

Scope and Content of Bio Geography; Nature of Biosphere

Part II (1+1+1 System) Geography Hons.

Paper: IV

Module: VI

Topic: 3.1

Scope and Content of Bio Geography

Concept of Biogeography:

Biogeography is the geography of organic life, the study of the spatial distribution of animate nature, including both plants and animals and the processes that produce variations in the patterns of distribution. This branch of geography is concerned with the multitudinous forms of plant and animal life which inhabit the densely populated zone over the earth's surface, as well as the complex biological activities which are controlled by natural environment.

Biogeography forms an important link between the disciplines of geography and ecology, the ecosystem providing the fundamental integrating concept for the scientific study of many aspects of the man-environment complex.

Geography itself has been variously defined as the study of areal distributions, spatial patterns, locational analysis, man-earth relationships and the environmental relationships of man. Biogeography, in a similar way, encompasses all these aspects of study in relation to the living beings with an emphasis on the man's relations. Thus this branch of geography studies all biotic things consisting of the earth's environment in respect to man. Its study, therefore, involves the evaluation of distribution areas of biota which necessitates the deciphering of information available from propagation areas concerning the ecological potential, genetic viability, phylogeny of biotic communities as well as the spatially and temporally varying behaviour of environmental factors.

The basic material for biogeographic investigations consists of the organisms, plant and animal communities which exhibit wide extensions over the globe with varying degrees of concentrations. So more accurately, it is the study of the biosphere which envelops the surface of the earth and consists of all living-organisms living on land, aquatic and aerial areas. The environmental factors and the human activities which affect the distribution of living-being form the main substratum of biogeography.

Scope of Bio Geography

Biogeography, in its broadest sense, attempts to understand the interactions between and among the environment, animals, plants and man, all of which constitute the sub-systems of the global ecosystem. Thus bio-geographical studies include:

- To examine, by means of experimental analysis, the relationship between complex ecological systems and propagation areas e.g. in a forest, grassland, pond or an estuary.

- To analyse the spatial and temporal affinities between individual organisms and populations. For example, the spatial variations of an individual species of plant or animal may differ in the same type of ecosystem on account of the differences in the intake of solar energy or the nutrients present. In other cases the differences may be measured temporally and some species may increase or decrease after some time on account of competition, inhibition or mutualism. Still others may evolve into different species by accident, mutation or evolution.
- To evaluate the ecological potential of the area for a species of plant or animal. The potential may be influenced by abiotic factors like soil, relief, amount of nutrients present in a given area, climatic conditions of temperature, rainfall and moisture or by biotic factors like the methods of dispersal of that species, behaviour towards environment, reproductive rate, adaptations to environment etc.
- To measure the impact of anthropogenic factors which are responsible for the growth or extinction of certain species in a region as human behaviour is diverse in every region due to environmental variations.
- To explore the historical reasons of the patterns of biotic dispersal in the past which to a large extent influence the present distributional pattern as well. Examination of the past distributional pattern is done by palaeontological studies of fossil records.

It will be pertinent here to point out that the cause-effect relationships in the distributional pattern of biota are of paramount importance to geographers. Such studies are not done in any other science, as they are invariably linked with the local or regional environment. It is easy to evaluate for a geographer that the grasslands of the Americas are still in their original, flourishing state due to poor grazing by animals which in turn is associated with the recent inhabitation of these two continents by man. Similarly, it is on account of the separation of Australian continent, in the Eocene period, from the 'pangea' continent that the animal and vegetal forms of life differ from all the continents and the impact of geographic isolation is most prominent.

The study of the responses of plants and animals to their environmental conditions is within the purview of biogeography. Their behaviours cause different biological conditions in an area. It is fascinating to find that the flora and fauna of equatorial regions are different from those of temperate regions on account of variations in climate. Equally significant are the ways in which the plants and animals adapt to various climatic regimes. Responses to climate or to topography, soil and chemical nutrients are exhibited by plants in a multitude of morphological and physiological modifications. They are also markedly noticeable in wild animals as the animals of cold regions live in burrows and have a thick cover of fur or hair on their skin to save themselves against cold, while those living in tropical regions are devoid of the hairy cover and lead an arboreal life.

Variations in the biological productivity of various environments are noticeable, locally, regionally or even on a global scale. The geographic objective of their study is to elucidate the properties of geographical regions in all such cases. The information provided by the distributional pattern of the biota is a useful index for exploring the environmental specialties of the area. For instance, the xerophytic, scarce vegetation of an area is indicative of the arid conditions where precipitation is less than the required need for plants. The biotic dispersal, on the other hand, also provides a reliable evidence of human interference, as for example, the grasslands of the world have today largely been occupied by man and their original foliage cover has been lost.

Biogeography attempts to provide solutions to biotic disequilibrium which has now gradually crept in on a large scale. It imparts a better understanding of ecological functions and processes and of the nature of ecological inter-relationships. Such studies, undoubtedly, stimulate the geographer's interest in unfolding the intricacies of various ecosystems. Imbalances of energy and nutrient flows in these systems cause drastic

fluctuations of populations inhabiting them. The attention of geographers has now focussed on the study of ecosystems due to the rapid depletion of organic material and the increasing modification of the biosphere by man which has highlighted the serious complexity of existing ecological problems. The significance of man as a universal and long established ecological variable is, at last being fully realized by ecologists, biologists and geographers. Over-cropping, exacerbated by direct and indirect habitat modification has sparked off biological chain-reactions which man, as yet, has been unable to control completely. A synoptic view of such anthropogenic factors is one of the main tasks of biogeographers.

Content of Bio Geography:

Since biogeography is concerned with the study of plants and animals it is usually studied under two heads.

Phytogeography

It is the geography of plants, mainly concerned with the scientific study of their distribution in space and over time, and of the environmental elements influencing this distribution. It is akin to plant ecology, but broader in scope, drawing on chemistry, climatology, genetics, geology, history, palaeontology, physics, taxonomy and plant sociology. Plant geography is concerned with plants as social units and with the phenomena that affect their life-cycles, including the origin, formation, composition, and structure of plant communities, their development and change, the relationships among species and between species and their environment, and the classification of plant communities.

Today phyto-geographical studies are concerned with the higher forms of plants known as vascular plants which have well developed vessels to transmit water and nutrients to every part the plant. Nonetheless, a large bulk of non-vascular plants and micro flora exists on the earth which has a greater interaction with higher plants as well as with animals and man. The various effects of these lower and higher plants show their manifestations in soil formation, animal habitats and man's dependency.

Throughout the long history of biotic life on the earth there have been changes in the forms of life either by accident or by the slow process of evolution. A palaeontological history of the various life-forms denoting the evolution of plants from lowest micro flora to the highest forms is within the purview of phytogeography. Coupled with this process of natural evolution are the deliberate processes of selection to which man has been an integral part quite lately. Man has created new 'genotypes' and new ecosystems. Changes in the genetic make-up of plants have altered the future generations of vegetation cover in which human needs and perceptions have influenced the basic characteristics of certain plants. Inadvertently, such changes have replaced forests with croplands where the complex natural ecosystems of the woodland are replaced by the relatively simple field of a single crop organism and its associated plants and animals. Man thus forms the datum-line to explore the phytological aspects of nature.

Zoogeography

Another branch of biogeography is the study of animal life in its various aspects of distribution patterns and interactions with the environment called Zoogeography which includes the scientific study of various 'zooids', and the various other animals living in agglomerations showing interdependence on each other and the plants.

The study of distributional aspects of animals and their causal relationships started with the Darwinian era when Charles Darwin in the nineteenth century wrote the 'Origin of Species'. A. R. Wallace, a

contemporary of Darwin, was another great exponent of zoogeography. The great complexity of ecological factors which influence the animal distribution have been lately studied by Richard Hesse in his book entitled *Ecological Animal Geography*, as also by P.J. Darlington, C.S. Elton, C.G. Simpson and J.Z. Young. Animals, being devoid of the green chlorophyll are directly or indirectly dependent on plants for their food and sustenance and the complexities that emerge out of these inter-relationships make the zoogeographical studies more interesting.

Human intervention in animal life has often been a field of study in zoogeography. V. Zisweiler (1967) enumerated the extinct and vanishing species of animals which have been hunted by man for their hides, skin, fur and flesh. It is not astonishing to find, therefore, that in the last 500 years, one in every hundreds of the world's higher animals has become extinct and the shadows are closing around several more. Thus because of man's inadvertence and ignorance about their ecological functions and economic potentials, the process of extinction has escalated. Zoogeography attempts to evaluate the ability of various species of animals to adapt themselves to changing environmental conditions, which varies from one species to another. The basic consideration in such cases is the balance between reproduction and mortality. Some of the endangered species are handicapped by a low reproductive rate while others may have higher mortality rates.

Prepared by Suradhuni Ghosh

Nature of Biosphere

Biosphere, the organic world, is that part of the earth which contains living organisms, comprising the biologically inhabited soil, air and water.

- It is a relatively shallow zone in comparison the lithosphere and the atmosphere, as most of the organisms need specific climatic conditions to grow and survive.
- In the oceans also life is mainly confined to a depth of few hundred metres as far as the solar radiations can penetrate. But for all its limited extent, biosphere is a densely populated zone teeming with; a myriad form of life which exhibit bewildering varieties and complexities.
- The most readily visible part of the biosphere consists of larger plants and animals but they constitute a very small percentage of the whole. It is now known that about half a million species of plants and an equal number of species of animals inhabit the globe.
- Besides the larger animals and plants, small microscopic organisms called micro-flora and micro-fauna inhabit the soil, water and air. A microscopic examination of the humus-rich top soil reveals that in one gram of soil there may be as many as 100,000 algae, 16 million fungi and perhaps several billion bacteria.
- Any study of biosphere involves the study of the habits and habitats of all plants and animals against the backdrop of environment. All living creatures show inter-dependence on each other and a complexity of inter-relations, as they do not exist in isolation.
- In this complexity of inter-relationship the key position is occupied by green plants which have the unique ability to use solar energy to manufacture food from simple substances like carbon, hydrogen, nitrogen, oxygen etc. The food thus manufactured and the solar energy stored is essential not for them alone but also for the multitudes of various animals through which it is circulated. Animals are therefore, directly or indirectly dependent on plants. In some cases such activities are mutually beneficial, in others antagonistic. For example, many plants rely on animals for pollination or seed dispersal, while plants frequently provide food, shelter and protection to animals.
- Biosphere is not just a collection of living organisms, rather it is a place where its animate and inanimate objects interplay and display a spectrum of life-forms and environment.
- The animate parts of biosphere are wholly dependent on the inanimate environment of land, soil, air and water within which they exist. Living organisms have their total dependence on this environment for water, light, oxygen, carbon dioxide and other mineral nutrients, all of which are necessary for the very existence of life.
- Conversely, the inorganic environment is profoundly affected by the existence of the organisms which inhabit it. There is thus a continual exchange of energy and mineral nutrients within the organic and inorganic parts of the biosphere.
- Biosphere includes man as well, who through his various activities has changed the various life-forms and the landscape. Domestication of animals and plants and the resulting activities of ranching, pastoralism, livestock-rearing, agriculture, deforestation etc. have changed the original landscape of this planet to a large extent.
- Human is the main agent who has destroyed and altered the nature's equilibrium at every location and compelled the plants and animals to adopt various modifications in their form and physiology. Still the main stem of biogeography lies in the study of plants and animals as the study of major world soil-

climate-vegetation units, vegetation history, energy and chemical nutrient flows, ecosystems and distribution patterns of plants and animals.

- The biosphere consists of all animate objects including man, and the various activities of man in relation to the biosphere form the core of biogeographical studies.

Prepared by Suradhuni Ghosh