

present, eyes sunken, microphthalmic, and eyes not visible; pigmentation level was categorized as fully pigmented, mostly pigmented, mostly depigmented, and totally depigmented/albino. For all families of fishes, scalelessness was categorized as "have scales," "do not have scales," or "mixed" (some species have scales, some do not). We could not find reliable information on the scales for 22 of them, usually small, little known families, none of them with hypogean representatives. Of the rest, 257 (64.0%) have scales, 117 (29.2%) do not have scales, and 27 (6.7%) were mixed. There are 18 families of fish with troglomorphic representatives. Of those, seven (38.8%) families have scales, seven (38.8%) do not, and four (22.2%) contain both scaled and scaleless species. Our results suggest that levels of blindness, depigmentation, and scalelessness is different even among species of the same family and that simplification and/or loss of scales are common features among troglomorphic fishes, but that the lack of scales in the family as a whole cannot be considered a preadaptive feature. Different phylogenetic histories, selective pressures, and genetic independence governing these features account for the explanation of these results.

ONE EYE BUT NO VISION: TROGLOMORPHIC *ASTYANAX FASCIATUS* (PISCES: CHARACIDAE) WITH REGENERATED EYES DO NOT RESPOND TO LIGHT

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One of the most intriguing questions in evolutionary biology is the degree to which behavior can be viewed as a consequence of morphology. We explore this issue by examining behavior associated with the loss of phenotypic structure and its presence, using responses to light by characid blind cave fish, *Astyanax fasciatus*, that are eyed and eyeless. Our experiments examine subjects that are epigeal (eyed surface) and troglomorphic (blind cave) forms. We compare their photoresponsiveness with blind cave fish with restored eyes. These are produced transplanting the lens from an epigeal fish into the optic cup of a blind cave form. The lens from the surface fish stimulates growth and development of the eye, restoring optic tissues lost during cave fish evolution. Fish were placed an aquarium with one half illuminated with dim or bright white light or infrared light, the other half dark. Their photoresponsiveness was examined by scoring their presence in the illuminated or dark half. Our results strongly suggest that both the blind subjects and those with restored eyes are indifferent to the illumination whereas the surface forms are not. Deactivation of the genes responsible for scotophilic behavior and/or lack of appropriate neurological connection may account for these results.

DIFFERENCES IN FEEDING BEHAVIOR, PREY SIZE, AND DIETARY COMPOSITION AMONG BANDED SCULPIN POPULATIONS IN PERRY COUNTY, MISSOURI

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In the early 1990s, unique populations of banded sculpin (*Cottus caroliniae*) were discovered in Missouri, showing troglomorphic adaptations typical of many cave species. Banded sculpin are traditionally crepuscular feeders. We were interested in investigating the differences in feeding behavior of these unique cave sculpin populations from typical surface populations. Stomachs were removed from samples collected for a previous study and analyzed for content. At the study sites, contents were flushed, using a non-lethal method, from the stomachs of fish found and taken to the laboratory for analysis. Initially, results indicated surface sculpin had an average stomach content weight ~6x that of the cave populations, while there was not a significant difference (ANOVA, $p < .05$) in total body weights. Surface sculpin total body weight was only 1.1 times the weight of the cave sculpin. Surface sculpin stomachs contained an average of 21% Diptera and 72% digested material. Organic debris (5%) was also found in the surface sculpin stomachs. In the cave sculpin, the stomachs contained 55% partially digested invertebrate material, 10% Amphipoda, and a higher percent (11%) of organic debris compared to surface sculpin. The cave sculpin stomachs also contained 70% acanthocephalon parasites occurrence, which were not found in the surface populations.

FRESHWATER OLIGOCHAETES (ANNELIDA) IN FINE SEDIMENTS OF CAVE STREAMS AND SEDIMENT CHEMICAL COMPOSITION

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We report on quantitative collections of aquatic oligochaetes from fine sediments of 8 cave streams in Illinois and Missouri, USA. Four of these streams were sampled monthly for one year. Eight annelid genera (*Haplotaxis*, *Dero*, *Pristina*, *Pristinella*, *Limnodrilus*, *Rhyacodrilus*, *Tubifex*, *Varichaetadrilus*) were collected. Some of the species identified are associated with more pristine conditions and others with organic enrichment. Measuring slide mounted specimens, we estimate the minimum volume of worms per unit volume of fine sediment in the cave streams. Examination of monthly samples did not reveal any statistically significant seasonal patterns in worm density or diversity. Sediment samples were analyzed for a variety of chemical constituents. We expected these would be positively correlated with the same constituents in water samples, but no such trend was detected for calcium, magnesium, sodium, and potassium. Metals in sediment samples showed some tendency to co-vary. For example, elevated iron levels in sediment samples were typically associated with increased lead and nickel levels in the sediments. Mercury was detected twice as often (6 of 12 monthly samples) in sediment samples from one wild cave that experiences heavy visitation as it was in three less frequented caves (3 of 12 monthly samples each). Lead was present in most sediment samples but only a few water samples, while Atrazine was detected in few sediment samples, but was more common in water samples.

STUDY OF A CONVERGENT CAVE BEETLE/CAVE CRICKET PREDATOR PREY SYSTEM

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Darlingtonia kentuckensis is a cave dwelling trechine beetle found in caves of the Cumberland Plateau (MP-II) (Barr 1985) that has evolved specialized foraging behavior that allows it to prey upon the eggs of the cave cricket, *Hadenocercus cumberlandicus*. *Neaphaenops tellkampfi*, a trechine beetle found in caves of the Pennyroyal Plateau (MP-I) in west-central Kentucky (Kane & Poulson 1976; Kane & Ryan 1983; Griffith & Poulson 1993), has also evolved similar specialized foraging behavior that allows it to prey upon the eggs of *Hadenocercus subterraneus*. The predator-prey interaction between *N. tellkampfi* and *H. subterraneus* has been previously studied (Kane and Poulson 1976; Griffith and Poulson 1993). Unlike the *N. tellkampfi/H. subterraneus* system, the dynamics of the *D. kentuckensis/H. cumberlandicus* system are unknown. Due to the fact that caves are similar in selective pressures but discontinuous in space, the comparison of *D. kentuckensis/H. cumberlandicus* to *N. tellkampfi/H. subterraneus* may give evidence for convergent evolution.

COMMUNICATIONS AND ELECTRONICS

CAVING LIGHT USING 24 SERIES/PARALLEL WHITE LEDs

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A caving light design using four parallel strings of six Nichia White LEDs in series does not need as many LEDs to match the strings as when they are all wired in parallel. The circuitry is based on the MAXIM 1698 integrated circuit, which has provisions for efficient dimming and switch mode operation using an external MOSFET. By carefully selecting the inductor and other components for low loss, it is possible to achieve efficiencies greater than 90% using surface mount components. The electronics and 24 LEDs are mounted on a 1.25 x 1.75 inch printed circuit board.

SIMPLE WHITE LED LAMPS FOR PRIMARY AND EMERGENCY LIGHTING

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An array of 24 (or more) LEDs can be mounted in a red "Easter Seals" headpiece along with a simple adjustable linear current source that can be powered from any 4-6 volt battery pack. The result is a waterproof lamp, using 4 AA alkaline batteries, which can be adjusted from very dim (25mA current, 100 hours life) to very bright (440mA, 3-4 hours life). The light pattern, with 20° half-beam width LEDs, is similar to a carbide cap lamp (with a large polished reflector), with a large bright area and plenty of side-light. The "rings" and sharp cutoff of halogen lamps are absent. In a 2-week test, the white, even