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Masculinization of the Female Phenotype as a Response to Male Sexual Harassment: A Phylogenetically Widespread Effect with Implications for Human Health

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Background

Across a wide range of species biologically female individuals exhibit masculinized phenotypes potentially adaptive strategy in response to sexual harassment(1). However, a phylogenetic map featuring the diversity of species in which this has been reported not appear in the literature Whether the mechanisms underlying masculinization in response to sexual threats and harassment are conserved across species is also not known. Some mechanisms underlying general phenotypic transformation in response to predatory threats do appear to be significantly conserved, at least across vertebrate species. (2). Gene expression pathways underlying masculinization in some fish species (see Figure 2a) have been well characterized. Publicly available gene expression pathway platforms can be leveraged identify species in which comparable pathways may exist and their degree of similarity in other species.(3)(4) This is an important first step in determining whether shared, possibly conserved biological mechanisms may engaged in response to sexually threatening environments in other species, including our own. The presence of shared biological mechanisms and gene expression pathways underlying masculinization in fish and in mammalian species may provide a strengthened understanding of the role sexual harassment and sexual threats may play in masculinization syndromes in human females

Objectives

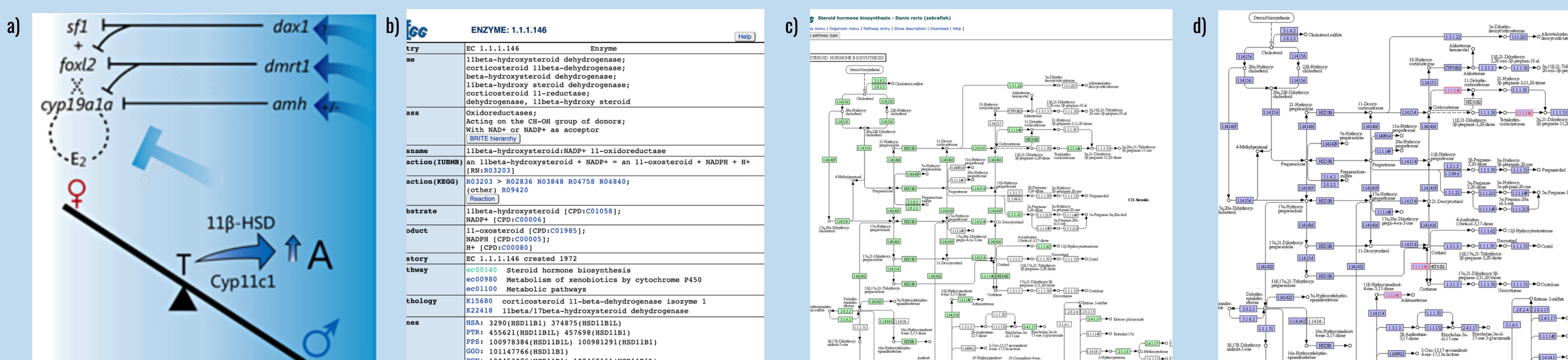
1. To characterize the phylogenetic diversity of female masculinization in response to sexual harassment by males
2. To identify commonalities in gene expression pathways linked to masculinization in a non-mammalian vertebrate (fish name) and humans.
3. To build a biological foundation for generating testable hypotheses for masculinization in response to sexually threatening environments in our species.

Methodology

1. Phylogenetic Reconstruction:

- a. A scoping literature review conducted to identify presence or absence of effect across taxa. Identified species mapped onto phylogeny (Figure 3) using TimeTree, (5) PhyloT (6), iTOL (7) and PhyloPics silhouettes (8)

2. Comparative Pathway Analysis

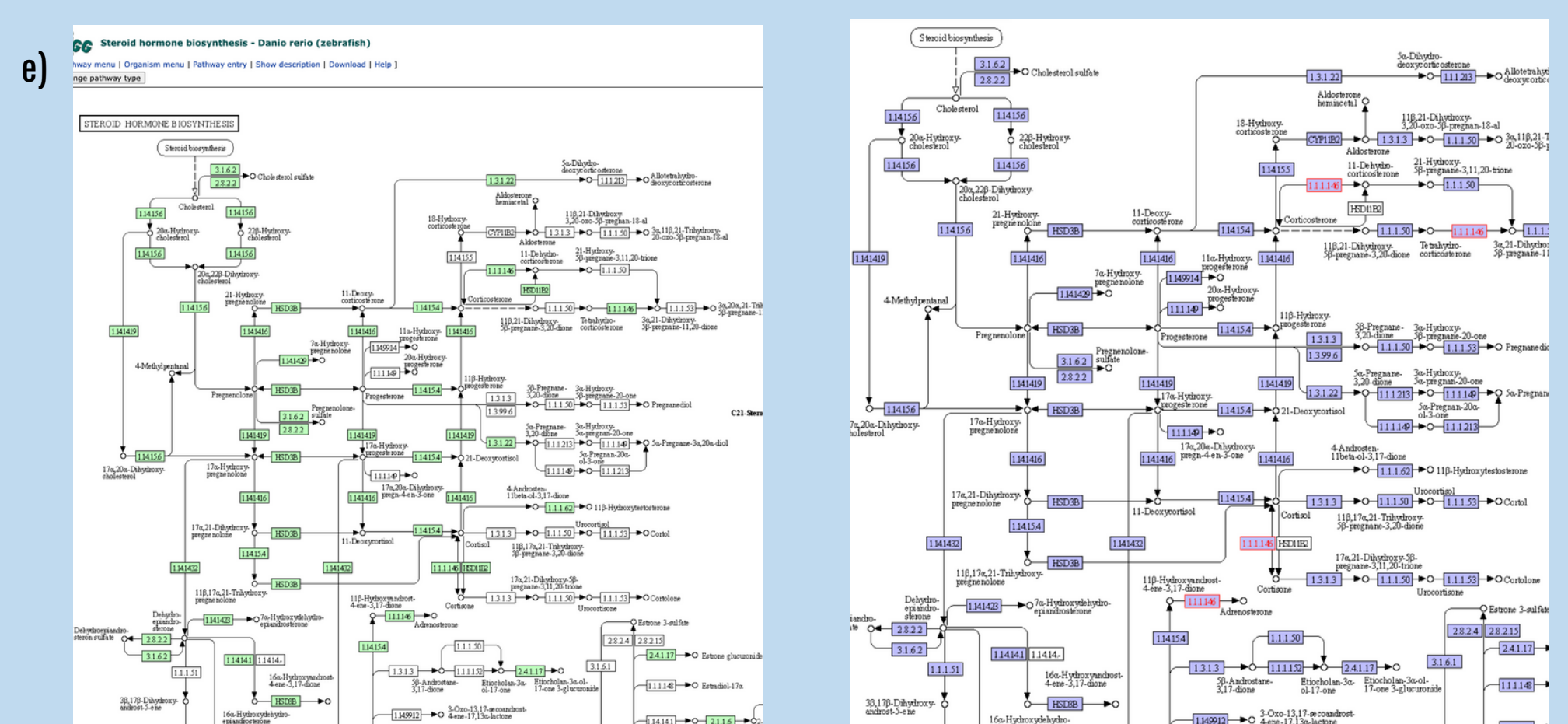


11b-hsd selected as a pathway of interest in the masculinization of fish

Consulted the KEGG info page on 11B-HSD, one of the pathways in which 11B-HSD is involved is Steroid Hormone Biosynthesis

This is the HUMAN steroid hormone biosynthesis pathway. BUT, highlighted in green, are the genes/enzymes/etc, that is shared with Danio Rerio

Within the Steroid Biosynthesis pathway, KEGG highlights 11B-HSD in red (still human pathway)



11B-HSD highlighted in red from the human pathway (purple) is also highlighted green in the species comparison pathway, indicating that 11B-HSD is conserved in human and Danio rerio steroid hormone biosynthesis pathways.

Limitations and Discussion

Here we present the phylogenetically diverse range of species in which environmental sexual threat (sexual harassment) may induce a masculinized phenotype. We have also shown that specific steroidogenesis pathways (11B-HSD) that play a central role in andromorphic changes in fish, are also present in a highly conserved form in other species, including humans. Notably, some of the species in which andromorphic changes have been identified may exhibit characteristics of sequential hermaphrodites. As such, while they do masculinize, often in response to social environmental change, these species may represent a unique phenotype with less relevance to mammalian masculinization. In all species, phenotypic changes are the product of multiple interdependent mechanisms.

While the 11 B HSD gene expression pathway leading to masculinization in the presence of sexual harassment in fish exists in humans, there is currently no evidence to support its role in human female masculinization. The causes of many forms of human female masculinization syndromes are well known. Some have identifiable genetic origins, others can be traced to environmental chemical exposures. Neither a linkage between environmental social stressors to female masculinization nor mechanisms have yet to be identified in women.

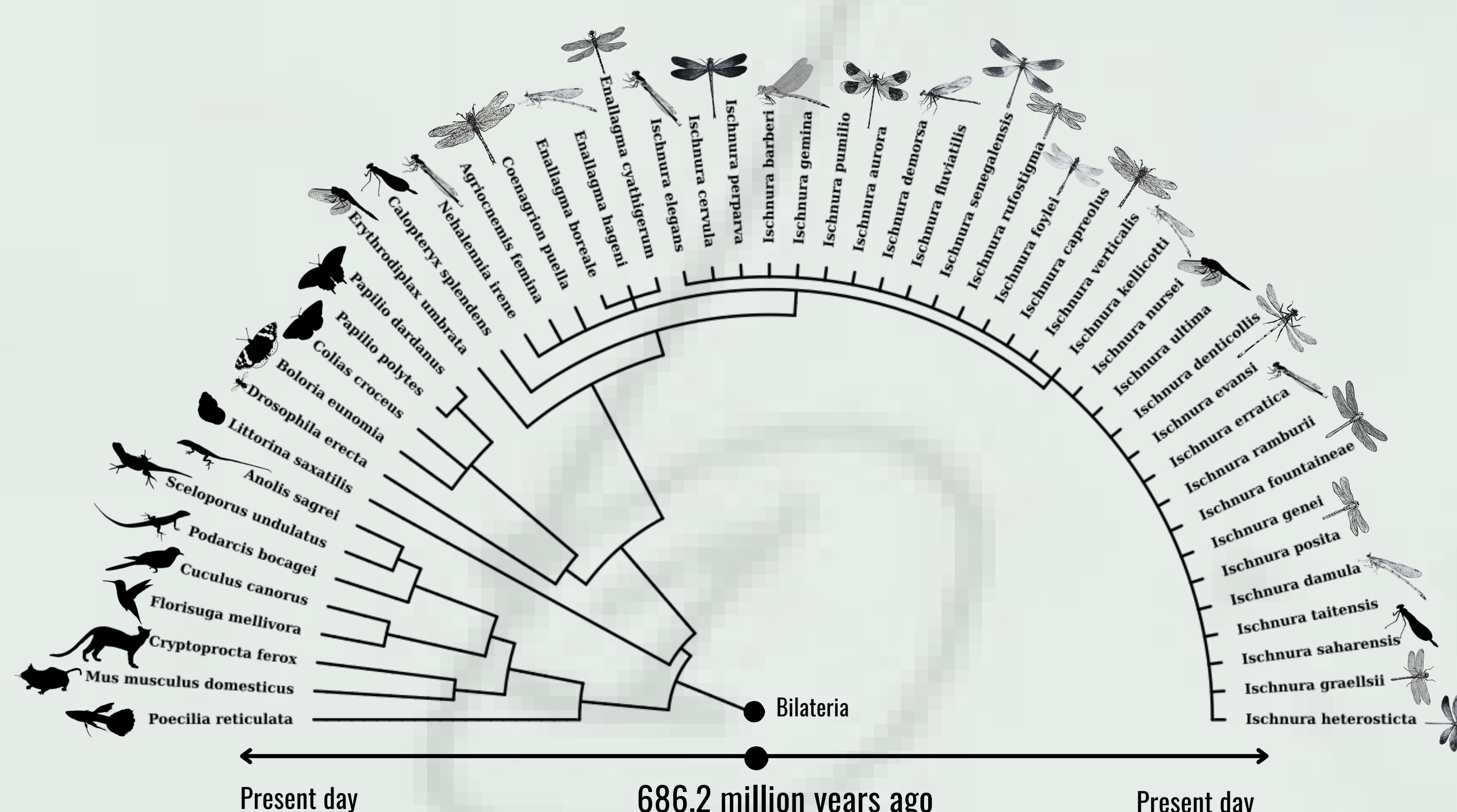
Still, it should be noted that masculinization in response to sexual harassment is phylogenetically widespread suggesting that it is either conserved evolutionarily or has evolved independently in a diversity of taxa.

In either case, it suggests that phenotypic masculinization may be an adaptive strategy for females encountering sexually harassment. Possible adaptive hypotheses for the effect could include: 1) protecting females from the physical harm associated with sexual coercion linked to harassment 2) increasing female partner choice 3) reducing the fitness costs borne by females harassed by males (decreased access to food, safety, offspring, other mating opportunities).

While we explicitly compared known masculinization pathways in teleost fish to humans, the common ancestor of the species lived over 400 MYA and significant biological differences have evolved in each. Therefore, the translation and ultimately, any application of these findings to women's reproductive health must proceed using proper scientific methodologies and sensitivity to these issues for modern human life.

Figure 3

Phylogeny of Masculinization



*This phylogeny does not comprehensively include all species in which xxx has been identified. Rather it demonstrates the phylogenetically widespread nature of the phenomenon,

Conclusions

Women's health researchers are increasingly recognizing the physiologic effects of adverse social environments on female cardiovascular, reproductive and mental health. Awareness of the phylogenetically widespread presence of phenotypic masculinization in sexually threatening environments should spark interest in exploration of related effects in women.

Citations

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