

*Nature's
Wonders* **Frogs**
of the **World**



Volume 2: Poison Dart Frogs

A 3D Model set by Ken Gilliland

Nature's Wonders

Frogs of the World

Volume 2: Poison Dart Frogs

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Nature's Wonders

Frogs of the World

Volume 2: Poison Dart Frogs

Introduction

This second volume of Frogs of the World focuses on the Dendrobatidae family of which there are over 170 species. These spectacularly colored frogs of Central and South America are commonly called "poison dart frogs". They acquired this name due to the indigenous natives, who use their toxic secretions to poison the tips of their blow darts.

The warning coloration of these frogs is correlated with the toxicity of the species. Its function is a warning to potential predators that the prey animal has defenses such as being unpalatable or poisonous. Thus their aposematism helps prevent them from being attacked. However other frogs have cryptic coloration with minimal to no amount of observed toxicity. The species that have the greatest amount of toxicity, derive this from their diet of ants, mites and termites. While the species that exhibit cryptic coloration and have low to no amounts of toxicity, eat a much larger variety of prey.

Some toxic compounds found on poison dart frogs' skin have pharmacological properties that have proven to be valuable in bio-medical research. Medicines to fight HIV, Alzheimer's, Cancer, as well as painkillers over two hundred times more powerful than opioids, without the addictive properties, have been produced from them.

Most species of this family are threatened due to human infrastructure encroaching on the places they inhabit. This in turn threatens the discovery of new medical breakthroughs.

Overview and Use

The set comes in two versions; a Poser version that supports Firefly and Superfly rendering and a DAZ Studio version which supports 3Delight and Iray rendering.

A common base model is used to recreate digitally the six different species of Poison Dart Frogs included in this set. Each species uses specific morphs from the generic model to single-out its unique features, plus each has its own set of texture maps. The base model is not included in this set. It is [available for purchase separately](#).

Creating a Specific Frog using Poser

1. For this example, we'll create the Harlequin Poison Dart Frog.
2. Load Poser, select the FIGURES library and go to the Nature's Wonders Amphibians folder.
3. To create a Harlequin Poison Dart Frog, use the "Nature's Wonders Frog" base model.
4. Go to the POSES library, then to the Nature's Wonders Amphibians/Frogs of the World folder and the Firefly or Superfly sub-folder.
5. Select the Harlequin Poison Dart Frog (or a frog of your choice) and load/apply it to the Frog base model by clicking the mouse. This species pose contains both the morph and texture settings to turn the generic model into the selected frog.

Creating a Specific frog using DAZ Studio

1. For this example, we'll create the Harlequin Poison Dart Frog.
2. Load DAZ Studio and go to the "Animals" "Nature's Wonders" "Amphibians" folder.
3. To create a Harlequin Poison Dart Frog, use the "Nature's Wonders Frog" base model.
4. Go to the Nature's Wonders Amphibians/Frogs of the World folder and select the subfolder of which renderer you want to use, 3Delight or Iray.
5. Now select the Harlequin Poison Dart Frog (or a frog of your choice) and load/apply it to the frog base model by clicking the mouse. This species pose contains both the morph and texture settings to turn the generic model into the selected frog.

Sizing & Poser Issues

All the frogs included in this set have been scaled to their appropriate sizes in relation to human figure models. In the case of Poison Dart frogs, which are very, very small with lengths of around one-inch (25 mm), it is suggested that the transform dials (xtrans, ytrans, zrotate, etc.) be tuned to a more delicate sensitivity (via properties) to ensure greater control over placement of the frog.

This extremely small size can produce some issues in Poser. The frog may disappear when the camera is in close focus. The "hither" setting on Poser's cameras is set to 0.800 by default. Reducing this setting to "0.0" will correct this issue.

A second issue can appear when rendering a small frog solely (without any other items in the scene). It will produce a default square shadow. It is a known bug with Poser. To correct this issue, include a second larger item off-screen and the shadows will render correctly.

Rendering & Lighting Issues

The frogs will render perfectly in most conditions in Poser and DAZ Studio. With DAZ Studio, the materials were set-up and tuned in Uber Environmental lighting, so using other lighting systems (such as AoA lighting in 3Delight) may cause texture seams and require the adjustment (lessening) of bump, displacement and/or normal map values.

Harlequin Poison Dart Frog (*Oophaga histrionica*)

This frog produces histrionicotoxins. This neurotoxin is absorbed from insects in their diet and stored in glands in their skin. It is notably less toxic than other poison dart frogs. Tests have shown that mice can survive a 5 mg/kg dose of histrionicotoxin and recover within 3 hours with no lasting effects.

Range and Habitat: South America; this species of poison dart frog is endemic to the El Chocó region of western Colombia.

The Harlequin Poison Dart Frog is normally found on the ground of tropical rain forests, among fallen limbs or leaf litter.



Identification (Measurements Snout to Vent): 0.96-1.5 inches (25-38 mm). The Harlequin Poison Dart Frog has a variety of color morphs, which can be found in surprisingly close proximity, with different populations being located on adjacent hillsides within its native range. For example the base color can be a bright orange, with a webbing of black over the entire body. In other color morphs, the base color may be of clear to dull orange, yellow, red, white or blue and the web pattern can vary from small lines to big lines, speckled or incomplete lines. They may even be a completely black frog with just a few spots. The Bilsa Biological Station (operated by the [Jatun Sacha Foundation](#)) has three color morphs—red, yellow, and orange—within their 3000-ha protected area, located within Ecuador's Mache and Chindul coastal mountain range.

Call: The species has a very repetitive duck quack-like call.

Behavior and Reproduction: Generally the males call from a low perch to advertise their presence and lead the female to a site, where she deposits her eggs inside leaf-litter that is dark and moist.

When the eggs hatch, a parent transports the newly hatched tadpoles to a tiny water

reservoir, which is often in the axil of a bromeliad. Since the larva is an obligate egg-feeder and will starve without this form of nutrition, the mother returns periodically and lays unfertilized eggs, on which the tadpoles feed until ready to metamorphose and exit the water.

Diet: Small invertebrates such as ants and termites.

Typical Lifespan: They live up to 9 years in captivity.

Status and Threats: Least Concern. It is a relatively common and adaptable species, that is able to live in disturbed habitats. Nevertheless, with the ongoing destruction of the rainforest, its numbers appear to be declining. Although this is at a level unlikely to be fast enough to justify listing it in a more threatened category.

Black & Yellow Poison Dart Frog (*Dendrobates leucomelas*)

This is one of the largest species in the genus Dendrobates. It secretes an alkaloid toxin, through glands on its skin, that interfere with nerve impulses and can lead to heart failure or fibrillation.

Range and Habitat: South America; This species is found from the Guianan Orinoco drainage of Venezuela, north to the Ro Orinoco (in Bolvar and Amazonas States), east into Guyana to the Essequibo River, south into extreme northern Brazil, and west into eastern Amazonian Colombia. In Venezuela it has been recorded from sea level up to 500 m.

The Black & Yellow Poison Dart Frog prefers the very humid conditions of the tropical rain forests, where it can be close to fresh water, flat rocks, trees, plants (notably bromeliads), and the leaf litter of the forest floor. During the dry season, they are known to congregate in damper places, such as under rocks or fallen tree trunks.



Identification

(Measurements

Snout to Vent):

1.38-1.97 inches
(35-50 mm).

Predominantly, these frogs have a bright yellow coloration with varying numbers of broad black stripes and/or spots that extend over the whole body. Some morphs are orange in color, and variations existing within the species dictate the extent of the markings, which may range from fine spots to thick, unbroken banding.

Call: Males use

vocalizations such as chirps, buzzes, pleasant "birdlike" trills and hums, lasting for 10 to 15 seconds, to attract females. Direct behavioral actions facilitate courtship and stimulate oviposition.

Behavior and Reproduction: This frog is diurnal by nature. It lives in small groups in the wild and is known to be fiercely territorial, attacking neighboring groups with surprising ferocity for a creature of its size.

Male poison dart frogs find the best site for the female to deposit a few large eggs, usually on the underside of a leaf that is near water. The eggs are then fertilized, protected and maintained by the male. It is the male's duty to keep the eggs moist so that they can grow. Eggs hatch into tadpoles about 10 to 14 days after fertilization. At

70 to 90 days, the tadpoles will have fully meta-morphed into frog-lets. They become mature between 12 and 18 months.

Diet: Ants, termites, tiny beetles, crickets, and other small insects and spiders.

Typical Lifespan: 5-7 years in the wild and 10-15 years in captivity.

Status and Threats: Least Concern. This frog has shown some minor decline in population due to over-harvesting of wild specimens for the exotic pet trade. But the species' ability to be easily bred in captivity has led to a fall in prices within that trade, which in turn has helped to stop the problem of over-harvesting.

Strawberry Poison Dart Frog (*Oophaga pumilio*)

This frog produces a specialized toxin called pumiliotoxin 251D. This toxin has a negative stimulating effect on cardiac function and is also a severe disruptor of the sodium potassium ion channels within cells. Upon ingestion of this toxin, organisms experience convulsions, paralysis, and death. While the Strawberry Poison Dart Frog is not the most poisonous, it is the most toxic member of its genus.

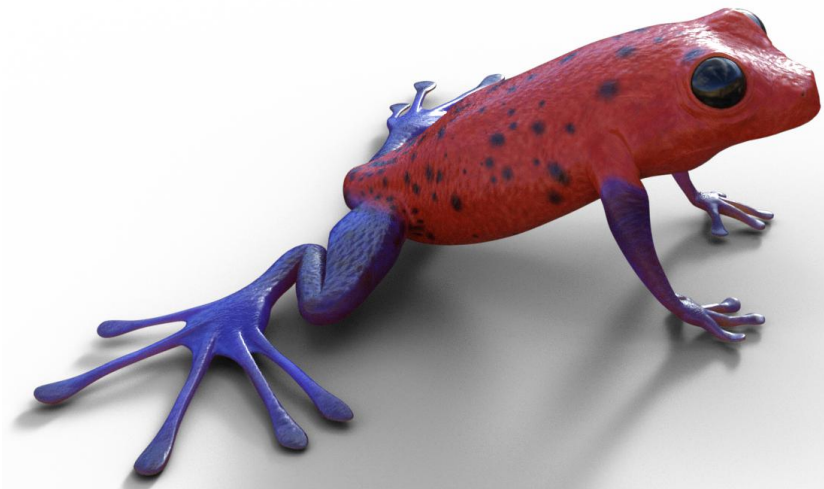
Range and Habitat: Central America; its range extends from eastern central Nicaragua, through Costa Rica and northwestern Panama.

This is a diurnal and mostly terrestrial frog of humid lowland and premontane forest, cacao plantations, and abandoned forest clearings. At one site in Costa Rica this species has been detected in forest-palmito, forest-pasture, palmito, and pasture.

Identification (Measurements Snout to Vent): 0.69–0.87 inches (17.5–22 mm).

The Strawberry Poison Dart Frog is perhaps most famous for its widespread variation in coloration, comprising approximately 15–30 color morphs, most of which are presumed to be true-breeding.

Typically they are bright red with blue legs, although with their great variation in coloration they may also be blue, yellow, white, green, black or



orange. Their legs are typically darker and have some degree of blackish mottling. Their dorsal surface may also feature dark spots or mottling. The eyes of these frogs are fairly large, dark and set on the sides of the head. Since the skin is very moist it gives them a somewhat glossy appearance in bright light.

Call: The mating call is a loud continuous clicking-like sound.

Behavior and Reproduction: This frog is diurnal and primarily terrestrial, and can often be found in leaf litter in both forested and disturbed areas. Individual territories have been estimated at 2.5 m² and the males appear to be fiercely territorial.

Observations concerning mating behavior suggest that some of these frogs are at times polygynous. Females lay a clutch of between three to nine eggs in moist leaf-litter; in captive specimens clutch sizes of six to sixteen eggs have been recorded. The eggs hatch approximately seven days after oviposition and the adults then carry

the developed tadpoles from the forest floor to water filled bromeliads. The tadpoles have a very specialized oophagous diet, feeding solely on unfertilized eggs supplied by the female. Sexual maturity is reached at a minimum size of 19 mm (approximately 10 months).

Diet: Small invertebrates, mostly ants and mites.

Typical Lifespan: Up to 17 years in captivity.

Status and Threats: Least Concern. Habitat loss, from urbanization, agriculture and logging, as well as over-collection for the pet trade are the principal threats to this species. It is believed that they are currently being unsustainably collected, and because of the apparently low fecundity of this species, the possibility exists that this over-harvesting might lead to localized population declines. Frogs found on distinct islands are particularly susceptible to both over-collection and the development of the islands for tourism purposes. The great majority of reported trade over the period of 1991 to 1996 was in live animals, presumably by the herpetological pet market. The largest overall exporter of these frogs during this time period was Nicaragua (>95% of exports) and the USA consistently accounted for over 80% of recorded live frog imports from Nicaragua during this period. This species makes up 7% of all CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) amphibian trade.

Chytrid fungus was not detected in Bastimentos Island populations in Panama, but it has been found on museum specimens of this species, as well as in captive collections in Europe. In Costa Rica, individuals have been found to be infected with ranavirus, and chytrid fungus, as well as co-infected with both pathogens. A lowland population in Costa Rica was found to have high prevalence of chytrid fungus, though there seems to be seasonal variation in Bd presence within populations. The current impact of this pathogen on *O. pumilio* is not known. At La Selva, observed declines seem to be driven by climate-driven reductions in quantity of standing leaf litter.

Dyeing Poison Dart Frog (*Dendrobates tinctorius*)

This frog produces pumiliotoxins which are weaker than the toxins many other Poison Dart Frogs produce, still they are sufficiently toxic to discourage most animals from feeding on them. These toxins cause pain, cramping, and stiffness. Local tribes use D. tinctorius for decoration in a unique way. They pluck feathers from the back of young parrots, then the frogs are rubbed on the parrots' exposed skin. When the feathers regrow, the toxin causes them to appear yellow or red rather than green. These altered feathers are highly prized by the indigenous tribes.

Range and Habitat: South America; this species is distributed throughout the eastern portion of the Guiana Shield, including parts of Guyana, Suriname, Brazil, and nearly all of French Guiana.

It lives among moss-covered rocks, in a dark, moist environment near small streams, in the small isolated forest areas surrounded by the dry, prairie-like Sipaliwini Savannah at elevations from 315 to 430 m. This forest habitat is rather humid and warm with temperatures ranging from 22 to 27 degrees Celsius during the day to 20 degrees Celsius at night. Typically this frog remains on the ground, but it has been found in trees at heights of up to 5 m.



Identification

(Measurements

Snout to Vent):

1.57-1.97 inches (40-50 mm). This frog is large for a poison dart frog and is one of the most variable in coloration. Typically, the body is primarily black, with an irregular pattern of yellow or white stripes running along the back, flanks, chest, head, and belly. In some morphs, however, the body may be primarily blue, primarily yellow, or primarily white. The legs range from pale blue, sky blue or blue-gray to royal

blue, cobalt blue, navy blue, or royal purple and are typically peppered with small black dots. The "Matecho" morph is almost entirely yellow with some black and only a few specks of white on the toes. Another unique morph, the citronella morph, is primarily golden yellow with tiny splotches of black on its belly and royal blue legs that have no black dots.

Males are typically smaller and more slender than females. The males have larger,

heart-shaped toe discs, while the female's toe discs are circular. Also the females have arched backs as opposed to the males who have curved ones.

Call: During mating, males emit a series of soft calls to attract females.

Behavior and Reproduction: It breeds seasonally in the wild, usually during the rainy season (February and March). In captivity, it is known to breed year round. Males position themselves on a rock or a leaf and produce quiet calls in order to attract a female. Females then follow these calls to locate the male. Once found, females fight aggressively over the male. Afterwards, the victorious female begins the courtship ritual by gently stroking his snout and dorsal surface with her forelegs. Courtship may also involve chasing and wrestling between the male and female. Finally, the male leads the female to a secluded location of his choosing near a water source to mate and lay eggs. Unlike most frog species, which practice the mating ritual of amplexus, males of this species do not display this behavior. The eggs laid by the female hatch after about 14-18 days, and the juvenile tadpole matures into an adult in 10-12 weeks. The total time to independence for the frogs is about 84-102 days and both sexes reach sexual maturity at 2 years of age. Unlike most frogs which lay their eggs in water, the eggs of this species are placed in consistently-moist, mossy areas underneath rocks or logs.

Diet: Ants, beetles, flies, mites, spiders, termites, maggots, and caterpillars. It's toxicity comes from eating ants, so in captivity, this species loses its poisonous properties due to the lack of toxic compounds within the food it is fed.

Typical Lifespan: 4-6 years in the wild. In captivity, it is known to live on average about 10 years, and can survive for up to 12 years.

Status and Threats: Near Threatened. The destruction of rainforest habitat by fires and by humans for farmland has contributed to the decreasing numbers of *D. tinctorius* in the wild. The illegal pet trade has also negatively impacted the existence of *D. tinctorius* by smuggling hundreds of these frogs out of Suriname into pet stores worldwide. With this pressure from illegal trade and shrinking habitat, this species has become one of the most threatened of all the poison dart frogs in the neotropics..

Golden Poison Dart Frog (*Phyllobates terribilis*)

The Golden Poison Dart Frog's skin is densely coated in an alkaloid toxin, one of a number of poisons common to dart frogs (batrachotoxins). This poison prevents its victim's nerves from transmitting impulses, leaving the muscles in an inactive state of contraction. This can lead to heart failure or fibrillation. The average wild *P. terribilis* is generally estimated to contain about one milligram of poison, which is enough to kill about 10,000 mice or between 10 to 20 humans or up to two African bull elephants. The Choco Emberá people carefully expose the frog to the heat of a fire, which causes the frog to exude small amounts of poisonous fluid. The tips of arrows and darts are soaked in this fluid and they keep their deadly effect for over two years.

Range and Habitat: South America; endemic to the Pacific coast of Colombia in the Cauca and Valle del Cauca Departments.

Its natural habitats are rivers, mountain streams and swamps.

Identification (Measurements Snout to Vent): 1.85-2.17 inches (47 mm (male)-55 mm (female)). Adult females are typically larger than males. This frog occurs in three different color varieties or morphs:

- Mint green morph. The largest morph of *P. terribilis* exists in the La Brea area of Colombia, and is the most common form seen in captivity. The name "mint green" is actually rather misleading, as the frogs of this morph can be metallic green, pale green, or white.



- The yellow morph is the reason it has the common name golden poison dart frog. The yellow *P. terribilis* specimens are found in Quebrada Guanguí, Colombia. These frogs can be pale yellow to deep, golden yellow in color. A frog sold under the name "gold *terribilis*" was once believed to be a deeper

yellow *P. terribilis*. However, genetic tests have proven these frogs to be uniform-colored morphs of *Phyllobates bicolor*.

- Orange morph. While not as common as the other two morphs, orange examples of *P. terribilis* exist in Colombia, as well. They tend to be a metallic orange or yellow-orange in color, with varying intensity.



Call: Their calls are long sustained trills, consisting of a rapid succession of individual notes uttered at a rate of 13 per second, with a dominant frequency of 1.8 kHz.

Behavior and Reproduction: In the wild, *P. terribilis* is a social animal, living in groups of up to six individuals; however, captive *P. terribilis* specimens can live in much larger groups. The frog is normally diurnal.

Golden poison frogs are thought to mate year round. Each breeding involved two or more male frogs and one female. Males attract females by using a variety of high pitched calls. Mating could be described as a frantic frenzy where individuals move quickly around each other during egg laying. The eggs are laid on the ground; after they hatch, the males transport the tadpoles to permanent pools.

Diet: Primarily ants, although many kinds of insects and other small invertebrates can be eaten (specifically termites and beetles, which can easily be found on the rainforest floor).

The lethal poison this species produces comes primarily from the ants it eats in the genera *Brachymyrmex* and *Paratrechina*. Like the other poison dart frogs, this frog becomes harmless when raised in captivity, away from its natural food sources.

Typical Lifespan: In the wild, they are believed to live up to 5 years or more and over 20 years in captivity.

Status and Threats: Endangered. Golden poison frog populations have been decreasing due to deforestation for agricultural purposes. They can be found in fewer than five areas.

Ecuador Poison Dart Frog (*Ameerega bilinguis*)

This frog is also called the 'Little Devil' and is moderately toxic. The alkaloid toxins, secreted from the frogs' skin, interfere with nerve impulses, which can lead to heart failure or fibrillation.

Range and Habitat: South America; found in Colombia, Ecuador, and possibly Peru, from the Ecuadorian Amazon Basin in Napo, moist forests in the Eastern tropical Altitudinal Zone and from the department of Putumayo.

Its natural habitats are subtropical or tropical moist lowland forests, rivers, intermittent rivers, freshwater marshes, and intermittent freshwater marshes. This species lives in leaf-litter close to streams of primary and secondary Terra Firme forest and seasonal flooded forest.

Identification (Measurements Snout to Vent): 0.8-1 inches (20-25 mm). This frog has multiple colors; deep red to orange on the top of the head and back, turquoise to white along the flanks, brown to aqua

legs with bright yellow patches on the shoulders and hips. The underbelly is turquoise.

Call: It has a loud and elaborate call.

Behavior and Reproduction: After the eggs hatch, the adults transport the tadpoles on their backs to ponds, where the tadpoles complete their development.

Diet: Ants, termites and mites.

Typical Lifespan: Unknown.

Status and Threats: Least Concern. It is threatened by habitat loss, but also severely threatened by the fungal infection, *chytridiomycosis*, which has been linked worldwide to dramatic population declines and even extinction of some amphibian species. It is caused by climate change.



Special Thanks to:

.. to my beta tester, FlintHawk

...and to Charles Taylor for Poser Coding help and Szark for Iray Material help

Sources:

- "300 Frogs: A Visual Reference to Frogs and Toads from Around the World" by Chris Mattison. Firefly Books Ltd, Buffalo, NY, 2007
- Convergent Substitutions in a Sodium Channel Suggest Multiple Origins of Toxin Resistance in Poison Frogs by Rebecca D. Tarvin, Juan C. Santos, Lauren A. O'Connell, Harold H. Zakon, and David C. Cannatella. Oxford University Press (on behalf of the Society for Molecular Biology and Evolution). 2016.
- Animal Diversity Web. <http://animaldiversity.org>
- Genomic Resources <http://genomics.senescence.info>
- Wikipedia <http://wikipedia.org>

Watch and Read:

- Why We Must Save the Frogs. <https://youtu.be/NvP6j4Dj0VA>
- Save the Frogs. <http://savethefrogs.com>

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