Journal from the James

How nature works …

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To look out on nature, be it a mountain forest such as we have in Idyllwild, a desert or even a tropical forest, what appears to many is a hodgepodge of plants and animals. Admittedly, nature can appear to be a bit messy at times, at least according to our often more organized propensities. For sure, it is often difficult to notice a structural organization in nature, at least to the casual eye.

What is more evident and can be easily understood is the functional organization of nature. Each species, each individual within an area, an ecosystem, regardless of where it is, does have a specific and often unique role it plays in the "theater of life," as it were.

Those roles center around the main organizing force of nature: energy. To understand the role and uniqueness of each species or how nature works, we need to understand how energy flows through an ecosystem. We all know that the energy we are talking about comes from the Sun. And it is a lot of energy. Each day, the Earth's surface receives more than 750,000 gigawatts of energy (one gigawatt equals a billion watts), compared to the annual human use of electricity of only 2.2 gigawatts.

What does it do with all that energy? This is where the functional organization comes into play. Ecologists who study this energy as it flows through ecosystems have divided the biological world into four basic functional groups: producers, primary consumers, secondary consumers and tertiary consumers. Sounds like something straight out of an economics book.

The producers are obviously the plants — all of them. Through the wonder of photosynthesis, these plants collect enough solar energy to run the entire biological world. These plants capture energy that then becomes available to the primary consumers, plant-eating animals. Secondary consumers are animals who eat primary consumers and tertiary consumers eat both primary and secondary ones.

Functionally, each plant and animal is well organized into what level — trophic level — they belong. Each species of plant collects the Sun's energy in a specific form; for example, grass vs. trees. This dictates what type of primary consumer can use these forms. Deer eat grass, beavers eat bark. The secondary and tertiary consumers then eat whatever animal they are adapted to catch. Owls catch mice, cougars catch deer. Because each plant, each animal, has very specific ways of capturing energy, the ecosystem can be viewed as a fine-tuned machine, an energy-capturing machine — each species, each organism doing its functional part to capture and pass on the energy to the next tropic level, maintaining the smooth flow of energy through and eventually out of the ecosystem.

In a functioning ecosystem, all the players are doing their parts in the smooth passage of energy from one level to another. If we should disrupt this flow by removal of some of the players, as we have done with large carnivores, that energy flow can be disrupted, blocked. I liken the flow of energy through an ecosystem as the structure of an evergreen trees. When a tree is healthy, it tapers majestically from its broad base (the producers) upward toward its ultimate peak (the top consumers). Cut the top of this tree — remove the carnivores — and it can no longer grow (energy flow upward) and becomes distorted, growing grotesquely out of shape. The tree, the ecosystem, is no longer healthy and begins to die. Healthy ecosystems require all their players. That is how nature works.