes, these animals have both eyes on the same side of the head and stay most of their lives buried and camouflaged on sandy and muddy substrates of almost every ocean, feeding on fishes and benthic invertebrates (Sakamoto, 1984; Kramer, 1991; Gibb, 1997). It is likely that the primary type of Stunfisk, Ground, is based on the close relationship between pleuronectiform fishes and the substrate they live in. Species of this group are very valuable for the fishing industry (Cooper & Chapleau, 1998).



**Figure 23.** Stunfisk and a pleuronectiform fish.

### Dragalge

**Species:** *Phycodurus eques*; **Common name:** leafy seadragon.

Dragalge (Fig. 24), a Pokémon belonging to the Poison and Dragon types, was based on a leafy seadragon. This species is found in Australia and it is named after its appearance: this fish has appendages throughout its body that resemble leaves (Larson et al., 2014). This feature, also present in the Pokémon, allows the leafy seadragon to camouflage itself among algae (Wilson & Rouse, 2010). Dragalge is the evolved form of Skrelp, a Pokémon based on a common seadragon (see above).

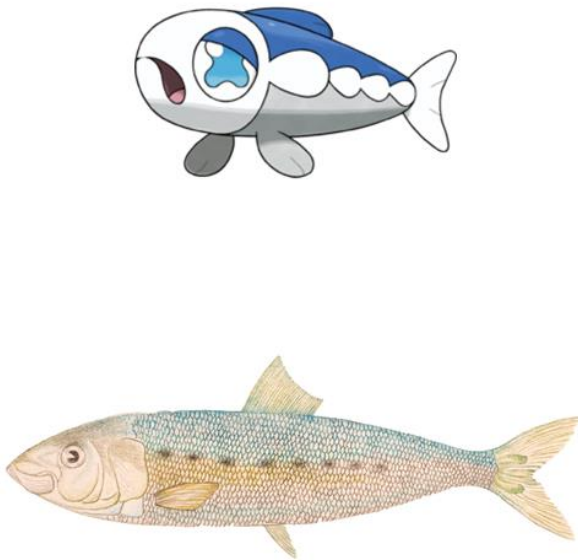


**Figure 24.** Dragalge and *Phycodurus eques*.

### Wishiwashi

**Species:** *Sardinops sagax*; **Common name:** Pacific sardine.

Wishiwashi (Fig. 25) was probably based on the Pacific sardine, a pelagic fish with high commercial value and quite abundant along the California and Humboldt Currents (Coleman, 1984; Gutierrez-Estrada et al., 2009; Demer et al., 2012; Zwolinski et al., 2012). The lateral circles of the Pokémon are a reference to the dark spots present on the lateral areas of the real fish (Paul et al., 2001). Furthermore, Wishiwashi has the ability to form a large school, just as sardines do (Emmett et al., 2005; Zwolinski et al., 2007).



**Figure 25.** Wishiwashi and *Sardinops sagax*.

Another parallel is the geographic location: the Pokémon belongs to Alola, a fictional region based on Hawaii, and *S. sagax* is one of the most common sardines in the Eastern Pacific Ocean. From the mid-1920's to the mid-1940's,

for example, *S. sagax* supported one of the largest fisheries in the world. The stock collapsed in the late 1940's, but in the 1990's it started to recover (McFarlane et al., 2005).

### **Bruxish**

**Species:** *Rhinecanthus rectangulus*;  
**Common name:** reef triggerfish.

Bruxish (Fig. 26) was probably inspired by the species *Rhinecanthus rectangulus*, the reef triggerfish of the Hawaiian reefs and other tropical regions (Kuitert & Debelius, 2006; Dornburg et al., 2008). Bruxish has powerful jaws, just like the reef triggerfishes that prey upon a wide variety of invertebrates, such as hard-shelled gastropods, bivalves, echinoderms and crustaceans (Wainwright & Friel, 2000; Froese & Pauly, 2016).

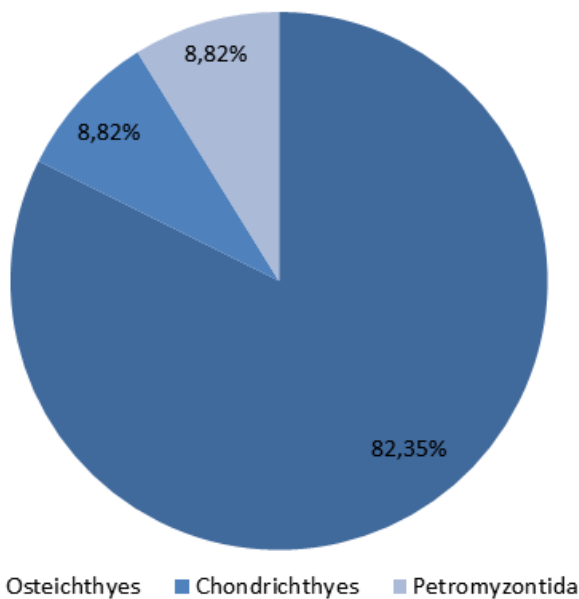


**Figure 26.** Bruxish and *Rhinecanthus rectangulus*.

Besides the strong jaw, the overall body shape and the flashy coloring, another parallel can be seen: this Pokémon is an inhabitant of the Alola region (the Pokémon version of Hawaii) and *R. rectangulus* is actually the state symbol fish of the Hawaiian archipelago (Kelly & Kelly, 1997).

**POCKET FISHES UNDER SCRUTINY**

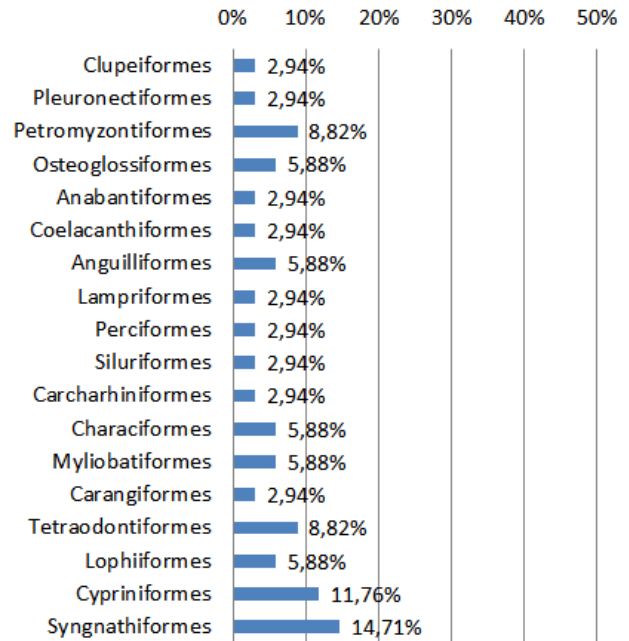
The majority of the identified Pokémon (85.29%) is, expectedly, Water-type. A large portion of them (29.41%) was introduced for the first time in the third generation of the franchise, in the Hoenn region.



**Figure 27.** Representativeness of fish classes in *Pokémon*.

Only three fish Pokémon were classified in the superclass Petromyzontomorphi (8.82%): the lamprey-like Tynamo, Eelektrik and Eelektross, all of them belonging to the same evolutionary line. In the superclass Gnathostomata, the class Osteichthyes is represented by the highest number of

Pokémon: 28 in total (82.35%, Fig. 27). Inside this class, the most representative groups were the order Syngnathiformes (14.71%, Fig. 28), family Syngnathidae (15.63%, Fig. 29) and the genus *Petromyzon* (10.00%, Fig. 30).



**Figure 28.** Representativeness of fish orders in *Pokémon*.

Most of the real fishes on which the Pokémon were based (55.88%, Fig. 31) live in marine environments, followed by freshwater (continental water environments, 32.35%) and finally, brackish water (estuarine environments, 11.76%).

The “fish” species found in the Pokémon world consists of a considerable portion of the ichthyological diversity in our world. According to Nelson et al. (2016), the Osteichthyes class corresponds to 96.1% of all vertebrate fish species (30,508 species), followed by the Condrihthyes with 3.76% (1,197 species) and the Petromyzontida with just 0.14% (46 species). In *Pokémon*, the proportions of taxa

(taxonomic group) that inspired the creatures follow a roughly similar distribution: within the 26 taxa in which the evolutionary families of the Pokémon were based, 23 are Osteichthyes class (88.46%), two are Condriichthyes (7.7%) and one is Petromyzontida (3.84%). If the games follow a pattern of introducing more fish Pokémon over time, it is expected that these proportions will gradually become more equivalent as each new generation of the franchise is released.

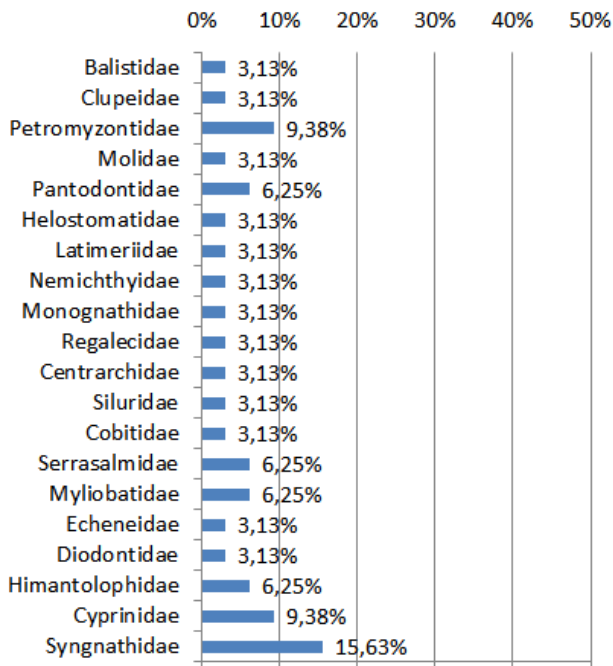


Figure 29. Representativeness of fish families in Pokémon.

**ALMOST A BIOLOGICAL POCKET-WORLD**

Our analysis shows that fish Pokémon are very diverse creatures, both taxonomic and ecologically, despite being a small group within the Pokémon universe (with 801 “species”).

The fish Pokémon are represented by several orders, families and genera of real fishes and, as previously stated, this is actually

a relevant sampling of the ichthyological diversity of our planet. The marine Pokémon described here are inhabit from abyssal zones to coastal regions, including reefs. The creative process of the fish monsters in the game must have included a fair share of research on real animals.

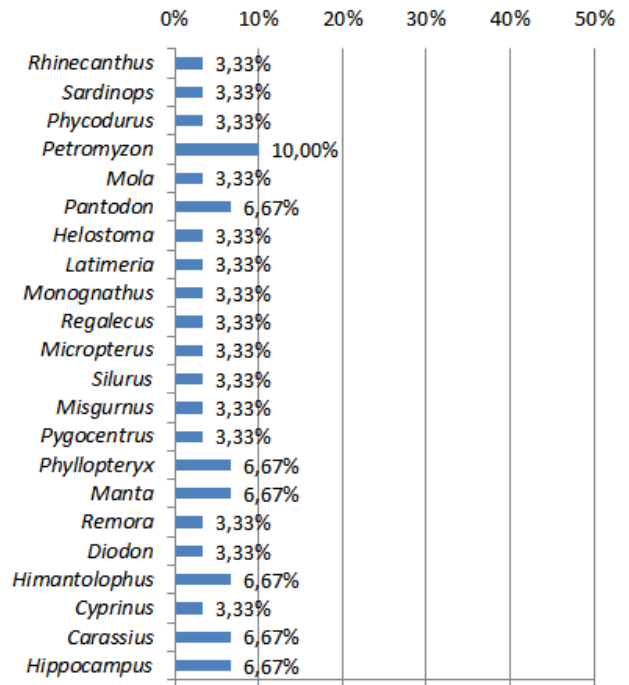
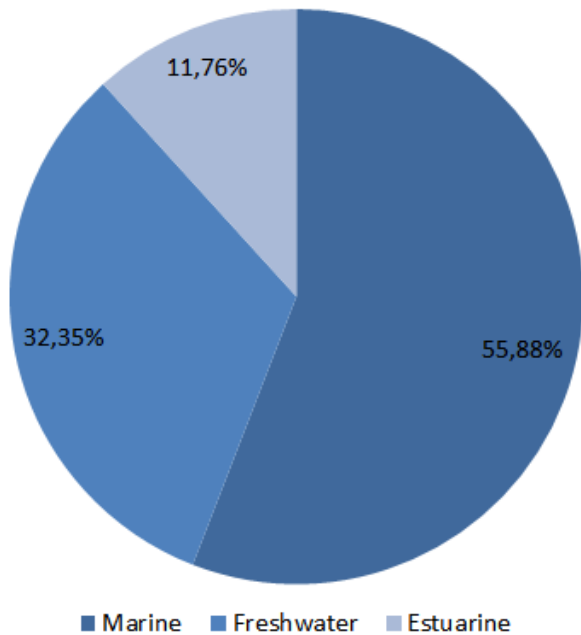


Figure 30. Representativeness of fish genera in Pokémon.

The Hoenn region, which has the largest playable surface and includes areas with “too much water”, is also the region with the highest number of fish Pokémon. Furthermore, the majority of these Pokémon live in the marine environment and belongs to the Osteichthyes class, as is observed for real fishes (Nelson et al., 2016; Eschmeyer et al., 2016). However, it is also important to underline that marine fishes are those with the more attractive colors and shapes and, therefore, higher popular appeal, which is vital for a game based in charismatic

monsters (Darwall et al., 2011; McClenachan, 2012; Dulvy et al., 2014).



**Figure 31.** Environments inhabited by the fish Pokémon.

In the present work, the analogy between fish Pokémon and real species allowed a descriptive study of the “Pokéfauna” in a similar manner in which actual faunal surveys are presented. These surveys are an important tool for understanding the structure of communities and to evaluate the conservation status of natural environments (Buckup et al., 2014). It is noteworthy that the association of the monsters with real fishes was only possible because Pokémon have several morphological, ecological and ethological traits that were based on real species.

*Pokémon* is a successful franchise and many of its staple monsters are already part of the popular imaginary. The creation of the pocket monsters was not done in a random manner; they were mostly inspired by real organisms,

particularly animals, and often have specific biological traits taken from their source of inspiration. Thus, analogies between Pokémon and our natural world, such as the ones performed here, open a range of possibilities for science outreach.

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#### ABOUT THE AUTHORS

**Augusto Mendes** began his journey as a Pokémon trainer in his childhood, when his parents gave him a green Game Boy Color with *Pokémon Red* for Christmas. Currently, he is a master’s degree student in the Program of Marine Biology and Coastal Environments of UFF, where he works with zooarchaeology of fishes and education.

**Felipe Guimarães** is in love with Pokémon (since he first watched the TV series) and the natural world. He graduated in Biology from the UERJ, where he worked with taxonomy and ecology of fishes. He also works with popularization of science and environmental education.

**Clara Eirado-Silva**, when she was eight years old, told her parents she would study sharks. She has always been passionate about art too and draw since her childhood. Currently, she holds a “Junior Science” scholarship, working on fishing ecology with emphasis on reproductive biology. In her free time, she draws her much loved fishes.

Although Pokémon is not exactly Dr. **Edson Silva**’s cup of tea, he watched all movies with his daughter, who’s crazy about the little monsters. As fate would have it, his work on population genetics of marine organisms attracted a master’s student (A.B.M.) who’s an equally crazy pokéfan. May Arceus not spare him from the monsters!