



Ants & Bats & Things Like that

ecology of the Spirit

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Introduction

For several hundred years since the Enlightenment the European intellectual effort has been to separate the teachings of God (theology) from the teachings of the Earth (ecology). Both the scientific and religious communities made an all out effort to describe reality in their own way. The separation occurred because at the time of the Enlightenment what had been explained from a religious point of view was being interpreted through scientific knowledge. Two camps emerged.

Since human beings began to structure thought, there was the world that was seen and that world that was unseen. There were the things that one touches and that which is a mystery. For primitive people both the experienced and the mystery were real. There was no thought given to their separation. One can see this in the stories of indigenous people. The seen and unseen worlds were one world.

With the introduction of present-day science, religious people found that what was explained with the word "God" was explainable in different ways. Thus, a profound effort was made to rationalize the Christian faith in particular and make the Christian story sound more sophisticated..

What emerged from the Enlightenment was a tension that said, "If you believed in science you rejected God." I do not know who created the premise first. My suspicions are that such thought emerged from the religious community. The church was losing its authority, and there needed to be a way to gain it back. Everything was to fit into the religious paradigm, or it was not true.

Remember that Copernicus, the Polish astronomer, proposed that the earth is not the center of the universe. It is the sun. The rebellion to that insight caused Copernicus to be excommunicated from the church. What probably upset the church was not a change in the shape of the solar system. Rather, with the earth no longer at the center of the universe, what does one do with the location of hell, which the church conceived to be at the center of the earth, thus, the center of the universe.¹

One of the problems I have with denying the scientific method is that this means I must deny my experiences of what I call reality. Do our senses communicate anything? Is the information true?

In my view the scientific method, human experience, does not negate God and God's activity. They are not mutually exclusive. What the reader needs to realize is that one both believes in God and trust one's senses.

¹Ferris, Timothy, Coming of Age in the Milky Way, (New York: William Morrow, 1988), 67.

When a person engages in a study of God and a study of the environment the questions are: how does a person's ecology fit into one's understanding of theology and how does a person's theology fit into one's understanding of the Earth. It is almost necessary to settle this at the outset. Do these two disciplines negate each other? Do they water down one another? Or do they enhance one another.

We have been taught in both the secular and Christian communities that the thought patterns of the two disciplines are different, the paradigms are not the same, and the gulf prevails. There have been attempts to homogenize the two disciplines. But that ends up to be poor science and very poor theology.

We must learn to interface the two disciplines. We might discover that ecology and theology nurture each other. They live interdependently with each other.

This study into which we enter is a study of the ecology of God. The term for God will be the third person² of the Trinity, Spirit. We will explore three things in each chapter: 1) the relationship between God and humanity, 2) the relationship between the human and the non-human worlds, and 3) the relationship between humans and humans.

Before entering into the details of this study I would like you to explore with me a deep concern I have regarding religious education and its role in life and in the Church.

I believe that Christian education is about the business of conversion. I realize Lutherans shy away from this word because it smacks of putting feelings over faith, salvation based on experience and work righteousness, humanistic centrality over God-centeredness, and emotional manipulation, just to name a few.

I use "conversion" to describe eye-opening experiences that happen of their own accord and are life changing events. The word does not belong solely to the religious life. People have eye-opening and life-changing experiences in all walks of life. It affects thoughts, feelings, and perceptions. Conversion is not a once in a life-time experience. It happens again and again. For most these conversion events become the filtering agents, the models for interpretation, for one's perceptions and experiences.

For some, conversion means to come to a saving knowledge of Jesus Christ. But this is not the end. One must continue to be converted because the nature of Christ is such that there are so many nuances to what Christ does. One must continue to understand and to commit to the work of God in Christ.

In the Church we are to teach for conversion, for eye-opening experiences, for life-changing insights, for amendments of behavior so that people may know the depth and the riches of God

²The Greek word persona means mask.

and God's world in their personal lives.

How did the title of this resource come to be? In 1989 I spent over two weeks in Costa Rica wandering through two tropical rain forests. Three learnings of this event for me were that bananas do not grow on trees, bats, along with birds, insects, and other mammals, are pollinators, and some ants live solely on fungi.³

The discovery of mutualism and interaction of species in various and unique ways caused me to think about mutualism between humans, human and non-humans, and God and all creation. There is a benevolent relationship between God and the human world, and it is not solely for the fulfilment of human life. It is also to God's benefit as well. This nature of God is called "Spirit."

The key words for this resource are popular in the vocabulary of the 90's: ecosystem, diversity, mutualism, inclusivity, and spirituality.

Chapter I

THE HOME OF GOD

ECOSYSTEM

The word "eco" (oiko) in Greek means "home." Ecology is the study of the "home" focusing on the relationships in the system. Thus, the word "ecosystem" is used in environmental studies.

All of existence is interdependent. "There are no free lunches." Everything has a price. Impact on one aspect of the environment has impact on another. Under study today, for example, is how the depletion of rain forests in South and Central America influence the weather of North America.

A new concept that is receiving more and more acceptance is that the world itself is a living being. The Gaia hypothesis (the word is the name of the Greek goddess for Earth) holds that life acts as a self-regulating system by controlling the planet's atmosphere. It was put forth in the mid 1980s by J. E. Lovelock and challenges the conventional belief that living matter reacts passively in the face of threats to its existence. It argues that earth's living matter - air, water, and land surfaces - form a complex system which has the capacity to keep our planet a fit place to live.⁴

Since sensitivity to the environment has become an issue, we have begun to realize that humans

³Note the opening frames of the movie, "The Lion King"

⁴Lovelock, J. E., Gaia - a New Look at Life on Earth, (New York: Oxford University Press, 1987).

are not the only species in existence. Other organisms possess history as well. What is revolutionary in this is that organisms other than humans have a say in what is happening to the Earth, and the values of other organisms are not contingent on how they serve humanity.

There are some thinkers who give the impression that ecosystems are better off without humanity. They perceive the natural order as pristine and good when a habitat is not disrupted by the presence of humans. When the human species is introduced into a natural setting there is a change, and the influence is determined abusive.

The reality is that the ecosystem is not limited to the interaction of species in the non-human world. The ecosystem includes the human species, too. All creation calls Earth "home."

We can consider the world a stage on which the props and scenery are also the actors.

In addition Christians affirm that God is an actor on this same stage. We celebrate with the Psalmist, "The earth is the Lord's and all that is in it, the world, and those who live in it; for he has founded it on the seas, and established it on the rivers" (Psalm 24:1).

H. Paul Santmire in The Travail of Nature says that there are three "fundamental data of theological reflection: God, humanity, and the world of nature."⁵

God lives relationally in the world. If we listen to our rhetoric, our word for God in relation with this world is "Spirit." We do not get carried away with detailing the doctrine of the Trinity. We may use Creator, Savior, Sanctified, etc. interchangeably. Though a discussion of the Trinity may raise some questions about this notion, the clear division of each of the three persona is commingled when we use the word "Spirit."

In our faith affirmation, the Apostles' Creed, the Third Article speaks of God in the present as one who acts relationally. The First Article confesses God the Creator, and the Second, God the Redeemer. The Third Article confesses the Spirit in connection with:

The Christian Church, the communion of saints,
The forgiveness of sins,
The resurrection of the body, and
Life Everlasting.

The world is God at work. God cannot be excluded from the processes of life.

In the Nicene Creed the Holy spirit is proclaimed as proceeding from the Father and the Son. The imagery of this statement is intriguing because it gives powerful substance to the concept of the Spirit. The Spirit is not the whimsical activity of God to do the bidding of whatever and whoever. The Spirit is the Creator creating, the Redeemer redeeming, etc.

⁵Santmire, H. Paul, The Travail of Nature, (Philadelphia: Fortress Press, 1985), 9.

A way of saying all of this is: "Spirit" is the ecological word for God.

When viewing our ecosystem and reflecting ecologically, it is imperative that we realize that within the human world community there are many races and cultures who call the Earth home. The tendency is to perceive a world that is only within one's territory and experience. Anyone beyond this realm is only a number, possibly a non-person, maybe an alien.

There may have been a day not many years ago when people could be isolated from each other, but that time has passed. Isolation and barriers have been broken down because of TV, transportation, and the mobility of people. Our world community comes to our door. We discover many people who call the same place "home." This is true for all non-human entities. It is also true for God.

Chapter II

NICHE KNOWING

DIVERSITY

Everything that exists has a place in the ecosystem. Ecologists call this a "niche," meaning profession, occupation, business.

In the natural world an organism is described as a producer, consumer, or a decomposer. In many instances a species' role is understood. However, the niche of some species, e.g., ticks, is unknown or maligned. How about ants and bats?

Unfortunately, in our anthropocentrism an entity's worth is often determined by its known usefulness to humanity. If an organism is not deemed utilitarian to humans, then it has no value. This is arrogance on the part of human beings when one recognizes the fact that we do not know everything. Also, worth, at least for Christians, is something that is given by God to the organism before we learn an organism's niche or an organism's value to us.

We are learning that a species' occupation at the least is its contribution to the diversity of its habitat.

There are three unique facets to a species' diversity: characteristics, history, and profession. The profession, the niche, is what the organism does for the sake of its habitat and for its own survival. Characteristics are the external and internal features of the organism. This history of an organism is what has happened over time to shape 1) the entity itself and 2) the entity's function. As a species interacts with the environment it adapts to survive and procreate. In all instances a species has developed to what it is today over the ages. Scientists call this process adaptation or evolution.

We are told, for example, that beetles were the earliest pollinator of flowers. As we observe the process of pollination by various birds, insects, and mammals we see that flowers have adapted to allow certain species to pollinate them. Obviously, these are not beetles. Over millions of years of development species have taken over the professions once the domain of the beetles.

Diversity in the natural world is most clearly seen in the Tropics. In the Temperate Zone, the one in which we live, the variety of species is fewer and the population of any given organism tends to be more concentrated geographically. In the Tropics plant and animal species are more greatly distributed. Thus, there is a greater variety of species in a given space.

Let me illustrate. In the Temperate Zone trees of the same species tend to grow in close proximity to one another. Forests will be composed of a few types of trees bunched together. In the Tropics species of trees are spread over a vast geographical area. To scientists this explains why Tropical trees tend to have more colorful flowers and fruit. Pollination is relatively easy when the same plants are close to one another. But when they are spread out over great distances the tree needs to wave an indicator so the appropriate pollinator can more successfully find the specific species. The fruit is also more lush in appearance so that animals responsible for seed dispersal will be more interested in assisting the trees in spreading its young.

The greater the diversity of an area the more organisms spend energy to compete for their survival.

How did diversity in the non-human world get started? No one really knows. One hypothesis is that diversity is a way organisms avoid disease and become less vulnerable to pests.⁶

Paul Ehrlich says that diversity is the most precious non-renewable resource of our planet. The greater the diversity in an ecosystem, the healthier that system is.⁷

When diversity is discussed biblically, it is in terms of a person's profession within the life of the church. Paul says the profession of each person is a gift of the Holy Spirit.

What is interesting is that Paul is more concerned with the diversity of gifts, talents, and professions than he is with the diversity of characteristics and histories of the people (I Corinthians 12:14-31). In fact, he says specifically that in Christ there is no diversity, neither Jew nor Greek slave nor free, male or female. All are one in Christ (Galatians 3:25-29).

Within the church and world communities diversity is affirmed as more than profession. There is diversity of characteristics and histories.

⁶Ehrlich, Paul, The Mechanics of Nature, (New York: Simon and Schuster, 1985), 234.

⁷Ibid., 213.

It seems to me that diversity in all three facets is a gift of the Spirit. One's profession, characteristics, and history are equally gifts of God.

When we reflect on the multi-cultural/racial nature of human existence it is essential that all people see themselves and others as bringing into the situation something very special.

In this sense the human is organically different from other species.

A person's skin color, culture, history, and occupation may be interrelated in some way, but they are not as integral for humans as they are in the non-human world.

In the non-human world a species' history and characteristics zero in on that species' niche. In the human world the contribution of each individual is made to the system in all three facets, each being important.

Human diversity is viewed as a problem, obstacle, and pest. There was a melting pot notion at one time in the United States. The diminishing of differences was the goal.

Diversity has been the cause of divisions and wars. Lines are drawn that people of different races and culture many times cannot and do not cross.

Diversity is a cause of fear. When someone different arrives on the scene, there is need to cautiously proceed in developing relationships if one has not already run away. The risk to relate to that person at all is minimized if one can exercise some type of power over the other.

The negative aspects of diversity in the human community are manifested in competition and the desire to be better and elite. Diversity has also been cause for lording one race or culture over another and treating humans as commodities.

The racial arena has been fomenting for many years. The religious arena has been fomenting much longer in world history.

How do we look at the diversity of people? Is diversity a gift of the Spirit or is it a mark of Cain? Is it something to be celebrated or negated? Is diversity an evil in its own right, a "necessary evil," or a gift of the Spirit.

To focus on diversity in this resource is to help us:

1. See diversity of our characteristics, history, and occupation as a gift of the spirit. As God has endowed people with talents and abilities to serve the Church and the world, so has God gifted us with our characteristics and our histories to benefit each other.
2. Accept diversity of people as crucial for the well-being of the human community as we see diversity in the non-human world as a non-renewable resource.
3. Practice diversity within the human and non-human community.

When Luther explains the First Article of the Apostles' creed he says, I believe that God has created me and all that exists." What does "and" mean? Is it simply a way to include everything in some thoughtless way? Or does it have some implications with regard to equating all things?

The Church has struggled over the problem of elitism and inclusivity. Where do we draw the line?

I learned in Sociology 101 that cultures who are not as developed as ours in the United States were experiencing "cultural lag." I interpreted that to mean that we were far ahead of many types of people in this world. Now I have learned that 1) "primitive" means "original" and 2) people we call "primitive" are much further advanced in ways that we are not.

One can say that diversity levels everything in God's creation. Or one can say that diversity lifts everything up. Diversity has nothing to do with superiority and inferiority. Diversity is a gift of the Spirit in its own right and exists for the sake of the well-being of the ecosystem.

Chapter III

FIGS AND WASPS

MUTUALISM

In the non-human world there are positive and negative interactions between species. All of these types of interactions occur in each ecosystem. They contribute to making the system work.

The types of interactions are:

- | | |
|--|---------------------|
| 1. Neutralism | 6. Predation |
| 2. Competition: Direct Interference type | 7. Commensalism |
| 3. Competition: Resource use type | 8. Protocooperation |
| 4. Amensalism | 9. Mutualism |
| 5. Parasitism | |

Types 2 through 4 can be classed as "negative interactions," types 7 through 9 as "positive interactions," and 5 and 6 as both. Types 7 and 9 are normally classed as symbiosis.⁸

For the purposes of this study I want to focus on mutualism, though the other interactions are worth studying because of their theological implications. That must be saved for another time.

There are several reasons for this attention to mutualism. First, as scientists research the non-human world, there are new discoveries on how various species benefit one another. Susan Grant, author of Beauty and the Beast, states that what we once thought were aggressive

⁸See Appendix I for details of each of these interactions.

relationships between organisms are in reality mutually beneficial relationships.

Second, when discussing the relationship between God and humanity we must acknowledge that it is mutual. Both God and humanity benefit each other. As humans depend upon God, so God depends upon humans.

Third, in the course of human events mutualism is the only win/win posture. Any other forms of interaction sited above ultimately are lose/lose.

Mutualism can be illustrated with several dramatic examples. The first is the relationship between figs and wasps.

Each of some 900 species of fig plants . . . is pollinated exclusively by its own species of fig wasps. The flowers of the fig plants are tiny and grow inside the roughly spherical fig that people eat (which is not strictly a fruit, but closer to an inside-out bouquet). The tiny female wasp enters the fig, deposits pollen on the flowers, lays eggs in the flowers, and then dies. The wasp larvae grow inside the flower, which they largely consume, and form pupae. The wingless male fig wasps emerge before the females and march around inside the fig looking for flowers containing females. They use their telescoping abdomens to copulate with the females before the latter emerge from their pupae. The males then die without even leaving the fig. The winged females emerge, collect pollen from the remaining flowers, and leave that fig in search of another in the proper condition to begin the cycle again.

The fig (including the commercial varieties) and their wasps are utterly dependent upon one another. The fig sacrifices some of its tissue to the feeding wasps in return for being fertilized. The wasp cannot mature anywhere else. Thus, if there were no figs, there would be no fig wasps and vice versa. Indeed, the first Smyrna figs that were grown in California could not produce a crop of mature figs until the appropriate species of fig wasp was introduced.⁹

A second illustration is the relationship between certain trees and ants.

Thomas Belt, an English engineer and enthusiastic naturalist working in Central America (in the nineteenth century), noticed that the bull's horn acacia tree harbored ants. This tree, common to the New World tropics, has fat hollow thorns near the base of its feathery leaves. Ants live inside the thorns and in hollow twigs on the tree. At the tip of the leaflets, the acacias group tiny pellets of nutritious material, now called Beltian bodies. The ants greedily devour the Beltian bodies. They eat no other part of the tree, though, and they attack any caterpillar or grazing mammal that tries to feed on a bull's horn acacia. Belt commented, "I think that these facts show that the ants are really kept by the Acacia

⁹Ehrlich, 163.

as a standing army.” . . .

. . . the ants not only protect their acacias from animal attack, but may even help them out in competition with plant rivals.¹⁰

A third example of mutualism is the leaf cutter ant. These ants I observed in Costa Rica in January of 1989. Ants would parade from their hill to a plant several hundred yards away, cut leaves the size of a human thumb nail, and then carry their treasure back to the nest.

The ants have a garden in the nest. To this garden they add the leaves they cut from plants near by. The garden in turn produces a fungi which is food for the ants.

The dependency between this fungus and the ants has become such that the fungus has no reproductive system. When a queen ant leaves the nest to establish a new community, the queen takes a portion of the garden with her.

A fourth example is the termite. There are hordes of these creatures in the tropics. They have tunnels on trees and mounds on the ground. They are a well-known example of mutualism - the association between the termites and the specialized protozoans that inhabit their guts. The protozoans, unlike the termites, are able to digest the cellulose of the wood that the termites eat and release sugars that the termites absorb. The termites benefit by being able to use wood as a food stuff, while the protozoans are supplied with food and a suitable environment.

The observation of mutualism in the environment is an exciting trip.

When describing the works of God in the human world, we can see a variety of ways that God gives power so that people can live in mutually beneficial relationships with each other.

Galatians 5 is a case in point. Here Paul talks about styles of life in this way: “But the fruit of the Spirit is love, joy, peace, patience, kindness, goodness, faithfulness, humility, self-control; against such there is no law.” It is significant to note Paul’s metaphorical use of fruit and Spirit.

In the natural world in order for fruit to occur, a flower must be pollinated. There are two basic methods of pollination: animals (birds, mammals, and insects) and wind. Animals do most of the pollinating in the Tropics. As we get further away from the equator we see wind pollination more frequently.

Fruit, by the way, is not simply the type we eat. All seeds are fruit, some being more edible by humans than others.

Just as fruit depends upon an outside source to be pollinated so we can talk about the Spirit of

¹⁰Susan Grant, Beauty and the Beast, (New York: Charles Scribner’s Sons, 1984), 16-18.

God as an outside source who touches us and causes good to be done in, through, and by us.¹¹

According to Paul in Galatians, what are these fruits the Spirit creates?

HUMILITY/KINDNESS/JOY

Humility is not the putting down of the self, but the lifting up of the “other.” It is not that one is lesser or considers oneself lesser. Humility is the capacity to make others great!

The context and tension within which humility is best discussed is that of human sin, on the one hand, and human potential, on the other. As sinners we humble ourselves before God, depending upon the righteousness of Christ and the forgiveness of sins. We do not to depend upon our own goodness. We are unworthy. On the other hand, we have value as we are gifted by the Spirit to lift others up.

Humility is the opposite of arrogance and pride which find themselves centered in the ego. The Greek words for “humility” are praus and praotes. These words are also translated as “gentle.” When translating Galatians 5:22 the Revised Standard Version of the Bible uses “gentle.” The Today’s English Version, i.e., Good news for Modern Man (TEV), uses “humble.” The word “humble” is a far more exciting word. To me, gentleness, though a significant virtue, tends to be passive.

Additional words in Galatians 5 which can deepen our understanding of “humility” are “kindness” (i.e., the treatment of others as kin, brothers and sisters) and “joy” (a word in the Greek that has the same root as “love”).

If humility is the act of making others great, both human and non-human, it means to treat “others” with celebration (to make the other famous) and gentleness, with the “sense of caresses,” as William Barclay puts it.¹²

SELF-CONTROL

If there is one life-style of the Spirit that could be misinterpreted as a moralistic statement, it is this one. More than likely this is due to the fact that a person is often advised, “If you would have controlled yourself you would not have gotten yourself into this predicament,” or something in that order.

Self-control as a life-style nurtured by the Spirit deals with being a steward of oneself.

This gift of the Spirit builds upon humility. In order to make others great we need to be someone

¹¹The words ruach (Hebrew) and pneuma (Greek) mean wind, breath, and Spirit.

¹²William Barclay, A New Testament Wordbook, (New York: Harper and Brothers, ?) 103-104.

ourselves. Self-care is not borne out of self-centeredness, but out of love of the neighbor. Personal choices regarding our own habits are made out of respect for the welfare of our sisters and brothers. (Notice how Paul handles eating meat in I Corinthians 8:1-13.)

To practice self-control is to treat ourselves as "God-created good," as worthy, not worthless. In addition, by Christ's alien righteousness, we are made good. We are to treat ourselves as we would treat all of creation, all that is redeemed, and all that hopes for redemption.

Self-control addresses how we respond to others, how we deal with our "inner being," and how we deal with our bodies.

We respond to stimuli, both human and non-human, out of our own wills. We choose how we will react to others. Knee jerk reactions are under the control of the will even though they appear to be spontaneous.

Our "inner being" is another matter. Here we are in the area of "secret" resources of ourselves which we sometimes do not understand ourselves. We sense those things that well up in us. They are not always discernible. These can be addictions and desires which want to take over our very being.

The care of our bodies is related to self-control. This subject is very popular today: fitness programs, wellness discussion, stress management, diet. workshops, etc. The topic of chemical use, abuse, and misuse fit here.

There are many tapes, books, programs, clinics, and workshops available to deal with these areas of self-control. Anything you would like to change in your very being has an advisor of some type. What is the advice? The suggestions are usually that a change of heart (or attitude) is necessary.

In I Corinthians 6:19-20 Paul identifies the body as a temple of the Holy Spirit. As total beings we are instruments of the Spirit (one of Luther's favorite metaphors), and the Holy Spirit is in our very physical being.

A life that is to deal gently and humbly with others cannot at the same time be void of the management of self. In Romans 12 Paul lays on us his expectations of the Christian person: being a living sacrifice, transformed, discerning the will of God, aware of the gifts in the Christian community, practicing genuine love, contributing to the needs of the saints, blessing those who are persecutors, and so on. Only by the work of the Spirit can we accomplish this style of life.

PEACE/PATIENCE

There are conflicting views over what peace is and how peace is accomplished. Is peace a commodity achievable by the overpowering of another or is there another alternative? Is peace the end or the means to an end or both?

It is the understanding of the New Testament that peace is a result of the cross. From this historical event peace emerges, and toward the final days (the eschatological event) the Spirit directs peace.

What is peace? I prefer the Hebrew word “shalom.” It means wholeness, health, restoration into community, and the presence of justice.

The Spirit’s gift of peace is God leading us to restore that which is and has been alienated back into community.

Peace builds on the other gifts of the Spirit: humility, self-control, and patience. Peace seeks to value the other. Peace is something that evolves from within.

Peace benefits from patience. The Greek word for patience, μακροθυμια, is translated by Chrysostom as the ability to take revenge against another, but utterly refusing to do so.¹³

Peace is not the opposite of war or the avoidance of conflict. Peace is involvement in bridging the gaps and mending the breaches. This means one can be caught up in the prevailing hostilities.

The mutualism called forth by the Christian life means living a sacrificial life. In Ephesians we find these words:

“Therefore be imitators of God, as beloved children. And walk in love, as Christ loved us and gave himself up for us, a fragrant offering and sacrifice to God.” (5:1-2)

The writer then proceeds to identify behaviors that disrupt mutuality: fornication, impurity, covetousness, filthiness, silly talk, and levity. The alternative is to walk as children of light “for the fruit of light is found in all that is good and right and true” (5:9). The admonition follows that Christians look carefully at how they walk, be filled with the spirit, and always give thanks.

Another aspect of mutualism is the Spirit-empowered act of forgiveness. First, forgiveness is the acceptance of another, not approval of the other’s behavior. Implied in this is the expectation that behavior will change. Second, forgiveness is restoring broken relationships, making friends out of enemies. Third, forgiveness is openness to diversity.

In the multi-cultural/racial world mutualism is a desired outcome, an ideal. For people of diverse backgrounds, cultures, and characteristics to live in harmony is an ultimate goal.

There are four things we can learn from this discussion of mutualism in human relations. First, a person needs to have a sense of self-hood. One does not benefit another unless a person is somebody. Self-affirmation, self-respect, and self-worth are different words for the same thing.

¹³Ibid., 84.

Second, when a person encounters another, especially if they are different in any way, intimidation is a possible response. We can meet strength to strength, weakness to weakness, or strength to weakness. To be strong in oneself does not mean the other must be weak. This accomplishes nothing. If one is weak and permits the other to be strong this is intimidation. This is something we allow to happen to ourselves. Strength to strength is the winning posture for each encounter.

Third, one does not deal with the two items above without conflict within oneself and conflict with another. Conflict is resolved when both or all parties are willing to live in a win/win environment.

Fourth, mutualism is achieved through communication, knowing how to share, being willing to share, and being open.

Though there are a variety of interactions in the non-human world, mutualism between God and humanity and between humans is the ultimate goal of the Spirit of God.

We are to benefit.

Others are to benefit.

And God benefits.

Chapter IV

ANTS AND BATS

INCLUSIVITY

Over the years of advancement in technology humans accomplish many things. (WOW!) Although other animals have been able to manipulate their environments, humans have done this in greater detail, with great eloquence, and unfortunately, with great indifference and destruction to the Earth.

There is always the debate about what distinguishes humans from other animals. Reason was a suggestion year ago. But we have learned that other animals think, too. Then the thumb was suggested as something that can manipulate a tool. This, too, is not unique to humankind. Other creatures also fabricate tools.

I would like to suggest that the difference between humans and non-humans is the speed with which we can work and develop. While other creatures must adapt themselves to their environment, humans can adapt the environment to themselves. Adaptation in the non-human world is a slow process. The role of the mind in the human world enables adaptation of the environment to be a rapid process.

Can it be that the desire to do things rapidly and the ability to work quickly have contributed the most to the destruction of and indifference to the diversity in our world? A hurried life-style is

not conducive to treating the human and non-human worlds with respect, responsibility, and reverence.

I appreciate the words of David Suzuki in the forward to a guidebook on outdoor education called Rediscovery - Ancient Pathways - New Directions. He states his case so clearly it is worth quoting fully here.

Like most of the people living in North America today, I am a non-native. My ancestors came to Canada from Japan at the turn of the century . . .

North America, to the native people living here, is more than simply a place, a piece of turf. Land embodies culture, history, and the remains of distant ancestors. Land is the source of all life and the basis of identity. Land is sacred. An overriding sense in aboriginal perceptions is that of gratitude for nature's bounty and beauty. Gratitude and respect.

Land in modern North America is currently regarded as a commodity, to be purchased, exploited for its resources, and sold for profit. Land, for most people, does not embody cultural history. Land is profane. Indeed, to refrain from exploiting an opportunity to log, mine, farm, or otherwise develop is an obscenity, a waste.

Our modern land ethic is causing a cataclysmic upheaval on this planet. Species of plants and animals are becoming extinct thousands of times faster than has ever occurred before; their habitats destroyed by human beings. Global deforestation is causing vast changes in the patterns of water availability, weather, climate, and soils. Human-caused desertification is accelerating. Massive global pollution is putting not only other life forms but even our own children's health at risk.

Twenty percent of the world's population - the industrialized countries - are now utilizing over eighty percent of the planet's exploited resources, and they continue to demand even more, in growing consumption and profits.

From an ecological perspective, Homo sapiens is a species temporarily out of biological control. We are now the most numerous and ubiquitous largest mammal in the world. But armed with the muscle power of science and technology, our impact on the planet is beyond anything ever experienced in the history of life on earth. We have initiated an "extinction spasm" that Harvard ecologist E. O. Wilson estimates now claims over seventeen thousand species a year. . . .

Why are we destroying the very support systems for all life on Earth? Apart from our powerful urge for profit, it is our lack of sacred respect for the land and the other life forms sharing our habitat that exacerbates the problem. Today, over eighty percent of North Americans live in cities, man-made environments that have been created by us according to our ideas of beauty and utility. In the countryside, the fields, orchards,

pastures, and even forests have been manicured and managed to meet human needs. This creates an illusion that we have the knowledge and the power to control nature. Indeed, in urban settings, "weeds," "pests," and "vermin" - animals and plants that defy human control - are seen as dangerous, dirty, and disgusting.

Essentially, nature has become alien, an enemy, and we live with a terrible delusion that somehow we are different, no longer subject to the same rules that govern all other life forms. We have lost all sense of belonging in nature and have become intoxicated with the short-term benefits of science and technology that have bludgeoned nature into apparent submission.

But in spite of all our great achievements in science and technology, we remain incredibly ignorant about the natural world. We have only identified 1.4 million of perhaps 30 million species in the world, and of those we do know, we have little knowledge about their basic biology.

In order to stop our blind rush down the present pathway, we have to undergo a profound change in attitude and perception. . . . We are members of an ecosystem in which stability and continuity are possible only when we stay in balance with other living creatures.

Clearly, we also need a renewed sense of earth as home; belonging to the land, connected to all other living things.¹⁴

The human brings "mind" into the ecosystem, and it is my conjecture that the mind is intended to be that talent that humanity introduces into the world, not simply for the benefit of humans, but for the benefit of all species.

I have defined inclusivity as the art of retaining, celebrating, and benefitting from diversity. It is to this end that the "mind" needs to be applied.

Humans have used the mind to make the world simpler and more convenient. Watch the way things are marketed. The appeal is made to our desire for ease. As the world becomes more convenient we are told we can do many more things. This convenience contributes to a more hurried pace.

We have created environments which are potentially pest free. It is uncomfortable to find a mouse or a bat or ant around the home. Thus, over the years we have developed chemicals to rid the house of various pests. When we do encounter them in the out-of-doors, we express fear and disgust and feel uneasy.

¹⁴Thom Henley, Rediscovery - Ancient Pathways - New Directions, (Vancouver: Western Canada Wilderness Committee, 1989), 11-14.

We need to examine how our attitudes have been shaped and how human creature-comforts have set the values by which we determine the survival of other creatures in this world.

We cannot dispose of what we perceive to be the undesirable creatures. We need to assure their existence as much as we assure the existence of the human being. Though we will make judgments about what will survive, thrive, and be deprived, we need to keep at the forefront of our thinking that diversity is the key resource.

An agronomist stated that because we have such effective pesticides, insecticides, and fungicides, we can produce some of the most luscious fruits in great quantities. At the same time these chemicals introduce poisons into the system that can have a destructive impact on the total ecosystem.

The question the agronomist raised was whether the consumer would be willing to purchase blemished fruit at the supermarket. He opined that to change present consumer attitudes would take a major educational task and would more than likely be an unsuccessful revolution.

Have you noticed what fruits we avoid and throw away?

Inclusivity is the art of retaining diversity, a major change for life-styles.

Paul Ehrlich says several important things about the endangerment of the diversity of species:

First, the primary cause of the decay of organic diversity is not direct human exploitation or malevolence, but the habitat destruction that inevitably results from the expansion of human populations and human activities.

Second, many of the less cuddly, less spectacular organisms that Homo sapiens are wiping out, are more important to the human future than are most of the publicized endangered species. People need plants and insects more than they need leopards and whales (which is not to denigrate their value).

Third, other organisms have provided humanity with the very basics of civilization in the form of domestic animals, a wide variety of industrial products, and more important medicines. None-the-less, the most important anthropocentric reason for preserving diversity is the role that microorganisms, plants, and animals play in providing free ecosystem services without which society in its present form could not exist.

Fourth, the loss of genetically distinct populations within species is, at the moment, at least as important a problem as the loss of an entire species. Once a species is reduced to a remnant, its ability to benefit humanity ordinarily declines greatly, and its total extinction in the relatively near future becomes more likely. By the time an organism is recognized as endangered it is often too late to save it.

Fifth, extrapolation of current trends in the reduction of diversity implies a denouement¹⁵ for civilization within the next 100 years comparable to a nuclear winter.

Sixth, arresting the loss of diversity will be extremely difficult. The traditional “just set aside a preserve” approach is almost certain to be inadequate because of factors such as runaway human population growth, acid rain, and climate change induced by human beings. A quasi-religious transformation leading to the appreciation of diversity for its own sake, apart from the obvious direct benefits to humanity, may be required to save other organisms and ourselves.¹⁶

Inclusivity is the art of celebrating diversity.

How do we choose to use our minds? Is our intelligence a gift for all or just for anthropocentric accomplishments? Would we dare commit our minds to developing and implementing ways to benefit all creation? This is what it means to practice inclusivity.

It is within this context that I believe we need to envision the Church. The Church is to be an inclusive community in its own right. At the same time the Church is to be an agent of inclusiveness in the world. The Church is a community of people brought together, Luther says, by the Holy Spirit who calls, gathers, enlightens and sanctifies people. The Church is an intentional act of God honed by the Spirit of God.

The community of faith is not an exclusive community unto itself. It has a role in the whole ecosystem.

On Pentecost, the birthday of the Church, the Spirit appeared as fire, and the people gathered together were speaking in many foreign languages. In these languages the people proclaimed the mighty works of God (Acts 2:1-47).

When Paul describes the Church as the body of Christ in I Corinthians 12 it is intended to show the necessity of various roles within the gathered community.

Ephesians 4 is a fascinating text because it addresses the community of faith as individual believers in relationship with each other then turns the Church out to the world.

Jesus calls his disciples. There is a reminder that though he will be absent from them, the Spirit will be sent to teach them and bring to remembrance what they should know (John 14:15-31).

I Peter 2:1-10 and I Corinthians 3:16 identify the Church as the people of God in the world.

¹⁵Definition: final disentanglement of intricacies.

¹⁶Paul Ehrlich, “The Loss of Diversity,” Biodiversity, Wilson, Ed. (National Academic Press, 1988).

Romans 6:1-11 envisions the Church as the resurrected people who walk in the power of God in the world.

The metaphors of the Church only make sense in the context of an ecosystem. As disciples, people of God, resurrected persons, aware, relational, and the Body of Christ, the Church is another entity in the ecosystem. The peculiarity of the Church is that it recognizes the diversity, the complexity, and the conflict in this world.

As the human is one of many in the ecosystem and brings the special gift of “mind” to the system that can think through and contribute by maintaining diversity, the Church is the system which brings to the whole world the mind of God and the intentions of the Spirit.

The Church should be the entity in the ecosystem that embraces and affirms the world with all of its diverse characteristics, realizing the uniqueness of all.

The Gospel is to touch everyone. The response may not always be the same. If the Church neglects to minimize efforts to impact people on the one hand or to measure the effort in numbers of response on the other, we have misinterpreted the mission of the Church and the power of the Word of God. The Church’s task is to be faithful in proclaiming the Gospel to the ends of the earth as it is empowered to speak as given utterance by the Spirit.

The Church must move from seeing diversity as an enemy to diversity as a necessity.

How does the Church practice the art of retaining, celebrating, and benefitting from the diversity of people, culture, and religious systems? The answer is not in watering down the Gospel nor putting down others. The answer is found in the sense of the Church’s identity as the biblical report testifies. We are the disciples of Christ, the people of God, the Body of Christ, etc. We have integrity and at the conversation table of the world we dare to be our full persons as we recognize the gifts of all.

In the light of this read Romans 14:1-15:13. Here Paul deals with handling diversity in the early Church. Note what makes people different. These differences may not be the same as they are today, but give attention to how Paul instructs us to handle the diversity. Refer to Romans 12:9-13, too.

Baptism is that event that brings us into this whole movement. It is the inclusive act. It is how a person enters the Church. By this act one also enters a special relationship with the world. Birth is how one enters the world’s ecosystem. Baptism is incorporation into the suffering of the world. We are called by God to be world-loving.

This love is best expressed in forgiveness. Earlier forgiveness was described in one way as openness to diversity. The gift of forgiveness allows others to be who they are. Forgiveness is not confined to mending broken relationships. It is behavior that draws people together with the

right to be, accepting them with their characteristics, professions, and histories.

The unique aspect of the Church is that it is empowered and directed by the Spirit and has the capacity to keep current with what is unfolding in the world.

I have called the practice of inclusivity an “art.” To my way of thinking, the ability and skill to be inclusive depends upon three things. First, we must lay aside our preconceived notions about others. We know we do this with stereotyping.

Secondly, we must understand that our attitudes and behavior are shaped by the institutions in which we live. These systems from time to time can be designed to be exclusive and elitist.

Third, we must develop coordination between our faith and our behavior. This requires practice, reflection, feed back, confession and forgiveness, and listening to God.

There are many things with which we are uncomfortable and things which we despise. Ants and bats and things like that fall into this category for many people. Such debilitating attitudes extend to fellow human beings. There are people whose characteristic features, cultures, histories, and/or professions we find objectionable.

If diversity is to be retained, celebrated, and beneficial then inclusivity needs to be a conscious effort of the mind in all we do.

Chapter V

ECOLOGY OF THE SPIRIT

SPIRITUALITY

The word “spiritual” has such a wide spectrum of meanings. We use this word in the Church to distinguish between the things of God (spiritual) and the things of the flesh (carnal). It is used in a philosophical sense in making a distinction between concrete reality (material) and unseen “reality” (spiritual).

Spirituality is a style of life that can be a talent or a skill that one develops with which a person acts in a sensitive, caring, and gentle manner with all of life. Many people who espouse reverence for life are often called spiritual even if they do not posit God.

In the Christian tradition the word “spiritual” is used for the faith relationship between God and human beings.

When reflecting on the ecosystem the Christian community acknowledges its spiritual dimensions. It is the unique task of the Church to name the work of God in the world. It is the Christian who

says, "God!" It is the Christian who identifies the activity of God. It is the Christian who utters the word "Spirit." This is an act of faith in God.

Our world is composed of a geosphere, a hydrosphere, an atmosphere, a biosphere, a noosphere (mind), and a pneumasphere (Spirit).

This world is a divine sphere. The Psalmist views the world as such (104:1-4)

Bless the Lord, O my soul! O Lord my God, you are very great.
You are clothed with honor and majesty, wrapped in light as with a garment
You stretch out the heavens like a tent,
you set the beams of your chambers on the waters,
you make the clouds your chariot,
you ride on the wings of the wind,
you make the winds your messengers, fire and flame your ministers.

We live in the sphere of the Spirit and must be as sensitive to it as we are to one another and to the non-human world.

Ecologists talk about listening to the Earth. Is the Earth also a voice of God?

From an ecological perspective one can say that reverence is spiritual, and spirituality is the practice of the divine presence.

For Christians, spirituality is more than this. The heart of spirituality is faith.

Faith is described in four ways. First, faith is intellectual assent. It is a way of thinking. It means that something cannot be proved, but we rely on it as fact. When we say we believe in God or in things about God, it is a "leap of faith," as Kirkegaard would say. It is an assent to something that is as true for us. But there is no way to scientifically demonstrate it. Faith as intellectual assent belongs to all the disciplines of learning and inquiry. This is usually what people mean by faith. Faith in Jesus Christ is treating Jesus Christ as a removed, non-personal historical object. Doubt belongs to this component of faith. It appears within a continuum of critical analysis at the one extent and skepticism of the source of information at the other end. Doubt is legitimate. We might call it the "struggle of ownership."

Second, faith is a word we use for a type of relationship, a relationship of trust and obedience between two or more entities. It is like the word "love." One has faith in another. We trust the other party to be competent, faithful, supportive, etc. When we turn our lives over to another, we entrust ourselves to that person.

A good example of this is the relationship we might have with doctors. We put our faith in them. We obey them. We trust their diagnosis and prognosis.

To have faith in Jesus Christ means to entrust ourselves to him, to put our lives in his hands. "Take my life and let it be . . ."

When Scripture talks about faith it means trust in and obedience to God. "If you love me you will keep my commandments. And I will pray the Father, and he will give you another Counselor, to be with you for ever, even the spirit of truth . . ." (John 14:15-17). (Note: In John, Love (or faith), obedience, and then revelation occur in that order.)

Faith in Jesus Christ is not a natural response. "I believe I cannot by my own reason or strength believe in Jesus Christ or come to him." Here is Luther again. Who makes this faith possible? Who motivates, empowers? The Holy Spirit, that's who!

Third, faith is a response to an encounter with Jesus Christ. Note the story of the Samaritan woman at the well of Jacob (John 4:7 ff). Through a chance and unlikely meeting with Jesus the woman believes. By the way, Jesus meets the woman. She does not meet him. Our encounter with Jesus Christ is at his initiative, not ours. Faith is a response to the person of Christ. It is his doing. He starts it. Luther again, "The Holy Spirit calls me . . ."

Fourth, faith is the very presence of the risen Christ in our lives. "Christ in you, the hope of glory" (Colossians 1:27). "If Christ is in you . . ." (Romans 8:10).

In Romans 8:10-11 Paul presents the idea that the risen Christ and the Holy Spirit are one in the same.

What is important to note is that faith is an embodiment of Christ in one's life. Paul talks about the human body as being God's temple in which the Spirit dwells (I Corinthians 6:19-20).

The power of God is in fact the power of him who is both the Creator and Redeemer of the world. It is this very power that empowers faith in us. We can also speak of faith as Christ himself entering our very being.

With faith as a result of God's activity in our lives faith cannot be contained in us. We become media, channels for the Holy Spirit. One of these channels is the expression of our love. As we say words and do deeds, as we speak and act in love, as we minister to the needs of the world with bread from the earth and bread from heaven, as we are agents of restoration and healing, so the Spirit is shared.

The faithful are not the exclusive channels of the Holy Spirit. However, the faithful are a definite, intentional, and self-conscious channel.

At the heart of spirituality in the Christian Church is the understanding that we live in a faith relationship with God which is an intimate relationship with Jesus Christ himself enabled by the Holy Spirit. From this we develop a larger sensitivity to all of life.

Spirituality is living in time and no time (the meaning of eternity). The God in whom we believe encompasses all of life. Our experiences occur in a linear fashion. But for God all that happens is. This is a philosophical notion, but it helps to remind us that spirituality is living in the mind of God.

Spirituality is an affirmation of the resurrection. We live as resurrected people. We are people with a promise. This simply means that the future is now. Look around you. The material has not vanished. You are not in another world. You are here. But we treat life and the objects of life with the sense of newness.

Spirituality is practiced in several ways: devotion, retreat, and simple and tender life styles. However practiced, spirituality celebrates and affirms the divine presence.

There is one act of spirituality that Christians practice and that commingles all the spheres. It celebrates the physical world, the dimensions of the mental world, and the depth of the spirit world. It is Holy Communion. We receive the gifts, the benefits, and the sacrifice .

One way to define spirituality is: openness to conversion. Conversion is an eye-opening experience that clarifies our understanding and directs our lives. It happens in many ways and for many reasons.

Conversion is the work of the Holy Spirit.

When spirituality is practiced, the Spirit cannot be set in stone, one's feelings cannot be predetermined, nor can the impression be given that there is only one experience of the Spirit. The Spirit ruminates in our lives stirring up what is possible. The Spirit is unpredictable, moving and generating activity. As we live in this relationship with the Spirit, events do not fall into a pattern or a system.

To risk conversion is to risk having our minds and life styles changed. A spiritual person is a God-trusting person who takes the chance of being made new for the situation one encounters in an unfolding world.

In the non-human world organisms interact with each other and adapt to one another. Is this true of the interaction between the Spirit of God and the human world? Do both the Spirit and the humans benefit from each other? As the word "Spirit" is the ecological word for God so "spirituality" is the ecological word for faith.

To practice spirituality is to live ecologically with all of life,
to dare to live within a world we see and do not see
to be engaged by the Spirit
to intentionally embrace and be embraced by the Spirit of God
to live for the benefit of others.

CONCLUSION

We stand in wonder of the Spirit of God as the Spirit moves in our midst, being God in relation with us and God enabling the relations in the world.

As people of God, redeemed in Christ, we are to live celebrating diversity and teaching inclusivity.

As spiritual people we live as people of faith, sensitive to all that surrounds us.

Being a Christian is living in and depending upon the ecology of the Spirit.

Appendix I

ANALYSIS OF TWO-SPECIES POPULATION INTERACTIONS

0 - Indicates no significant interaction

+ - Indicates growth, survival, or other population attribute benefitted

- - Indicates population growth or other attribute inhibited

<u>Type of Interaction</u>	<u>Species</u>		<u>General Nature of Interaction</u>
	<u>1</u>	<u>2</u>	
1. Neutralism	0	0	Neither population affects the other
2. Competition: Direct Interference Type	-	-	Direct inhibition of each species by the other
3. Competition: Resource Use Type	-	-	Indirect inhibition when common resource is in short supply
4. Amensalism	-	0	Population 1 inhibited, 2 not affected
5. Parasitism	+	-	Population 1, the parasite, generally smaller than 2, the host
6. Predation	+	-	Population 1, the predator, generally larger than 2, the prey
7. Commensalism	+	0	Population 1, the commensal, benefits while 2, the host, is not affected
8. Protocooperation	+	+	Interaction favorable to both but not obligatory
9. Mutualism	+	+	Interaction favorable to both and obligatory

Types 2 through 4 can be classed as "negative interactions," types 7 through 9 as "positive interactions," and 5 and 6 as both. Types 7 and 9 are symbiotic.

Appendix II

EXAMPLES OF MUTUALISM

ANTS - For a long time ants have not been considered pollinators. Rather they are seen as nectar thieves. However, the discovery has been made that they promote cross-pollination. In Proverbs 6:6-8 it says, "Go to the ant, you lazybones: consider its ways, and be wise. Without having any chief or officer or ruler, it prepares its food in summer, and gathers its sustenance in harvest." Plants that depend on ants for seed dispersal, technically termed myrmecochorous ("ant-carried") plants, produce seeds with features well-suited to their tiny partners. First, the seeds are small. They are also usually white or very light in color, easy for the near-sighted ants to detect against a dark seed pod or the ground. Most have a mass of oil tissue, known as the elaiosome or oil body, that attracts the ants. The elaiosome contains a mixture of fatty foods and sometimes a little sugar or starch as well.

APHIDS - Kept by ants and milked.

BEES - They are almost reliant on flowers for their food. Bees can transport pollen because of the hairs all over the body and "honey" stomachs. They are attracted to flowers by a fragrant scent. Bees also secrete scents on rich food sources so flowers can be repeatedly visited by the bee and other hive mates. Bees also use dances to communicate to others the location of the nectar.

Bees pollinate asters, blueberry bushes, and goldenrod.

BLACKBERRIES - Seed dispersal is the fruit eaten by animals and voided.

BLACK CHERRY TREES - Protected by ants. If the tree is close to an ant hill the defoliation of the black cherry by tent caterpillars is less likely.

BLOODROOT - Seeds are dispersed by ants. Since these plants set their seeds in the spring it is at the same time ants are coming out of dormancy and looking for food. The seed pods are close to the ground so they are accessible to the ants. Ants also disperse seeds of wild ginger and hepatica.

CINQUEFOIL - Pollinated by bees. There is a road map on the flower for the bee to find the pollen. The flower appears yellow to human eyes, but to bees it appears quite differently with dark streaks on the petal pointing to the center of the flower.

COLUMBINE - The swinging flower makes it difficult for birds to feed on. Hummingbirds can hover in the air not needing a platform.

DANDELIONS - Seeds dispersed by wind. Other species that use wind are: elm and maple.

ELDERBERRY - Beetle pollinated. The nature of flowers pollinated by beetles is that they are primitive: large, thick petals, many of them, and heavy fragrance. Beetles on flowers are like bulls in the china shop.

EVENING PRIMROSE - The flower glimmers in the darkness and attracts moths which are its pollinators. The flowers usually offer their nectar in long thin spurs, suited to the long tongues of moths. The flower has no pedestal for the moths upon which to land. They must either scramble to hang on or hover in the front of the flower, rapidly beating their wings.

FUNGUS - An important group of underground-fruiting fungi, the truffles and false truffles, disperse their spores via consumption by animals, very much like fruit-bearing plants. Truffles and false truffles are the fruiting bodies of underground fungi that are important for the survival of most forest trees, especially pines, firs, and spruces. Filaments of these fungi grow on or in the roots of these trees and assist them in extracting moisture and minerals from the soil. In some cases the fungi actually create fertilizing compounds for the tree roots. Such associations between fungi and roots are called mycorrhizae or "fungus-coated-roots." For the most of the year the fungi live and grow as a thin webbing of pale threads among the roots, but when weather conditions are just right - warm and moist - the fungi rapidly produce fruiting bodies loaded with spores. Many of these push up through the soil to emerge as our familiar woodland puffballs and mushrooms. The wind disperses spores from these. But the truffles and the false truffles form fruiting bodies that stay underground. It is easy enough to see how the above-ground or epigeal fungi travels far and wide. Underground fungi have an aroma and taste that attract wild animals who desire them for food. Voles feed on this food. The forest benefits from the fungi; the animals benefit as well.

HUMMINGBIRDS - The flowers they pollinate are odorless, bright colored (reddish orange and red), and rich in nectar. Landing platforms are absent.

JEWELWEED - Explosive mechanism catapults seeds out of pods.

MILKWEED - The flowers have a peculiar pollination relationship with bumblebees. Milkweed flowers produce pollen in two bundles or pollinia connected by a little bridge, the corpusculum. When a bee steps on the flower, the pollinia cling to its feet. Field research shows that in many cases milkweed pollinia are so busy that they make the bees stumble over their heavy feet and fall off the flowers. Most of the bees then fly some distance away before they settle on another milkweed. This promotes outbreeding, because milkweed plants send out underground stems that produce nearby clones of the central plant. The pollinia sometimes get the bees tangled up in the flowers, and in disentangling themselves they may tear off claws, feet, or even their lower legs. The heavy pollinia also demand that the bees spend more energy when they carry them just to stay aloft. It seems, in fact, as if bumblebees are in for nothing but trouble if they visit milkweed flowers. Why do they keep doing it? The secret lies in the high pay scale of this hazardous job. Milkweed flowers produce copious amounts of rich nectar. Although the risks of working a milkweed flower are high, the rewards compensate for it.

MONARCH BUTTERFLIES - Cocoons developed on milkweed plants give the monarch a bad taste to birds.

SUNFLOWERS - This flowers is protected by ants to discourage other insects from laying eggs on the flower.

RASPBERRIES - Seed dispersal by animals eating berries and voiding.

TURTLES - This animal is responsible for dispersing the seeds of wild strawberries. They are eaten and voided.

VIOLETS - Exploding mechanism catapults seeds out of the pods. The seeds are dispersed by ants. See bloodroot.

YUCCA - Its desert relative has an interesting pollination process. These plants are pollinated by a small female moth that lays her eggs, a few at a time, in the depths of the flowers. When the eggs hatch the tiny caterpillars start to devour the flower ovules which should become the plants offspring. If this infanticide were complete the yucca would long since have become extinct. But the flower produces enough ovules to feed their hungry guests and still have some left over (called mast cropping). Each caterpillar needs to consume about 20 ovules to reach maturity. On the average six caterpillars live in each flowers. The yucca flower produces 200 ovules on the average. The plant can afford to sacrifice some of its young and still have enough to perpetuate itself.

Appendix III

BAT FACTS

Bats are mammals, but such unique ones that scientists have placed them in a group of their own, the Chiroptera, which means "hand-wing." Chirinox - Greek word for one who is master of one's hand. There are two major groups: the Microchiroptera and the Megachiroptera. Flying foxes belong to the latter group. Nycteris - Greek word for bats.

Bats are the most widely distributed mammals, surpassed only by rodents and people.

Bat fossils have been found that date back approximately 50 million years, but, surprisingly, the bats of that ancient period very closely resembled those we know today.

Linnaeus, the father of modern taxonomy, was so impressed by the similarities between bats and primates (lemurs, monkeys, apes, and humans) that he originally put them into the same taxonomic group. Today's scientists generally agree that primates and bats share a common shrewlike ancestor, but belong to separate groups. Bats are not related to rodents.

Like humans, bats give birth to poorly developed young and nurse them from a pair of pectoral breasts.

Bats are, for their size, the slowest reproducing animals on earth. On average, mother bats rear only one young per year, and some do not give birth until they are two or more years old. Exceptionally long-lived, a few may survive for more than 30 years.

Typically, bats are very loyal to their birthplaces and hibernating sites. How they find their way over the long distances that often exist between their hibernating and feeding areas remains largely a mystery.

When bats are reared they are segregated into bachelor colonies.

Wings

Some bats use wings to capture insects in flight. Wings act much like a tennis racket, deflecting insects toward the mouth.

Another function of the wings is associated with rich vascular network in terms of gas exchange. Carbon dioxide is dissipated through the wings as well as the lungs.

Two types of flight exertion - cruise and sprint.

Predator/Prey/Food

Bats consume one fourth to one half their body weight in insects each day. Many insects consumed are human pests, like mosquitoes and flies. Worldwide, bats are the major predators of night-flying insects, a category that includes mosquitoes and numerous crop pests. A North American bat can catch up to 600 mosquitoes in a single hour.

Prey rarely outwit the bats.

70 percent of the bats eat insects. There are some that feed on fruit and nectar. There are a few carnivorous bats.

Echolocation

Like dolphins, most bats communicate and navigate with high-frequency sounds. It is called echolocation.

Several groups of moths have developed highly specialized auditory devices (ears) for detecting high frequencies of echolocation.

Pollination

Flowers pollinated by bats are usually white, creamy, or greenish in color and generally have strong musk and sour scents. Flowers usually contain large quantities of nectar.

300 plant species in the Old World tropics alone rely on the pollinating and seed dispersal service of bats.

Housing

Information about how to find obscure sites, such as small cave entrances, apparently is passed on from generation to generation.

Prey

Bats are not prey for any one other mammal. If discovered it is more by accident. Animals that prey on bats: opossums, skunks, and long-tailed weasels. Owls, hawks, and falcons are avian predators of bats. Snakes are frequent predators.

Wintering

In temperate regions, cold winters force bats to migrate and hibernate.

Contributions

Guano is source of saltpetre (sodium nitrate). It is used in the production of gun powder and other explosives.

Wide varieties of many of the world's most economically valuable crop plants also rely on bats for survival: bananas, breadfruit, avocado, dates, figs, peaches, mangoes, cloves, cashews, carob, balsa wood, and tequila.

In the tropics bats are considered a "keystone" species because they are crucial to the lives of plants in an entire ecosystem.

Bats are important indicators of a healthy environment, and they should be a welcome part of four neighborhoods. Like canaries in a mine, they serve as early warning systems for dangerously high pesticide and pollution levels.

Bats are valuable in the reforestation in the tropics.

Studies of bats have contributed to the development of navigational aids for the blind, birth control and artificial insemination techniques, vaccine production, and drug testing, as well as to a better understanding of low-temperature surgical procedures.

Bats are depicted as heroes in some Pacific Island legends. In China they are held in high esteem as omens of good luck and happiness.