Biodiversity Protection, Farmers and Breeders Right

Prof. Padmavati Manchikanti, Prof. Narendran Thiruthy | IIT Kharagpur

Lecture 02: Types of Biodiversity, Megabiodiverse Centers

Welcome to lecture 2. In this lecture, we will cover the aspects of biodiversity and what are the different types of biodiversity. One from the point of view of how do we measure biodiversity, and other from the point of view of the nature of biodiversity. We will also take up the aspect of mega diverse nations, and how mega diverse nations are contributing to the commitment on conservation. So moving on to the basic concepts that we will deal with in this particular lecture. There are different types of biodiversity as ecologists and biodiversity scientists use.

Today there are various ways in which biodiversity can be measured. Learning of biodiversity is another important facet which has grown to the context of work across an international platform. Mega biodiverse countries and their role in conservation. In the last part of the lecture, we will deal with the aspect of international cooperation and coordination when it comes to biodiversity and some insights into this aspect.

So, when we come to the context of biological diversity, all of you would well know that biodiversity is uneven globally. Different regions have different level of species. Generally biodiversity is greater in the tropical regions. Higher temperatures leading to higher rates of metabolism foster species richness. There are a lot of co-evolutionary processes that need to be understood when we look at growth of biodiversity in any particular region.

In terms of tropics and the temperate regions, tropical regions have more biodiversity and therefore also harbor the most diverse genomes. Scientists who have been involved in the understanding of why biodiversity is different at different places have come up with several hypotheses to explain the uneven distribution of biodiversity. So, let us understand what are some of these hypotheses in relation to biodiversity and the relevance to distribution of biodiversity. So, one hypothesis is about evolutionary time. Now, the evolutionary speed hypothesis is about the fact that older species have been there for a longer period of time and therefore, there is higher diversity compared to the newer ones.

Also species richness is greater towards the tropics because high temperature enhances the evolutionary speed. There is another hypothesis in relation to climate stability. The greater the uniformity of the climate in a particular habitat space, more are the number of species that occupy that particular habitat. Now, uniformity in climate, availability of

resources obviously, have a bearing when it comes to the number of species. Another hypothesis is about spatial heterogeneity.

This takes into consideration the ecological niches. Species tend to coexist in a greater fashion where we have a large number of ecological niches. That means, there is a greater availability of resources and since species coexist, there is less competition. The other hypothesis is about productivity. Here it is all about the energy flow in the food web and this is an important determinant with respect to the context of greater richness of biodiversity.

So, certain areas have greater production because of the sustainable practices associated with those specific regions and therefore, this kind of a hypothesis, the key to it is practices associated with specific regions. So, some of these hypothesis explain why do we see so much of difference in the diversity of species in a given area and also in a larger context of the regions itself. Let us understand the different types of diversity. Species richness is a simple count of the species in a given area. This is helpful to understand the number of species and also species evenness.

When it comes to the context of species diversity, we need to understand certain terms. For instance, exotic species, endemic species and ubiquitous species. Ubiquitous species as the name indicates are the species which are available at all different points of time, generally available in most areas. Then we come to exotic species are some species which are very unique. In the context of conservation, we recognize the endemic species and if you refer to the earlier aspect that I mentioned, over a period of time certain species tend to be restricted to specific regions and that is where we come to the context of what we call endemism.

So, endemism, what is endemism? Endemism is the context where a particular species or a group of species are found exclusively in a particular geographical area, thereby they are not available in other parts of the world. And understanding endemism is very important to take up conservation measures. So, there are several regions in the world where we find lot of species that are endemic in nature. We now come to the aspect of genetic diversity. So, here we are looking at how gene based variations bring variation in the characteristic of individual species.

Today with the advancement of technologies such as the PCR, ability to fingerprint genomes, not only that because today we know the grammar of genomes, we are able to understand differences at the molecular level as well. So, this is something which also explains diversity at the genetic level, and that understanding is very useful to understand how species evolve, how species present different characteristics, how

multiple characteristics are linked. Sometimes very good traits are linked with very bad traits that is not so desirable traits. So, if we have something which is high grain number and also disease resistance, then that is a trait which will be very useful to go hand in hand. Then we come to the context of ecological diversity.

Now this type of diversity is the diversity that we see in the ecosystem as a whole. For instance, we are looking at a mangrove. A mangrove is a ecosystem and it has a lot of diversity in species, a rainforest has a lot of diversity. So, ecological diversity gives us an insight into the variety and frequency of different ecosystems and the components of these ecosystems. Here we also study the interrelationship of the species and also with respect to the environment.

So, in this illustration, you would appreciate how to distinguish different types of biodiversity where sometimes we see not only differences in certain species as you can see in the second illustration here, but also sometimes we can understand the nuances of an entire ecosystem which includes the living and the non-living component. World over, there are several biodiversity hotspots recognized, and these biodiversity hotspots provide an understanding of the species diversity and also the endemism in relation to those species. Today, there is a big threat to biodiversity hotspots and therefore, biodiversity hotspots have also become the area of priority for conservation activities. The criteria to announce a biodiversity hotspot includes two important aspects and those are the aspect of species endemism and the degree of threat. Up to 70 percent or more loss of its primary vegetation is a big threat to biodiversity hotspots.

So, therefore, there is an urgent need to also protect biodiversity hotspots and therefore, this is another area which is necessary from the point of view of conservation studies. We now come to the important aspect of understanding how to measure biodiversity. To those who are involved in biodiversity research, who are working in the area of conservation, scientists measure biodiversity in various ways. We have the different terms of biodiversity. In order to measure biodiversity, we have the measurement at the local system and also in a larger area.

So, if one way to undertake a simple understanding of a number of species in a community or within a small space in a given habitat, you will be looking at measuring what is called alpha diversity and whenever we are looking at different species within a given location, then we deal with beta diversity. Sometimes ecologists and scientists also study the sum of alpha diversity and beta diversity and that is gamma diversity. When we are looking at a biosphere as such and a measurement of species in that particular biosphere, we use the term omega diversity. Then there is also the context of looking at taxonomy or toxic diversity. Today, we need taxonomies more than ever

before because it is the species identification which is the starting point of understanding the nature and scope of the species and it is relevant to the ecosystem.

So, phylogenetic understanding is very important when it comes to biodiversity studies as well. Now, let us look at the context of the categorization of biodiversity from the nature of the habitat. What you see in this illustration is biodiversity as per the nature of a particular region. So, we have agriculture biodiversity, dry and humid land biodiversity, forest cover and forests encompass forest biodiversity. Inland waters are very important area for study on biodiversity and they constitute inland water biodiversity.

Island biodiversity, marine and coastal biodiversity and another way of categorizing biodiversity is to look at mountain biodiversity. At this point of time, I would like to mention that the Convention on Biological Diversity in its initial conference of party meetings had the huge task of looking at first understanding what is the nature of biodiversity world over. If the world had to be divided into specific regions, then this is where we are looking at based on the nature of biodiversity, we need to look at taking up the objectives of the convention. So, in the very initial conference of party meetings, the designation of different types of these areas of biodiversity became the starting point to look at the work program under the different aspects of the agenda laid out at the different COP meetings. Let us briefly understand the importance of these different types of biodiversity.

So, agriculture biodiversity is a very important part of biodiversity. This includes all components of biological diversity that are relevant for food and agriculture and that which constitute the agro-ecosystem. So, we derive benefits in terms of food, raw material for goods, then medicines from plants and other sources. This also forms a basis of income and livelihoods. World over, farming is a very important activity and in the case of many countries, it is also the primary way of sustenance.

So, agro-biodiversity also performs several ecosystem functions. There are certain native ecosystem functions, for instance soil and water conservation. The maintenance of soil fertility is very important and all of this is very essential to human survival. There are a lot of efforts taken up worldwide to understand agro-biodiversity not only from the scientific context, but also to create a policy impact in terms of bringing in schemes for national implementation. So, monitoring agro-biodiversity is very imperative.

I would like to bring to your attention one of the very important tools that was developed which is the biodiversity integrated assessment and computation tool. What is this tool about? This uniquely seeks to assess biodiversity from the qualitative and quantitative aspects. Some of the things that are assessed are land use, how fragmentation of habitat

happens, infrastructure requirements, how human activities erode biodiversity, understanding of the mean species abundance and several other such parameters. These help make informed decisions when it comes to the policy. So, therefore, they are very important policy indicators that are possible that come out of this.

And some of it also extends into the conservation activities which help decision makers, governments to understand biodiversity concerns. Today the tool is also being used to understand conventional carbon pricing and this can be used as a tool to access funds for conservation activities. So, this is one aspect of several other tools are also available which help in assessing agriculture biodiversity. There is so much of research happening in the area of agriculture biodiversity that we get to know newer insights into the nature of agriculture biodiversity and how do we see this changing with respect to time and space. We come to the other aspect of dry and sub humid lands, 47 percent of the earth's terrestrial area is approximately the number where you see the dry and semi arid regions.

They also support some very interesting biodiversity and these countries which are part of the dry and sub humid lands have also several endemic plant species. Understanding of this biodiversity helps in understanding species adaptation to harsh conditions. First biodiversity has assumed a lot of importance world over and here we are looking at a large forested region which supports multitude of plants, animals, microorganisms, the entire milieu of the environment in which they thrive. So, when we understand the complex interactions of these organisms which live within the forest area, it allows us to also understand how the environment sustenance, the changing environmental conditions due to spontaneous and anthropogenic interface and how ecosystem functions actually are maintained in the forest system itself. One interesting aspect of the forest biodiversity is the context of restoration.

Today we are looking at a restoration of the forest ecosystem because forests are a very important supportive mechanism when it comes to any region due to the diversity of species. So, one of the ways in which there are several initiatives, there are several certification schemes, one illustration that you can see on the slide is the forest ecosystem restoration initiative established in 2015 by the Korea Forest Service. This provides us an insight into what are the capacity building exercises that are taken up for restorative activities. Today we are looking at restoration of not only degraded systems, but today it has become very imperative for us to look at restoration of forest ecosystems, restoration of livelihoods, restoration of the environment. It is in that context that a detailed understanding of this initiative is very important to look at some of the successes with respect to restoration of forests.

Now, when we come to inland waters, at some places we see the boundaries between the

aquatic and the terrestrial areas are blurred. This is where we look at the context of inland waters and this supports a lot of biodiversity. And it is in these regions that we see also a very interesting interaction of different type of species, and these are also important areas for looking at overall implementation of international and national targets. Freshwater species, endemism is one area for study. The landscape itself is a very interesting aspect to look at changes to the ecosystem and how the changes to biodiversity happen in these regions.

So, there are a lot of studies which look at the characterization of inland waters from the point of view of how it supports livelihoods. So, we come to the aspect of island biodiversity. Islands are quite vulnerable today being away from the mainland, and islands also constitute a very important aspect where one-tenth of the world population lives in the islands. These ecosystems are very unique, and again here we have a lot of species that are endemic found nowhere else. And preserving these ecosystems would also mean understanding of those ecosystems and therefore, taking up activities in relation to how island biodiversity supports economy, livelihood, well-being.

Islands are also places where you find lot of people from the indigenous groups. So, how do we understand their relationship with respect to biodiversity conservation as well as the environment as a whole. Today there are a lot of habitat changes happening in the island areas as well, and they have become very vulnerable. Small island states are an important area of focus when it comes to conservation and sustainable use. 70 percent of the earth surface is the aspect of where we look at marine and coastal biodiversity.

They also support 95 percent of the biospheres as well. There is also an aspect of livelihood which becomes important when we look at this type of biodiversity. So, today we see enormous changes in the oceans because of lot of activity, industrialization. Understanding the vulnerability or resilience of this ecosystem is very important to understand how measures have to be taken up. I would like to bring to your attention the ecologically or biologically significant areas or the EBSAs.

Now, these have been carved out as special areas in the ocean where restorative activities have become very important on one end. On the other end, there are also regulatory activities that have been brought in so that sustainable use of this resource can also happen. So, these are also now become an important area for study internationally. Mountain biodiversity continues to be a very important area of research, and it is interesting to study mountain biodiversity not only from the point of view of the biodiversity as it is, but also mountains support a lot of livelihoods. In fact, many for many of them in the world that is the place where they live.

So, mountain biodiversity is also a very important area where you see high species richness and several countries have lot of mountain biodiversity. So, when we look at the nature of biodiversity, a given country may have some of these as predominant type of biodiversity. Therefore, when we look at the overall implementation of the international goals or commitments, we need to look at in some cases all of these together depending on the predominant nature of biodiversity in a given region. And today we are all in it together, we have common, but differentiated responsibilities. So, individual nations are not only looking at conservation activities within, but are also contributing to efforts internationally.

And this is where what makes it very relevant from the global commitments to conservation. We will deal with these aspects in the further lecture on biodiversity mapping. Thank you.