Book review

Not just great TV — broad insights from extreme animal performance

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Feats of Strength: How Evolution Shapes Animal Athletic Abilities
Simon Lailvaux
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Have you ever had to run for your life? Hopefully not. But, deep down, how fast do you think you could go, if you really, really had to move quickly? Have you ever had to catch your own dinner, without the aid of technology? I bet not, unless you were trying to catch chickens in a Philadelphia back yard in preparation for a heavyweight bout, under Rocky Balboa’s watchful eye.

Simon Lailvaux’s superb new book gets you thinking these things, and much more. Feats of Strength uses performance as a lens to explore first the why and then the how of some of the most remarkable animal athletic abilities. I defy you not to be boggled that a peregrine falcon named Frightful is capable of diving at 242 miles per hour (with a tow up to a potentially non-biological altitude, but still, wow). Or that hawkmolts jam the ultrasound echolocation signals of bats… with their genitals. Or that an oil secreted by barracuda increases their speed by 65 percent. Or that there is a parasitic crustacean that eats a fish’s tongue and then latches onto the stump, replacing it.

Performance is also a wide-angle lens. Although the first four chapters of the book focus on specific behaviors — running, jumping, biting, foraging, fighting, and reproduction — Lailvaux’s integrative biological approach means that all manner of ecological and physiological processes, together with evolutionary theory and fascinating additional examples, are rolled together.

Lailvaux does a fine job explaining the relevant evolutionary theory, such that a broad audience can get their heads around the larger concepts driving the research. Simple, useful examples (why do men have nipples?) are employed to good effect.

Interesting trade-offs in response to evolutionary pressures and in animal life-histories abound. As a result of sexual selection, female stalk-eyed flies are saddled with eyes stuck out on giant stalks — a trait that they don’t need to compete for mates and that is certainly sub-optimal for quick maneuvers on the roll or yaw axes. So they compensate with longer wings. And we learn a bit of interesting genetics here too: the limits of separating the morphology of the sexes. We further learn that wolf spiders must find an optimum rate of foraging: consuming large prey or multiple prey too quickly causes so much sluggishness that they miss further prey-capture opportunities, to an extent that they must ‘throttle back’ their prey capture to an optimum rate.

Looking for extremes of performance also allows you to sweep the full range of life in interesting ways. In physiology again, we learn that temperature adaptation in fish can be so extreme that certain species at opposite ends of the temperature scale have completely non-overlapping ranges: for example, the highest temperature one species can survive lies below the lowest temperature another can endure. It’s cool to learn how far adaptation can drive such presumably fundamental molecular machinery to new operating
regimes given (at some point) a common starting place.

Lailvaux does strong service to scaling analyses in the context of performance too. The discussion of gigantothermy is particularly interesting, exploring the cost–benefit analysis of leveraging giant size to handle thermoregulation. The ghost of J.B.S. Haldane is somewhere in the ether nodding approvingly that we have remembered his admonitions — yes, we have not forgotten that the eagle is larger than the sparrow, and the hippopotamus larger than a hare, despite the failure of zoology textbooks to tell us these things (although, to be fair, maybe most of them do now).

Some of the physiology supporting performance is extraordinary. I was fascinated to learn that mammals consume 30% less energy when raised in a sterile environment — I had never considered a direct conversion of immune system costs to calories. This leads to all sorts of interesting questions and makes the struggle between host and parasite very real.

Lord Kelvin famously said, “when you can measure what you are speaking about, and express it in numbers, you know something about it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind”. Performance turns out to be a good lens for mechanistic and evolutionary questions for just this reason: by measuring relevant metrics, such as maximum speed, bite force, jump height, shrimp spearing appendage acceleration, and then placing them in a broader analysis, one can bring numbers to bear on a whole host of systems and thereby address big-picture questions and drill down on mechanisms.

Of course, there are lots of issues with gathering these numbers. In perhaps the most controlled case, a laboratory, to what extent can each lizard be ‘motivated’ to run maximally each time? Lord Kelvin famously said, “when you can measure what you are speaking about, and express it in numbers, you know something about it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind”. Performance turns out to be a good lens for mechanistic and evolutionary questions for just this reason: by measuring relevant metrics, such as maximum speed, bite force, jump height, shrimp spearing appendage acceleration, and then placing them in a broader analysis, one can bring numbers to bear on a whole host of systems and thereby address big-picture questions and drill down on mechanisms.

The book is structured well — not that it really matters, all of it is remarkable and the gems of unbridled humor are spread evenly throughout. The book explores the potentially more accessible and thought-provoking, ultimate big-picture questions in the first half and more mechanistic research in the later chapters. Thus, some of the more nitty-gritty mechanisms are kept until later. Though perhaps slightly lengthy and in-depth in places for a popular book, the long text is worth it to have a comprehensive look at this fascinating perspective.

The final chapter addresses performance in humans. Lailvaux moves through a well-threaded and diplomatic introduction to crack on with our putative place in the performance world — as endurance hunters. Our novel heat-loss method, sweating, turns out to be so good that we are now making bioinspired robots that use it to keep cool. Maybe we should keep just one trick up our sleeve?

The book is frequently hilarious. The irreverent, youthful but worldly style will have you blunting out your coffee more than once. From “the animal equivalent of belligerent Morris dancing” to describing the work of “pea enthusiast” Gregor Mendel, it makes for a clever, entertaining read. There is something for just about everybody here, from specialist to the interested public — and many biologists may find links to new areas to consider. With its holistic approach and giddy enthusiasm over high-speed cameras and the latest gadgets, the book captures the ethos of a subset of researchers. Highly recommended for anyone who wants to know a bit more of the fascinating world of science behind the dexterous and amazing feats we are fortunate to see on shows like Planet Earth.

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Quick guide

Cryptic male choice

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What is cryptic male choice? In general, cryptic male choice is any process during or after copulation — and hence is hidden from us — by which males bias the number or quality of sperm they transfer to females to fertilise eggs. More formally, cryptic male choice arises when male provision of gametes to females is non-random with respect to female phenotype, with that provision varying in terms of the number or quality of gametes. For instance, males may pass more sperm to virgin females or highly fecund females, as these females may represent a more valuable reproductive resource (Figure 1).

I thought females are the choosy sex? We often do think of females as the choosy sex, a rule of thumb that goes right back to Darwin. But, while it is true that males and females typically differ in the strength of sexual selection acting on them, both males and females can be choosy, and both sexes can actively compete for mates.

Do females vary in quality then? Yes, they do. Indeed, there has been renewed interest in the whole idea of male mate choice over the last decade or two, and not just in sex-role reversed species (where males are the limiting sex and females compete amongst themselves for male partners). However, the focus has been mainly on pre-copulatory choice. For males, what is most important is if females vary in how many eggs they have available for them to fertilise. If a female has lots of eggs to fertilise, it may pay a male to make sure he passes enough sperm to fertilise those eggs. If a female has few or no eggs, then males may be best served not inseminating that female and saving sperm for other females.

Don’t males always have lots of sperm? That is the stereotype, but it is a bit of a myth really. Whilst individual sperm may be cheaper to produce...