Patterns of Speciation and Extinction and the Divine Valuing of Creation

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http://hdl.handle.net/2144/3917

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The near-universal concern over the current rate of species extinction must be contextualized, given the occurrence of previous mass extinctions during the course of Earth’s natural history. Current scientific knowledge regarding patterns of speciation and extinction present two challenges to the theologian: 1) how to understand God’s relationship to these patterns; and 2) how to understand God’s valuation of transient creatures in creation. After reviewing current theories regarding speciation and extinction, the implications for theology are addressed, particularly the need to account for extinction as an undeniable feature of cosmic history.

The world’s species are in serious decline, a situation simple to detail even if figures are less than precise. Somewhere between 5 and 40 million species of living creatures populate the earth. Estimates place the present rate of extinction at up to 50,000 species per year. According to the latest State of the World publication, “[t]hree fourths of the world’s bird species are declining, and nearly one fourth of the 4,600 species of mammals are threatened with extinction.”

Prime factors in current extinctions are loss of habitat (e.g., destruction of rain forests) and ecosystem disruption (e.g., introduction of non-native species, overharvesting).

Whether from a “shallow” anthropocentrism or a “deep” ecocentrism, concerns abound. At the very least, the richness of biological resources available for human use and enjoyment is in serious jeopardy. On a larger scale, there is a sense that something “out there” (God, the universe, the web of life—to name a few candidates) is being shortchanged in the narrowing of biological diversity. Of added concern is the human role in the situation, as “[f]or the first time, a single species—Homo sapiens—has become a vast, destructive ecological force.”

Concerns, however, must be contextualized, and contextualization is a dicey business. Simply put, what context? If historical perspective is considered to be coterminal with human history, then trends are clearly new and alarming. An unprecedented extinction event requires prompt attention and action. When placed in cosmic historical perspective, however, the issues become murkier. What if, as seems to be the case, this is not the first period of mass extinction, but merely the latest of a number of such periods? Does precedence diminish concern, or does historical inquiry push past precedence to find the unprecedented in this period of extinction (e.g., the human factor), and thus foster rather than inhibit concern and action?

Religious voices increasingly insist that proper respect for divine artistry demands protection of endangered species. What sort of warrant is there for a religious ethic regarding endangered species? Ethics from an ecological perspective often operates on the principle that “what ought to be is derived from what is.”

What “is,” so far as nature/creation is concerned? This essay will outline patterns of speciation and extinction, then examine theories regarding those patterns, particularly as they influence the theist’s concept of the nature and direction of God’s activity in this world and our valuation of the world.
Historical notions of species appearance and disappearance

That species appeared and vanished was a relatively novel idea in the 1700s. Jewish and Christian traditions claimed one primary act of creation, and for much of Western history there was no reason to challenge the idea that, once created, the orders of living things remained fixed. The position that individual channels of overflowing divine goodness as exemplified in God’s creatures might stop flowing was inconsistent with God’s infinitude and ongoing concern for creation.  

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The emergence of fossil remains as a subject of scientific and religious discussions in the eighteenth century required new conceptions. The prevailing viewpoint became old earth catastrophism, in which an ancient earth experienced several epochs of creation of biological forms, each epoch coming to a complete end through catastrophe with no carry-over of species from one epoch to another. Typically this was combined with a belief that some past processes either no longer operated in the present or operated at a diminished level.

Following the lead of Charles Lyell in geology, Charles Darwin challenged these assumptions in the mid-1800s with his model of speciation, characterized by uniformity of process and incremental changes in life forms, with the gradual emergence of new species over extended periods of time. Darwin’s was primarily a model of speciation, with extinction handled by auxiliary hypotheses. For Darwin, species might disappear in one of two ways: 1) a species might linger long enough to register upon the fossil record, yet ultimately prove to be a loser in the struggle for survival and truly become extinct; or 2) a species might evolve into a significantly different form (a process known as “pseudo-extinction”). In either case, the end result was the presence of a particular form in the fossil record and its absence in the current panoply of living species.

Key to Darwin’s theory is the matter of incremental change, and at this point Darwin met his most substantial challenge. The fossil record, exhibiting fits and starts, left major gaps to be filled in imaginatively. The imagination fired by Darwinian theory saw a procession and progression filling in the gaps through a steady, inexorable diversification of the biotic community. To skeptics, however, the list of species leaving the tail-end of one segment of the fossil record so differs from that which begins the next that it seemed improbable that Darwinian evolution could account for the dramatic difference.

Current concepts

Current theories suggest that forms of life on earth coalesced approximately 3.5 billion years ago, with animals emerging somewhat less than a billion years ago. Today’s significantly broader data from the fossil record challenges Darwinian evolutionary theory, since neither speciation nor extinction seem to occur incrementally—which in turn has raised questions about the uniformity of natural processes.

Speciation seems to occur fitfully, with long periods of stability punctuated by periods of rapid appearance of new species. Why the explosion in speciation at some times, and the dearth of it in others? Com-
menting on the explosion of speciation during a 5-10-million-year segment of the Cambrian period and the fact that subsequent periods do not show a similar explosion, Richard Leakey writes:

It was as if the facility for making evolutionary leaps that produced major functional novelties—the basis of new phyla—had somehow been lost when the Cambrian period came to an end. It was as if the mainspring of evolution had lost some of its power.9

Extinctions similarly punctuate the record. While the number of species in existence at a given time has increased overall, the fossil record exhibits a series of extinctions of moderate degree in which 15 to 40 percent of animal species disappeared. On five occasions,9 massive extinctions appear to have taken place in which 65 to 95% of all animal species disappeared. As Richard Leakey describes it:

The Big Five [extinctions] interrupted that rise [of diversity] to dangerously low levels.... This handful of major events, from oldest to most recent, are: the end-Ordovician (440 million years ago), the Late Devonian (365 million years ago), the end-Permian (225 million years ago), the end-Triassic (210 million years ago), and the end-Cretaceous (65 million years ago).10

The resulting pattern of species development highlights two seemingly contradictory facts: 1) The present geological period has the highest species diversity within natural historical time (at least prior to the current period of extinction related to human causes); and 2) virtually all species no longer exist. Leakey notes:

Some thirty billion species are estimated to have lived since multicellular creatures first evolved in the Cambrian explosion. According to some estimates, thirty million species populate today’s Earth. This means that 99.9 percent of all species that have ever lived are extinct. As one statistical wag put it, “To a first approximation, all species are extinct.”11

A number of culprits have been identified for precipitating mass extinction, with the most likely candidates considered to be meteorite impact and/or volcanism with concomitant changes in climate and sea levels. Since 1980, the darling of catastrophes has been meteorite impact, with the suggestion that the impact of a large meteorite (diameter >10 km) disrupted global ecosystems and led to mass extinction some 65 million years ago. Primary evidence for this theory is the high level of the element iridium found at the K/T boundary,12 but other evidence points in this direction as well.

Does this theory account for one mass extinction or many? While the main focus has been on the dinosaur extinction of the Cretaceous period, some scientists have pushed the theory further. David Raup, among others, considers the claim that all extinctions are the result of meteorite impact and subsequent systemic disruption, and further, that these extinctions happen periodically at intervals of approximately 26 million years.13 Extinction would thereby be catastrophic and periodic. Raup himself is tentative with this proposal, and few scientists consider it likely.

A close cousin to impact theory is that of volcanism.14 Volcanic eruption can seriously disrupt the earth’s ecosystem, as well attested in the 1991 eruption of Mt. Pinatubo in the Philippines. If volcanic activity increases substantially, climate change occurs at a rate faster than organisms can adapt. Volcanism may also account for high iridium levels at those points in the geological record that coincide with mass extinctions.15

Beyond these catastrophic disruptions, attention focuses on population patterns themselves. Contemporary ecological theory emphasizes the interrelatedness of species within ecosystems. The loss of a few key species can collapse an entire ecosystem, resulting in the loss of almost all its species.16 Species population rarely remains constant for any length of time, and patterns of fluctuation are difficult to decipher. Is there a descriptive regularity to population patterns? The simple relationship once
thought to exist between food/prey and predators is actually quite complex. Not only do population patterns fluctuate wildly, but it is highly suspected that population patterns are chaotic.\textsuperscript{17} Natural fluctuations occasionally bring population levels down to the lower end of survivability. As David Raup puts it, extinction can be as much the product of bad luck as of bad genes.

One of the legacies of the Darwinian revolution imposed a very particular view of the world on Western intellectual thought. According to that perspective, species thrive because they are superior in some way to their competitors; they win in the "struggle for existence," to use Darwin’s phrase. Similarly, species go extinct through succumbing to competition; they are failures in life’s struggle… But one of the more important developments of evolutionary biology in recent years is the recognition that luck, not superiority, plays a cogent role in determining which organisms survive, especially through times of mass extinction.\textsuperscript{18}

Difficulties with the twin pillars of classical Darwinism—uniformitarianism and incremental change—have become substantial enough to bring them renewed scrutiny as central organizing principles of evolutionary theory. While Darwinian evolution has not been unseated from its preferred position in the scientific community, catastrophism has reclaimed a major place in the explanation of extinction and subsequent re-speciation.\textsuperscript{19} Catastrophes precipitate crises among species, with a resulting disintegration of entire ecosystems. This claim then links to a second, in which the suddenly-open playing field brought on by mass extinction results in an explosion of new forms. A larger number of complex creatures emerges in a shorter period of time than would be predicted under a Darwinian evolutionary scheme. Further, the forms that emerge in an explosion of speciation do not necessarily resemble those of the previous extinction. Principles of complex organization seem to play a role. The quest and the question is not only to discover the principles, but also why they seem to operate at one time and not at another.

**Evolution, theology, and ecological ethics**

What effect does recent scholarship have upon theology and the understanding of God’s ways with this world, particularly in relationship to species? Two major reconsiderations should take place. First, theology should describe God’s relationship to the world in such a way as to account for extinction as well as rapid speciation. Divine design arguments certainly cannot be framed as they were in the seventeenth century, nor even as they were in the past century, where theology accommodated evolution by allowing God’s design to blaze a path of progress. If “design” is perceived too tightly, it is difficult to avoid the conclusion that God wasn’t overly-enamored with certain efforts. Having followed several different design projects and seen fit to abandon some of these in midstream.

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If “design” is perceived too tightly, it is difficult to avoid the conclusion that God wasn’t overly enamored with certain efforts. Having followed several different design projects and seen fit to abandon some of these in midstream. Such a scenario gives an interesting slant to Van Gogh’s conjecture that the world was “a study that didn’t come off.”\textsuperscript{20}

It is still possible, however, to speak of divine design in coherent fashion. There has to be some looseness allowed, with God’s design establishing parameters and marking
the channels through which random generation and transmutation of forms may take place. There is a discernible trajectory of increasing complexity and diversity even though this trajectory is intermittent and scattered. Clearly organisms increase in complexity at a variety of levels. Diversity over time increases. Sentience emerges. Occasional mass extinctions seem to operate as wildfires do in ecosystems, to clear the landscape for a profusion of new forms. Extinctions are contextual. As Holmes Rolston states:

Even species come and go, over millions of years.... The half-life of a species is typically upward of ten million years. Some become extinct without issue, but nature's long-standing trends transform others and increase the numbers of species present in each later epoch, as well as their richness.... Even the few crashes and mass extinctions, though setbacks, have reset life's direction.... Retrenchments in the quantity of life were followed by explosive inventiveness in its quality.22

Under such a view, theology laments the current extinction not simply because it opposes an overall trajectory and pauperizes a world which God steers toward richness, but also because there is no clearing for new forms to flourish in a world hoarded by humanity.23

Secondly, theology needs to understand value in a way that does justice to the "temporal" as well as the "eternal". That something endures through time might be a consideration in its value, but not its chief determiner. Failure to appreciate this has led theology to value the soul disproportionately over the body, the human over the animal, and to assume that God values only that which endures. With this in mind, theology which took a Darwinian approach felt obligated to move God's concern for all creatures from the individual to the species. Tennyson observed, "So careful of the type [Nature] seems, so careless of the single life,"24 which was an echoing of Mary Wollstonecraft's theological observation that "[i]t is the preservation of the species, not of individuals, which appears to be the design of Deity throughout the whole of nature."25 Tennyson, like Wollstonecraft, was wrong. If profligate with individuals, then creation is profligate with species as well. It is difficult to see how current knowledge suggests a divine preference for species over individuals.

The answer is not to consider God as disvaluing both, but to understand that a more complex valuational scheme pays attention to various structural levels in the world. Theology must develop a nuanced understanding of divine valuation. In this regard, contemporary ecological theory is helpful as it cautions not to isolate value at one level. Just as the physical world has the three dimensions of space and the fourth dimension of time, so valuation needs to take into account the three dimensions of individuals, species, and systems, joining these together with the dimension of process

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ues present at various levels. Thus, species are valuable not only as the form through which individual lives flow, but as parts of systems in which the presence of a species shapes and moves the system and its components along an uncharted path.

Conclusion

Endangered species preservation is an ethical issue that requires adequate scientific knowledge as well as theologically informed ethical principles. Theology and science can interact constructively in this regard to avoid either oversimplification on one hand, or a bafflement which precludes action on the other. Fortunately, the complexity of science’s description of speciation and extinction patterns can be matched by theology in its description of God’s connections to and desires for the world. Theology’s peculiar power is to provide a conceptual framework for understanding the present dilemma of species extinction by drawing us outside ourselves and our fixation on purely human pursuits that leads to catastrophe for others of God’s creatures. Theology enables us to perceive the nature of God’s connection to the world and the ways in which God channels value through the creation. That perception is an integral part of addressing the current crisis in species extinction and cutting short a catastrophe of human origin.

Works cited:


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**Endnotes:**

1. Brown et al., p. 13. Estimates of present extinction rates vary widely, with common portrayals of “one species per day” or “three species per day.” Extinction estimates are the result of multiple factors, such as the number of species per hectare, the average range per species, and the rate of habitat destruction.

2. For a history of the “shallow” and “deep” designations made popular by Arne Naess, see Session, pp. ix-xiv.


5. Rolston, p. 58. This principle is disputed by some philosophers and theologians as an impermissible deviation from the ethical norm that What ought to be can never be derived from what is.

6. Carl Linnaeus, the father of modern taxonomy, wrote in his *Philosophia Botanica* of 1751: “There are as many species as the infinite being created diverse forms in the beginning, which, following the laws of generation, produced as many others but always similar to them. Therefore, there are as many species as we have different structures before us today.” Cited in Hsü, p. 218.

7. Ratsch, pp. 15-16

8. Leakey and Lewin, p. 27.

9. The exact number of mass extinctions is contested. William Glen, for instance, claims evidence for up to twelve periods of mass extinction. Glen, p. 25.

10. Leakey, p. 45.

11. Ibid., p. 39.

12. Iridium is an element in the platinum family which, due to its “iron-loving” qualities, sank to the center of the planet in the early stages of earth’s development. Its presence at the K/T boundary, the juncture between the Cretaceous Period (dinosaurs and conifers) and the Tertiary Period (the modern era of mammals and flowering plants) is strongly suggestive of meteorite impact.

13. See Glen, pp. 26-29, for a history of discussions about extinction and periodicity.

14. For the argument for volcanism and against impact theory, see Officer and Page, pp. 158-77.

15. Iridium is also consistent with volcanism, but only with deep core volcanoes. Most volcanoes are shallow and form at the edge of surface plates. Volcanoes at the center of plates tend to be fewer, but deeper.


17. See Leakey and Lewin, pp. 149-170. One difficulty is that “chaos” is a popularly invoked concept, although it is difficult to prove. As has been pointed out, “chaos, sufficiently complicated periodicity, and what [is] called strict randomness...can rarely be phenomenologically distinguished from each other...” Wildman and Russell, p. 78.

18. Ibid., 17-18.

19. There are, of course, those who refuse to give up on uniformitarianism, and see in catastrophism a return to pre-Darwinian ignorance. Briggs, pp. 230-36. It must be admitted that neither is the fossil record sufficiently complete nor are dating methods sufficiently precise to settle conclusively the question of the swiftness of past mass extinctions.
20. Quoted in Dillard, p. 69. Dillard takes issue with Van Gogh’s comment, but only because her sense of God’s profligacy is matched by her awe at the intricacy of God’s work.


22. Rolston, p. 221.


25. See Rolston, pp. 192-245. Few scholars have explored the notion of value in regard to the natural world as extensively as Rolston.

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This essay received a First Prize and the Grand Prize.