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Phytogeography- An Overview

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ABSTRACT: Phytogeography , phytón = "plant" and, geographía = "geography" meaning also distribution) or botanical geography is the branch of biogeography that is concerned with the geographic distribution of plant species and their influence on the earth's surface.[1] Phytogeography is concerned with all aspects of plant distribution, from the controls on the distribution of individual species ranges (at both large and small scales, like species distribution) to the factors that govern the composition of entire communities and floras. Geobotany, by contrast, focuses on the geographic space's influence on plants

KEYWORDS: phytogeography, plant, distribution, composition, communities, geobotany, space, species, branch

I.INTRODUCTION

Phytogeography is part of a more general science known as biogeography.[2] Phytogeographers are concerned with patterns and process in plant distribution. Most of the major questions and kinds of approaches taken to answer such questions are held in common between phyto- and zoogeographers.[1,2]

Phytogeography in wider sense (or geobotany, in German literature) encompasses four fields, according with the focused aspect, environment, flora (taxa), vegetation (plant community) and origin, respectively:[3][4][5][6]

- plant ecology (or mesology – however, the physiognomic-ecological approach on vegetation and biome study are also generally associated with this field);
- plant geography (or phytogeography in strict sense, chorology, floristics);
- plant sociology (or phytosociology, synecology – however, this field does not prescind from flora study, as its approach to study vegetation relies upon a fundamental unit, the plant association, which is defined upon flora).
- historical plant geography (or paleobotany, paleogeobotany)[7]

Phytogeography is often divided into two main branches: ecological phytogeography and historical phytogeography. The former investigates the role of current day biotic and abiotic interactions in influencing plant distributions; the latter are concerned with historical reconstruction of the origin, dispersal, and extinction of taxa

The basic data elements of phytogeography are occurrence records (presence or absence of a species) with operational geographic units such as political units or geographical coordinates. These data are often used to construct phytogeographic provinces (floristic provinces) and elements.[8]

The questions and approaches in phytogeography are largely shared with zoogeography, except zoogeography is concerned with animal distribution rather than plant distribution. The term phytogeography itself suggests a broad meaning. How the term is actually applied by practicing scientists is apparent in the way periodicals use the term. The American Journal of Botany, a monthly primary research journal, frequently publishes a section titled "Systematics, Phytogeography, and Evolution.[9]" Topics covered in the American Journal of Botany's "Systematics and Phytogeography" section include phylogeography, distribution of genetic variation and, historical biogeography, and general plant species distribution patterns. Biodiversity patterns are not heavily covered. A flora is the group of all plant species in a specific period of time or area, in which each species is independent in abundance and relationships to the other species. The group or the flora can be assembled in accordance with floral element, which are based on common features. A flora element can be a genetic element, in which the group of species share similar genetic information i.e. common evolutionary origin; a migration element has a common route of access into a habitat; a historical element is similar to each other in certain past events and an ecological element is grouped based on similar environmental factors. A population is the collection of all interacting individuals of a given species, in an area.[10]

An area is the entire location where a species, an element or an entire flora can occur. Aerography studies the description of that area, chorology studies their development. The local distribution within the area as a whole, as that of a swamp shrub, is the topography of that area. Areas are an important factor is forming an image about how species interaction result in their geography. [11]The nature of an area's margin, their continuity, their general shape and size relative to other areas, make the study of area crucial in identifying these types of information. For example, a relict

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area is an area surviving from an earlier and more exclusive occurrence. Mutually exclusive plants are called vicarious (areas containing such plants are also called vicarious). The earth's surface is divided into floristic region, each region associated with a distinctive flora. [7]

II.DISCUSSIONS

Phytogeography has a long history. One of the subjects earliest proponents was Prussian naturalist Alexander von Humboldt, who is often referred to as the "father of phytogeography". Von Humboldt advocated a quantitative approach to phytogeography that has characterized modern plant geography.[12]

Gross patterns of the distribution of plants became apparent early on in the study of plant geography. For example, Alfred Russel Wallace, co-discoverer of the principle of natural selection, discussed the Latitudinal gradients in species diversity, a pattern observed in other organisms as well. Much research effort in plant geography has since then been devoted to understanding this pattern and describing it in more detail.

In 1890, the United States Congress passed an act that appropriated funds to send expeditions to discover the geographic distributions of plants (and animals) in the United States. The first of these was The Death Valley Expedition, including Frederick Vernon Coville, Frederick Funston, Clinton Hart Merriam, and others.[8]

Research in plant geography has also been directed to understanding the patterns of adaptation of species to the environment. This is done chiefly by describing geographical patterns of trait/environment relationships. These patterns termed ecogeographical rules when applied to plants represent another area of phytogeography.[13]

Floristics is a study of the flora of some territory or area. Traditional phytogeography concerns itself largely with floristics and floristic classification,.

China has been a focus to botanist for its rich biota as it holds the record for the earliest known angiosperm megafossil.[9]

Species distribution, or species dispersion,[1] is the manner in which a biological taxon is spatially arranged.[2] The geographic limits of a particular taxon's distribution is its range, often represented as shaded areas on a map. Patterns of distribution change depending on the scale at which they are viewed, from the arrangement of individuals within a small family unit, to patterns within a population, or the distribution of the entire species as a whole (range). Species distribution is not to be confused with dispersal, which is the movement of individuals away from their region of origin or from a population center of high density.[14]

In biology, the range of a species is the geographical area within which that species can be found. Within that range, distribution is the general structure of the species population, while dispersion is the variation in its population density.

Range is often described with the following qualities:

- Sometimes a distinction is made between a species' natural, endemic, indigenous, or native range, where it has historically originated and lived, and the range where a species has more recently established itself. Many terms are used to describe the new range, such as non-native, naturalized, introduced, transplanted, invasive, or colonized range.[3] Introduced typically means that a species has been transported by humans (intentionally or accidentally) across a major geographical barrier.[4]
- For species found in different regions at different times of year, especially seasons, terms such as summer range and winter range are often employed.
- For species for which only part of their range is used for breeding activity, the terms breeding range and non-breeding range are used.[15]
- For mobile animals, the term natural range is often used, as opposed to areas where it occurs as a vagrant.
- Geographic or temporal qualifiers are often added, such as in British range or pre-1950 range. The typical geographic ranges could be the latitudinal range and elevational range.

Disjunct distribution occurs when two or more areas of the range of a taxon are considerably separated from each other geographically.[16]

III.RESULTS

Distribution patterns may change by season, distribution by humans, in response to the availability of resources, and other abiotic and biotic factors.

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Abiotic

There are three main types of abiotic factors:

1. climatic factors consist of sunlight, atmosphere, humidity, temperature, and salinity;
2. edaphic factors are abiotic factors regarding soil, such as the coarseness of soil, local geology, soil pH, and aeration; and
3. social factors include land use and water availability.

An example of the effects of abiotic factors on species distribution can be seen in drier areas, where most individuals of a species will gather around water sources, forming a clumped distribution.[17]

Researchers from the Arctic Ocean Diversity (ARCOD) project have documented rising numbers of warm-water crustaceans in the seas around Norway's Svalbard Islands. Arcod is part of the Census of Marine Life, a huge 10-year project involving researchers in more than 80 nations that aims to chart the diversity, distribution and abundance of life in the oceans. Marine Life has become largely affected by increasing effects of global climate change. This study shows that as the ocean temperatures rise species are beginning to travel into the cold and harsh Arctic waters. Even the snow crab has extended its range 500 km north.

Biotic

Biotic factors such as predation, disease, and inter- and intra-specific competition for resources such as food, water, and mates can also affect how a species is distributed. For example, biotic factors in a quail's environment [18]would include their prey (insects and seeds), competition from other quail, and their predators, such as the coyote.[5] An advantage of a herd, community, or other clumped distribution allows a population to detect predators earlier, at a greater distance, and potentially mount an effective defense. Due to limited resources, populations may be evenly distributed to minimize competition,[6] as is found in forests, where competition for sunlight produces an even distribution of trees.[7]

Humans are one of the largest distributors due to the current trends in globalization and the expanse of the transportation industry. For example, large tankers often fill their ballasts with water at one port and empty them in another, causing a wider distribution of aquatic species.[8]

Clumped distribution, also called aggregated distribution, clumped dispersion or patchiness, is the most common type of dispersion found in nature. In clumped distribution, the distance between neighboring individuals is minimized. This type of distribution is found in environments that are characterized by patchy resources. Animals need certain resources to survive, and when these resources become rare during certain parts of the year animals tend to "clump" together around these crucial resources. Individuals might be clustered together in an area due to social factors such as selfish herds and family groups. Organisms that usually serve as prey form clumped distributions in areas where they can hide and detect predators easily.[19]

Other causes of clumped distributions are the inability of offspring to independently move from their habitat. This is seen in juvenile animals that are immobile and strongly dependent upon parental care. For example, the bald eagle's nest of eaglets exhibits a clumped species distribution because all the offspring are in a small subset of a survey area before they learn to fly. Clumped distribution can be beneficial to the individuals in that group. However, in some herbivore cases, such as cows and wildebeests, the vegetation around them can suffer, especially if animals target one plant in particular.

Clumped distribution in species acts as a mechanism against predation as well as an efficient mechanism to trap or corner prey. African wild dogs, Lycaon pictus, use the technique of communal hunting to increase their success rate at catching prey. Studies have shown that larger packs of African wild dogs tend to have a greater number of successful kills. A prime example of clumped distribution due to patchy resources is the wildlife in Africa during the dry season; lions, hyenas, giraffes, elephants, gazelles, and many more animals are clumped by small water sources that are present in the severe dry season.[10] It has also been observed that extinct and threatened species are more likely to be clumped in their distribution on a phylogeny. The reasoning behind this is that they share traits that increase vulnerability to extinction because related taxa are often located within the same broad geographical or habitat types where human-induced threats are concentrated. Using recently developed complete phylogenies for mammalian carnivores and primates it has been shown that the majority of instances threatened species are far from randomly distributed among taxa and phylogenetic clades and display clumped distribution.[11]

A contiguous distribution is one in which individuals are closer together than they would be if they were randomly or evenly distributed, i.e., it is clumped distribution with a single clump.[12]

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Less common than clumped distribution, uniform distribution, also known as even distribution, is evenly spaced.[13] Uniform distributions are found in populations in which the distance between neighboring individuals is maximized. The need to maximize the space between individuals generally arises from competition for a resource such as moisture or nutrients, or as a result of direct social interactions between individuals within the population, such as territoriality. [20]For example, penguins often exhibit uniform spacing by aggressively defending their territory among their neighbors. The burrows of great gerbils for example are also regularly distributed,[14] which can be seen on satellite images.[15] Plants also exhibit uniform distributions, like the creosote bushes in the southwestern region of the United States. Salvia leucophylla is a species in California that naturally grows in uniform spacing. This flower releases chemicals called terpenes which inhibit the growth of other plants around it and results in uniform distribution.[16] This is an example of allelopathy, which is the release of chemicals from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes. Allelopathy can have beneficial, harmful, or neutral effects on surrounding organisms. Some allelochemicals even have selective effects on surrounding organisms; for example, the tree species Leucaena leucocephala exudes a chemical that inhibits the growth of other plants but not those of its own species, and thus can affect the distribution of specific rival species. Allelopathy usually results in uniform distributions, and its potential to suppress weeds is being researched.[17] Farming and agricultural practices often create uniform distribution in areas where it would not previously exist, for example, orange trees growing in rows on a plantation. Random distribution, also known as unpredictable spacing, is the least common form of distribution in nature and occurs when the members of a given species are found in environments in which the position of each individual is independent of the other individuals: they neither attract nor repel one another. Random distribution is rare in nature as biotic factors, such as the interactions with neighboring individuals, and abiotic factors, such as climate or soil conditions, generally cause organisms to be either clustered or spread. Random distribution usually occurs in habitats where environmental conditions and resources are consistent.[21] This pattern of dispersion is characterized by the lack of any strong social interactions between species. For example; When dandelion seeds are dispersed by wind, random distribution will often occur as the seedlings land in random places determined by uncontrollable factors. Oyster larvae can also travel hundreds of kilometers powered by sea currents, which can result in their random distribution. Random distributions exhibit chance clumps .

IV.CONCLUSIONS

Species distribution can be predicted based on the pattern of biodiversity at spatial scales. A general hierarchical model can integrate disturbance, dispersal and population dynamics. Based on factors of dispersal, disturbance, resources limiting climate, and other species distribution, predictions of species distribution can create a bio-climate range, or bio-climate envelope. The envelope can range from a local to a global scale or from a density independence to dependence. The hierarchical model takes into consideration the requirements, impacts or resources as well as local extinctions in disturbance factors. Models can integrate the dispersal/migration model, the disturbance model, and abundance model. [22]Species distribution models (SDMs) can be used to assess climate change impacts and conservation management issues. Species distribution models include: presence/absence models, the dispersal/migration models, disturbance models, and abundance models. A prevalent way of creating predicted distribution maps for different species is to reclassify a land cover layer depending on whether or not the species in question would be predicted to habit each cover type. This simple SDM is often modified through the use of range data or ancillary information, such as elevation or water distance.

Recent studies have indicated that the grid size used can have an effect on the output of these species distribution models.[22] The standard 50x50 km grid size can select up to 2.89 times more area than when modeled with a 1x1 km grid for the same species. This has several effects on the species conservation planning under climate change predictions (global climate models, which are frequently used in the creation of species distribution models, usually consist of 50–100 km size grids) which could lead to over-prediction of future ranges in species distribution modeling. This can result in the misidentification of protected areas intended for a species future habitat. The Species Distribution Grids Project is an effort led out of the University of Columbia to create maps and databases of the whereabouts of various animal species. This work is centered on preventing deforestation and prioritizing areas based on species richness[23]

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