

dilettante

1 [N-COUNT 可數名詞] 尤指藝術方面的半吊子，淺薄涉獵者； You can use dilettante to talk about someone who seems interested in a subject, especially in art, but who does not really know very much about it. [disapproval] [Formal]

true for species as a whole. The catch is that the same evolutionary

process that ensures a species' survival can also be its downfall.

species can reach when it gets to say, "Okay, the hard work is done. I can coast now, getting by on what I have." Because all species are continually adapting, the pressure is constant.

Biology

Ecosystem



—
Everything is connected.

Ecosystem

In biology, an ecosystem encompasses a community of interacting species and their nonliving environment. All components play a part in determining the characteristics, from the type of soil to the amount of sun or water available. Some animals cooperate, others compete, and changes in any component can affect both the fitness of individual species and the health of the entire system.

When you learn about ecosystems, you gain insight into how diverse components interact in defined environments in a way that promotes the continued existence of the system. Individual species may gain and lose, and the system itself exposed to challenges that it must adapt to and recover from, but the web of interaction that has developed supports the holistic functioning of the system.



An interconnected web



The key point to understand about ecosystems is that they are systems. The different parts don't exist in isolation; they interact and interconnect in myriad ways. If we intervene in them, we can't expect the outcomes to be predictable. We need to look at them as a whole and respect that it's sometimes better to leave them alone than to try improving them. But we often suffer from intervention bias, the desire to always do something instead of leaving things alone, when it comes to ecosystems. We forget that they've evolved to manage quite well if we let them get on with it.

60 let —
60 let —

For instance, in areas that are prone to forest fires, the local fire department may attempt to put out every single fire they hear about as soon as possible, regardless of size. The problem is that fire is a natural part of these ecosystems. It is only humans that view naturally occurring fires as a problem. As destructive as wildfires can be, they also have ecological benefits. Burning dead plants releases the nutrients they contain back into the soil, helping to fertilize the next generation of plants. Fires cut through the thickest areas of plants, letting sunlight through to reach new areas.¹ They wipe out alien species and diseased plants.²

consensus



Perhaps most importantly, regular small fires burn up accumulating plant matter. If humans intervene and put these out, larger amounts of fuel build up and pave the way for fires that are beyond the scope of what the ecosystem can handle. Often, the harder we try to control ecosystems, the harder they fight back.³

Likewise, our efforts to save endangered species from extinction often focus on interventions, rather than on preserving



help me finish this sentence, * used as a filler for you to fill up: As deleterious as * can be, * also has * benefits.



As deleterious as excessive sugar consumption can be, it also has momentary benefits.



show me more



As deleterious as procrastination can be, it also has unexpected benefits for creativity and problem-solving.



As deleterious as stress can be, it also has the potential to motivate and enhance performance under certain circumstances.

As deleterious as social media addiction can be, it also has the ability to connect people from different parts of the world and facilitate information sharing.

As deleterious as failure can be, it also has the power to teach valuable lessons and foster personal growth.

As deleterious as excessive screen time can be, it also has the convenience of accessing vast amounts of information and entertainment.

As deleterious as climate change is, it also has created an opportunity for innovation and the development of sustainable technologies.

As deleterious as urbanization can be, it also has led to increased economic opportunities and cultural diversity in cities.



is this sentence right: help me finish this sentence, * used as a filler for you to fill up: As deleterious as * can be, * also has * benefits.



Yes, that sentence is grammatically correct. It provides a template for filling in the blanks with specific examples or concepts to highlight the potential negative and positive aspects of a particular subject.



how would you revise it



Here's a revised version of the sentence:



"Please assist me in completing this sentence: * serves as a placeholder for you to fill in: Despite the deleterious effects of *, it also offers several beneficial advantages."

the natural ecosystems they need to survive in. Take the case of elephants. African elephants are currently considered vulnerable, not endangered, but it is believed they may end up extinct in a matter of years if current rates of poaching and habitat destruction continue.⁴ Asian elephants are classed as critically endangered.⁵

The best thing we can do for elephants is to preserve their habitats, allowing them to live and breed naturally. But much of the effort to save elephants from extinction is focused on captive breeding programs, especially artificial insemination. While this works⁶ and is safer than other methods of captive breeding, elephant artificial insemination is a classic case of us failing to recognize and support the value of ecosystems. It is incredibly expensive⁷ and produces results that are far more limited than if we were to hypothetically use the same funds to preserve elephant habitat.⁸ In addition, artificial insemination only produces more captive elephants which are deprived of the space they need to roam and the social ties they would otherwise enjoy. They have much higher infant mortality rates than wild elephants and a substantial number die from conditions related to their limited space for movement.⁹

Ecosystems are not just about their individual parts. Sometimes we're too focused on trying to reinvent and improve upon them that we forget they're quite capable of self-organizing.

« Economic systems are, of course, complex structures, in which the pattern of interactions resembles a web. This means that the

dominant party in one interaction may well be the subordinate in another. Control thus diffuses through the ecosystem, generally from entities with high energy demands to those with more modest requirements. The ability to adapt to, or at least to accommodate, the power structure remains the ticket to success for all players—dominants and subordinates alike—regardless of how much influence an entity wields. »

Geerat Vermeij ¹⁰

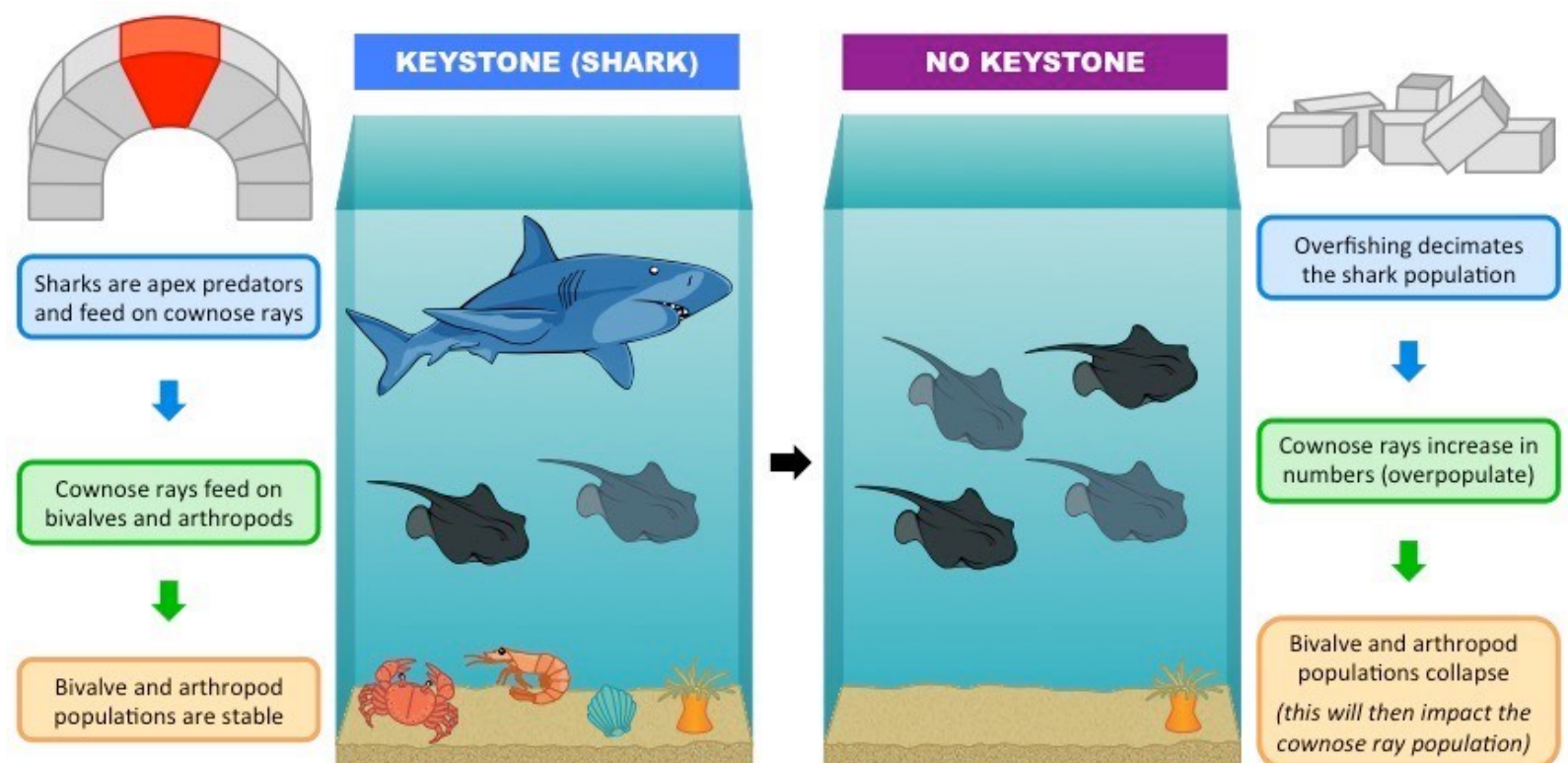
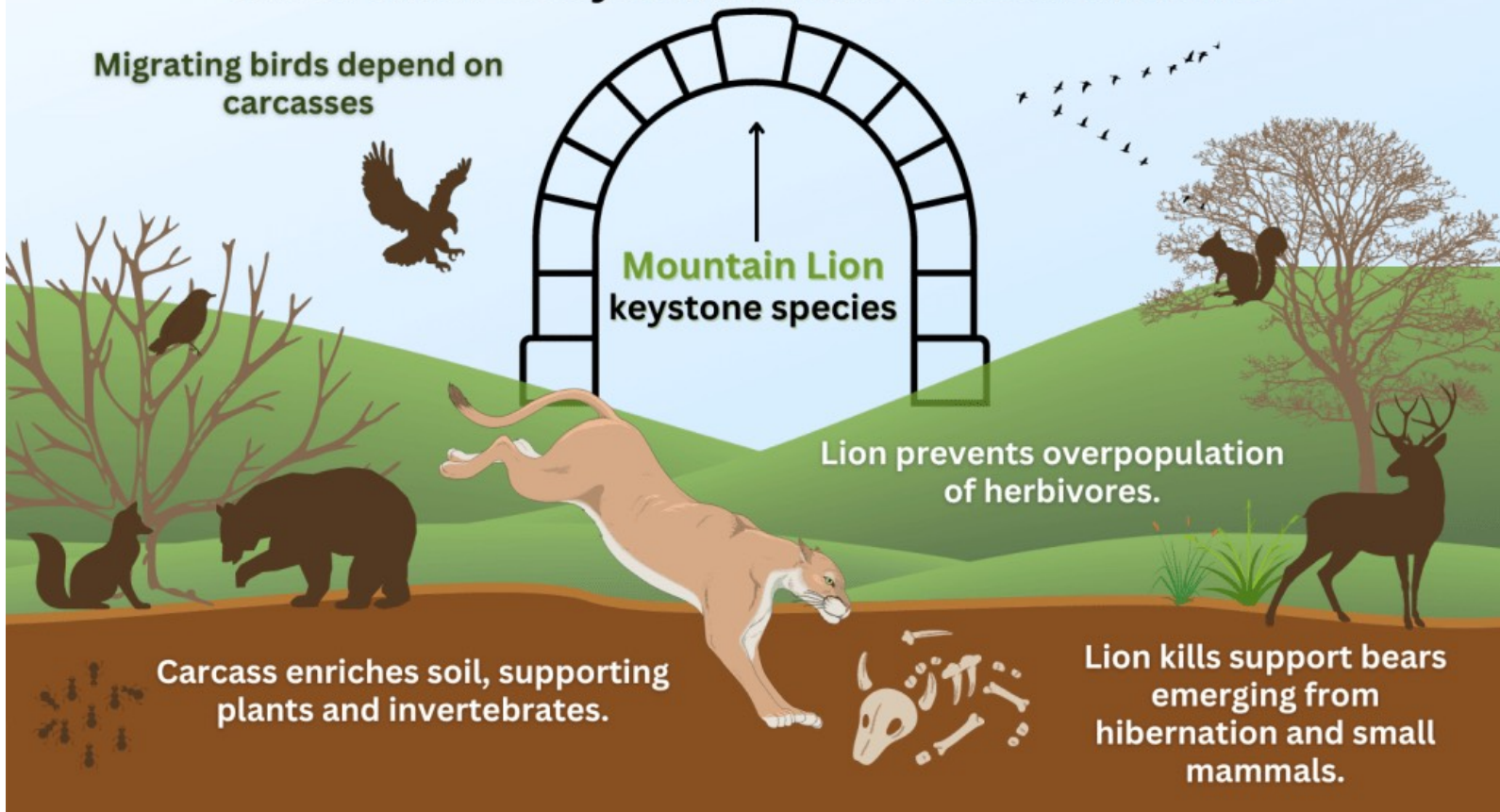
There is no size restriction on ecosystems. Isolated puddles in rocks have their own ecosystems, but so too does the ocean. Matter and energy move across ecosystems. Animals migrate, pollen blows around, and water can transport a variety of species or materials to other systems. Very few ecosystems are completely closed. Long-distance migration of many species ties ecosystems together.

 Organisms within an ecosystem have varying degrees of importance for the maintenance of that system. Some are foundational to its survival. These are known as keystone species: organisms that would cause an ecosystem to completely change or collapse altogether if they were not present. Without them, new and possibly destructive organisms could take over the same niche. The

→ game changer

Keystone Species

A keystone species is a species with a dramatically large effect on an ecosystem relative to its abundance.



name comes from zoologist Robert T Paine, who compared them to the special stone known as a keystone, that is used at the top of an arch to ensure its structural stability. Without the keystone, the arch would collapse. It is a small component, but everything else depends on it. Keystone species can be hard to identify, as they may only be present in low numbers or may not be highly visible species. We can only know for sure that an organism is a keystone if its numbers drop and we see the knock-on effects of that.

It is common for keystone species to be predators (organisms that eat other, usually smaller, organisms) as they play a crucial role in maintaining the numbers of their prey. Predators tend to be present in relatively small numbers compared to their prey. In other cases, herbivores (organisms that eat plants) are important for maintaining the levels of certain plants, thereby keeping the habitat in a favorable state for other organisms. Some species can have reciprocal relationships [see the chapter on Reciprocity] wherein the loss or reduction of one would harm the other and the effects would ripple out to the rest of the ecosystem. So, in general the value of keystone species is dependent on their ability to either provide what other species need to survive or to control population levels.

↳ An example of a keystone species is the sea otter, which lives in kelp forests. Sea otters eat sea urchins, which in turn eat kelp. If there are enough sea otters in the ecosystem, they prevent the numbers of sea urchins from getting too high. Without the sea otters, all the kelp would get eaten, which would eventually also lead to the demise of the urchins. In addition, kelp plays a valuable role in removing carbon dioxide from the atmosphere, benefiting

the environment as a whole, and supporting a wide variety of other species. Without the sea otters, the ecosystem could not survive. No other predator in the same habitat could fill the same niche as the sea otter. If their numbers drop too low, it could have a genuine impact on global climate change. ¹¹

③ Finally, ecosystems aren't static. The internal dynamics are constantly changing as the system adjusts to and recovers from disturbances. Some ecosystems are robust, others more fragile. Some have a high capacity for resistance, which is the tendency of a system to remain close to its equilibrium state. It takes a significant disturbance to affect these ones. Resistance is contrasted with sensitivity, describing those systems for whom very weak disturbances can have a profound effect.

Also measurable is a system's resilience, which is the speed it recovers after a disturbance. The strength of an ecosystem is thus better considered in more than one dimension. Sensitive systems with very high resiliency can be just as strong as highly resistant systems that have trouble bouncing back.

This is why ecosystem is such a useful mental model. The parallels with human organization are clear. Our family units tend to function as their own system and so can our teams at work. But we are also part of the larger ecosystems of our cities or organizations, and people can move across ecosystems with ease, bringing change and challenge. ?

—Sidebar: The Law of the Minimum



The Law of the Minimum

The Law of the Minimum states that the yield of a crop will always be dictated by the essential nutrient that is available at the lowest level. No matter how abundant the other essential nutrients are, being deficient in one will always limit the crop's growth. If the level of that nutrient is increased, another will become the limiting factor. One way to envision this is as a bucket with a hole through which water leaks out. The bucket cannot fill to the brim as a result. The deficient nutrient is the hole in the bucket.

The law comes from botanist Carol Sprengel, who formulated it in the 1820s. Biochemist Justus von Liebig later popularized the concept. It is an important concept for farmers to understand. When the price of a particular fertilizer increases, some farmers are tempted to use less of it and more of cheaper nutrients. But this stunts the growth of their crops, as the other nutrients do not compensate for the deficient one.

It is not necessarily what is available that matters. What is scarce can be paramount too. We can see this in our own lives as well. If you skip on sleep to have more time, tiredness then becomes the limiting factor to your productivity, not time.

In manufacturing, a bottleneck is a similar concept. A factory process can only move as fast as the slowest step. Likewise, in mathematics we refer to multiplying by zero which is akin to the Law of the Minimum—put a zero at the end of a

multiplicative calculation and it cancels out the numbers before it, no matter how high.

« Over time, closed systems produce fewer and fewer innovations, because closed systems, by definition, are based on certain increasingly unchallengeable fundamental principles. »

Gary Hart ¹²

Trade ecosystems

Examining the silver trade between China and Spain in the 16th century brings out many of the nuances of ecosystems, demonstrating how there are limits to their organization and infrastructure and how more is accomplished when you work within them.

The first lesson comes from the results of China trying to maintain a closed trading system. For various reasons, over a long period the imperial government did not want to trade with other countries. Fearing a weakening of power or thinking that there was not much to bother trading for, the government in Beijing banned all trade.

Trade with China, however, didn't stop, it was just done in a different way. No policies, customs, duties or official infrastructure meant that trade was carried out primarily by smugglers and pirates. European merchants knew that China was the largest economy in the world and therefore represented a huge economic opportunity.¹³ Once they figured out how to get there, Europeans became part of the environment. Certain individuals and groups in China adapted accordingly, integrating the opportunities the Europeans offered into the trade ecosystem.

The disruption caused by the arrival of the Europeans with their goods created opportunities for smaller players to compete with those traditionally at the top of society. The result was an extensive criminal network that soon threatened the power of the government, and which became a contributing factor to Beijing repealing the trade laws and opening up somewhat for business.



Handwritten notes in green ink: 27 2020 1-14

The second lesson about ecosystems comes from looking at what happened in China when trade was opened up. To start, we need a little background. Another motivation for the trade policy change was that Beijing needed money. The traditional currencies, either bronze or paper, had been rendered completely useless by short-sighted policies that put political image ahead of economic sense. By the time those European ships sailed up, everyone in China was paying for goods with the little silver bits and shaved-off lumps carried around in their pockets. The problem was that China's silver mines were depleted. There was no way to infuse new currency into the system when it was needed, and an economic system without the raw materials to produce new currency is like a forest that stops getting light. The Chinese government needed the Spanish ships with their tons of silver mined in the Americas.¹⁴

Trade policy changes can be likened to an environmental change that impacts an ecosystem—a new, invasive species, a persistent change in the amount of rainfall. Changes that affect the environment in a widespread fashion will inevitably produce successes and failures. Some species will adapt and take on new territory or create a new niche, and others will die off, unable to respond to the challenges. In China, there were many individuals and groups who adapted, capitalizing on the instability brought about by the changing trade laws. These adaptations in turn forced others one or two steps removed from direct trade to adapt to the resulting new businesses with their labor and land requirements.

Thousands of acres were planted with the trees that hosted the worms that produced silk. Raw silk was produced by the ton.

And now that the Chinese had a market, other adaptations to the changing ecosystem followed.

As they got to know their customers, according to Quan Hanshen, the Taiwanese historian, they acquired samples of Spanish clothing and upholstery and in China made perfect knockoffs of the latest European styles. Into the galleons went stockings, skirts, and sheets; vestments for cardinals and bodices for coquettes; carpets, tapestries, and kimonos; veils, headdresses, and passementeries; silk gauze, silk taffeta, silk crepe, and silk damask.¹⁵

According to Charles C. Mann, who charts the changes to China that were a result of the silver trade in his book *1493*, the Chinese began making an exceptional variety of goods to sell to the European market. Whatever the Chinese charged, it was still cheaper than the goods the Europeans could make themselves, and China paid more for silver than anyone else in the world.

The leadership in Beijing didn't adapt so well to the changing economic ecosystem. They could not direct the resulting business boom to stave off inflation, and the silver itself was a double-edged sword. It financed state projects, but the silver "was ever a political threat to the dynasty, because it controlled neither the trade nor the source."¹⁶ And "so much silver flooded into China that the price eventually dropped," resulting in significant loss of revenue for the government.¹⁷ When ecosystems change, new species can become dominant and keystone as the interaction between species alters. Silver changed the economic ecosystem so significantly that the

power relationships between various groups in China changed and evolved.

The third interesting lesson regarding ecosystems comes from the mini-ecosystem that grew within the larger changes to China's trade policy: a very resilient Chinese community in Manila. This community originally started when trade with the mainland was outlawed, presumably to have a place to actually conduct trade. The community grew, and when the trade policy was changed it grew some more. As Mann describes, Manila's Chinese inhabitants far outnumbered their Spanish counterparts in the European enclave in the city. The Spaniards were constantly uneasy about this Chinese community. They didn't understand it and looked down on it, but were also quite dependent on it. The Chinese could produce better goods at lower prices than the Europeans could produce or import themselves, but their foreignness and their numbers meant that the Spanish were always psychologically on the defensive.¹⁸ It was like the Spanish were rare components in the ecosystem of Manila, who did not appreciate the value the far more common components, the Chinese, provided.

There is no evidence for any Chinese plot to oust the Spaniards—which would have made zero economic sense—but perhaps the legacy of a century of conquering caused the Spanish to view all Chinese actions through the lens of potential aggression. Whatever the reason, the Spanish introduced restrictions that caused rebellion by the Chinese, which the Spanish took as reason to massacre the population.¹⁹

However, the ecosystem of Manila was very resilient. The abundance of both Chinese goods and people that could keep filling a necessary role in this ecosystem was the source of resiliency. Despite the Spanish committing seven separate massacres of the Chinese population in Manila, the trade and the town always came back.

New residents came; more goods were exchanged. The value of the trade, to both the Spanish and Chinese, from the level of individuals to government, created a system that could bounce back after each significant event, and there was no shortage of the raw materials and humans that the community required. The economic infrastructure was valuable, attractive and efficient. It got goods moving, made a lot of people some money, and a few people wealthy. The trade also facilitated a projection of power for both the Chinese government (via the infrastructure developments they made with the silver) and the Spanish (via perceived control over lucrative overseas trade.) So, despite the periodic catastrophes of widespread murder, the system had evolved to have high resiliency.

« The diversity of species present seems to impart long-term survival to an ecosystem.»

Rafe Sagarin²⁰

A new approach to building the perfect football team

The lessons we can learn from ecosystems are ones that we can apply in our organizations. After all, any business is dependent on a web of interactions and influences that includes employees working in different areas, customers, competitors, regulation and governments, and trends and changes in the global environment. So how can we integrate the value of considering the system in how we develop our businesses? We can look at an example from the world of American football.

In 1979, Bill Walsh^{*} became the general manager and head coach of the worst team in the American National Football League. By 1989, he had developed a dynasty of championship winners. His accomplishment is credited to one meta-factor: he created a culture in the San Francisco 49ers' organization that recognized the exceptional value a well-functioning ecosystem can provide. As Michael Lombardi explains in *Gridiron Genius*, "In short, Walsh took over a team with no high draft picks, no quarterback, and no hope. Three years later, that team won the Super Bowl. It got there following Walsh's formula, what he called his Standard of Performance: an exacting plan for constructing and maintaining the culture and organizational DNA behind the perfect football franchise."²¹

Walsh recognized that a football organization's culture is ultimately the system that will determine if a team can sustain the effort needed to win a championship. When Walsh took over the 49ers and began rebuilding the organization, he was "relying on one premise... that all the components of the 49ers' structure had to be

a single unitary construction, all pointed toward the same direction, all generating the same energy, interdependent in the goal of creating a great football team, from the janitors on up.”²²

In an ecosystem, all species have a role to play. On the African savannah, the elephants and lions may receive a lot of the attention from tourists, but their survival depends on the less glamorous beetles and baobabs making their contributions. Walsh believed that “everyone has a role, and every role is essential.” By making this philosophy a cornerstone of the 49ers’ culture, Walsh sought to demonstrate that winning football is the product of a well-functioning system; each individual knowing what was required of them and what their contribution was supposed to be was vital for success. It was the organization that was going to win. Not the coach. Not the individual players. “The critical factor whenever people work together,” according to Walsh, “is that they expect something of each other. It’s not just that the coach expects a lot of the players—it’s the fact that the players expect a lot of each other.”²³

Species migrate. Players get traded. Walsh was determined to build a culture that could survive and positively respond to inevitable change. In his book, *Finding the Winning Edge*, he wrote, [“The structure of an organization must have the flexibility and adaptability to meet unexpected obstacles, crises, or developments.”²⁴ The stronger and more resilient a system, the easier it can adapt and bounce back.] This is why, for Walsh, a successful organization wasn’t about superstar players or running a particular offensive formation. It was about building a culture that

could be flexible in effectively responding to ever-changing environmental pressures.

★ Walsh also understood that his cultural ecosystem wasn't closed. What happened off the field in the personal lives of his team could have an impact on their ability to maintain the 49ers' culture. He thus expanded the culture to include initiatives that could help prevent disturbances from which his ecosystem might not be able to recover. One of these was a "Life Skills Program" for the players that had "four major thrusts, all aimed at equipping otherwise unprepared players for adult life."²⁵ There was a continuing education program, a confidential personal and family counseling program, a confidential drug counseling program, and a financial advisory program. As David Harris observes in *The Genius*, "Most coaches just use a kind of one-size-fits-all approach, but Bill understood that different guys have different buttons. Fifty guys weren't all motivated the same way. Bill put in the extra work to figure out each of their personalities and what drove each."²⁶

In scouting for talent, Walsh said, "Don't just say he can't do this and can't do that. Find every player's possible contribution and identify the reason to take him rather than just the reasons not to."²⁷ Maybe the way a player could contribute wasn't needed by the 49ers at that time, but Walsh seemed to recognize that it takes a wide array of skills and specialties to help a team reach optimum performance, and thus it was important to keep an open mind when looking for talent.

One other fascinating property of ecosystems is that different organisms produce different systems, even if the environments are extremely similar. A desert in the Sudan does not have an identical

look and operations to a desert in Australia. [This concept might explain why teams following the same system do not necessarily produce the same results.] As Michael Lombardi explains, “Many have tried to copycat Walsh’s offense by hiring his former assistants and associates or anyone else who could lay claim to the West Coast lineage, believing that simply employing someone to run the scheme is enough to create the kind of success Walsh had with it.” ²⁸ Most of them failed. Why? Essentially, ingredients matter.

Finally, with all complex systems, which ecosystems are, the results of the interactions are not always predictable. Accordingly, the culture of the organization did not always translate into an output of wins. The 49ers didn’t win the Super Bowl all the time. The dynamics involved in winning a football championship are too complex to be able to identify and adjust for every factor. Walsh’s system though, did better than anyone else’s. He won three Super Bowls in his 10 years with San Francisco, which is an exceptional achievement in that league.

—Sidebar: The Reality of Living in a Web

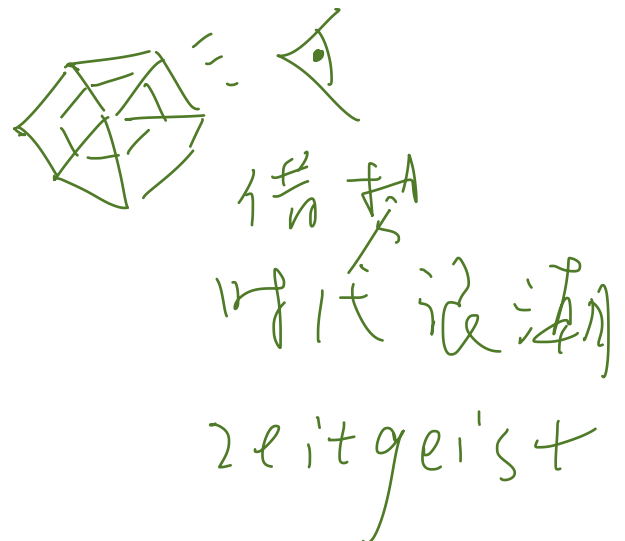
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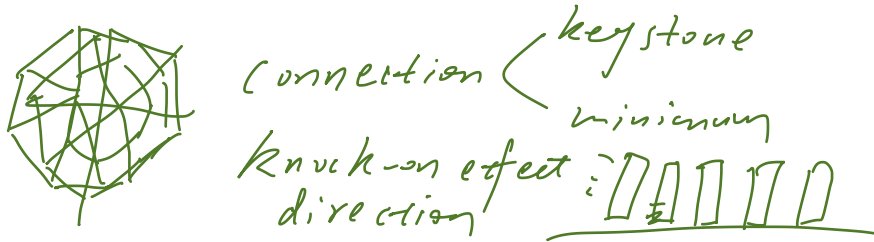
The Reality of Living in a Web

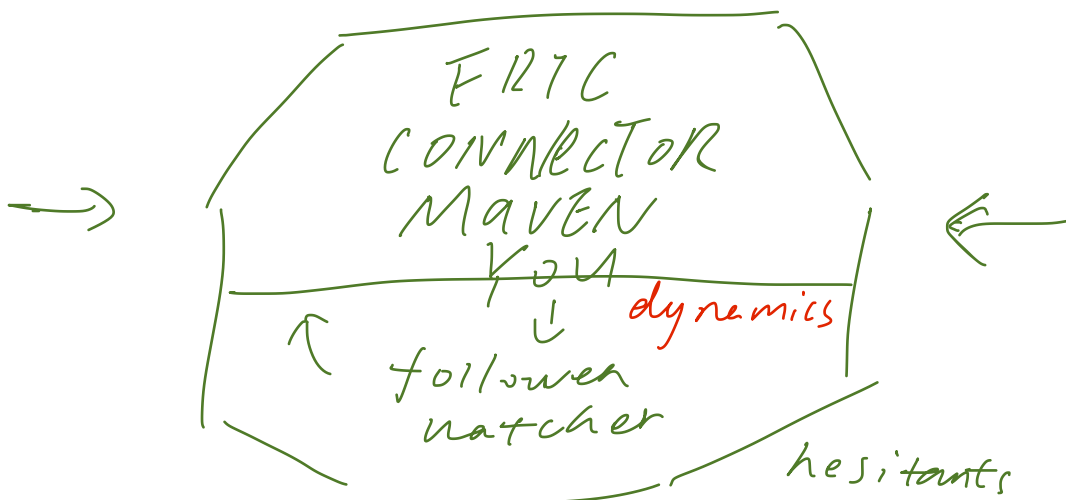
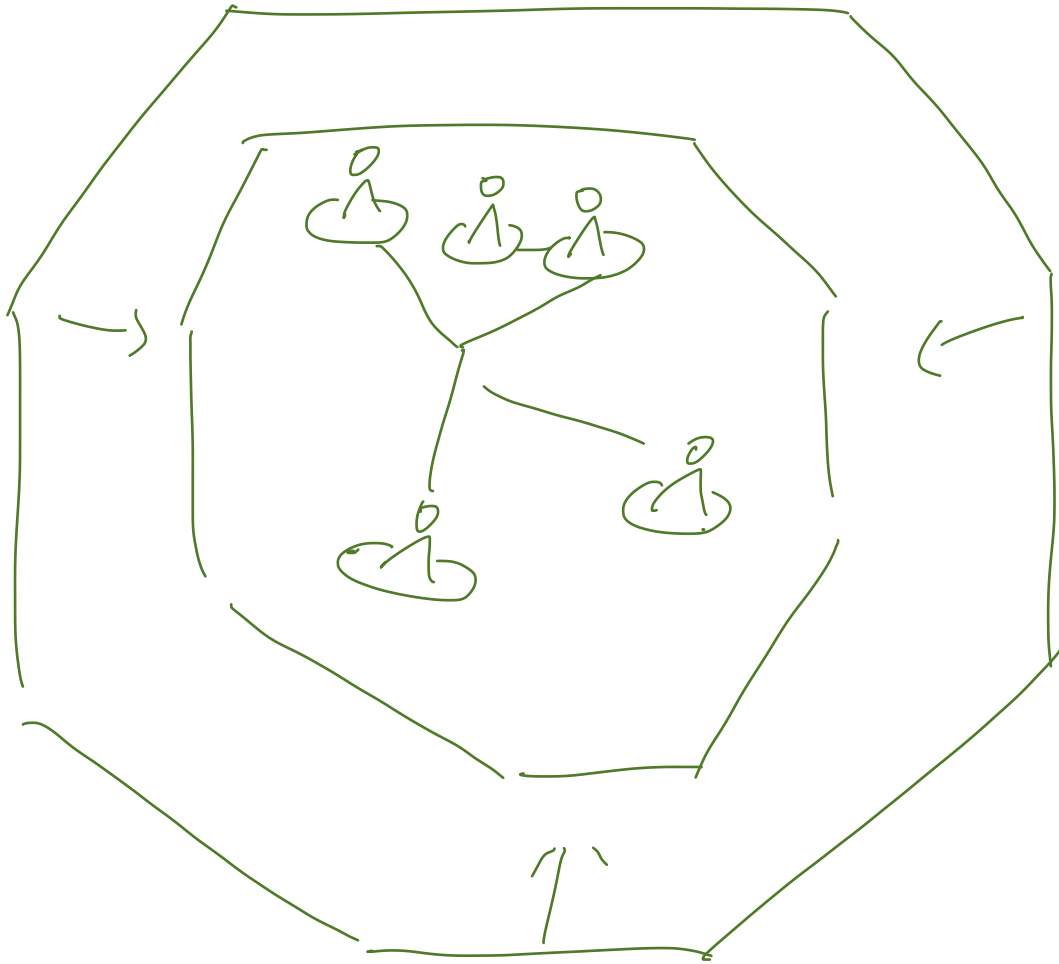
Too much of any one external factor can effectively kill a system. If you think about the narrow range of temperatures that humans can exist in, compared to all the possible temperatures that exist in our solar system, you can appreciate that significant change in external factors like light, air quality, etc. can devastate the stability of an ecosystem. So too with any business. External stability is important for overall success. Even if you can't control the external factors, you must pay attention to them. In order to have customers you need a large pool of people with enough money to buy your product. In order to run an office, you need a stable economic environment and tax system. In order to have employees, you need a strong education system that teaches the skills you require, and an urban structure that allows people to live a satisfying life on the income you provide. If we love our system, we must also do what we can to influence the external factors that are required to keep our system going.



Conclusion

Nothing exists in isolation. Everything is connected. The ecosystem lens reveals that the actions of any one species have consequences for many others in the same environment. Many systems can take care of themselves, possessing abilities to correct and compensate for changes and external pressures. We need to take the time to learn how the components of our system are interconnected so we can understand how our actions will impact the connections and affect the outcome we are trying to produce.





Honesty, Substance, principles



- Ethan -

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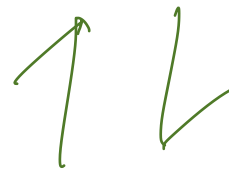
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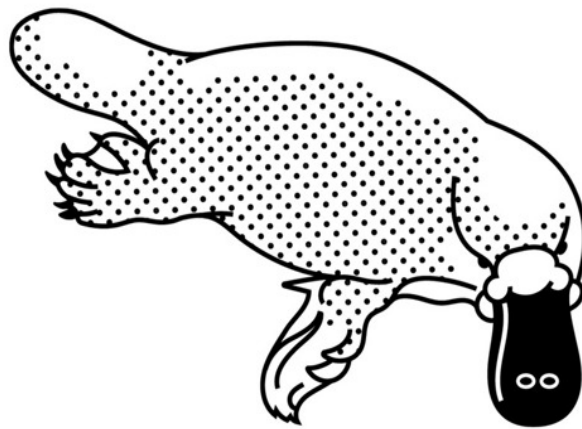


The Gift
of Imperfect

shame

Biology

Niches



—
Find a good fit.

Niches

In the biological world, some species are categorized as generalists, who cover a large territory and face more competition but are flexible in meeting their needs. Others are specialists who occupy a smaller territory and face less competition but are more rigid in their requirements. Both are vulnerable in their own ways. It is not always better to be one or the other but knowing which you are can help you strategize your continued survival.

↳ The ecological niche of a species refers to the role it plays in the ecosystem in which it is found. Every species in an ecosystem has a niche. A species' niche includes everything that affects its ability to reproduce and survive. For example, the amount of water and sunlight it needs, the temperatures it can tolerate, and how much space it requires to live are all part of its niche and are *called abiotic factors*, meaning the non-living aspects of an ecosystem.

Generalist organisms have a broad niche. Those with a broad niche can survive in a variety of places as they are usually capable of eating different foods and are able to tolerate different environmental conditions. This usually means that they can protect themselves from different predators, tolerate hot and cold or wet and dry conditions, and eat a wide variety of meats and plants and other foods. For this reason, generalists are not greatly affected by rapidly changing environmental conditions and so they can maintain large populations. Such organisms include cockroaches, rats, raccoons, and humans.

« Generalists can survive and flourish in just about any setting. But specialists tend to be much less comfortable with habitat change.»

Peter Ungar¹

Specialist organisms, on the other hand, have a very distinct set of roles in the ecosystem. For example, some specialists can only survive in specific locations or eat particular foods. They are more prone to extinction. Specialists, therefore, have a harder time maintaining large population sizes because it is common for land conditions to change and for resources such as foods to diminish over time. However, in places like tropical rain forests with stable environmental conditions, it is advantageous to be a specialist because they tend to have fewer competitors, whereas most of the generalists must compete against each other.

Another reason why specialists do well under stable environmental conditions is that they possess mechanisms that allow them to not only survive but thrive in those particular locations. For example, some animals can eat foods that are toxic to other animals, and tiger salamanders have developed the unique ability to seek out and breed only in ponds without fish so their larvae will not be eaten. This means that they will thrive in environments full of their particular requirements but do poorly when they are placed in environments lacking these. Think of koalas and their particular diet of eucalyptus, or the giant panda struggling to avoid extinction in part because its specialized diet

consisting mostly of bamboo makes it unable to adapt to changing environmental conditions.

« The generalist method is adequate if stakes are low, but increasing specialization is often mandated when the stakes—the standards of performance in competition—are high. »

Geerat Vermeij²

Social animals allow for divisions of labor within their groups, such as having defense specialists. For humans, the species may be a generalist, but as individuals we strongly specialize.

—Sidebar: Competitive Exclusion Principle

Competitive Exclusion Principle

The competitive exclusion principle, also known as Gause's Law, states that perfect competition between two species requiring the same resources to survive in the same niche is impossible. Georgii Frantsevich Gause first identified the principle in 1934 when he found that two species of bacteria requiring the same resources could not coexist in a petri dish. One species will find its own niche by becoming increasingly specialized to require different resources from the other. This is known as resource partitioning. If it doesn't, the second species' slight advantages will become significant enough to wipe out the first. For instance, if there are two carnivores in the same area that hunt the same prey animals, one species will always have some meaningful advantage, like greater speed or camouflage. This will enable it to outpace its competitor, which will have to find another food source or face extinction.

The competitive exclusion principle explains why we see such a diverse range of organisms within ecosystems. Even though they inhabit in the same area, each occupies its own niche and has traits that distinguish it from its neighbors. Natural selection only allows the fittest organisms to survive. Fitness refers not only to how well suited a population of organisms is to its environment, but also how well adapted it is in comparison to its competitors.

For instance, red squirrels were once the UK's sole squirrel species. They thrived in coniferous forests and deciduous woods for around 10,000 years. In the 1870s, gray squirrels were introduced to the UK. Since gray and red squirrels inhabit the same biological niche, living in the same areas and eating the same foods, they couldn't coexist. Red squirrels have now been eliminated from many areas of the UK. They mainly survive in areas where the two species are kept apart, such as on islands. Population figures are estimated at around 140,000 red squirrels and 2.5 million gray squirrels.¹ The larger numbers of gray squirrels mean they consume the available supply of acorns first and take over suitable shelter. They also carry a virus that can be deadly to red squirrels.² Gray squirrels have stronger digestive systems, so they can derive more energy from their food. Despite extensive conservation efforts, it is possible red squirrels may be extinct within years.

« Species that can't handle an environmental makeover have three options: move, die, or change. »

Peter Ungar³

Surviving and thriving

Invention is an area where this model fits well. If the invention is useful for everyone, like the light bulb or telephone, it's essentially a generalist forging into new territory. Specialists from your previous environment can't follow quickly because they don't have the capacity to adapt easily to the new environment. But once that new environment is open for competition, the other generalists will be right on your heels. You need to lock down as large a territory as you can defend before the other generalists arrive. This territory must have everything you need to reproduce and survive. If it does, it becomes your base, the place from which you can continue to grow and take on the other generalists.

Specialized invention, in contrast, focuses on catering to a smaller niche. The advantages of this are that once you own the niche, you are incredibly hard to dislodge. Your invention fills the niche so completely, there is very little incentive for anyone to invest in developing a competing product. Your growth is capped, but as long as the environment remains stable, as long as there is a continued need for your invention, you have significantly less competition to deal with than the generalists. An example of specialization is Zildjian cymbals. The company has been around since 1623 and has become so synonymous with great music and the artistry of drumming that they have no real competition among professional drummers. The group of professionals is small enough that there is no incentive to try to compete with Zildjian cymbals. If you want to sell cymbals, better off going after larger groups, say, to

people who teach music, or even people who listen to music and want to bang around on a drum kit at weekends.

A generalist faces more competition every day. Surviving and reproducing are a constant struggle. So, for them it would seem that stress is part of existence. To be means to compete—for territory, for food, for a mate. This is reflected in how we talk about the large, generalist companies: the constant fight for market share to stay ahead of the changing market conditions by offering new and better products and merging with or taking over other companies to grow even bigger.

Specialists, on the other hand, have less of a daily struggle. No one else wants their territory, like the fishless ponds where tiger salamanders breed, or their food, like the panda's staple of crunchy, nonnutritious bamboo. Their day-to-day stress is lower. But as soon as the environment starts to change, the stress explodes. Being unable to adapt means death. At the species level, it means extinction. When no one needs what you are selling anymore, like encyclopedias to put on your bookshelf, there is nowhere else to go. Your niche disappears.

Most people don't realize that the fax machine, something that sends images over wires, was invented in the 1840s. We tend to think of it as this failed technology that started with a short-lived boom in the early 1980s. But no, as soon as we could send information over wires, we experimented to discover what the full scope of that information could be. Images were an early example of what could be sent. The fax survived for over 150 years in part because it lurched from niche to niche, staking out the few small

but often powerful areas where the ability to transmit images was game changing. How did it do this?

To start, fax users didn't exist. If you never had the ability to send images, if you didn't even know it was possible, then it isn't something you were likely pining away for. Therefore, developers of fax technology identified and sought out small groups of potential users to create a market. Appeal to small, unrelated groups, was one of the main challenges for the technology for almost a hundred years. It was never very obvious who the technology would be extremely useful for. As Jonathan Coopersmith explains in *Faxed*, "Despite numerous efforts by inventors and some state support, pushes to develop facsimile technology never created corresponding significant pulls by market demand."⁴

In addition, the fax niche was a protected environment. "For facsimile, that protected niche was both institutional and technological.... These protected environments allowed a fragile and expensive technology to survive." Fax developers deliberately sought out markets with less competition "where faxing received greater resources (including users willing to pay the high costs) and support, giving it an opportunity to mature and develop."⁵

Faxing needed a specialist niche because it couldn't compete with the early generalist of the telegraph. The telegraph "had enormous advantages of easier use, much lower cost, less interference in transmission, and an already-developed infrastructure as well as users who had [by now] incorporated the standard telegram into their business routines."⁶

Fax's first niche was with the newspapers—a niche that it helped solidify by creating an expectation that only faxed

photographs could fill. “Judged strictly by numbers, facsimile was a minor technology. Less than a thousand transmitters and receivers existed in 1940. Their impact was greatly out of proportion to their numbers, however, because they enabled newspapers to print the latest photographs with the latest stories, visually transforming the news and strengthening the role of photographs in newspapers.”⁷ Once the public had photographs with their news, there was no going back. It might have been a small niche, but it was one that, at the time, only faxing could fill.

Faxes stayed around and progressed because there were some niches that they fit perfectly. The military was another early consumer, and its requirements were filtered back into the development of the technology. Anyone who needed images was interested in fax, as well as anyone who needed messages with as little room for error as possible. Both of these were requirements for the military. From weather diagrams to direct orders, by directly copying images, faxing ensured that as long as the technology and necessary infrastructure worked well, nothing was lost in translation.

There was a downside to focusing on niche markets. It allowed the technology to develop with complete incompatibility across the different manufacturers as they competed for the same small pool of clients. “In reality, deliberate incompatibility fragmented the market and scared away potential users fearful of choosing the wrong system.”⁸ In the world of business, fax was originally adopted as an intraoffice tool, and machines compatible with those of another organization were not needed. This lack of compatibility and standards had to be addressed before fax could

become the generalist of the 1980s and '90s. “Starting in the early 1980s, the combination of increasing deregulation, true compatibility, quickly dropping costs, and rapid technological change created a blossoming of new machines, applications, and services.”⁹ Fax was finally able to survive out of the niche.

In terms of information over wires, telegraphy, then telephony, became the generalists in the environment. Faxing could not compete with their lower cost and ease of use. It was through identifying and marketing to niches that fax managed to survive until the conditions changed, and the technological advancement and social interest allowed it to flourish as a generalist for a time.

« Natural selection has a limited repertoire of potential forms from which to choose, and convergent evolution is the result. »

George R. McGhee ¹⁰

Convergence

In biology, convergence refers to the process wherein organisms evolve analogous traits that were not present in their last common ancestor. [In other words, species that are not closely related to each other will find the same solutions to the same problems in their quest to survive.] This occurs when different unrelated species occupy niches with the same qualities and constraints, for instance, if two species both live in areas at a high altitude with little water, or in densely wooded, humid areas—but on different continents.

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We call traits that emerge through convergence “analogous structures” or “homoplasies” (convergence is also known as homoplasy). Homoplasies can include body shapes, the presence of organs, behaviors, markings, types of intelligence, social structures, vocalizations, breeding habits and so on. While they are unlikely to be entirely identical, they have the same form or purpose. [Convergence is fascinating because it shows us that biology does involve a degree of predetermination. Evolution is not an entirely random process. Certain features and behaviors recur again and again for the simple reason that they are the best way of surviving within an environment with certain characteristics. ¹¹]

Take the example of flight; an ability that has evolved in birds, bats, some types of dinosaurs, and insects. Each species is unrelated, and each evolved wings as a means of getting around, tens of millions of years apart. The wings of both birds and bats started off as regular limbs for land-based locomotion and still contain traces of finger bones. Take a look at the bones in a bat's



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趋同演化 [编辑]

维基百科，自由的百科全书

趋同演化（英語：Convergent evolution），也称**收敛进化**，是指兩類在亲缘關係上很遠的生物，因為長期處於相似的生活環境而**演化**出相似的特征。这些特征并未出现在它们的**最后共同祖先**身上。**支序分类学**将这种现象称为**同塑性**。飞行的**多次演化**是趋同演化的典型案例，带翅**昆虫**、**鸟类**、**翼龙**和**蝙蝠**都各自独立演化出了飞行能力。由趋同演化产生的相似特征称为**同功**（英語：analogous），而有共同起源的结构或特征则被称为**同源**，不同生物之间同源特征可能具备不同的功能。鸟类、翼龙、蝙蝠的**翅膀**是同功结构，负责达成飞行这一能力，而其**前肢**是同源结构，尽管功能不同，但有共同的起源。

和趨同演化相反的概念是「**趨異演化**」，指的是同一類生物如果長期處於不同的環境下，就會分化出不同的身體構造。与趋同演化相似的另一概念是“**平行演化**”，指原先具备相似性状的物种，在相似的环境压力下演化出相似特征。例如几种不同的**飞蛙**就是从树蛙平行演化而来。

植物中也有许多趋同演化的案例，例如**C₄类二氧化碳固定**，借助果实传播种子，**捕食昆虫**等。



两种**多肉植物**，**大戟属**和**星球属**，它们的亲缘关系较远，却有十分相似的结构特征。

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wing, and you'll see something with a structure not unrecognizably unlike your own hands, elongated into the spidery structure of a wing. There are obvious differences. A bat's wing consists of thin skin stretched over bones, whereas birds' wings are covered in feathers. The reason why bats and birds converged is simple. Both lineages evolved in niches where flight became essential for their survival.¹² The number of potential ways to fulfill a function is finite.¹³

A more widespread example is the evolution of eyes. It might seem natural to us that most animals, except ones living underground or at the depths of the sea, have eyes. But the fact that so many unrelated lineages evolved organs that look the same and function in the same way is extraordinary. The eye of a squid has much the same structure as that of a spider. Human and octopus eyes are similar, despite the closest common ancestor having lived 550 million years ago and only possessing a basic eyespot.¹⁴ Echolocation, another way of "seeing," evolved in unconnected lineages: cetaceans, bats, shrews, tenrecs, some birds, and possibly hedgehogs. Clearly these are the best possible traits for certain types of biological niches.

Due to convergence, we can tell by looking at a niche what kind of organisms would occupy it even without seeing them. For instance, if scientists discover a new nectar-producing plant, they can also predict the existence of an insect specially evolved to feed from it, even if said insect hasn't been discovered yet. If there's a keyhole, there's also a key somewhere that fits it. In popular culture, organisms from other planets are generally depicted as wildly different to anything on earth. But convergent evolution

suggests that might not be the case and that other life forms could have evolved to be recognizably similar to ones on earth.

→ As humans, we are in part the product of the pressures of our environment. Each of us occupies various niches throughout our lives, which we must adapt ourselves to fit. By and large, the same pressures acting on people and the same incentives seem to produce the same outcomes. If you took a baby from an Amazonian tribe and switched it with a baby from a wealthy family in Canada, would it grow up any different from other Canadian babies? Probably not. While some traits may be inbuilt, it would have to adapt to its ecosystem.

Convergence explains why people in disconnected cultures throughout history have made similar tools, told similar stories, organized themselves in similar social structures, cooked similar food, and generally found analogous solutions to the problems they faced. John Thomas Osmond Kirk, writing in *Science & Certainty*, compares biological traits to mathematical concepts in the way that they seem to exist beyond our definition of them, reappearing again and again everywhere we turn, as if they are laws of the universe.¹⁵

[It's important to understand that it is the environment that makes the organism.] When we look at the behavior of others, it's easy to imagine we would never do the same if we find them abhorrent. For instance, a corrupt politician stealing aid money or a neighbor turning on a neighbor during a genocide. But it's possible that if we were in the same niche, we would act in much the same way. It's a lot easier to be empathetic if we look at the environment that shaped someone instead of merely considering the end result.

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To a certain extent, we are all more predictable than we would like to admit.

We misunderstand that equivalent problems tend to have equivalent solutions, as convergence shows us. Our own problems may feel unique, which leads us to ignore the solutions that worked for others in equivalent situations. Yet just as bats and birds found analogous ways to solve the problem of flight, often what works for others would work for us too.

Defining a generalist

Generalists face more daily competition, but they are more adaptable. They maintain a large population that occupies a broad niche. In the world of consumer products, Coca-Cola used advertising to become one of the world's most successful generalists. Coke's spread and ability to compete in most geographical and socioeconomic markets was all down to its advertising campaigns.

Originally a medicinal tonic, Coke's first advertising efforts were a turn away from these roots to market its product as a beverage for "relaxation and enjoyment."¹⁶ As the 19th century turned into the 20th, Coke created an image associated with refinement and the upper class. Instead of isolating its product as being out of reach, it was one of the first examples of selling first an idea before a product. Anyone could join that upper echelon by buying the right brand, in this case a five-cent Coke.

Using pretty women, celebrity endorsements, and vast sums of money—\$750,000 in 1909 alone, which is over \$18 million in today's dollars—Coke convinced consumers that they weren't just buying a drink. They were buying a lifestyle. "By the 1920s Coke had established itself as *the* national brand of soft drink."¹⁷ Their advertising created an image in which everyone could participate. To drink Coke was to live a better life.

In *The Coke Machine*, Michael Blanding chronicles that "as it became more and more a part of the landscape, lifestyle started imitating advertising: Films began incorporating the drink into scenes, music started spontaneously referring to it in lyrics." Thus,

Coke became a ubiquitous part of life. It was just there. Everywhere.¹⁸

From these roots, Coke attained success as a generalist. It survived in different environments because it appealed to a diversity of consumers. There were no class or ethnic barriers to Coke. The lifestyle associated with a Coke was available to everyone. Whereas other brands had previously tended to market by class or gender or location or other identifiers, Coke just sold itself to people. That was arguably the company's greatest innovation.

The 1920s saw the company come up with the first of many memorable slogans. By far the most popular at the time was "the pause that refreshes." This slogan positioned Coke as "a momentary time-out."¹⁹ Again, this is a generalist approach, because a break from the frantic pace of each day is something everyone wants and needs. Who doesn't want a pause that refreshes? Coke slogans became particularly captivating during the Depression, a period in which Coke sales did well. Drinking the beverage became a momentary escape. "A better life was only the pop of a bottle cap away."²⁰

World War II made Coke international as bottling facilities started all over the world so that American troops could have easy access to the drink that reminded them of home. When times change, generalists can adapt more easily, and this was what happened with Coke during the war. They used the sentiments of soldiers and Coke's new international presence to inform new advertising campaigns that associated Coke with US prosperity. Directed at soldiers, the campaigns reminded them what they were

fighting for, and in the war-torn international markets it offered foreigners a piece of American luxury.

When Coke had to position itself against Pepsi, its most significant competitor, “Coke marketed itself as the product for everyone—workmen and businessmen, soldiers and socialites—[while] Pepsi focused solely on young middle-class families.”²¹ Pepsi tried to carve itself a small niche in Coke’s vast territory.

Over time, everyone from Santa Claus to polar bears has been seen drinking Coke. In 1963 Coke had the number one ad budget in the United States, spending 53 million dollars a year on ads and targeted consumer research. “After the challenge from Pepsi, Coke redoubled its efforts to associate Coke subliminally with almost *everything*.”²²

Around this time, they “created the first successful Coke slogan in years: ‘Things go better with Coke.’ *What* went better didn’t matter so much—Coke could just as well spark romance as childhood friendship. It was left to the consumer to fill in the blank.”²³ Advertisements no longer talked about what Coke tasted like or contained. It didn’t matter. In such vast territory, Coke had to be adaptable to different environmental pressures. It was this flexibility that was the key to its success. The general image could be adapted to suit any particular.

The ability to survive and flourish in any setting was brought home by the New Coke failure. “Consumers rejected the two sodas they actually liked better in blind taste tests, in exchange for the one whose brand image made them feel better.”²⁴ Being a generalist in the world of beverages wasn’t about taste. People were attached to Coke not as a drink, but as a representative of the

nostalgia of good moments. Coke's malleability was how it conquered such a large spectrum of the population.

Conclusion

An ecosystem is comprised of niches, and we can think of these as roles to be filled. There is a trade-off between specialization—dominating a smaller niche—and generalization, occupying a larger niche. Specialists have less competition and stress, but only in times of stability. Generalists face a greater day-to-day challenge for resources and survival but have more flexibility to respond when times change.