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Published in:
Peer Community in Evolutionary Biology

DOI:
10.24072/pci.evolbiol.100008

Link to publication

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Citation for published version (APA):
Groot, A., & Smadja, C. (2017). Bioluminescent sexually selected traits as an engine for biodiversity across animal species. *Peer Community in Evolutionary Biology*, *2017*, [100008]. https://doi.org/10.24072/pci.evolbiol.100008

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Download date: 01 Apr 2020

Peer Community In
Evolutionary Biology

Bioluminescent sexually selected traits as an engine for biodiversity across animal species

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doi: 10.24072/pci.evolbiol.100008

Open Access

Cite as: Groot A and Smadja C. 2017. Bioluminescent sexually selected traits as an engine for biodiversity across animal species. *Peer Community in Evolutionary Biology*. doi: 10.24072/pci.evolbiol.100008

A recommendation of

Ellis EA, Oakley TH. 2016. **High rates of species accumulation in animals with bioluminescent courtship displays.** *Current Biology* 26:1916–1921. doi: 10.1016/j.cub.2016.05.043

Published: 3 January 2017

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In evolutionary biology, sexual selection is hypothesized to increase speciation rates in animals, as theory predicts that sexual selection will contribute to phenotypic diversification and affect rates of species accumulation at macro-evolutionary time scales. However, testing this hypothesis and gathering convincing evidence have proven difficult. Although some studies have shown a strong correlation between proxies of sexual selection and species diversity (mostly in birds), this relationship relies on some assumptions on the link between these proxies and the strength of sexual selection and is not detected in some other taxa, making taxonomically widespread conclusions impossible.

In a recent study published in Current Biology [1], Ellis and Oakley provide strong evidence that bioluminescent sexual displays have driven high species richness in taxonomically diverse animal lineages, providing a crucial link between sexual selection and speciation.
It was known that bioluminescence has evolved independently more than 40 times, with males often using it as a mating signal but with also some other

possible adaptive functions including anti-predator defense and predation. Moreover, it has been reported that small marine lanternfishes and sharks that use bioluminescence in mate identification had a greater concentration of species than other deep-sea fishes that use bioluminescence for defensive purposes [2-4]. But no one had ever determined whether this pattern is consistent across diverse and distantly related animal groups living on sea and land.

Ellis and Oakley [1] explored the scientific literature for well-resolved evolutionary trees with branches containing bioluminescent lineages and identified lineages that use light for courtship or camouflage in a wide range of marine and terrestrial taxa including insects, crustaceans, cephalopods, segmented worms, and fishes. The researchers counted the number of species in each bioluminescent clade and found that all groups with light-courtship displays had more species and faster rates of species accumulation than their non-luminous most closely related sister lineages or ancestors. In contrast, those groups that used bioluminescence for predator avoidance had a lower than expected rate of species richness on average.

Nicely encompassing a diversity of taxa and neatly controlling for the rate of species accumulation of the encompassing clade, the results of Ellis and Oakley are clear-cut and provide the most comprehensive evidence to date for the hypothesis that sexual displays can act as drivers of speciation. One question this study incites is what is happening in terms of sexual selection in species displaying defensive bioluminescence or no bioluminescence at all: do those lineages use no mating signals at all or other mating signals that are less apparent, and will those experience lower levels of sexual selection than bioluminescent mating signals, i.e. consistent with Ellis and Oakley results? It would also be interesting to investigate the diversification rates in animal species using other modalities, such as chemical, acoustic or any other type of signals used by males, females or both sexes, to determine what types of sexual signals may be more generally drivers of speciation.

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