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The evolution and thermal dependence of inducible defences in mosquito larvae.

Temperature profoundly influences the reaction rates and efficiency of all physiological systems. During predator-prey interactions we often expect temperature to directly influence the locomotor capabilities of both predator and prey, and thus alter the dynamics of the system. However, predation is seldom just a simple game of 'cat and mouse'. Prey can induce behavioural and morphological defenses that increase their chances of escape and survival. Prey can commonly achieve this by reducing their activity and making themselves less conspicuous to predators. However, reducing activity constrains total foraging time and can lead to substantial energetic costs. For ectothermic prey, increases in temperature could magnify these costs by increasing total metabolic demands. We tested this idea by examining the effect of temperature on the costs of behavioural responses to predators in mosquito larvae. Larvae of the urban mosquito *Aedes notoscriptus* avoid predation by reducing activity. Our previous research has shown that the response is indeed costly, retarding growth and development and manifesting smaller adults that have a shorter adult lifespan when not fed. We expect these costs to be exacerbated in larvae reared at higher temperatures or, larvae will trade-off the increased costs by limiting their behavioural response at warmer temperatures. This study provides an examination of the influence of temperature on the costs of inducible defences in prey and provides insight into the subtle effects of the thermal environment on ecosystem dynamics.

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Respiratory and Olfactory Turbinate Dimensions in Aquatic and Terrestrial Carnivorans

The mammalian nose contains an extensive set of scroll-like, paper-thin bones known as turbinates (or turbinals). The turbinates are a fundamental feature of the class Mammalia and key to two of their hallmark features, endothermy and olfaction, and yet we know relatively little about their anatomy and function. We used high-resolution CT scan data to quantitatively analyze turbinate structure and scaling in a wide range of carnivorans. Measurements include nasal cavity volume, respiratory, and olfactory turbinate surface areas. The varying thermoregulatory, locomotor, and olfactory demands among living carnivorans suggest that species with differing ecologies should have different turbinate dimensions. For example marine species are expected to have enhanced respiratory surface area in response to greater demands for heat and water conservation. A comparison of aquatic and terrestrial species in four families (Ursidae, Mustelidae, Otariidae, and Phocidae) reveals that aquatic species (both freshwater and marine) exhibit reduced olfactory surface areas and greatly expanded respiratory surface areas. The one exception is the extinct, tropical Caribbean monk seal (*Monachus tropicalis*) that has a respiratory surface area similar to that of terrestrial species. This, and the fact that the river otter (*Lontra canadensis*), a species with ready access to drinking water, has expanded respiratory surface area, suggest that the primary function of the respiratory turbinates is heat rather than water conservation in both the aquatic piinipeds and mustelids.

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Metabolic Function and Aging in Yeast

The most widely proposed mechanistic explanation for the aging process links the production of free-radicals and other oxidants produced during aerobic respiration to biomolecular damage that results in aging. While the scientific origins of this concept extends back nearly 100 years, considerable controversy currently exists regarding the importance of metabolic rate to longevity. We are pursing another potential explanation for aging-the increase in genomic instability that occurs during aging. This phenomenon has been most extensively characterized in the budding yeast, Saccharomyces cerevisiae, in which there is a large increase in the rate at which genetic heterozygosity is lost in the daughter cells of aging mother cells. Recent research indicates that the age-induced increase in genomic instability may be caused by defects in the biogenesis of iron sulfur clusters (ISC) in the mitochondria. These defects produce cells that are unable to carry-out oxidative phosphorylation because of damage to mitochondrial DNA. This mitochondrial dysfunction may lead to increased rates of genomic instability and a loss of respiratory capacity. Yeast cells in this state experience a crisis in which they show reduced growth rates, high rates of cell cycle arrest, and an increase in nuclear genome instability. This is thought to be caused by a reduction in the mitochondrial inner membrane potential which causes defects in molecular transport into and out of the mitochondria, affecting ISC biogenesis. We will present the results of experiments in which we track the localization of fluorescently labeled ISC proteins for yeast grown on different metabolic substrates and as cells recover from the metabolic crisis induced by a loss of mitochondrial DNA. Additionally we will discuss the affects of mutations in ISC proteins on yeast metabolic function.

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The head-down posture of seahorses: an adaptation for pivot feeding?

Syngnathid fishes capture prey by rotating their head quickly towards prey, and subsequently sucking it into their snout. Previous studies showed that head pivoting is driven by elastic recoil of the epaxial muscle tendons. However, not only the head moves during pivot feeding in syngnathids: the head pushes off against the anterior part of the trunk, which is displaced in the opposite direction. Since the position of the trunk relative to the head is unique (for a fish) in some species of Syngnathidae (e.g. seahorses, seadragons), this could have consequences (or even be an adaptation) for pivot feeding. To study the effects of several mechanical characteristics of the head and trunk during pivot feeding, a forward dynamic model of a pipefish (closely resembling the ancestral condition) and a seahorse (phylogenetically most derived condition) was developed using Matlab-Simulink. In all simulations, an equal amount of elastic energy is released to actuate the joint between head and trunk. Increasing the pipefish's head-to-trunk orientation from parallel to perpendicular changes the path traveled by the mouth to become more distant from the initial location of the eyes, which increases the volume of water around the eye in which the synganthid fish can strike at prey. In addition, the head-to-body angle of our seahorse model appeared to be optimized for this variable (eye to prey distance), which could imply that the head-to-body posture of seahorses may have evolved for this purpose.