保全医学と生態系の健康

Conservation Medicine and Ecological Health

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Hello everyone. I am Koichi Murata, President of the Japanese Society of Zoo and Wildlife Medicine, and I will be acting as the coordinator of today's symposium.

Let me begin by saying a big "thank you" to all of you for coming. It is wonderful to see so many people here despite it being a cold Sunday morning.

First of all, I would like to speak to you about the purpose and intent of this symposium project. The theme of the present symposium is "One World, One Health." In other words, conservation medicine is an academic and research discipline aimed at the concept that the entire earth has its own health.

Now, what does conservation medicine actually consist of? In all probability, most of you here are hearing the term "conservation medicine" for the first time. That is reasonable and totally understandable because the discipline of conservation medicine was not pioneered here in Japan but in North America, where it was first established just 15 years ago in 1997.

This slide shows how conservation medicine is aimed at achieving human health, animal health and ecosystem health in a comprehensive manner that addresses the relationship between all three. Put simply, the concept of health does not exist individually and separately in people, animals or ecologically, but stems from their mutual relationships. This is a quite radical and essential definition of health.

Conservation medicine, which focuses on addressing these issues, is an idea that at heart pursues ecological health. It is an interdisciplinary approach that reaches into a variety of research fields including political and social issues. It involves NPOs and ordinary citizens rather than scholars, per se.

The core aim and target of conservation medicine is the protection and preservation of biodiversity because maintaining biodiversity is extremely important. I'm sure you have all had many opportunities to hear the word "biodiversity". The mass media takes up the subject frequently and in 2010 an international conference called the 'COP 10 (The 10th Conference of the Parties to the Convention on Biological Diversity)' was held at Nagoya. But what exactly is biodiversity? And why is it so important? When we ask these questions again, we see that there are some areas that remain unclear.

As this figure indicates, the global environment is facing many threats at present. The red marks show the causes of this critical situation. Among the critical factors harming the Earth that we hear about often are climate change (or global warming), the eutrophication of lakes, and the problem of acid rain. But in fact it is the disappearance of biodiversity itself which is considered to be the single biggest risk to the Earth at present. The entire global ecosystem itself may be endangered if that risk continues to increase. Actually, biodiversity is considered to have a greater effect on the global environment than is usually stated in the mass media.

So what is the significance or meaning of protecting biodiversity? Up until now, various researchers and

academics have tried to explain why it is so important. A great many theories have been postulated and, among them, the idea put forward by Stanford University researcher Dr. Gretchen C. Daily of "ecosystem services" is considered particularly important. The idea behind ecosystem services is that protecting and preserving biodiversity can yield benefits for people. Accordingly, we must preserve biodiversity sustainably so that people can continue to enjoy the benefits of biodiversity. Personally I don't like this idea very much because it is rather anthropocentric but, as a theory, it has the merit of being very easy to understand and is useful for providing a rationale for why biodiversity should be preserved.

These ecosystem services can be grouped into several categories. For example, there are so-called "cultural services," so-called "conservation services," and what can be termed "supply" services. Ecosystems are considered to provide various services that are beneficial to people, and these services are related to each other. Among them are so-called "regulating services". These include such things as flood regulation, weather regulation, and disease regulation. Or in other words, by conserving biodiversity we can enjoy the benefit of controlling diseases. So from this point of view, biodiversity is very important.

Now I would like to speak a little more on the subject of disease regulation, which is one of the points we will be discussing during this symposium. In the context of disease regulation there is a phenomenon called the 'dilution effect'. What this means is that biodiversity has the effect of diluting the incidence of disease. First proposed by the ecological researchers Ostfeld and Keesing, this is now a fairly well understood and accepted theory that mainly deals with the relationship between the amount of biodiversity and the prevalence of vector-borne diseases carried by arthropods such as ticks and mosquitoes.

I would like at this point to explain the dilution effect in some detail. The main idea is that certain kinds of diseases are kept under control where there is sufficient biodiversity, such as in environments where many species coexist. A specialized book has been written on the subject, as is shown on the slide. In illustrating the dilution effect, Keesing took up the subject of Lyme disease, an infectious disease transmitted by arthropods. Lyme disease is a zoonosis, meaning that it is a disease transmitted between animals and humans. It is actually a bacterial infection commonly spread by ticks. The disease-causing agents are bacteria belonging to the genus Borrelia. Essentially, the disease is maintained through a relationship linking the disease-causing bacteria, ticks and wild animals. From time to time, people also become infected. The disease causes a distinctive circular skin rash (known as erythema migrans), as well as flu-like symptoms such as fever. Lyme disease is not life threatening although, if treatment is delayed, symptoms can become severe. However it is not something we need to fear very much.

These days however, the incidence of people infected by Lyme disease is spreading worldwide. In particular, many cases of infections are reported among urban dwellers who go camping or pursue other outdoor activities in the countryside.

In a short while I would like to talk in a little more detail about the connection between Lyme disease and the preservation of biodiversity. But before that, I will try to give a simple description of the life cycle of ticks. Near the end of this symposium, I believe Dr. Goka of the National Institute for Environmental Studies will be talking about ticks. But in simple terms, ticks grow through the larval and nymph stages by sucking the blood of many kinds of vertebrate animals, and then, when they reach the adult stage they lay eggs. That's their life cycle in a nutshell.

To sustain their life, ticks require nutrition in the form of blood from mammals or birds. However, they don' t draw this blood from pre-selected hosts, but rather, they encounter a host animal at random and then begin sucking its blood. They may end up drinking the blood of an animal whose blood is unpalatable to them and if the blood is unpalatable they may die, (or at least their growth may be retarded).

In the case of Lyme disease, it turns out that ticks harboring the bacteria that cause Lyme disease are particularly fond of the blood of mice. It is well understood that if they get the opportunity to drink mouse blood, they grow very well and tend to proliferate. This is a key point. For instance, let's take a look at an environment model. There are lots of animals here. This environment has lots of different kinds of animals that ticks feed on, and within it there are some mice. But there are also animals not favored by the ticks that transmit Lyme disease, such as birds and skunks. For some reason the blood of skunks appears to be particularly unpalatable. Ticks feed on the blood of individual animals at random so in this environment their chances of encountering a mouse are extremely low. As a result, their rates of growth and proliferation are not very high. But on the other hand, within a different environment where biodiversity is extremely low, (such as, for example, an environment in which most animals are mice, with only the occasional raccoon - a foreign exotic species), then most ticks will encounter mice, their favorite food source, and so their rates of growth and proliferation will be high.

Keesing and his fellow researchers conducted field studies to investigate how Lyme disease is actually propagated in a species-rich environment. In this figure, the horizontal axis shows the species diversity and the ratio of ticks infected with Lyme disease is plotted along the vertical access. The environment on the left is extremely simple with impoverished biodiversity and with hardly any mammals apart from mice. When ticks obtained from this environment were examined, a large number of Borrelia bacteria, the pathogen causing Lyme disease, were found on the ticks' bodies. But when the same kind of survey was carried out on ticks from within a biodiversity-rich environment, only a very few were found to be carrying Borrelia.

Naturally, there are counterarguments. But on the other hand, there are reports that a similar dilution effect can be observed in the case of West Nile virus and other viral diseases such as the Sin Nombre virus. I'm sure you have all heard of the term "emerging infectious diseases." These are infectious diseases that have recently begun to spread in the human world, and in most cases emerging infectious diseases are zoonoses. A zoonosis occurs when a disease-causing agent that is present in one or more species of animals newly crosses over to infect and cause disease in humans. As this map shows, most zoonoses originate in tropical regions such as Africa, South America and Southeast Asia.

The reason is that originally in such areas, wild animals, pathogens and vectors had been living quietly together in a delicate balance, but that balance became destroyed because of developments such as agriculture. The collapse of the relationships between wild animals, pathogens and vectors allows new infections to spread to the people and livestock that colonized the areas. This map suggests that perhaps airplanes and ships carry diseases that occur in such places to industrialized countries such as the nations of North America, Europe and Japan where they can spread further.

On the other hand, there are some areas that are known as biodiversity hotspots. This slide shows the distribution of rare animals, endangered species and species indigenous to only a small area. Actually, many rare species of wildlife are found where biodiversity is abundant and the environment is rich. The places marked in red on the map are such hotspots and they actually overlap quite well with the places I showed earlier where new infectious diseases emerge.

As you are such an intelligent audience, I am sure you have understood what I've said up to now. Although the wild animals and pathogens living in these biodiversity hotspots affect each other and the balance between them is delicate, under natural conditions things tend to work out somehow and diseases do not spread very much. But when people go into such places and exert an influence on the environment or damage it with development, this balance can collapse. And when the balance collapses, the pathogens can exert an influence on livestock or people. In other words, we can say that by damaging biodiversity, people unleash a process of destruction that comes back to people again.

I've been taking about ecosystem services so far, but more fundamentally, unless people establish a better relationship with pathogens, vectors and wild animals, in my opinion we will not be able to maintain the earth's ecological health. This is one of the major reasons why we planned this symposium at this time.

So, in order to spread understanding of this purpose more widely, I have requested three lecturers to give talks on the subject.

The first lecturer is Prof. Michael Huffman, an associate professor at the Primate Research Institute, Kyoto University. Prof. Huffman has studied self-medication by primates, and specifically by the great apes. He has observed that apes control their own bodies, which means they can maintain their own health, heal themselves when they become ill, and even prevent illnesses from arising in the first place. From before, I have read Prof. Huffman's papers and specialized books with interest. I've invited him to talk to us today because I thought it would be a good opportunity for us to learn about the intelligence of apes and about their lifestyles, which are adapted successfully to the environment.

Our second lecturer today is Prof. Yoshio Tsuda, a researcher at the National Institute of Infectious Diseases. Prof. Tsuda is proceeding with his research from a stance of looking at disease from the perspective of mosquito biology rather than that of the relationship between mosquitoes and infectious disease. When you think of mosquitoes, you may only be thinking about how to squash them, but I think that if there is an environment in which mosquitoes can't live, then perhaps it is an environment where people can't live either. In this sense, I would like us all to learn how skillfully mosquitoes are engaged in their environment and how important an element of the environment they are.

Dr. Koichi Goka, who is also a researcher at the National Institute of Infectious Diseases, will give today's last lecture. Dr. Goka is now working mainly on the control of invasive alien species. However, originally he was researching tick damage to agriculture. Ticks are also very important organisms in the environment, and probably the soil cannot be kept in a healthy condition without their help. This means that environments without ticks are environments where people cannot live either. I would like everyone to realize this, and that is why I have invited Dr. Goka to speak to us.

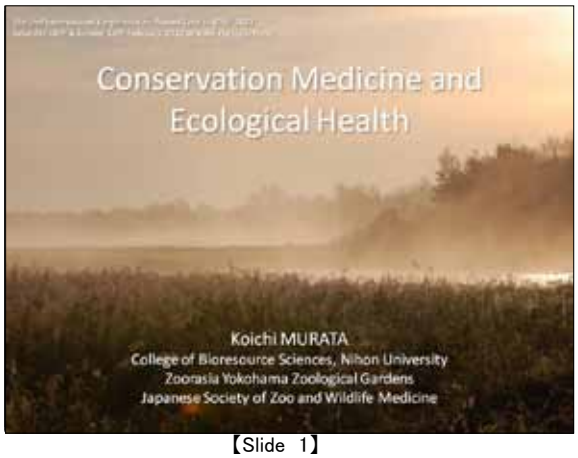
Now, I'd like to tell you about to the relationships I have with these three lecturers.

As for Prof. Huffman, although I have known his name for a long time, as I mentioned I first became acquainted with him in a research context at an international conference held several years ago on the non-human primate malaria parasite Plasmodium. At that time, Prof. Huffman was also working as a coordinator of the International Primatological Society (IPS). In spite of his busy schedule, he participated in the primate malaria conference, where he delivered a lecture. Perhaps because he was tired after that, I remember he slept deeply during the conference.

I met Prof. Tsuda for the first time five or six years ago. Although my specialty was avian malaria, I was almost totally ignorant about mosquitoes. I wanted to develop avian malaria research in some way by obtaining Prof. Tsuda's cooperation, so I have accompanied him on fieldwork across Japan and carried out research with him as his co-researcher. Even today I receive guidance from him about mosquito biology, behavior and classification.

I have also been acquainted with Dr. Goka's name for many years. Perhaps you too are aware of his activities through the mass media including TV. Although he is extremely busy with his research, he actively participates in drinking sessions outside of research hours and he has developed a habit of taking photos with his students. These are posted on Facebook. I introduced one of these photos earlier showing him and me together. At this symposium too, he has been taking photos with many people, and these will also be posted on Facebook.

Now it is time to hear the lectures from these three academics, which is the original purpose of this symposium. First, Prof. Michael Huffman, please start your talk now. I invite you all to enjoy his lecture.



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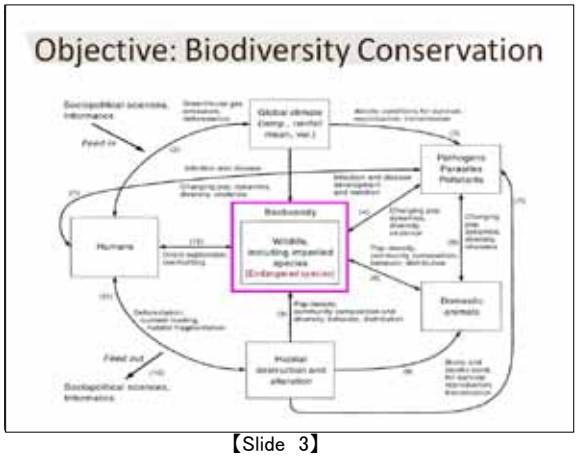

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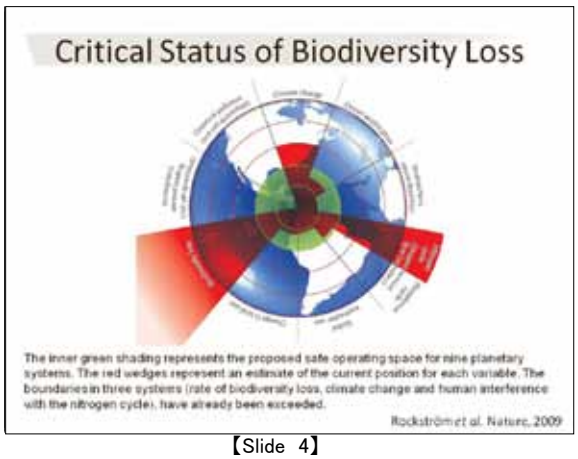

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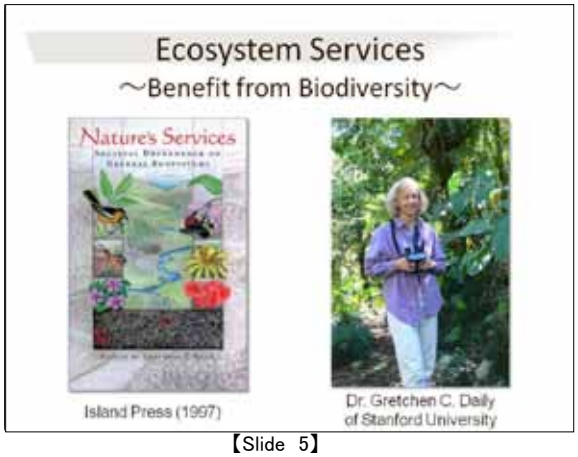

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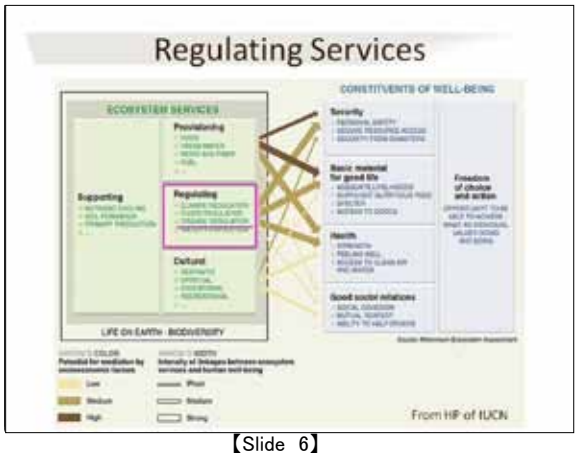

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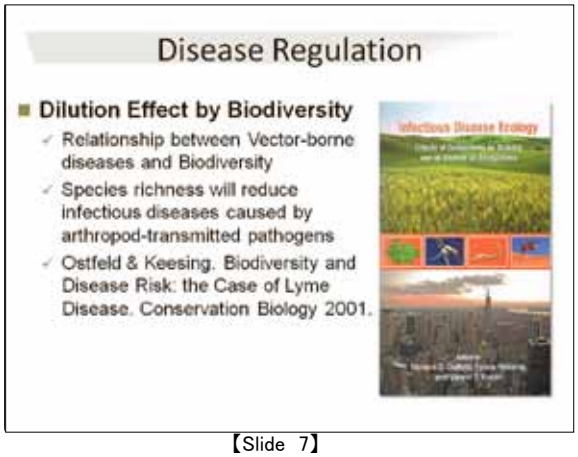

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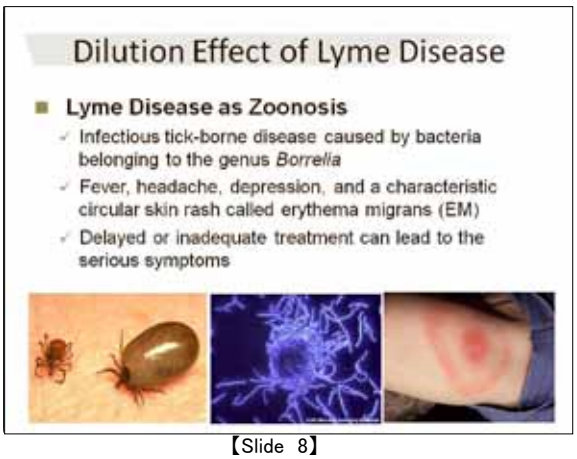

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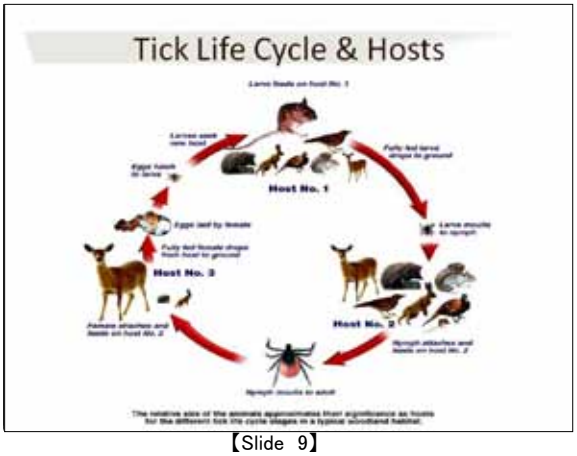

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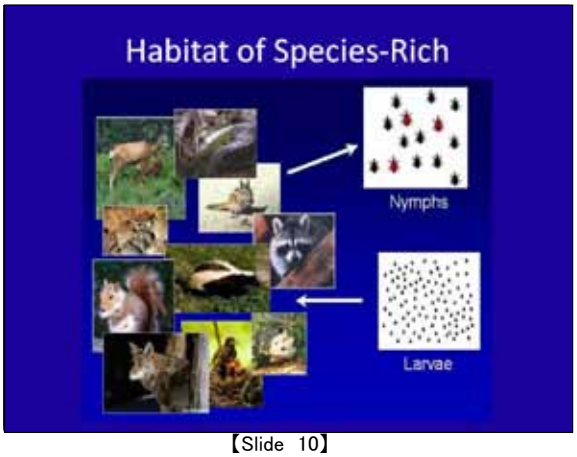

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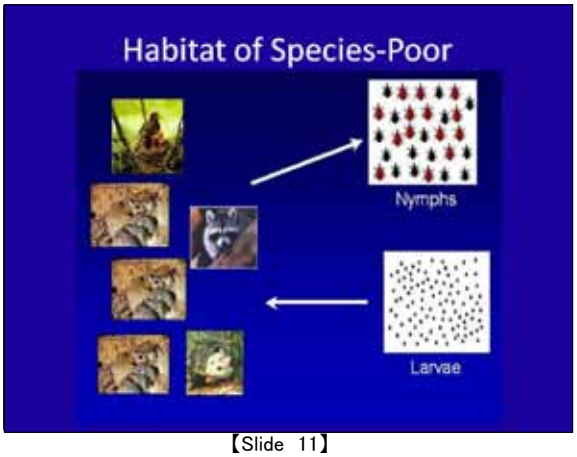

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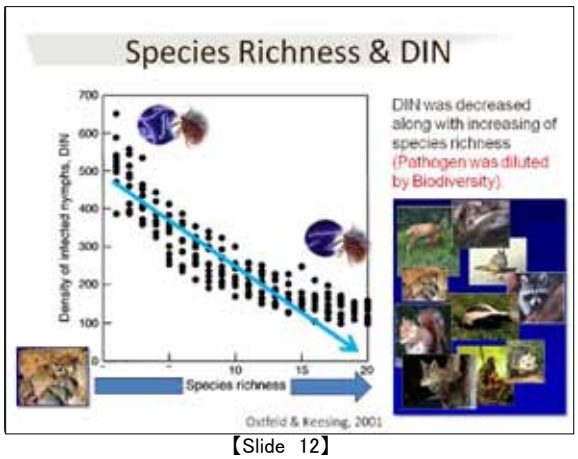

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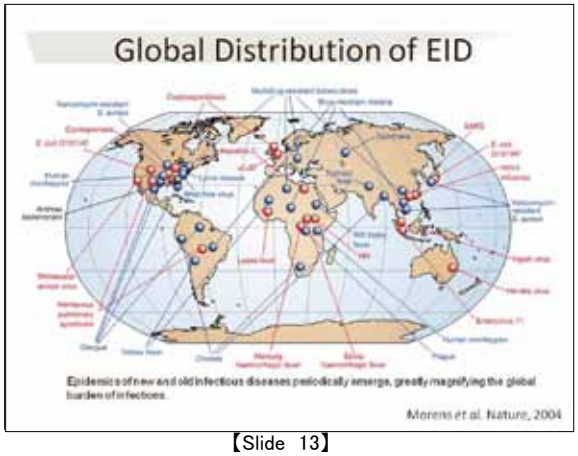

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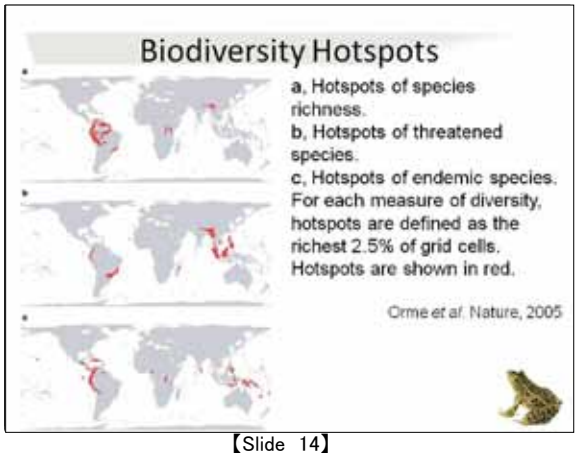

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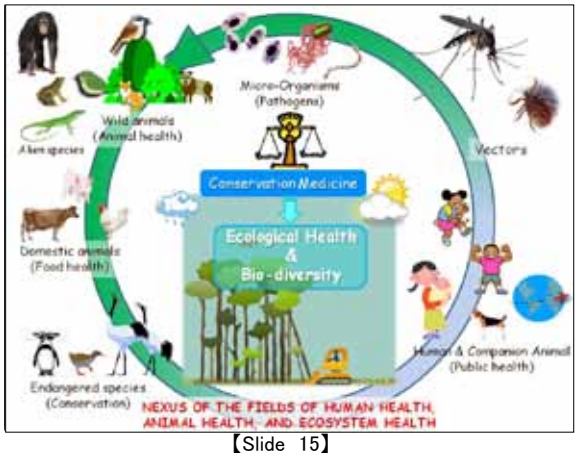

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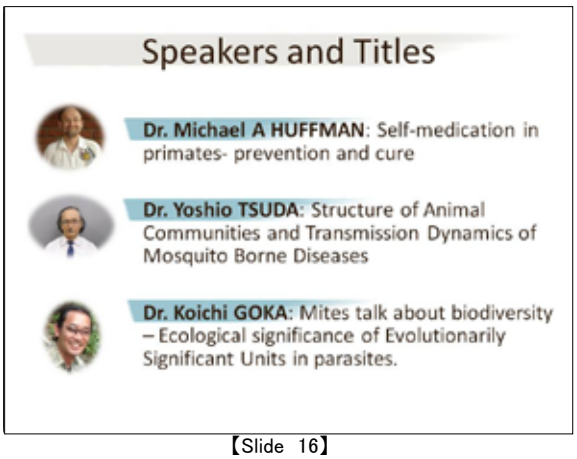

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