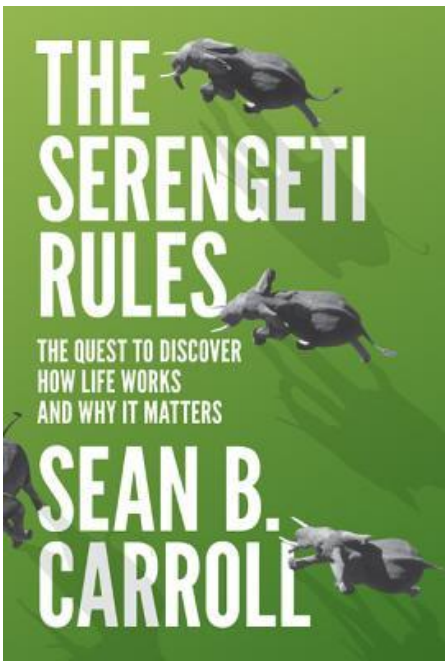

The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters

Sean B. Carroll

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The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters Sean B. Carroll How does life work? How does nature produce the right numbers of zebras and lions on the African savanna, or fish in the ocean? How do our bodies produce the right numbers of cells in our organs and bloodstream? In "The Serengeti Rules," award-winning biologist and author Sean Carroll tells the stories of the pioneering scientists who sought the answers to such simple yet profoundly important questions, and shows how their discoveries matter for our health and the health of the planet we depend upon.

One of the most important revelations about the natural world is that everything is regulated--there are rules that regulate the amount of every molecule in our bodies and rules that govern the numbers of every animal and plant in the wild. And the most surprising revelation about the rules that regulate life at such different scales is that they are remarkably similar--there is a common underlying logic of life. Carroll recounts how our deep knowledge of the rules and logic of the human body has spurred the advent of revolutionary life-saving medicines, and makes the compelling case that it is now time to use the Serengeti Rules to heal our ailing planet.

A bold and inspiring synthesis by one of our most accomplished biologists and gifted storytellers, "The Serengeti Rules" is the first book to illuminate how life works at vastly different scales. Read it and you will never look at the world the same way again.

The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters Details

Date	:	Published February 16th 2016 by Princeton University Press
ISBN	:	9780691167428
Author	:	Sean B. Carroll
Format	:	Hardcover 280 pages
Genre	:	Science, Nonfiction, Environment, Nature, Biology, Natural History, Evolution

From Reader Review The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters for online ebook

Andrea says

A thorough look at checks and regulations that rule natural world. So thorough in fact that I caught myself wondering where the author was going with his line of thought on multiple occasions. However, everything makes sense in the end, so appreciate Carroll being able to juggle so many threads of supporting evidence towards a logical conclusion.

That conclusion made me pause and think for a while. In afterword chapter Carroll uses an example of smallpox eradication as supportive argument for the possibility of many nations uniting together to solve a global problem that used to be deemed impossible, ie. reversing our impact on the environment caused by indiscriminate and irresponsible use of resources. That made the gears in my brain turn. Aren't pandemics a direct result of Serengeti Rules, where large density populations competing for limited resources become victim to disease as nature's way to balance out the books? Here in Alberta we are too familiar with the equivalent pandemics among burgeoning population of coyotes that develop mange. Are we fighting nature in our quest to preserve lives or to extend our life expectancy with our engineered drugs and sanitized way of living? That made me speculate further on cause and effect, as well as moral obligations of population control and our future as ever-expanding species in global environment. Perhaps this book puts humans on a special pedestal, like we are somehow above the Serengeti Rules, but I don't think that's the case at all. I think in a way we prevent nature to balance itself by being simply us. Interesting subject and I recommend everyone to familiarize themselves with it.

Joshua Buhs says

Sometimes you swing for the fences--and miss.

(Yes, I'm watching baseball as I review this.)

In the acknowledgments section, Carroll says that his editor asked him to write a short, provocative book. This was his attempt.

Well, it was short.

The argument that Carroll wants to make is that the same kinds of rules that organize life on the molecular level also operate on the ecological level. The suggestion he wants to make follows from this--we have learned to intervene in disease processes and re-establishing these rules when they go awry; we will probably continue to do so. And what we need to do now is intervene in ecosystems where these rules have also been altered beyond working, and get them up and running again.

It's not very provocative, is it, except in tangential ways.

After an introductory chapter, Carroll moves through two sections, each of a couple chapters. The first deals with molecular biology, building to the idea that biological processes are often regulated by negative regulation--that is to say, the immediate regulating agent might keep something from happening, unless in

the presence of some other condition. He goes through a number of the usual topics. There is Walter Canon and the wisdom of the body; and, importantly, Jacob and Monod.

He adds some more examples, but this is really a Biology 101 lecture.

The second section moves on to organismic and ecological biology, but stays in the Biology 101 mode. We have Charles Elton and food chains, then Robert Paine and trophic cascades--plus, again, some more recent work. Again, Carroll is at pains to point at that negative regulation is important. Urchins destroy kelp. But put otters into the system, and kelp forests flourish again.

I am sure that Carroll would admit that this is very basic biology--it's meant to be popular. But I think the book could have stood *some* complication, on another levels. There are some annoying American habits--treating Africa as largely undifferentiated: a unified place. A blindness to issues of cultural imperialism (white man comes to save African big game.) There's no discussion of economics--and what there is is (subtly) odd, tut-tutting over socialist experiments and praising the philanthropy made possible by capitalism, but not really looking at capitalism as a driving force of ecosystem alteration.

In a popular science book, one could skip that, I guess, but the biology, too, is overly simple. He writes about cholesterol as a cause of heart disease, without taking into account recent contradictory evidence. He writes about tropic cascades as straightforward, easily diagnosed and easily manipulated--as long as there's enough money--without really taking into account stochastic ecological processes. I guess the point was to keep it simple for comparisons sake, but that just really raises other questions.

Ok, both molecular and ecological organizations rely on negative regulation. This hardly makes them the same. Are there other reasons to consider them different? Are molecules the same as organisms? I'm not sure Carroll--or anyone--would agree, but there's where the analogy leaves us. The upshot is this: the comparison is too brief--and not provocative enough. Whether I know that negative regulation is also present in molecular biology or not--this will not change my view on the need to quit fucking up ecosystems. Or even what to do about it. What is the ultimate point here?

For real, I think the point is to make a documentary; the book, it seems, was an afterthought even as it was written. Carroll has done some executive producing, and it is hard (impossible!) not to see the chapters as parts of a larger documentary. The introduction comes not only with visuals, but with its own soundtrack.

Even the name, he admitted, was chosen more for its evocativeness than it epitomizing the argument. "The Serengeti Rules"--the discovery that animal populations are regulated, and how--were worked out, mostly, in places other than the Serengeti--the Great Lakes was home to a lot of it, as was the Pacific Northwest and a number of islands. But these don't sell the same way Serengeti does: they do not connote the primitive splendor that is associated with that mythical place called Africa.

And maybe this would make a better television documentary, though I wouldn't bet the rent on it. The visuals would be better, true enough.

As a book, though, it's a miss.

PS: The book has one of the most annoying citation systems possible; I guess it doesn't matter too much, though, since most of the endnotes are just to specific studies and don't try to place the book in any wider literature. It's Bio 101, after all.

John says

Quite Possibly The Most Important, Most Influential Popular Science Book on Biology for Our Time

How do animals (and plants) regulate their numbers? Why does the human body possess a great degree of self-regulation, culminating with healing? Why should biology matter to you and me? Distinguished evolutionary developmental biologist Sean B. Carroll explains how and why the rules regulating ecosystems apply to the human body in his "The Serengeti Rules: The Quest to Discover How Life Works And Why It Matters". One of our foremost communicators of science, Carroll combines his vast scientific knowledge, superb storytelling talent and fine prose in demonstrating that there is indeed a "common underlying logic to life" as expressed by the similar rules regulating vast scales of biological organization, from the organ systems of the human body to immense ecosystems like East Africa's Serengeti. Organized into three sections, Carroll's latest book is a bold, provocative, and compelling exploration of the rules governing life on Earth, conveyed through his vivid, often insightful, accounts of those biologists who discovered them. In "Everything Is Regulated", he introduces to two pioneering figures of early 20th Century biology, Harvard University physiologist Walter Cannon, and Oxford University ecologist Charles Elton, describing how Cannon stumbled upon homeostasis and Elton made sense of the "economy of nature", recognizing the importance of regulating numbers of animals via the existence of food webs. In “The Logic of Life”, Carroll describes the importance of Jacques Monod’s and Francois Jacob’s discovery of enzyme regulation, and how it influenced a later generation of molecular biologists in the United States and Japan in understanding the origin of cancer and in developing suitable drugs for treating it. In “The Serengeti Rules” – the book’s longest section – Carroll describes how marine ecologist Robert T. Paine recognized the existence of keystone predators on top of the food chains of ecosystems, and how this led to the discovery of trophic cascades, in which the presence or absence of keystone predator and prey species have substantial impacts on regulating the structure and population densities of ecosystems. He concludes by showing how the ecological rules of regulating animal numbers – “The Serengeti Rules” - have been applied successfully in bringing back from the verge of extinction, the once lush Gorgongosa of Mozambique and in wiping out forever, the lethal scourge of mankind that was smallpox. In citing these and other examples, Carroll impresses upon us the need to employ “The Serengeti Rules” to preserve forever, Earth’s biodiversity, not merely for our sake, but for the sake of succeeding generations of humans. For these reasons “The Serengeti Rules” may be recognized as one of the most important popular science books published this year, and perhaps, one of the most influential of our time.

Abu Hayat Khan says

this book was in a list published last year by physicist Sean M Carroll. interestingly Sean B Carroll is a biologist, I’m not sure if both of them have any family ties or not.

you may have stumbled upon a popular sci-fi doomsday scenario on alien nanobots. it goes like this: an advanced alien civilization can create artificially intelligent nanobots with few simple logic: find any interesting material (hydrocarbon or metals or anything), dismantle the material into its basic constituents, use these constituents to replicate yourself. if such nanobots ever reach our planet, they will devour everything on its path and that would be the demise of human civilization. (for more such scenarios, please see "Life 3.0: Being Human in the Age of Artificial Intelligence" by Max Tegmark)

but if you think for a while, you would realize that bacterias are the ultimate nanobot of nature, but they

never do this to human or planet earth.

E Coli bacteria double itself within twenty minutes, with this speed, a single E Coli can bring about a population that weighs as much as the planet earth in just two days. but we never see that happens, not only for E Coli but also for other millions of species of microbial flora.

it was quoted that: anything that is found to be true of E. coli must also be true of Elephants. one may argue that elephants have longer gestation period and they bear few offspring in a lifetime. but, Charles Darwin himself calculated that despite its slow breeding capacity elephant within fifty generation or only within 2500 years would exceed the volume of the earth. so why doesn't it happens for the elephant either?

Serengeti national park is a UN world heritage lies mostly in Tanzania and least in Kenya. it harbors earth's biggest and the last megafauna in a vast natural grassland (or meadow or Savannah or steppe or tundra whichever name you prefer). this book describes the rules those govern how such a vast ecology regulates itself by the mean of predator and prey, a delicate trophic balance.

US scientist Walter Cannon first coined the term "homeostasis" to describe how various physiological process within human body regulates themselves to maintain an optimal operating condition. later this idea was further extended into molecular biology. Mr. Carroll citing the example of how E Coli switch between glucose to lactose metabolism, how human body regular blood (LDL) cholesterol etc. these all breakdown into something called negative feedback control. apparently, as an organism from E Coli to an elephant, in all biological system homeostasis is maintained through negative logic, there is virtually no positive regulation. he also explained what happens when such negative feedback is broken, the condition is called cancer.

this book is about ecology and its regulation rules: the Serengeti rules. Mr. Carroll tried to demonstrate that the idea of Cannon's homeostasis is also applicable to Serengeti ecology and to any ecosystem in general. homeostasis of an ecosystem depends on the predators. predator play the role of negative logic in a trophic hierarchy, some apex predators are thus dubbed as the keystone species.

what happens when a negative feedback is removed from an ecological equation? well, it creates ecological cancer. deoxygenation of a lake due to green-blue algae bloom or crop devastation due to pest infestation are the sign of such missing negative logic.

how is the topmost predator population controlled (like the elephants)? this final piece is controlled by economics, formally known as the food chain, it is a bottom-up positive logic. if there is no food, the apex predator population will simply collapse.

what I understand, human as an apex predator can be regulated in two ways. the unfortunate path would be through the economics of ecosystem via the collapse of the food chain, that's what going to happen with anthropogenic climate change. or through humans good conscious to heed the Serengeti rules.

it is not a good idea for the human to become ecological cancer.

back to alien nanobot, is it possible to build nanobot that overrides Serengeti rules? I don't think so.

anyway, after listening to this book I want to visit Serengeti (such a cool name).

Jonna Higgins-Freese says

I was disappointed, I'd expected something much more interesting. But let me save you some time: keystone predators are important to controlling populations, as are food supplies. There are positive and negative feedback loops in nature.

Book says

The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters by Sean B. Carroll

“The Serengeti Rules” is a very good book that looks back at how the revolution in understanding the rules that regulate our biology unfolded and to look at where it is heading. Professor of molecular biology and genetics and member of the National Academy of Sciences, Sean B. Carroll takes the reader on adventure of amazing people who took on great challenges and accomplished extraordinary things. This captivating 288-page book includes ten chapters broken out into the following three parts: I. Everything is Regulated, II. The Logic of Life, and III. The Serengeti Rules.

Positives:
1. An engaging, well-written book.
2. Interesting topic, how life works at different scales and what we can do with such knowledge. Dr. Carroll is a gifted writer.
3. Good use of photos and charts to complement the excellent narrative.
4. In the introduction Dr. Carroll doesn’t waste time in laying down the expectations of the book. “The most critical thing we have learned about human life at the molecular level is that everything is regulated.”
5. Complex topics written at an accessible level for the masses. “And when cells escape the controls that normally limit their multiplication and number, cancer may form.”
6. A lot of interesting findings throughout the book. “In his own laboratory, Cannon aimed to figure out how emotions affected digestion. He observed that emotional distress also ceased digestion in rabbits, dogs, and guinea pigs, and from the medical literature that also seemed to be true of humans.”
7. At its heart this book is about extraordinary people who through determination overcome amazing challenges to make extraordinary discoveries. “Charles Elton is nowhere near as famous as Darwin or Malthus, but he is known to biologists as the founder of modern ecology, and the central mystery that gripped him was how the numbers of animals are regulated.”
8. Stories of how rules of physiological regulation were discovered. “But it turns out that life—from the molecular scale all the way up to the ecological scale—is usually governed by longer chains of interactions than we first imagine, with more links in between. We need to know about each of those links and the nature of the interactions between them to truly understand, and to intervene in, the rules of regulation on every scale.”
9. A look at the discovery of the link between heart disease and serum cholesterol levels. “Men with levels greater than 260 milligrams of cholesterol per 100 milliliters of blood had five times the heart attack risk of those with levels below 200. The Seven Countries study found the same at the five-year mark. For example, the average cholesterol level of east Finlanders was 270, and they had more than four times as many heart attack deaths as Croatians with cholesterol levels below 200.”
10. Janet Davison Rowley’s impact to cancer research. “Rowley’s discoveries of specific but different

chromosomal changes in two different types of leukemia was strong evidence that at least some cancers were caused by specific, perhaps unique, genetic mutations."
11. Rules of regulation on the larger scale. "The proposal that predators regulate herbivore populations is now widely known as the "HSS hypothesis" or "Green World Hypothesis.""
12. Explains the Serengeti Rules. "Some species exert effects on the stability and diversity of their communities that are disproportionate to their numbers or biomass. The importance of keystone species is the magnitude of their influence, not their rung in the food chain."
13. A look at the Serengeti. "And indeed, the Serengeti is biologically very special. It is a vast ecosystem of almost 10,000 square miles that is bounded by natural barriers on all sides."
14. How key creatures have the biggest impacts. "The wildebeests' many direct and indirect effects on grasses, fire, trees, predators, giraffes, herbs, insects, and other grazers reveal that they are a keystone species in the Serengeti, with disproportionate impacts on the structure and regulation of communities. As Tony Sinclair put it, "Without the wildebeest, there would be no Serengeti.""
15. The story of Lake Erie. "Spurred by the dire condition of Erie and other lakes, the US Congress passed the 1972 Clean Water Act that authorized the Environmental Protection Agency to regulate the discharge of pollutants into waterways and to set the acceptable limits for water quality for humans and aquatic life."
16. Find out how some species explode in numbers. "Microcystis, planthoppers, baboons, cownose rays. What rule or rules of regulation have been broken that enabled these organisms to explode in numbers?"
17. A look at how the trophic cascades were manipulated to benefit the Wisconsin lakes.
18. A look at the Yellowstone Restoration.
19. The fascinating resurrection of the Gorongosa National Park. "In October 2004, he pledged $500,000 toward the park's restoration to Mozambique's Ministry of Tourism. That was to be a small down payment. In November 2005, he agreed to provide $40 million to the park's restoration over a thirty-year period. But this would not be a matter of merely sending checks from the United States. Carr and his foundation were to co-manage the endeavor on the ground with the Mozambicans."
20. An excellent section on lessons learned. "Every scientific recommendation requires political action for implementation. Scientists must equip politicians with the information necessary for making good public policy. I would add that another approach to securing the necessary political will is for scientists themselves to pursue public office."
21. Extensive notes and bibliography.

Negatives:
1. Even at its most accessible, molecular biology is difficult and some readers may feel lost early on in the book but don't give up as it progresses nicely and is ultimately rewarding.
2. Missed opportunity to add supplementary material such as a table of all the animals currently in the Serengeti and their vitals and/or interesting facts.
3. Not at the same level as his previous books, as an example Endless Forms and The Making of the Fittest are superior books.

In summary, Dr. Carroll succeeds in presenting a compelling case for how life works at its different levels through interesting stories. It's hard to match his previous works but overall this book is satisfying and makes an interesting link between physiology and ecosystems. Not perfect but if you are a layperson interested in how life works and why it matters this is a recommended book.
Further recommendations: "The Making of the Fittest" and "Endless Forms Most Beautiful" by the same author, "The Extended Phenotype" and "The Greatest Show on Earth" by Richard Dawkins, "The Gene" by Siddhartha Mukherjee, "I Contain Multitudes" by Ed Yong, "Life's Engines" by Paul G. Falkowski, "A Most Improbable Journey" by Walter Alvarez, and "A New History of Life" by Peter Ward.

Jimmy says

I love his dedication:

For the animals,
and the people looking out for them.

Let's all try to look out for the animals, including the human ones.

Here are three interesting questions from the Introduction that came about when "a second revolution" in biology occurred:

1. Why is the planet green?

2. Why don't the animals eat all the food?

3. What happens when certain animals are removed from a place?

The first revolution had to do with molecular rules. The second revolution based on those questions above led to "ecological rules that regulate the number and kinds of animals and plants in a given place." The author calls them "the Serengeti Rules."

And he also states "We have done a very poor job in considering and applying these Serengeti Rules in human affairs."

So we apply molecular rules to medicines. About 85% are rejected in testing. But we hunt, fish, farm, burn, forest whatever we please with little or no consideration of what we are doing to other species or their habitats.

Chapter 1 deals with the life and discoveries of Walter B. Cannon who served in WWI. He was disturbed by the number of soldiers who died after they were brought to him for help. He came up with the idea that regulation is the key to maintaining a healthy human body. The job of medicine, therefore, was to find ways to correct abnormal regulation in sick humans.

This becomes a metaphor for the planet as a whole. The earth needs to be regulated as well. For example, there are only so many food and water sources. This fits in well with ideas about over population. There are way too many humans to survive on this planet.

I am reminded of the concept of a keystone species by the question above: What happens when a species is removed from an area? It was the zoologist Robert T. Paine who first wrote about the concept in 1966 and 1969. He probably should have won a Nobel Prize. Now that idea is critical.

Chapter 2 discusses Charles Elton, known to biologists as the founder of modern ecology. He wanted to know how the numbers of animals are regulated. He is not as famous as Darwin or Malthus, but he should certainly be more famous than he currently is.

Elton went to the Arctic to study the food chain. He observed the importance of food, scarce on land but plentiful in the ocean. So it all starts with the oceanic food sources. Creatures eat fish, and land animals eat

those creatures, and the droppings promote land growth. Numbers depend on what part of the chain you are on.

Elton came up with phrases like "food chains" and "food-cycles" and "food-webs." He drew a schematic of these chains with Summerhayes in 1923.

Here are some photos:

https://commons.wikimedia.org/wiki/Fi...

And other chains:

https://www.google.com/search?q=elton...

Elton found out that foxes and owls increased when the lemming population was high and vice versa. There were also forces that could make large populations crash. (Humans some day?) His 1926 book *Animal Ecology* became a classic written in just 85 days while he worked on it at a breakneck pace.

A pyramid is also formed with the dominant predator at the narrow top. Elton was fond of Chinese proverbs like "One hill cannot shelter two tigers." Predators need to stake out their territory. I can't imagine how much territory a snow leopard needs with its scarcity of food in the Himalayas. Must make it so difficult now to save them.

It was commonly believed, even by Mr. Elton, that lemmings engaged in mass suicide when they overpopulated. There is actually no evidence of that, but the belief persists. The 1958 Disney film *White Wilderness* showed lemmings leaping off a cliff to their demise. The scene was faked: the animals were flung off the cliff by the filmmakers. The movie won an Academy Award.

"Anything that is found to be true of *E. coli* must also be true of elephants."--Jacques Monod and Francois Jacob.

Chapter 3: Jacques Monod almost died in a shipwreck. Fortunately, he lived to become a co-founder of the new field of molecular biology. He and his collaborators would discover some of the first general rules of the regulation of life at the molecular level, a feat that would earn him a Nobel Prize.

Monod had to deal with WWII for six years. Then, like the others I mentioned, he asked great questions. Like, How did a bacterium, so tiny it was barely visible in a microscope and without any nervous or endocrine system--just a bag of chemicals inside a membrane--"know" to make the right enzyme for whatever sugar was available? It all came down to "regulation." All life is "governed by longer chains of interactions than we first imagine, with more links in between."

What I find fascinating about all this is how it gets back to us and our feelings of free will. We are also "governed by long chains of interactions." Free will is a feeling not based in scientific reality.

Francois Jacob became Monod's partner and helped him to move further in his discoveries. Together they would crack the logic of enzyme regulation. Monod would famously say, "I think I have discovered the second secret of life." DNA was the first secret of life, and "allostery" would be the second. There would be connections to cancer and why it occurs.

Gradually, these discoveries led to the conclusion that what people eat makes them sick. It led to the use of statins for managing cholesterol.

Chapter 5 deals with Janet Davison Rowley, a pioneer in cancer research. She wanted to establish that cancer was a genetic disease. She took the same approach: find how the rules of regulation have been broken. Leukemia is a disease of regulation. The metaphor is used of a stuck accelerator so a car careens out of control.

Rowley herself was diagnosed with ovarian cancer in 2010. Throughout her treatment, she had biopsies and other samples of the tumor to her colleagues. She died on December 17, 2013. She had pre-arranged her own autopsy so researchers could study the progress of her disease.

For the remainder of the book, the author looks at rules that regulate populations: Chapter 6 about pioneering discoveries in various parts of the world, Chapter 7 about how those rules and a few others operate in the Serengeti, Chapter 8 about places where the rules have been broken, and Chapter 9 and 10 about extraordinary efforts to restore entire ecosystems.

"You push an ecosystem too far and suddenly all the rules change."--Robert Paine.

In Chapter 6 we learn about Mr. Robert Paine, an ecologist who deserves much more popular fame. As a young man, he asked questions like "Why is that tree green?" And then when someone answered "Chlorophyll," he responded, "Why isn't all of its greenery eaten?" Once again, it's the great questions that take these scientists to new places.

Paine discovered that the predatory starfish of Washington and New Zealand were "keystones" in the structures of intertidal communities. He coined the term "keystone species." What a great accomplishment.

He began tinkering with nature to make even more remarkable discoveries. He termed a new phrase "trophic cascades." It showed the cascading effect of the decline of a predator like the sea otter in an ecosystem. Many other examples of trophic cascades are given in the chapter.

Paine summed up his knowledge with a quote from George Orwell's *1984*: "Some animals are more equal than others."

Serengeti Rule #1: Keystones: Not all species are equal. Some species exert effects on the stability and diversity of their communities that are disproportionate to their numbers or biomass. The importance of keystones species is the magnitude of their influence, not their rung in the food chain.

Serengeti Rule #2: Some species mediate strong indirect effects through trophic cascades. Some members of food webs have disproportionately strong (top-down) effects that ripple through communities and indirectly affect species at lower trophic levels.

Chapter 7 deals with Tony Sinclair and the Serengeti. Rinderpest was a virus that killed many buffalo and wildebeest. As rinderpest was eliminated, more wildebeest meant more predators, less grass, more trees, fewer fires, more giraffes in a trophic cascade. Fascinating.

Serengeti Rule #3: Some species compete for common resources. Species that compete for space, food, or habitat can regulate the abundance of other species.

Serengeti Rule #4: Body size affects the mode of regulation. Animal body size is an important determinant of population regulation in food webs, with smaller animals regulated by predators (top-down regulation) and larger animals by food supply (bottom-up regulation).

Serengeti Rule #5: The regulation of some species depends on their density. Some animal populations are regulated by density-dependent factors that tend to stabilize population size.

Serengeti Rule #6: Migration increases animal numbers. Migration increases animal numbers by increasing access to food (reducing bottom-up regulation) and decreasing susceptibility to predation (reducing top-down regulation).

Tony Sinclair would be given the nickname "Mr. Serengeti."

Chapter 8: "It is failures in regulation of numbers of animals which form by far the biggest part of present-day economic problems in the field."--Charles Elton.

A major American city needs about 80 million gallons of water daily to survive. That's why Lake Erie and other water sources are critical to the survival of life. The spread of algae in such a lake is an ecological cancer.

Another example of Indonesia where tons of pesticide were used to kill brown planthoppers on rice. The predator of the insect was also killed, so there ended up being more planthoppers!

Another example is given of sharks and their critical role in the environment.

Chapter 9: The study of lakes (limnology) began at the University of Wisconsin in Madison in 1875. Lake Mendota would use some Serengeti Rules to cure some of its ills. To stop algae blooms, scientists who were proponents of trophic cascades proposed increasing predator fish. The result was a success story, and the details are fascinating. One key was that local fishermen supported the scientists and government regulators.

Another success story was the reintroduction of grey wolves at Yellowstone. They are many great videos available on Youtube. Preventing elk from browsing, willows and aspen flourished again.

Chapter 10: Focus on Ken Tinsley's efforts to save Gorongosa Park in Mozambique. Then a civil war drove people to poaching. Man, am I ever sick of revolutionaries. In 2002, Greg Carr came and focused on increasing tourism as a way to save the park. He brought in animals to start again. Important point: he helped the people in the surrounding areas. Want to help? Here's a tip: Buy shade-grown coffee from Mozambique like I do. Carr also focused on law enforcement.

In his Afterword, Carroll suggested some optimistic notes from the book *House on Fire* by Bill Foege:

1. Global efforts are possible.
2. Smallpox eradication did not happen by accident.
3. Coalitions are powerful.
4. Social will is crucial, and must be transformed into political will.
5. Solutions rest on good science, but implementation depends on good management.
6. The objective may be global, but implementation is always local.
7. Be optimistic.
8. The measure of civilization is how people treat one another.

Here is my negative takeaway as I read that list. It is time to fight back hard against "libertarianism." That ideology has caused more problems, at least here in America.

Enjoyed this book immensely.

Charlene says

I love Sean B. Carroll but this book was just ok for me. I was hoping for something as mind-blowing as Endless Forms Most Beautiful. I read that and have never looked at life the same again. The beginning of the book started out great, so great in fact that I felt like Carroll should be the person to replace Dawkins' old tired rhetoric, which should have been left behind with the 90s, with his own better understanding of life and evolution. However, the following chapters made it clear why Dawkins is still leading the pack while a more relevant, smarter, more current Carroll has a voice that doesn't reach cult following status. Carroll loves his history. I too love the history of science, but history can only be the backdrop when trying to help humans shift paradigms. History cannot take over in such a way that is obfuscates the present advances. I felt as if Carroll led us to water, time and time again, but never let us drink, like he did in Endless Forms. The beginning of the book promised a look at universal rules that would make clear how genetics is only part of the picture when trying to understand life. With such an introduction, I expected more discussion of the universal rules throughout the past and present and how those rules led to the increasing complexity seen throughout evolutionary time. Every time I finished reading about the history, I thought, 'Here it comes. He is going to relate it to our new understanding of networks, complexity, emergence, etc.' But, it always seemed to stop short of that.

If you are interested in a deep history of scientific discovery, than this book will not disappoint. Carroll excels in bringing scientific history to life for his reader.

I will continue to read Carroll books but I hope the next one will be more like Endless Forms and tie together all of the history with the most eye-opening phenomena unfolding around us.

Rakesh Nair says

Complex biological systems whether they be regulating the cellular workings of the body or regulating the massive ecosystems of co-dependant species across the planet are actually kept in balance using some simple inherent laws of nature. This book is an excellent introduction to such regulatory laws involving keystone species which shows how important it is to understand ecology on a fundamental level even if you have never been exposed to it before. The book drives in the realization that humans have been wreaking havoc in the natural world because of an unfortunate lack of understanding among folk of how ecological rules regulate the number and kinds of animals and plants in a given place and why these rules are so important.

John Kaufmann says

The fundamental question of the book: How does nature regulate itself so as to avoid overpopulation or extinction of various species? What limits the population of various species - food supply, disease, or predation? Why are some lakes rich with fish while others are devoid of fish and full of algae? What caused

the decline of the wildebeest on the Serengeti, and how did they come back? Armed with this knowledge, we may then be able to improve the workings of nature.

This book examines these and other questions. It does so primarily by example: the author recounts how various scientists have dug in and figured out what has caused various problems and how nature regulates itself. He looks at how various communities regulate themselves and how they get out of whck: from cholesterol (LDL) in the body, to the role of starfish and mussels in the intertidal community, rinderpest and wildebeest on the Serengeti, to the tradeoff between walleye and algae in Lake Mendota (Madison, Wisconsin), and others.

Sara says

Well, I finished this book in a week, which tells you how much I enjoyed it!

Certainly, this is a different style from previous Sean Carroll books. I had read Endless Forms Most Beautiful, which was enjoyable, but more convoluted and challenging to read. (But it is an important book given that evo devo is an important development in evolutionary sciences and Carroll is a pioneer in this field).

Apparently, it says in the acknowledgments section that Carroll's editor challenged him to write a shorter book. In addition to being shorter, the book is mostly organized by the accomplishments of different scientists. The narratives make the book very entertaining and less dry. It's a bit more simple to understand with the exception of the chapter on allosteric regulation.

The topic of the book is about regulation and homeostasis in both the human body and ecology; the latter is the bigger focus of the book. I thought the book was very good and a quick read. The methods of regulation and the discovery of biological principles were fascinating (I particularly enjoyed Elton's story, the scientist who basically discovered ecology). I might even introduce this to my biology classes as it fits nicely into a lot of Common Core ideas.

Recommended!

Andrea Norton says

I received a copy of The Serengeti Rules from NetGalley in exchange for an honest review.

When I started reading this one, I did what I usually do: took notes in Word since I don't have a hardcopy to highlight and write in; updated my status on Goodreads; and discussed it with my husband as I went.

Then something happened. I stopped doing all of those things, because I became so engrossed in this book that I forgot to take notes and update my status as I went.

That's how good this is. I admit, I'm what they call a science geek. I have always had a deep interest in

ecosystems and why certain things happen to animal communities on our planet. This book answers those questions from a different perspective: humans aren't to blame for every little thing. There is a reason why this species thrives while that one takes a hit in communities, and this book shows why with the evidence to back it up.

I absolutely love the stories included. The backstory to how we got to today in science is another thing that has always interested me, and this book didn't disappoint. There are diagrams and photographs throughout the book. The way it's written by Mr. Carroll made me feel like I was sitting in front of him talking to him, not just reading his words. He talks to the reader as if we're all equal, not like he's better than us because he's spent years doing this study. There were parts that made me cry, laugh and stare in shock.

I recommend this to anyone who likes science in general, but especially those interested in natural science, extinction, ecosystems and animal behavior. I don't think you'll be disappointed in this one!

Angie says

Sean Carroll is a fantastic decoder of the natural world. This book enumerates the different control mechanisms in nature, working more or less similarly on the molecular scale as on the ecological scale. The science of the interactions are very different, but the logic is the same -- double negative controls, for instance, in which an enabler really is just an inhibitor of an inhibitor, exist on both scales. Both the minute and the mega scales are complicated systems that are hard to manipulate if you have the tunnel vision of one variable at a time, as most research necessarily has (grants are easier to get if the problems are well-defined, even if the system isn't). He has some great stories, some of which I hadn't heard before at all. I could argue that a few of them are over-simplified, but Carroll is honest with his readers about when he does that and why. And he has his own story of visiting the Serengeti for the first time, which is lovely. He saves the best for last, so if you get bored with one particular story, skip ahead, don't put it down. The last story is about Gorongoza National Park in Mozambique -- that's worth sticking around for.

I got a free copy of this from Net Galley.

Tucker says

In “The Serengeti Rules” Sean Carroll has combined his extensive background in biology with masterful storytelling to present an eminently readable and understandable book about the rules and laws of biology and how they regulate life. A compelling and informative book that is definitely recommended.

Thank you to Princeton University Press and NetGalley for an advance copy of this book.

David says

This marvelous book is about how life regulates itself. The regulation is described on two levels; at the molecular level, and on the ecology level. These regulations, or "rules" are developed through stories, and it

is these fascinating stories that bring the narrative of discovery to life. Below I have tried to convey a hint of the many engrossing stories.

Physiologist Walter Cannon was an amazing scientist-soldier. During World War I he volunteered to be a doctor at the front. He saw many injured soldiers die of shock as their blood pressure plummeted. He tried feeding them sodium bicarbonate to reduce the blood's acidity. And the injured soldiers' blood pressure jumped up overnight, avoiding death due to shock! Later he observed many different ways the body maintains a balance through self-regulation.

Then the story-line switches to Charles Elton, the founder of modern ecology. The book describes how he got his education during expeditions to the Arctic. He discovered the population periodicities between various predator-prey pairs.

Then there is the story of the remarkable scientist, Ancel Keys. He earned an undergrad degree in economics, earned a PhD in oceanogray and biology at Scripps Institute, and then earned another PhD in physiology at Cambridge University. Then he joined the Harvard "Fatigue Laboratory" which organized an adventure in the Andes in northern Chile. There, he personally studied survival at 20,000 feet elevation for fifteen days. For six of these days he stayed on a diet of water and condensed food. Later he was called on by the Army to develop a nonperishable, light-weight food ration. He developed the so-called K-ration, which was named after him. After the war he did pioneering research on the relationship between cholesterol in the bloodstream and heart attacks. He collaborated in a large-scale epidemiological study in Europe and the U.S. and discovered a strong correlation between cholesterol and heart attacks.

At this point in the book, Sean Carroll points out that the rules regulating molecular giology are analogous to the rules regulating ecologies. He relates how three scientists came to the realization that populations are not primarily regulated by the weather. Instead, smaller herbivores are not usually food-limited, but are limited by their predators. But it was not easy to prove this hypothesis. Instead of trying to prove it simply through observations, it was necessary to intervene. It is called the "kick it and see" ecology.

In one example of this approach, Robert Paine peeled starfish from rocks and threw them into the sea in some areas, and left them alone in other areas. He carefully calculated the density of 15 species. He noted that acorn barnacles spread out, then were themselves crowded out by goose barnacles and mussels. Four species of algae limpets and chitons disappeared. A small predatory snail increased in number. Overall, the number of species reduced from 15 to eight.

The presence of one predator can control the composition of species in a community through its prey. Its presence affects not only the animals that it eats, but those it doesn't eat, as well. Starfish *negatively regulates* the population of the competitively dominant species. This flipped traditional thinking upside down.

The most fascinating story is that of the Serengeti nature reserve. In this area of 10,000 square miles, there are 360,000 large animals. The question Carroll raises is why did the number of buffalo increase from 16,000 to 37,000 from 1961 to 1965, and then to 54,000 in 1969? And, why did wildebeest increase from 99,000 to 770,000 from 1958 to 1973? The answer appears to be that East African domesticated cattle were vaccinated in those years against the rinderpest virus. It turned out that domesticated cattle were the reservoir for rinderpest, not the wildlife. The vaccinations had the effect of eliminating the virus from wild animals, too. The virus was a microscopic keystone in the ecology. Its presence negatively regulated the ruminants; its suppression allowed them to surge in number.

There is a remarkable story about how two researchers, Sinclair and Norton-Griffiths, flew a plane from Kenya to Tanzania to photograph wildebeest herds. They landed in Tanzania and were arrested for spying. They were confined under guard, but after three days escaped and dashed for their plane. They finally got home, developed their film, and discovered that the wildebeest population had doubled to 1.4 million!

There were many other effects on the ecology of the Serengeti. The numbers of lions and hyenas increased. This is understandable, as they are predators of the antelope herds. But the number of giraffes also increased! The reason is that there was less grass available, due to the growing herds, which suppressed wild fires, so more young trees could grow. This provided more food for giraffes. The ecology and food chains are quite complex. The shorter grass allowed more species of herbs to grow, thus supporting a more diverse population of butterflies. The grasses evolved compensatory growth response, regenerating above-ground growth. So the grasses provided MORE food when grazed than when they were protected!

Smaller animals tend to die mostly from predation, while large mammals (giraffes, hippos, elephants) are regulated by food supply. The dividing line is around 150 kg. But this is not a hard and fast rule. Deaths by predation occur mostly to resident antelope populations. They are more vulnerable to lions that are confined to a region to raise and protect their own young. As a result, migrating herds are much bigger than resident populations.

Throughout the book, it is emphasized that regulations at the molecular level and at the ecology level are very similar. They are often due to double-negatives, that indirectly increase trophic layers (prey of the prey) two down from the "keystone" predators.

Ecologies are often out of balance, due to human interference. Ecologies are often very complex. The real theme of the book is that we need to learn the "rules of nature", to help protect the world's ecologies. Human interference often goes awry because we do not fully understand the consequences. The entire book is told from a point of view of mysteries and discoveries. There are some very human stories that grabbed my attention. Carroll has written a beautiful book that got me to think how nature works.

Michael says

I read a sci-fi book a long time ago, The Legacy of Heorot, which took place on a different planet with a unique ecosystem. On Beowulf (the name of the planet), there were these huge predators called Grendels that gave the colonists a very difficult time. In true human fashion, the characters wiped the Grendels out and called it a day. What the hapless colonists didn't realize was the the Grendels ate their own young--an intermediary form that looked like a big fish--in such large numbers that only a relatively few Grendels ever grew to maturity (I guess there is some carnivorous African frog that actually does that). Having removed the apex predator (a keystone species, in ecology terms), and having interfered with a trophic level in the food web, the humans disabled a negative inhibition mechanism. Suddenly there were lots and lots and lots of juvenile Grendels, and then adult Grendels, and then...

It was a good book, but one I did not realize was based in actual ecology. The Serengeti Rules: The Quest to Discover How Life Works and Why It Matters is a book about life, and attempt to answer some fairly simple questions about our world. Why are there certain numbers of species? How does nature 'know' when there are too many, or too few, of something or other? What are the mechanisms that control population size? From molecular biology to wolves, scallops, algae, and wildebeests, the author carefully describes how all of this works. In telling the stories of the scientists who were the first to illuminate the principles that regulate

populations, the author connects systems within living things--enzymes, homeostasis, etc.--to macro systems of relationship between plants, animals, and planet earth. It is fascinating stuff.

Humans, like those hapless colonists of Beowulf, are constantly fucking up nature's balances. We kill this to get that, but end up with too much or too little of something else. While we are as natural as any other species on this world, we are unique in both our ability to make massive changes, and our capacity to understand what our actions will do to the world around us.

Someday, I think, Gaia is going to get sick of our shit and send us packing. Famine, disease, a more hostile climate: Mother Earth has ways to thinning the herd when things are out of balance. I hope I am not around to see it.

Great book, and a great review of my freshman Biology class from many ,many years ago (1987!)

Kerry says

This was a wonderful book. Review to follow when I catch my breath.

Gina says

I received this book from NetGalley. The book instantly drew me in with its storytelling and lush imagery. It's written in lay terms that the average reader can understand. The first half of the book is an overview of basic biological principles and breakthroughs as well as the history of ecology. The second half of the book covers ecology and case studies. The Serengeti Rules refers to the basic biological and ecological principles that determine the populations of animals in the wild such as food chains, keystone species, and migration. I appreciated the discussion of various case studies: sea otters, wolves, fish, buffalo, etc. One of the things I love about this book is that it inspires you to pick up a dozen other books to learn more about the topics discussed. It gives you little glimpses into a lot of different events in history and you want to read more to go more in depth. The book also expands your mind encouraging you to think critically with different forms of logic - positive, negative, double negative, top down, bottom up, rings, etc. You're forced not just to consider the most obvious explanations for things but to consider all explanations and the relationships between all the connected parts and how they might interact. This book will change your way of thinking and viewing the world. Fans of historical storytellers like Mike Dash, Erik Larson, or David McCullough will love this book as will those who are passionate about wildlife and sustainability issues.

Eric Lawton says

I think this is a very good book, though I regret buying it.
It is mostly about ecology, but starts with molecular biology and connects the two by showing that there are some general laws about regulation of complex systems that apply at the largest and smallest scales.
So if you don't know much about any of these topics, you will learn a lot, but if you have been reading about them even at the level of (for example) New Scientist or Scientific American you may find most of the material already familiar.

The ecology part is the most important and the last couple of chapters give us some rays of hope and ideas for slowing or reversing the current trend to loss of species.
I'll be circulating my copy around my friends who like science/nature but haven't read too much.
Sean B Carroll is a good writer, this is no exception. I first came across him with Endless Forms Most Beautiful: The New Science of Evo Devo and the Making of the Animal Kingdom, a topic I knew little about at the time. I loved that book and it inspired me to go get a shelf-full of books on development and evo-devo.

Sirad says

Really salty that I had to read this as a "textbook" for my Evolutionary Biology class, but I generally enjoyed what I learned from the stories that Sean Carroll brings together in order to synthesize a narrative that explained how the world works. The structure of the book was a bit weird though.
