Finding Fluorescence: utilizing community science to document novel biofluorescence occurrences and encourage community engagement in science

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All photos retrieved from Finding Fluorescence database.

Introduction

- Biofluorescence involves the absorption of light at one wavelength and re-emission at a longer wavelength due to fluorophores in specialized cells or structures in biological tissue [1].
- Finding Fluorescence is a public education and community science website designed in 2020 to encourage individuals to submit their own observations of organisms they find that experience biofluorescence [2].

Utilizing Finding Fluorescence, we sought to document novel observations of biofluorescence and propose possible ecological relevance through community submissions.

Methods

- Verification of organism identification through use of field guides, community science resources, and assistance from several biologists.
- Recorded excitation wavelength, organism, and description of fluorescence, as available.
- Novel documentations verified and compared via extensive literature reviews at the species, genus, and family level.

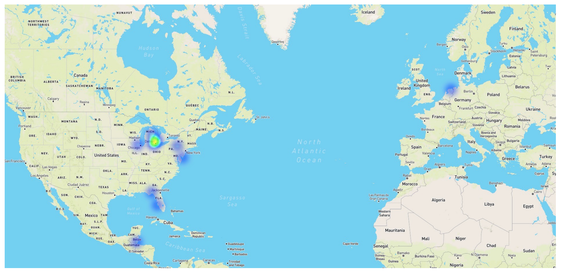

Figure 1. The current locations of where submissions to *Finding Fluorescence* originated from. Areas of yellow indicates concentrated submissions from a particular area, while blue indicates at least one submission from a given location.

Results

Finding Fluorescence Submissions

Phylum	Family	Genus	Species	Fluorescence Observed	Excitation	Emission	Location	New Observation
Arthropoda	*Apatelodidae*	*Apatelodes*	*torrefacta*	Yes	395-400 nm	Green	Entire surface.	Yes
	Bombycidae	*Bombyx*	*mori*	Yes	395 nm	1) Yellow 2) Light blue and yellow	1) Thorax and abdomen of female moths. 2) Fibers of cocoon.	1) Yes 2) Yes* (in cocoons)
	Cercopidae	N/A	N/A	Yes	390-395 nm	Green/blue	Entire surface.	Yes
	Hippoidea	*Emerita*	*talpoida*	Yes	390 nm	Yellow	Along the legs and crevices of exoskeleton.	Yes
	Libellulidae	*Pachydiplax*	*longipennis*	No	~395 nm	N/A	N/A	No* (*Pachydiplax longipennis*)
	Noctuidae	*Amphipyra*	*pyramidea*	Yes	~395 nm	Green	Along pattern on side of body.	Yes
	Saturniidae	*Eacles*	*oslari*	Yes	395 nm	Yellow	Abdomen.	Yes* (*Eacles imperialis*)
	Scarabaeidae	*Popillia*	*japonica*	Yes	320-400 nm (Black light brand not specified)	Blue	Surrounding mouth.	Yes
	Tipulidae	N/A	N/A	Yes	400 nm	Green	Head, thorax, and end of abdomen.	Yes
Basidiomycota	*Amanitaceae*	*Amanita*	*cokeri*	Yes	390 nm	Green	On universal veil remnants on cap of mushroom.	Yes
	Ganodermataceae	*Ganoderma*	N/A	Yes	~395 nm	Red, green	Bright red on underside of mushroom; light green along margin of mushroom.	Yes
	Russulaceae	*Russula*	N/A	Yes	390 nm	Green	Entire surface of mushroom.	No* (Various other *Russula* species)
Chordata	*Centrarchidae*	*Lepomis*	*cyanellus*	Potentially	320-400 nm (Black light brand not specified)	Unclear	Scales near gills.	N/A
	Gekkonidae	*Hemidactylus*	*turcicus*	Yes	400-415 nm	Green	Skull, along spine, and along appendages.	Yes* (*Hemidactylus frenatus*, *H. platyurus*, and *Pachydactylus rangei*)
	Hylidae	*Hyla*	*squirella*	Yes	400-415 nm	Green	Line spanning down the sides of body from snout to inner thigh.	Yes
		Smilisca	*baudinii*	Yes	400-415 nm	Green	Spots along flanks and inguinal area of body.	Yes* (*Smilisca baudinii*)
	Pythonidae	*Python*	*regius*	Yes	400 nm	Orange	All along body of snake.	Yes
Mollusca	*Naticidae*	*Neverita*	*duplicata*	Yes	390 nm	White	In spiral of shell.	Yes
Tracheophyta	*Solanaceae*	*Capsicum*	*annuum*	Yes	390 nm	Orange/pink	Entire surface, with pink concentrated near the bottom.	Yes* (*Capsicum annuum*)

Table 1. A summary of all identifiable submissions retrieved from Finding Fluorescence and noting its appropriate novelty status. An observation was considered novel if fluorescent observations were recorded in a previously undocumented location, of a new emission color, or under a previously untested excitation wavelength. An asterisk (*) denotes relevant fluorescent documentation exists, which will be summarized in Table 2.

Prior Relevant Fluorescence Documentations

Phylum	Family	Genus	Species	Fluorescence Observed	Excitation	Emission	Location	Source
Arthropoda	*Bombycidae*	*Bombyx*	*mori*	Yes	1)360 nm 2) 365 nm	1) Yellow-white and blue-purple 2) Yellow and blue	1) Cocoon fibers. 2) Cocoon fibers.	[3, 4]
	Libellulidae	*Pachydiplax*	*longipennis*	Yes	310-340 nm	Blue	Thorax, along wing hinges.	[5]
	Saturniidae	*Eacles*	*imperialis*	Yes	320-400 nm	Orange and brown-lavender	Not specified.	[6]
Basidiomycota	*Russulaceae*	*Russula*	Various *Russula* spp.	Yes	320-400 nm (Black light brand not specified)	N/A	N/A	[7]
Chordata	*Gekkonidae*	*Hemidactylus*	*frenatus*	Yes	395-400 nm	Green	Skull, along spine, and along appendages.	[8]
			platyurus	Yes	395 nm	Blue	Along the lower jaw bone.	[9]
		Pachydactylus	*rangei*	Yes	365 nm	Green	Skin around eyes and flanks.	[10]
	Hylidae	*Smilisca*	*baudinii*	Yes	360-380 nm	Green	On arms and inguinal area.	[11]
Tracheophyta	*Solanaceae*	*Capsicum*	*annuum*	Yes	1) 365 nm 2)Maximum 440 nm	1) Blue 2) Blue, low-green, low chlorophyll	1) Uniformly distributed on surface. 2) Not specified.	[12, 13]

Table 2. A summary of prior relevant fluorescent documentations as they relate to observations from Finding Fluorescence.

Conclusions and Implications

- We present at least 16 novel observations of biofluorescence, spanning 5 phyla, 15 families, and 16 species.
- Presence of fluorescence plays a role in key biological functions, such as reproduction, camouflage, communication, and prey attraction.
- Biofluorescence is a relatively untapped area of research which should be explored further to better understand unknown dimensions of ecological interaction in various organisms.
- Community science databases are effective means to engage the public in scientific discovery and intrigue and allow for a more extensive range of data collection for future studies.

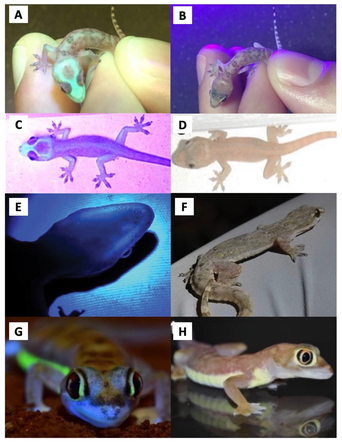

Figure 2. Diversity of fluorescence observations in closely related gecko species. Differences in fluorescence are proposed to serve the purpose of species recognition within geckos. **A)** Finding Fluorescence submission of *Hemidactylus turcicus under 400-415 nm excitation.* ***B)*** *H. turcicus* in natural light. **C)** Prior documentation of *Hemidactylus frenatus* under 395-400 nm excitation [8]. **D)** *H. frenatus* in natural light [8]. **E)** Prior documentation of *Hemidactylus platyurus* under 395 nm excitation [9]. **F)** *H. platyurus* in natural light [9]. **G)** Prior documentation of *Pachydactylus rangei* under 365 nm excitation [10]. **H)** *P. rangei* in natural light [10].

Acknowledgements

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References

[1]Lagorio et al. *Ro. Soc. Chem.* **14** 2015. [2]Whitcher, C. Finding Fluorescence. https://findingfluorescence.wixsite.com/home. 2020. [3]Xiaolong et al. *Mol. Bio. Rep.* **39** 2012. [4]Zhang et al. *Sci. China Life Sci.* **53** 2010. [5]Wiesenborn, W.D. *Psyche: J. Entomol.* 2011. [6]Phillips, L.S. *J. Lepid. Soc.* 1959. [7]Henkel et al. *Mycologia.* **92** 2000. [8]Ramesh, C. *Natl. Acad. Sci. Lett.* **45** 2022. [9]Maria et al. *Herpetozoa.* **35** 2022. [10]Prötzel et al. *Sci. Rep.* **11** 2021. [11]Whitcher, C. *Herpetol. Notes.* **13** 2020. [12]Huang et al. *SAA.* **288** 2023. [13]Kumke et al. *CRC.* 2009.