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Highlights

Revisiting Melanin Metabolism

Genetic Structure of Sitophilus Zeamais

Discovering Thoughts, Inventing Future

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Study of the Influence of High-Frequency Currents on the Fertility of the Soil

By F. F. Mende

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I. Introduction

An increase in the fertility of soil is one of the most important tasks of any state, since the high fertility of soil is the basis of national security. This state of affairs connected with the fact that high fertility provides with foodstuffs the population of the country [1].

There are different methods of an increase in the fertility, beginning from the use of the mineral fertilizers and concluding by the correct crop rotation [2]. In tsarist Russia in view of the absence at that time of the production of the mineral fertilizers was used in essence three-field system. This system assumed sowing the useful cultures only of times in three years. Two remained years soil rested and returned the hearth of the pairs, when nothing they sowed on the ploughed earth, when in the appropriate sections of graze cattle [2].

The use of the mineral fertilizers, widely utilized in the practice of agriculture at present, not the best method of an increase in the fertility, first of all because such methods are not ecologically clean [3,4]. The use as the fertilizers of nitrates, which ensure an exuberance in the plant and its foliage, presents special danger, but at the same time its fruits and leaves are saturated by the substances, which are harmful with the use.

For the named reasons the use of ecologically clean methods of an increase in the fertility of soil presents large prospects. Let us examine one of such methods, which are used for these purposes high-frequency currents.

II. The Laws of Penetration Fields on and Currents into the Soil

Deficiencies in the use of direct currents or currents of low frequency for treating the soil it consists in the fact that such currents apply to large depths, while the layer, in which is located the root system of plants it composes several ten centimeters. Use of the high-frequency currents it makes it possible to solve this problem, since in connection with the presence of skin effect such currents apply to the small depth from the surface, which depends on frequency and ground conductivity.

The electrodynamics of material media, which include the soil Maxwell's equations are described [5-8]. For the vacuum they take the form:

$$\mathrm{rot}\,\mathbf{E} = -\partial\mathbf{B}/\partial t\,, \qquad (2.1)$$

$$\mathrm{rot}\,\mathbf{H} = \partial\mathbf{D}/\partial t\,, \qquad (2.2)$$

$$\mathrm{div}\,\mathbf{D} = 0\,, \qquad (2.3)$$

$$\mathrm{div}\,\mathbf{B} = 0\,, \qquad (2.4)$$

where $\mathbf{E}$ and $\mathbf{H}$ - tension of electrical and magnetic field, $\mathbf{D} = \varepsilon_0\mathbf{E}$ and $\mathbf{B} = \mu_0\mathbf{H}$ - electrical and magnetic induction, μ_0 and ε_0 - magnetic and dielectric constant of vacuum. From (2.1-2.4) follow the wave equations

$$\nabla^2\mathbf{E} = \mu_0\varepsilon_0\,\partial^2\mathbf{E}/\partial t^2\,,$$

$$\nabla^2\mathbf{H} = \mu_0\varepsilon_0\,\partial^2\mathbf{H}/\partial t^2\,,$$

these equations show that in the vacuum can be extended the plane electromagnetic waves, the velocity of propagation of which is equal to the speed of light of

$$c = 1/\sqrt{\mu_0\varepsilon_0}\,.$$

For the material media of Maxwell's equation they take the following form:

$$\mathrm{rot}\,\mathbf{E} = -\tilde{\mu}\mu_0\,\partial\mathbf{H}/\partial t = -\partial\mathbf{B}/\partial t\,,$$

$$\mathrm{rot}\,\mathbf{H} = ne\mathbf{v} + \tilde{\varepsilon}\varepsilon_0\,\partial\mathbf{E}/\partial t = ne\mathbf{v} + \partial\mathbf{D}/\partial t\,,$$

$$\mathrm{div}\,\mathbf{D} = ne\,,$$

$$\mathrm{div}\,\mathbf{B} = 0\,,$$

where $\tilde{\mu}$ and $\tilde{\varepsilon}$ - the relative magnetic and dielectric constants of the medium and n, e, $\mathbf{v}$ - density, value and charge rate.

Author: e-mail: fedormende@gmail.com

Since the soil is conductor, let us examine the equation of current distribution in the conductor, which follows from Maxwell's equations:

$$\nabla \mathbf{D} = \rho;$$

$$\nabla \mathbf{B} = 0;$$

$$\nabla \times \mathbf{H} = \mathbf{i} + \frac{\partial \mathbf{D}}{\partial t}; \qquad (2.5)$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \sigma \mathbf{E}$$

In these equations ρ - the charge density, $\mathbf{i}$-the current density of conductivity, which is determined by differential Ohm's law

$$\mathbf{i} = \sigma \mathbf{E}, \qquad (2.6)$$

where σ - the specific conductivity of medium.

Current density in Maxwell's equations in this case can be expressed through the tension of electric field.

Let us rewrite equation (2.5) with the aid of Ohm's law (2.6):

$$\nabla \times \mathbf{H} = \sigma \mathbf{E} + \frac{\partial \mathbf{D}}{\partial t}$$

The represented equations are recorded in general form. Let us limit to the case, when fields change according to the harmonic law $e^{j\omega t}$. then

$$\nabla \times \mathbf{H} = (\sigma + j\omega\varepsilon)\mathbf{E}$$

This equation can be still simplified, since the conduction currents in the conductors are considerably more than bias currents, consequently:

$$\nabla \times \mathbf{H} = \sigma \mathbf{E}$$

Let us take rotor from both parts of this equation and will develop equation for the left side

$$\nabla \times \nabla \times \mathbf{H} = \nabla(\nabla \mathbf{H}) - \nabla^2 \mathbf{H} = \sigma \nabla \times \mathbf{E}.$$

Substituting values $\nabla^2 \mathbf{H}$ and $\nabla \times \mathbf{E}$ from Maxwell's equations, we obtain:

$$\nabla^2 \mathbf{H} = \sigma\mu \frac{\partial \mathbf{H}}{\partial t} \qquad (2.7)$$

This is an equation of skin effect, or the equation of distribution. Similar equations can be obtained and for the electrical fields on and the current densities of conductivity.

$$\nabla^2 \mathbf{E} = \sigma\mu \frac{\partial \mathbf{E}}{\partial t} \qquad (2.8)$$

$$\nabla^2 \mathbf{i} = \sigma\mu \frac{\partial \mathbf{i}}{\partial t} \qquad (2.9)$$

If fields change according to the harmonic law, equations (2.7 - 2.9) take the form:

$$\nabla^2 \mathbf{H} = j\omega\sigma\mu \frac{\partial \mathbf{H}}{\partial t}$$

$$\nabla^2 \mathbf{E} = j\omega\sigma\mu \frac{\partial \mathbf{E}}{\partial t}$$

$$\nabla^2 \mathbf{i} = j\omega\sigma\mu \frac{\partial \mathbf{i}}{\partial t}$$

Let us accept for the conducting half-space direction of flow for the axis z, and normal to the surface for the axis x and we will consider that current distribution along the axes in z it remains constant. The equation of distribution in this case will take the form:

$$\frac{d^2 i_z}{dx^2} = j\omega\mu\sigma i_z = \tau^2 i_z,$$

where $\tau^2 = j\omega\mu\sigma$ or

$$\tau = (1+j)\sqrt{\pi f \mu\sigma}.$$

The complete solution of this equation takes the form

$$i_z = C_1 e^{-\tau x} + C_2 e^{\tau x}.$$

Constant C_2 must be equal to zero, otherwise with $x = \infty$ current it will be infinitely great, which is impossible. Constant C_1 can be determined from the boundary conditions, by considering that on the surface of conductor with $x = 0$ is satisfied the condition $i_z = i_0$. Based on this conditions, we obtain:

$$i_z = i_0 e^{-(1+j)\tau x} = i_0 e^{-\frac{x}{\delta}} e^{-j\frac{x}{\delta}}, \qquad (2.10)$$

Where $\delta = \frac{1}{\tau}$.

It follows from (2.10) the equation that the value of current density decreases exponentially an increase in the distance from the surface and decreases in e of times at a distance δ from the surface. In connection with this this value is conventionally designated as depth of penetration. Specifically, this distance should be considered the distance, up to which high-frequency currents penetrate the soil.

In moist soil the conductivity on the direct current is from 10^{-2} to 10^{-3} S/m [9]. However, it depends on frequency, as shown in Fig. 1. As can be

seen from graph with an increase in the frequency ground conductivity increases.

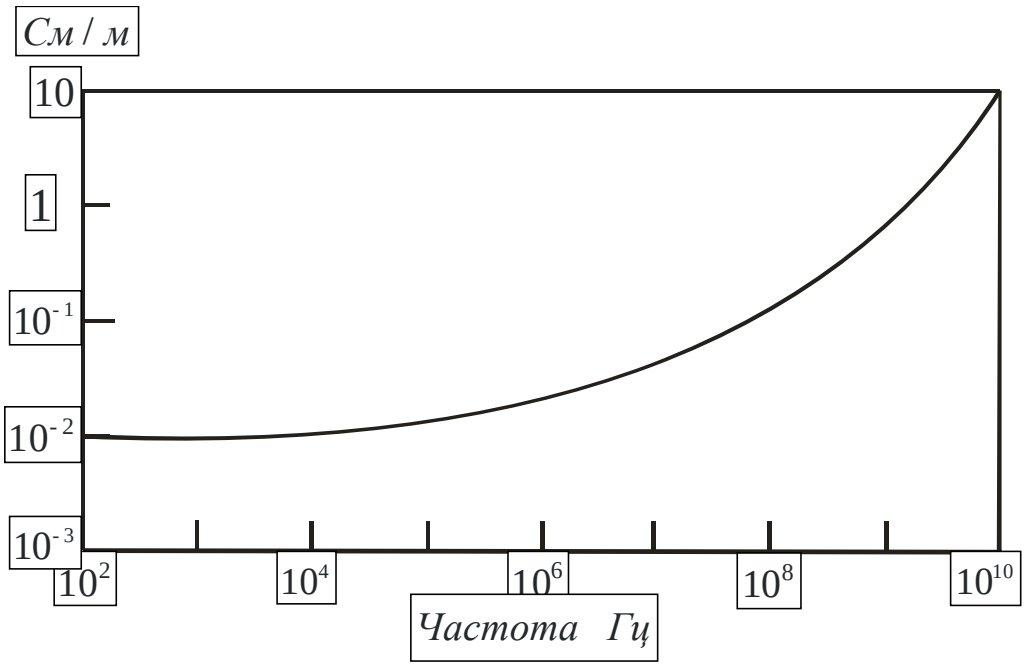

Fig. 1: Dependence of ground conductivity with humidity 10% of the frequency

The equivalent dielectric constant of moist soil also depends on frequency and with an increase in the frequency it decreases (Fig. 2).

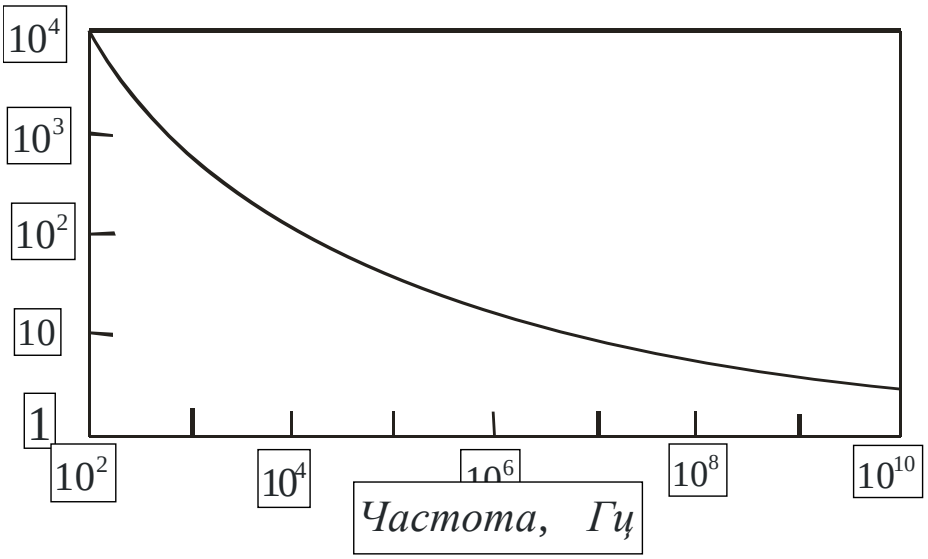

Fig. 2: Dependence of the equivalent dielectric constant of soil with humidity 10% of the frequency (along the y-axis they are postponed relative values of equivalent dielectric constant)

Using the graphs, depicted in Fig. 1 and Fig. 2, let us calculate depth of penetration fields on into the soil for the frequencies: 10^6, 10^7, 10^8, 10^9 and 10^{10}. These values will be respectively equal: 3.7m, 0.75m, 0.17m, 0.06m and 0.017m. Using these data, it is possible to select the value of frequency taking into account the depth of the germination of the root system of plants.

III. The Electrical Properties of the Biological Tissues

Biological tissues are - heterogeneous materials, with the complex microscopic structure. Separate cells constituting cloth, frequently carry out special functions and different types of cells they have

different structure. The parts of the cells – intracellular organelles - have the special specialized value. On the molecular level the cloth consists of the myriads of the most complex molecules, the simplest of which molecule of water. All these elements of cell, intracellular organelles, biomolecules, consist of the charged parts, on which the forces act, if they are placed into the electromagnetic field. The behavior of the separate elements of cell in the field depends on the field frequency, and their change as a result in the action of field it is manifested in the form the macroscopic dielectric constant of cloth. Dispersion proves to be complex even in simple biological materials. The qualitative description of the physical mechanism of that producing frequency changes in the properties is given below.

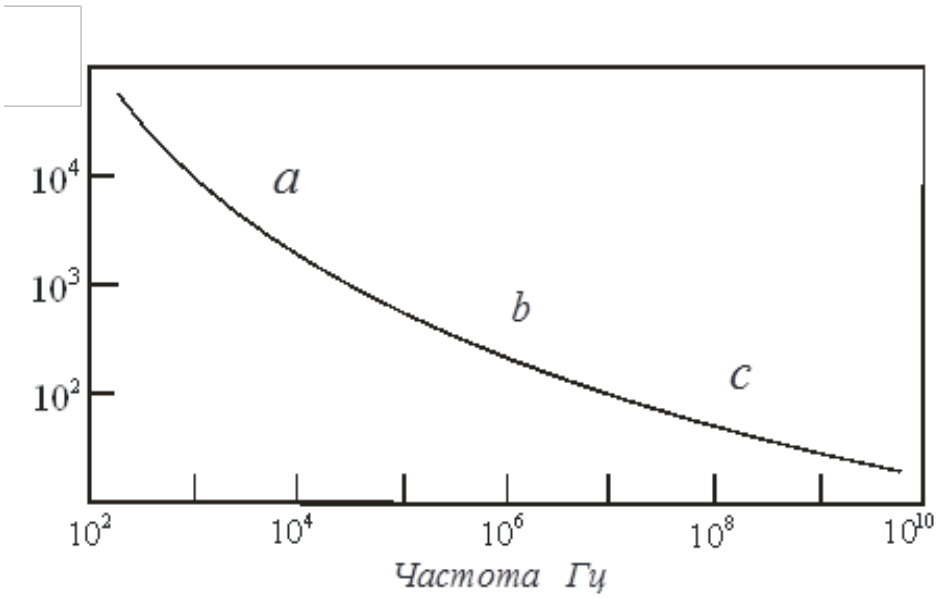

Fig. 3: Qualitative description of the dispersion of the relative the equivalent dielectric constant of biological tissue ε_{er} with the high liquid-water content (on the graph relative values ε_{er} they are postponed along the y-axis)

The dispersion of dielectric constant in different frequency bands can be connected with the specific features in the structure of biological tissue. In view of the limitedness of experimental information and complexity of problem some mechanisms proposed are more or less speculative. In Fig. 3 Is represented the dispersion of the dielectric constant $e_{of\ eq}$ of cloth with the high liquid-water content in the range of frequencies from 10 to 30 GHz. On the graph there are three regions of dispersion, which are designated by the letters a, b, c.

Dispersion of the type a is observed on the bottom edge of frequency band usually near the frequency 100 Hz and appears most incomprehensible of three forms dispersion. In this range the measured values of the permeability of the order 10^s. For the explanation to this dispersion several mechanisms were proposed, including the effect of the transfer through the cellular membrane and the relaxation of the ionic atmosphere around each cell. The ionic atmosphere is connected with the colloidal particles, which are located in the form of suspension in the solution of electrolyte. These particles are electrically charged because of constantly locating in them to ions or to the ions, adsorbed from the electrolyte. Each colloidal particle electrostatically attracts the ions of opposite sign, which surround particle, forming the dual layer of charges, or the ionic atmosphere, as shown in Fig. 4.

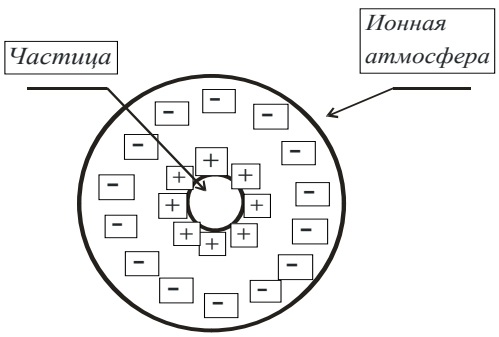

Fig. 4: N Particle in the environment of the ionic atmosphere

Electrostatic attraction makes possible to a certain degree for ions to move inside the layer along the area of the particle and it prevents them to leave surface. If we apply electric field, then the ions of opposite signs will be displaced and will create the induced resulting dipole moment for the entire particle together with its atmosphere. This moment can substantially increase the equivalent permeability of solution. According to the theory, proposed Shvarts [10], the relaxation time of dipole moment, connected

with the motion of ions, is determined by the diffusion of ions in the layer. Dispersion (or the phenomenon of relaxation) it was observed at the low frequencies in the suspensions of nonbiological substances. An example is represented in Fig. 5, (diameter of spheres -1.810 $^{-7}$, volume concentration 30%) in electrolyte solution [11].

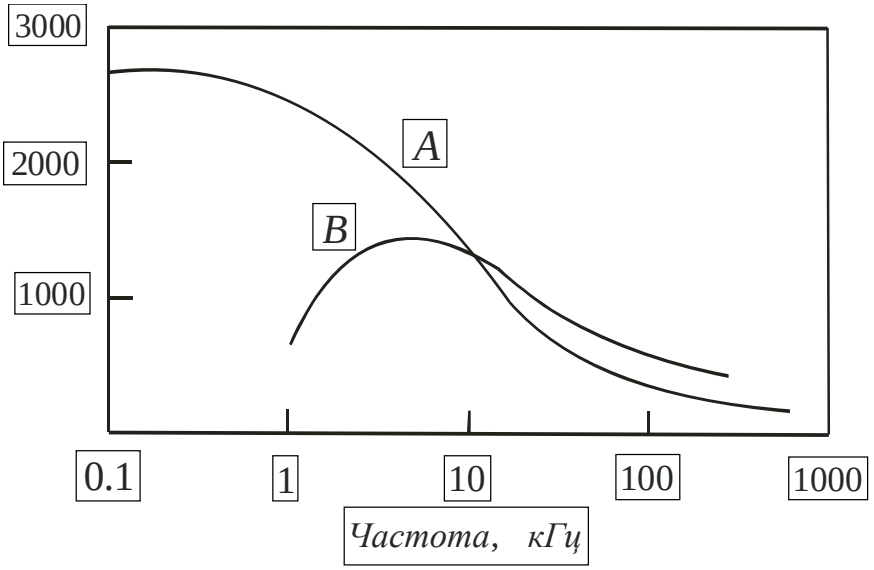

Fig. 5: Relative dielectric constant $\varepsilon_r = \varepsilon_r' + j\varepsilon_r''$ of the suspension of drop polystyrene

Dispersion of the type b (Fig. 5) it is explained by the basic structure of cell. In cloth with the high liquid-water content the internal part of the cell and the electrolyte, which surrounds it outside, is the conducting liquid, divided by cellular membrane. In this case conductivity the dielectric constant of the membrane is lower than in the divided by it media. The suspension of cells is the heterogeneous material, in which is observed the dispersion of equivalent conductivity and permeability, called Maxwell-Wagner effect.

Maxwell-Wagner effect it is easy to explain on the model of parallel-plate capacitor, shown in Fig. 6. In this model between the plates of parallel-plate capacitor are located two layers of uniform material, parallel to plates. Layers by thickness d 1 d 2 have the electrical parameters ε_1, σ_1 and ε_2, σ_2, which for simplicity are considered material and as the not depending on the frequency. For determining the equivalent parameters of two-layered material let us calculate the admittance of capacitor.

$$Y = \left[\sigma + j\omega\varepsilon_0\varepsilon_r(\omega)\right] A/d,$$

where A - the area of plates, $d = d_1 + d_2$.

From the simple correlations for the capacitor we determine conductivity on the direct current σ and relative the dielectric constant $\varepsilon_r(\omega)$ of the dual layer

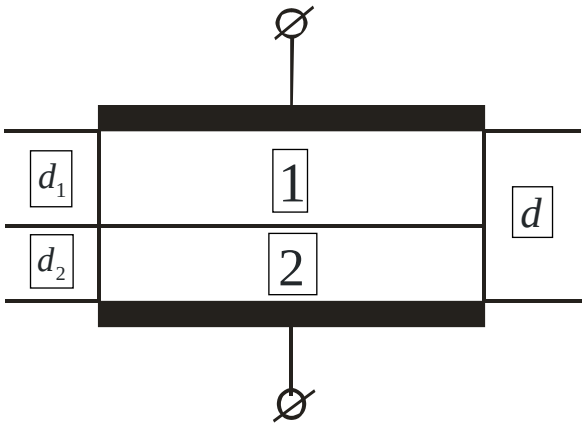

Fig. 6: Capacitor with the two-layered filling

$$\sigma = \sigma_1\sigma_2 / \left[\sigma_1(d_2/d_1) + \sigma_2(d_1/d_2)\right] \quad (3.1)$$

$$\varepsilon_r(\omega) = \varepsilon_{r\infty} + (\varepsilon_{rs} - \varepsilon_{r\infty})/(1 + j\omega\tau) =$$

$$\varepsilon_{r\infty} + \frac{\varepsilon_{rs} - \varepsilon_{r\infty}}{1+\omega^2\tau^2} - j\frac{\omega\tau(\varepsilon_{rs} - \varepsilon_{r\infty})}{1+\omega^2\tau^2} \quad (3.2)$$

$$\varepsilon_{r\infty} = \varepsilon_{r1}\varepsilon_{r2} / \left[\varepsilon_{r1}(d_2/d_1) + \varepsilon_{r2}(d_1/d)\right] \quad (3.3)$$

where

$$\varepsilon_{rs} = \left[\varepsilon_{r1}\sigma_2^2(d_1/d) + \varepsilon_{r2}\sigma_1^2(d_2/d)\right] / \left[\sigma_1(d_2/d) + \sigma_2(d_1/d)\right]^2 \quad (3.4)$$

$$\tau = (\varepsilon_{r1} d_2 + \varepsilon_{r2} d_1)\varepsilon_0 / (\sigma_1 d_2 + \sigma_2 d_1) \quad (3.5)$$

As can be seen from formula (3.2) the equivalent permeability of filling of capacitor depends on frequency, although the basic parameters of its parts (two layers) of the frequency do not depend. Formula (3.2) shows that the expression for the permeability of heterogeneous material takes the same form as for the uniform material with the dipole relaxation and the unique value of relaxation time τ.

If we into the capacitor place the multilayer material, which consists of n the parallel layers of material 1 with the overall thickness d_1 and n the layers of material 2 with the overall thickness d_2, that the main equivalent parameters of heterogeneous filling will be determined by formulas (3.1) and (3.5). As a result Maxwell-Wagner effect the value of the low-frequency permeability ε_{rs} of heterogeneous filling proves to be greater than permeability value of each individual part ε_{r1} and ε_{r2}. For example if σ_2 much more σ_2 and $\varepsilon_{r2} = 1$, the attitude $\varepsilon_{rs} / \varepsilon_{r1}$ much more than one with d_1 / d much more than one. Maxwell-Wagner effect in the suspension of biological cells is considerably more complex than in two-layered capacitor. However, the results of the analysis of this effect in both layersare similar. For the qualitative analysis of relaxation explanations introduced equivalent diagram (Fig. 7), approximately describing average biological cell in the suspension [13]. Electric current in the cell and its nearest environment is shown in Fig. 7. It consists of two parts. Current passing through the cellular membrane and the internal part of the cell, is elements R_i and C_m equivalent diagram, while the current, which flows along the environment near the cell, is the elements R_e, C_e. Admittance on the contacts of diagram in Fig. 8 it is equal

$$Y_e = G_e + \frac{\omega^2 \tau^2 G_i}{1 + \omega^2 \tau^2} + j\omega \left[C_e + \frac{C_m}{1 + \omega^2 \tau^2} \right]$$

where $\tau = G_m / G_i$, $G_e = 1/R_e$, $G_i = 1/R_i$.

If we consider that the bilogical material consists of such average cells, then the layer of material, placed into the capacitor, can be considered as the system, which consists of many equivalent diagrams, which present separate cell and connected together in different sequential or parallel combinations. For example, if N - the number of cells per unit of volume of material, A - the area of the plates of capacitor, d - the distance between the plates, then the volume of material Ad can be considered parallel combination from $\left[AN^{2/3}\right]$ the diagrams, each of which presents sequential combination from $\left[dN^{1/3}\right]$ the simple equivalent diagrams. Then the admittance, measured on the contacts of capacitor will be

$$Y = \left[\sigma + j\omega\varepsilon_0\varepsilon_r(\omega)\right] A/d = Y_e \frac{\left[AN^{2/3}\right]}{\left[dN^{1/3}\right]} \approx Y_e N^{1/3} A/d \quad (3.6)$$

$$\sigma + j\omega\varepsilon_0\varepsilon_r(\omega) \approx N^{1/3} Y_e \quad (3.7)$$

Where the brackets [ ] indicate the greatest integer value of value.

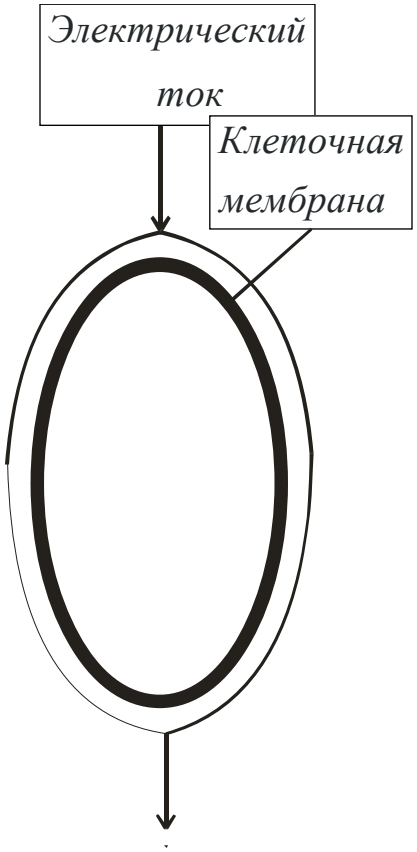

Fig. 7: Biological cell

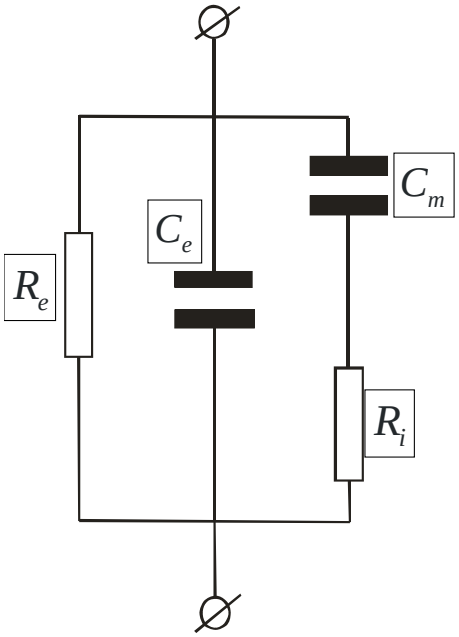

Fig. 8: Approximate equivalent electrical schematic of the cell

Proximate analysis shows that the basic parameters of medium are simply connected with the equivalent admittance of cell, which has the same dispersion. As a result the assumptions, accepted with the analysis, expression for the equivalent admittance (3.6) takes the same form as expression for the permeability of material with the dipole relaxation, characterized by the unique value of relaxation time τ.

In the general case of dispresiya type b it is characterized by the time allocation of relaxation. The carried out consideration shows that dispersion of the type b with the electrically heterogeneous structure of cell. An order of magnitude of relaxation time can be estimated, examining typical cell. Capacity C_m and complete conductance G_i enter into expression for the relaxation time. In the first approximation, capacity C_m is connected with the membrane of cell and possible are to assume that C_m proportional $r^2\varepsilon_m / t$, where r - a radius of cell, t - the thickness of the membrane, ε_m - the dielectric constant of the membrane. Analogously conductivity is connected with the current in the cell and must depend on the conductivity of media inside and outside the cell. Since these media have approximately identical conductivity σ_i, possible is to assume that G_i proportional $r^2\sigma_i / r$, then relaxation time is obtained order $r\varepsilon_m / t\sigma_i$ for the typical parameters of the cell $r = 10^{-5} m$, $t = 10^{-8} m$, $\varepsilon_{rm} = 3$, $\sigma_i = 1\ Cm/m$, $\tau = 2.7x10^{-8} s$, which corresponds to central frequency about 6 MHz. In the cloths, which consist of the cells of large radii, the dispersion of such type is observed with the lower frequencies.

Dispersion of the type c occurs at the higher frequencies and is caused by the dipole relaxation of the free water, which is contained in the cloth.

It should be noted that the frequency of dispersion is the higher, the less the physical dimensions of structure. The dispersion, connected with the cell, occurs at the low frequencies. Finally dispersion at the high frequencies is connected with the presence of water.

IV. Technical Realization of Experiments on a Study of the Influence of Currents in the Soil on its Fertility

In the previous division it is shown that the currents of different frequency, which flow through the soil and the root system of plants, differently penetrate the root system, therefore, and the influence of these currents on the cells of root system is different. This circumstance can influence an increase in the plants, and, therefore, also to their increase and productivity. It is shown also, that depending on current frequency they penetrate into the soil to different depth, which gives the possibility to localize time currents in its surface layer. This gives the possibility to economize energy, which must be expended on the excitation of such currents. The second important circumstance is the fact that with the aid of such currents it is possible to warm thoroughly soil both before the sowing and during an increase in the plants.

The procedure examined is separately productive in the hot-houses or over the small areas, which are characteristic for the homestead sections.

The realization of this procedure is characterized by laying into the soil of the bare wires, to which is connected the electric generator of the corresponding frequency and power. The distance between similar is selected by wires depending on the method of fitting the plants in the hot-house. For example, cucumbers are planted in the hot-houses by numbers; therefore its pair of wires is necessary for each such number. With the debarkation of plants it follows to embed by jack method into the soil several lines of the wires at the specific distance, after connecting between themselves even and odd lines. The procedure examined makes it possible in one and the same hot-house to carry out the comparisons of an increase in the plants, when currents act on the root system and when they do not act. For this generator they connect to the specific pair of wires, after leaving rest without the nourishment. It is possible to also carry out the comparison of an increase in the plants in one and the same hot-house, introducing into different pairs of wires the currents of different frequency and power.

The obtained results can be used for developing the technical task for the industrial production of generators for the purposes indicated.

V. Conclusion

In the article questions of the penetration of the electric currents of different frequency into the soil are examined. Is built the electric analogue of the organic cellular structures, which the root system of plants is. The dispersion properties of such structures are explained. The technical realization of experiments on a study of the influence of high-frequency currents in the soil on its fertility is proposed.

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Revisiting Melanin Metabolism with Revision

Revision of Our Research on Grey Hair Turning Black with Bioinformatics

By Bhaskar Vyas, Rajni Vyas & Anant Marathe

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Genesis of this report is due to several requests, initially generated by publication in a regional news magazine, Gujarat Medical Journal. We noted, as an accidental finding in our ongoing research on neuro-degenerative diseases treated with Bone Marrow derived Mesenchymal Stem Cells (BM-MSCs) or with Adipose Derived Mesenchymal Stem Cells (ADMSCs). We decided to academically progress the research by publishing it in a journal devoted to stem cell research [1]. This publication in turn has generated global interest and we are receiving reprint requests and the protocols. Meanwhile we have successfully translated ADMSCs to all three germinal layers [2]. Potential is thus expanded to a new drug discovery [3] OA paper [4] Diabetes paper.

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REVISITINGMELANINMETABOLISMWITHREVISION

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Bhaskar Vyas [α], Rajni Vyas [σ] & Anant Marathe [ρ]

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Advances in bioinformatics have so progressed that using computers as a dry lab, enormous data can be accessed. We therefore report on the progression of our research on MSCs as well as results obtainable with bioinformatics on several cytokines that may have impinged our research.

II. Materials and Methods

BM-MSCs are reported to have 120 cytokines and chemokines.[5] To publish the data on all 120 molecules that are being secreted from BM-MSCs would be far too voluminous. So, we summarize only with a largely secreted molecule, IL-6. IL-6 has a property to impact the functions of the cells of various tissue types. IL-6 search yields two different leads.

1-Molecular Function, that generates the following further leads, such as

- cytokine activity
- growth factor activity
- interleukin-6 receptor binding

2- Biological process search will yield the processes where IL-6 mediates are enumerated as follows:

- acute-phase response
- cellular protein metabolic process
- cellular response to hydrogen peroxide
- cellular response to lipopolysaccharide
- cytokine-mediated signalling pathway
- endocrine pancreas development
- glucagon secretion
- hepatic immune response
- humoral immune response
- inflammatory response
- interleukin-6-mediated signalling pathway
- maintenance of permeability of blood-brain barrier
- monocyte chemotaxis
- negative regulation of apoptotic process
- negative regulation of bone resorption
- negative regulation of cell population proliferation
- negative regulation of chemokine biosynthetic process
- negative regulation of collagen biosynthetic process
- negative regulation of fat cell differentiation
- negative regulation of interleukin-1-mediated signalling pathway
- negative regulation of lipid storage
- neuron cellular homeostasis
- neuron projection development
- neutrophil apoptotic process
- neutrophil mediated immunity
- platelet activation
- positive regulation of acute inflammatory response
- positive regulation of apoptotic DNA fragmentation
- positive regulation of apoptotic process
- positive regulation of B cell activation
- positive regulation of cell population proliferation
- positive regulation of chemokine production
- positive regulation of DNA-binding transcription factor activity

Author α σ ρ: Total Potential Cells Pvt. Ltd., Vadodara, India.
e-mail: bhaskarvyas2007@gmail.com

- positive regulation of epithelial to mesenchymal transition
- positive regulation of extracellular matrix disassembly
- positive regulation of gene expression
- positive regulation of glial cell proliferation
- positive regulation of immunoglobulin secretion
- positive regulation of interleukin-17 biosynthetic process
- positive regulation of interleukin-6 production
- positive regulation of leukocyte chemotaxis
- positive regulation of MAPK cascade
- positive regulation of neuroinflammatory response
- positive regulation of osteoblast differentiation
- positive regulation of peptidyl-serine phosphorylation
- positive regulation of smooth muscle cell proliferation
- positive regulation of T cell proliferation
- positive regulation of T-helper 2 cell cytokine production
- positive regulation of transcription, DNA-templated
- positive regulation of transcription by RNA polymerase II
- positive regulation of translation
- positive regulation of type B pancreatic cell apoptotic process
- positive regulation of vascular endothelial growth factor production
- post-translational protein modification
- regulation of angiogenesis
- regulation of astrocyte activation
- regulation of microglial cell activation
- regulation of neuroinflammatory response
- regulation of vascular endothelial growth factor production
- response to glucocorticoid
- T-helper 17 cell lineage commitment

A linear computer search yields random non-serialized progression of data as listed above. Each of the above will generate one or more leads that get integrated into numerous metabolic processes. The process is tedious, time consuming and will need integration with in-depth understanding of the process. In contrast, bioinformatics with its unique, refined software tools will process all of the above to give a result in the form of processes in progress chart. This chart will indicate the genes responsible for protein production such as STAT3 and will also include the proteins that constitute a receptor binding site such as EBS. Thus bioinformatics generates composite information concerning this scientific knowledge based on technology of gene expression of DNA, proteomics [7].

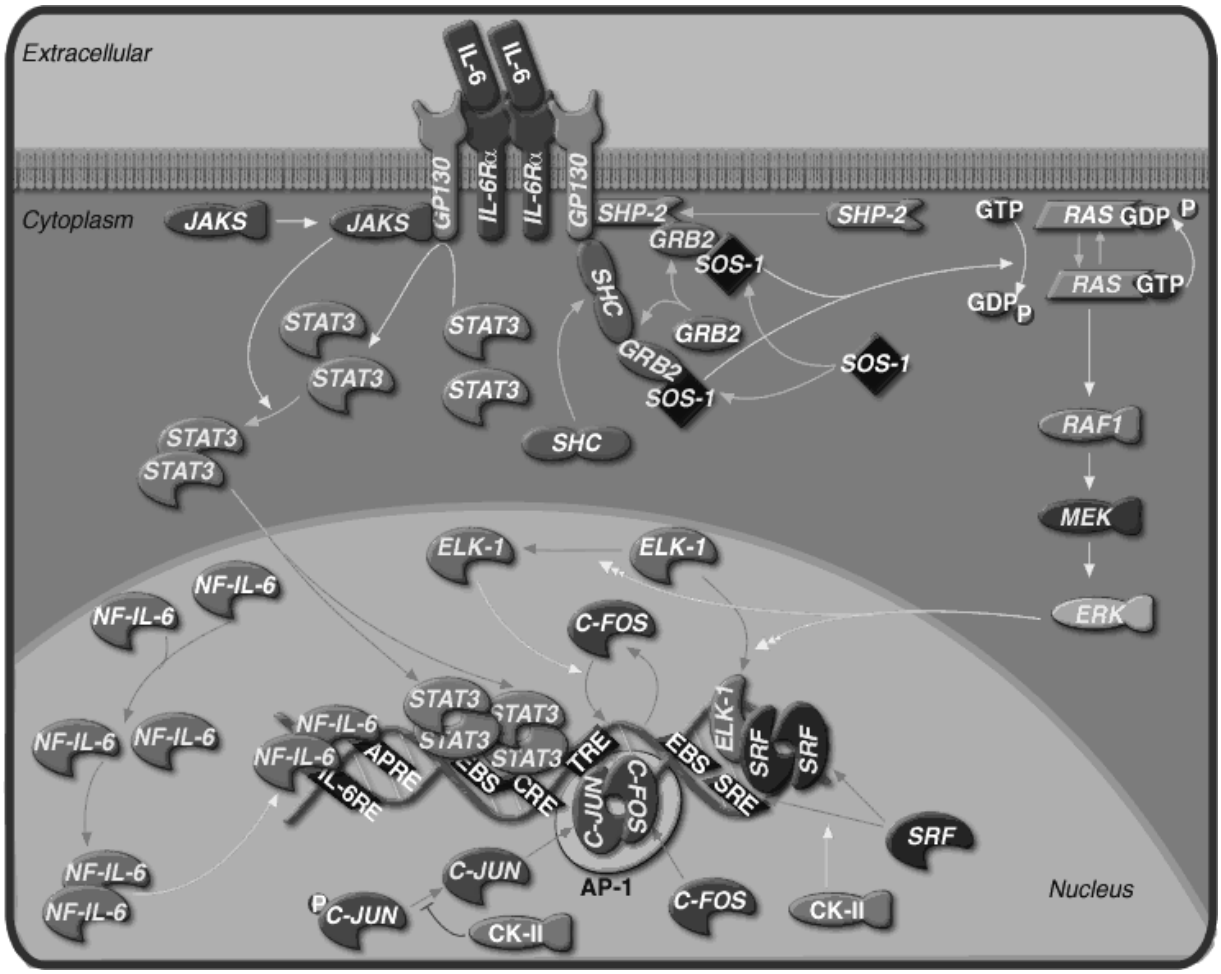

Fig. 1: https://data.broadinstitute.org/gsea-msigdb/msigdb/biocarta/human/h_il6Pathway.gif[6]

Melanin synthesis involves approx. 1500 proteins. Melanogenesis, in turn is influenced by several intrinsic factors such as molecules secreted by surrounding keratinocytes, fibroblasts, neural or endocrine cells. [8]

Focalization was arrived by consideration of the following factors:

1. Hair is ectodermal tissue.
2. Melanin is secreted by melanocytes that are regulated by melanocyte-stimulating hormones secreted by the skin, pituitary gland and hypothalamus. Endogenous secretions originate from endodermal tissue.
3. Mesenchymal Stem Cells are derived from the mesenchymal tissue.

We further focalize on IL-6 as one of the prime cytokines secreted by MSCs. It was selected for following reasons:

1. Endocrine pancreas development
2. Glucagon secretion
3. Interleukin-6-mediated signalling pathway
4. Negative regulation of bone resorption
5. Neuron cellular homeostasis
6. Positive regulation of epithelial to mesenchymal transition
7. Positive regulation of osteoblast differentiation
8. High expression of CD44 marker[9]

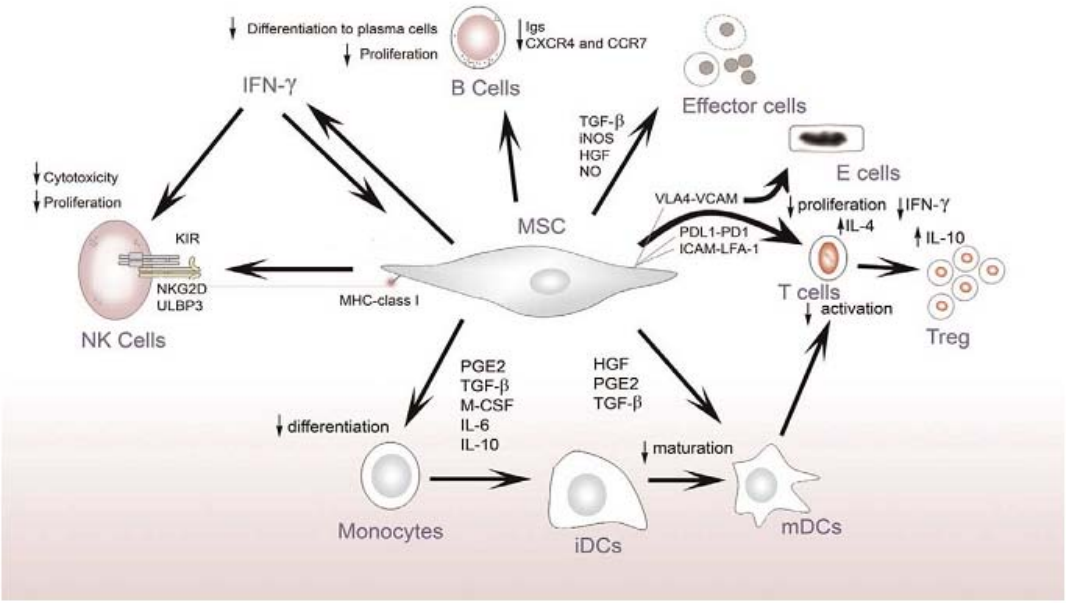

Fig. 2: Bioinformatics of mesenchymal stem cells

Legend:
NK Cells – Natural Killer Cells
KIR - Killer cell immunoglobulin-like receptors
ULBP3 - UL16-binding protein 3
IFNγ - Interferon gamma
MHC - major histocompatibility complex
PGE2 - Prostaglandin E2
TGF-β - Transforming growth factor beta
M-CSF – Macrophage Colony stimulating factor
IL – Interleukin
Igs – immunoglobulin
CXCR-4 - C-X-C chemokine receptor type 4
CCR-7 - C-C chemokine receptor type 7
iNOS – Nitric Oxide Synthase
HGF – Hepatocyte Growth Factor
PDL 1 - Programmed death-ligand 1
PD1 - Programmed cell death protein 1
ICAM - Intercellular Adhesion Molecule

Simplified bioinformatics chart (Fig. 2) arrived at the following properties as derived from various molecules as expressed by MSCs:

1) Multilineage translation
2) Facility to migrate to affected tissue and translate to it
3) Anti inflammatory property by virtue of paracrine secretions
4) Regenerative capability
5) They are HLA-DR negative, which makes them immunonaive.

Indian Council of Medical Research and Drug Controller General of India informed.

III. Results

Spindle shaped cells with a large molecule suggested a phenotype of BM-MSCs. This was verified with positive CD44 marker at National Centre for Cell Biology, Pune.

ADMSCs were verified with 4 positive markers, CD 44, CD 105, CD29 and CD 90 [Fig.3]

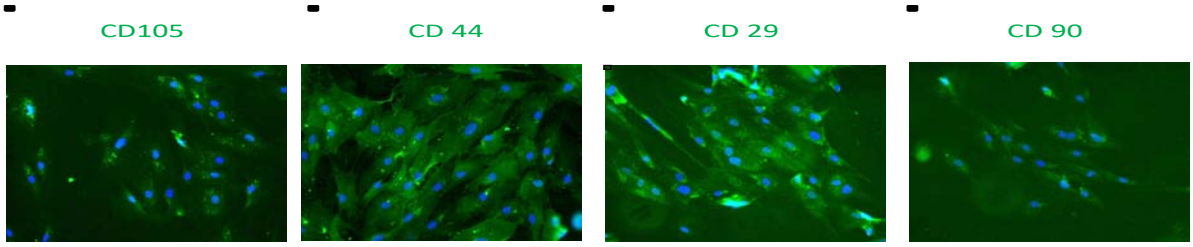

Fig. 3: CD positive markers CD105, CD44, CD29 and CD90.

ADMSCs were translated to a neuronal cell [Fig.4], Insulin secreting cell [Fig.5] and chondrocytes [Fig.6].

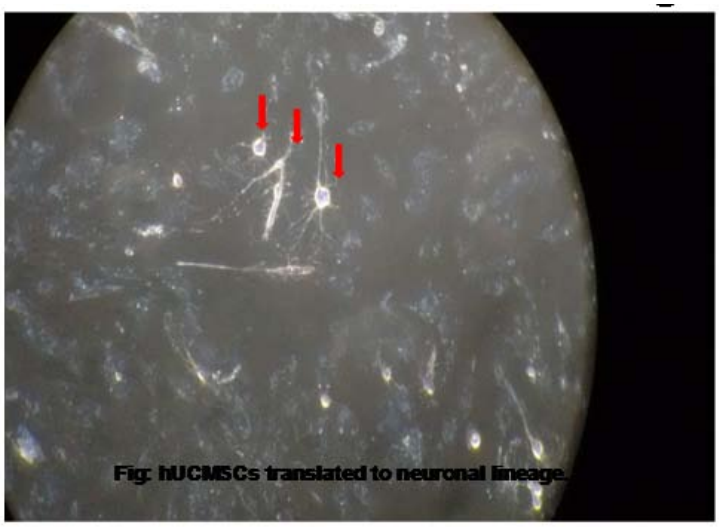

Fig. 4: Translation to neuronal cell

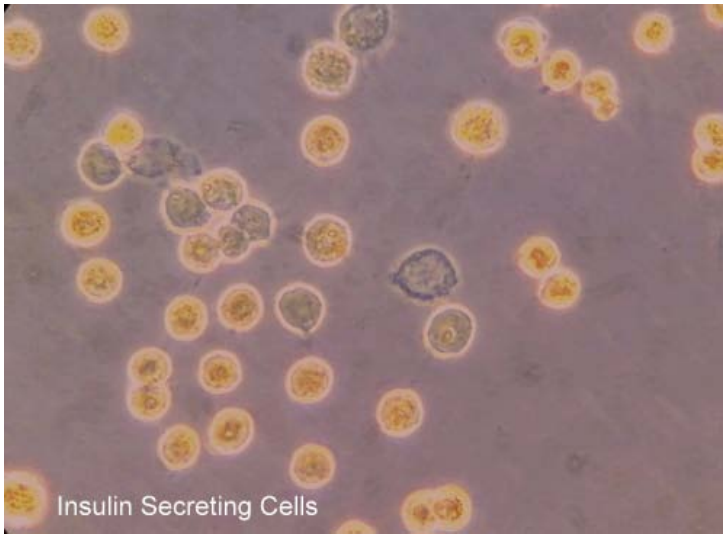

Fig. 5: Translation to Insulin secreting cell

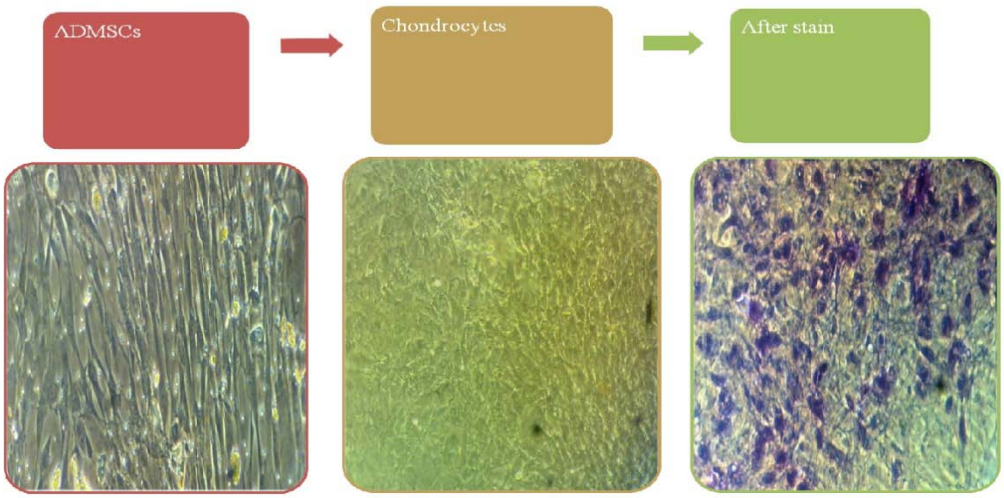

Fig. 6: Translation to chondrocytes

This yielded a proof of concept for preliminary clinical trial for application to degenerative neuronal conditions, diabetes mellitus: Type 1, Type 2, Maturity Onset Diabetes of Young Adults [4] and Osteoarthritis [3].

ICMR and DCGI notify that Stromal Vascular Fraction and MSCs are drugs that need to be investigated further.

IV. Discussion

While researching in a preliminary clinical mode, application of MSCs to diverse degenerative neurological conditions, an accidental finding of grey hair turning to black was observed. This paper highlights that howsoever ambiguous a finding in research, it should not be given a pass. Nature may appear to be playing dice but it does not.

Had Alexander Fleming given a pass to a chance non-occurrence of microbial growth in a particular Petri dish, penicillin may not have been discovered. Therefore, every occurrence, howsoever trivial, must be explained. Researchers usually publish positive results. We should derive inference as to how 10 of the 14 patients did not show the positive signs.

This accidental finding has charted a pathway to possible new drug discoveries. The process will take long to go through various stages of clinical trials. Yet, it is established, with additional evidence as presented in this research that it is plausible that ADMSCs may be a futuristic drug.

The paper also highlights how bioinformatics shortens the processes that would have taken a long time to establish in a wet lab.

V. Conclusion

The paper highlights that accidental findings do have a process that would have generated the occurrence. The process in melanogenesis involves all 3 germinal layers. That paved the way to a plausible clinical application of ADMSCs to apparently diverse appearing clinical conditions.

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Phylogenetic, Demogenetic Evolution and Genetic Structure of *Sitophilus Zeamais* in Sahelo-Sudanian Climatic Zone of West Africa (Senegal, Mali, Niger, Burkina Faso, Guinea Conakry)

By Ngagne Demba Sarr, Mama Racky Ndiaye & Mbacké Sembène
University Cheikh Anta DIOP Dakar

Abstract- Knowledge of the genetic distribution of *Sitophilus zeamais*, the main pest of maize stocks in West Africa, is a prerequisite for securing conserved maize crops. So far, most of the studies carried out to find a solution to the huge losses have been to identify bio-insecticides of vegetarian origin.

This article aims to highlight a possible genetic structure of *S. zeamais* according to 5 countries of the semi-arid zone [23], to identify the types of demographic and phylogenetic evolution of the populations of the insect in these countries.

Keywords: *zeamais sitophilus, genetic structure, semi-arid zone, selection, cytochrome B.*

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This article aims to highlight a possible genetic structure of *S. zeamais* according to 5 countries of the semi-arid zone [23], to identify the types of demographic and phylogenetic evolution of the populations of the insect in these countries.

This study will then make it possible to know the populations of the countries most prone to survival or extinction, through the evaluation of their genetic diversity and the identification of the type of selection that specifies them. To reach this objective, 60 insects were harvested in the countries. Exploitation of the Cytochrome B gene sequences corresponding to these individuals by population genetic study software (Bioedit, DNAsp, Mega, Harlequin, etc.) revealed a genetic structure of *S. zeamais* according to the 5 countries in the area, a close relationship between the populations of the insect which would be originating in Niger and at the end of the models of demographic evolution which are not confirmed however by the demogenetic tests.

Keywords: zeamais sitophilus, genetic structure, semi-arid zone, selection, cytochrome B.

I. Introduction

The maize weevil known scientifically as *Sitophilus zeamais* is a cosmopolitan insect particularly widespread in West Africa. The large losses of corn stocks with the significant socio-economic consequences that it causes have raised prospects for solutions. In semi-arid zones, most of these studies attempt to identify bio-insecticide products from plants [24], while genetic knowledge of the insect is also essential for an effective and sustainable solution. Thus this article aims on the one hand to highlight a possible genetic structure of *S. zeamais* according to 5 countries (Senegal, Niger, Mali, Burkina Faso, Guinea Conakry) of the semi-arid zone of Africa West and on the other hand to identify the types of demographic evolution of the populations of the insect in these countries and their degree of kinship.

The demonstration of a genetic differentiation of the insect according to these countries and the knowledge of the type of selection which characterizes the populations of the countries will make it possible to apprehend the capacities of survival of the insect in each country.

To achieve this objective, *Sitophilus Zeamais* insects were sampled in each of the 5 countries mentioned above. The 60 sequences corresponding to all of the individuals were exploited by software for studying population genetics (Bioedit, DNAsp, Mega, Harlequin, etc.), in relation to genetic structuring parameters (genetic distance, Fst, etc.), in relation to the objectives.

II. Materials and Methods

a) Sampling

i. Sampling locations

Harvesting of *zeamais Sitophilus* individuals was carried out in five (5) countries in the semi-arid zone [23]. These are Senegal, Mali, Burkina Faso, Guinea Conakry and Niger. (Table I).

Author α: Faculty of sciences and Technology, Department of Animal Biology, University Cheikh Anta DIOP Dakar, Senegal.
e-mail: ngagnedembasarr@gmail.com
Author σ: Faculty of sciences and Technology, Department of Animal Biology, University Cheikh Anta DIOP Dakar, Senegal.
e-mail: kiiraa12@gmail.com
Author ρ: Faculty of sciences and Technology, Department of Animal Biology, University Cheikh Anta DIOP Dakar, Senegal.

Table I: Sampling country

Countries	Sample Code	Number of individuals	Geographic coordinates	
			Latitude	Longitude
Senegal	SzSn	20	14°29'51''N	14°27'09''W
Mali	SzMl	10	17°34'14''N	03°59'46'' W
Burkina Faso	SzBf	10	12°14'99''N	01°33'42''W
Guinea Conakry	SzG	10	09°56'44''N	09°41'48''W
Niger	SzNg	10	17°36'28''N	08°04'54''W

ii. *Harvest of individuals*

In each of the above countries, 250 g to 1 kg of infested corn were collected from storage locations, through project partners. The samples have been sent to the laboratory where they are kept in jars with mesh lids for mass breeding. The insects collected at the end of this breeding were kept in alcohol at 95°C, then transported to the laboratory for a genetic study. Each sample is identified by a code: the first 2 letters designate the binomial name of the species (S for Sitophilus and z for Zeamais), the 2 letters which follow indicate the country of origin (example: SzSn, with S = Sitophilus, z = zeamais, Sn = Senegal. SzBf, with S = Sitophilus, z = zeamais, Bf = Burkina Faso.

b) Molecular method of analysis

The cytochrome B gene was chosen to be amplified. The choice is explained by its particularity to keep very long without wear and it is used regularly in the studies of insects [7].

i. *DNA extraction*

Extraction is the technique of releasing DNA from the cell. It includes the individualization of cells (digestion) and the destruction of their plasma and nuclear membranes (lysis). The digestion of the cells consisted of placing their legs and prothorax in tubes containing ATL buffer and proteinases K. After incubation, the tubes were centrifuged to separate the supernatant from the cell debris. To destroy cell membranes, cell lysis buffer (LA) was added first, then ethanol (96%) after incubation, in the tubes. Then the tubes are passed through columns with a silica membrane. Finally the centrifugation of the tubes made it possible to retain DNA on the siliceous membranes of the columns because it was negatively charged.

ii. *DNA purification*

The DNA of the tubes was purified by adding 2 buffers AW1 and AW2 in each column. After centrifugation of the tubes and precipitation of the DNA at the bottom, the buffers and the contaminants are discarded. The columns are then replaced in other tubes in which AE buffer has been added to unhook the DNA. The DNA is thus removed and stored at -20°C.

iii. *PCR of the mitochondrial Cytochrome B gene*

The PCR of the mitochondrial Cyt.B gene was carried out by 2 primers defined by Simon et al [21]. For each sample (tube), the amplification was made from a total volume of 25 µl, including a mixed volume of 23 µl and a volume of 2 µl of DNA extract. The mixed volume was made up of : 18.3 µl of milli water, 2.5 µl of 10X buffer, 1 µl of additional Mgcl 2, 0.5 µl of Dntp, 0.25 µl of each primer and 0.2 µl of Taq polymerase. (Table II)

Table II: Identification of the primers used and programming of the PCR

Gene	Primer Names	Primer Sequences	PCR Program
Cyt.B	CB-J-10933(F)	5-TATGTACTACCATGAGGACAAATATC-3	1. Initial denaturation: 94°C, 3 min ; 35 denaturation cycles : 94°C, min 2. Hybrization: 47°C, 1 min 3. Elongation: 72°C, 2 min ; elongation finale: 72°C, 8 min
	CB-N-11367(R)	5-ATTACACCTCCTAATTTATTAGGAAT-3	

iv. *Bioinformatics analyzes*

The sequences were corrected and aligned by the Clustal software implemented in the Bioedit program version 7.2.5 [6].

The genetic structure of *Sitophilus zeamais* has been understood in relation to parameters of genetic differentiation. These are genetic distance, Fst, Nm and the Amova Test. The genetic distance between countries was calculated by the Mega 7 software version 7.0.14 [6], the global Nm and Fst indices by the DNAsp software, while the Fst values between populations were calculated by the Arlequin software version 3.5.1.3 [3]. The AMOVA test, on the other hand, made it possible to determine the share of populations and individuals in the genetic structure of the insect.

Using the mitochondrial Cyt.B gene, the Network software[1] made it possible to construct the haplotype network using the maximum parsimony method.

The demographic history of the populations sampled in the different countries was apprehended from a "mismatch distribution" analysis of the populations, correlated with the evaluation of the demographic tests of D de tajima, Fs de Fu [5], of R2 of Ramos and H of Fay and Wu. This analysis is accredited by the demographic indices SSD (sums of squares of deviations) and RAG, calculated between distributions observed and expected by the software Arlequin 3.5.13 [3]. The values of D of tajima, of Fs of Fu were calculated by the software Arlequin 3.5.13[3]. While those of R2 of Ramos and H of Fay and Wu were calculated by DNAsp software.

Phylogenetic reconstruction makes it possible to clarify the relationships of kinship existing between haplotypes identified in the different agroecological zones. So in our study, we built 2 phylogenetic trees, one using the maximum parsimony (MP) method and the other using the maximum likelihood (MC) method, using the software Mega vesion7.0.14 [21]. The comparison of these 2 trees allowed to check the coherence of the interpretation of the phylogeny of the populations.

III. Results and Discussion

a) Results

i. Genetic structuring parameters

The Malian population of *S. zeamais* is homogeneous. The individuals of Burkina Faso and Guinea Conakry are genetically close (small genetic distance). On the other hand, the populations of Senegal and Niger which are characterized by high values of genetic distance, are made up individually of divergent insects. (Table III).

Table III: Genetic distance of *S. zeamais* within countries (all values are significant)

Countries	Genetic Distance	Standard deviation
Senegal	0,027	0,014
Mali	0,000	0,000
Niger	0,027	0,014
Burkina Faso	0,014	0,011
Guinea Conakry	0,011	0,006

The genetic distance between populations in the countries indicates that individuals from Mali and on the one hand from Guinea Conakry and on the other hand from Burkina Faso are genetically very close. The pairs of populations Burkina Faso-Guinea Conakry, Niger-Mali and to a lesser extent Mali-Senegal, have low genetic distance values. However, the values are high for the pairs Burkina Faso-Niger, Burkina Faso-Senegal, Senegal-Guinea Conakry and Niger-Guinea Conakry and very high between Niger and Senegal (Table IV).

Table IV: Genetic distance between countries (all values are significant)

Genetic Distance	Senegal	Mali	Niger	Burkina Faso	Guinea Conakry
Senegal		0,012	0,007	0,013	0,009
Mali	0,022		0,008	0,014	0,010
Niger	0,008	0,015		0,011	0,004
Burkina Faso	0,024	0,032	0,019		0,012
Guinea Conakry	0,014	0,022	0,007	0,024	

The values of Fst are relatively low for the pairs of populations Senegal-Mali, Senegal-Guinea Conakry and Mali-Niger. They are relatively high between Senegal and Niger and between Senegal and Guinea Conakry. But the values are very high between the pairs of countries Senegal-Burkina Faso, Guinea-Burkina Faso and Mali-Guinea Conakry. (Table V).

Table V: The values of Fst between the countries (the values in bold are not significant)

Fst	Senegal	Mali	Niger	Burkina Faso	Guinea Conakry
Senegal					
Mali	0,1736				
Niger	0,2216	0,1944			
Burkina Faso	0,2848	0,3282	**0,0455**		
Guinea Conakry	0,1427	0,2963	0,2106	0,3140	

Even if the Nm is more suitable for microsatellites, its values here attest those of Fst. Indeed, pairs of countries which are characterized by very high Nm values (Nm greater than 1) have low Fst values, (Table VI).

Table VI: Values of Nm between countries (all values are significant)

Country1	Country 2	Nm
Burkina Faso	Niger	5,24
Burkina Faso	Mali	0,51
Burkina Faso	Senegal	0,67
Burkina Faso	Guinea Conakry	0,55
Niger	Mali	1,04
Niger	Senegal	1,00
Niger	Guinea Conakry	0,94
Mali	Senegal	0,79
Mali	Guinea Conakry	0,59
Senegal	Guinea Conakry	1,17
Population Globale		0,90

The AMOVA Test corroborates the genetic structure of S. zeamais according to the 5 countries of the semi-arid zone, with a high Fst is significant. But the share of genetic variation in countries' populations in genetic differentiation is smaller than that of individuals within a population. (Table VII).

Table VII: AMOVA test (all values in gray are significant).

Source of variance	Degrees of liberty	Sum of squares of deviation	Variance components	Pourcentage of variance	Fixation indix
Between countries	4	34.817	0,5699 Va (Fst)	21,72	**Fst= 0,217**
Within countries	55	113,000	2,0545 Vb	78,28	**Fst= 0,783**
Total	59	147,817	2,6245	100	1,000

The Mantel Test reveals a negative correlation between genetic distance and geographic distance because r is negative and significant. (r = -0.534, P = 0.005). In other words when the geographic distance increases the genetic distance decreases. (Figure I).

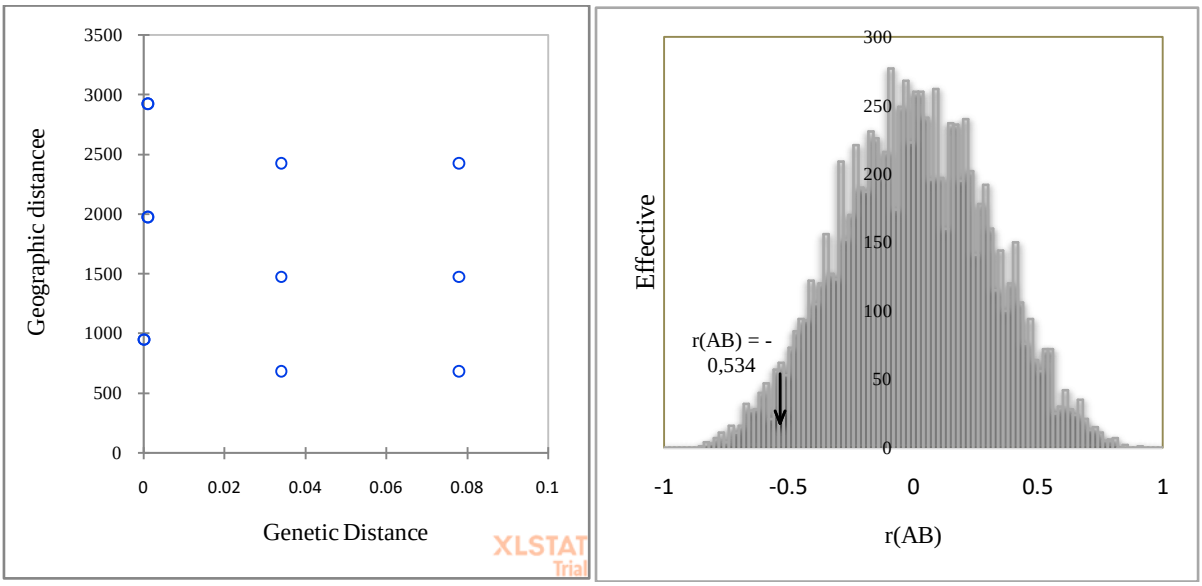

Figure I: Mantel Test : Correlation between geographic distance and genetic distance

ii. *Demogenetic and phylogenetic evolution parameters*

With the exception of Mali, all countries have high haplotypic diversity values and low nucleotide diversity values.

The populations of Senegal, Niger and Guinea Conakry present negative values of D of Tajima, values of Fs of Fu, SSD, Rg and R2 of Ramos positive. Burkina Faso is characterized by a negative Fs of Fu, values of D of Tajima, R2 of Ramos, SSD and Rg positive. The demogenetic test values are zero for the population of Mali. However, none of the parameter values is significant for all populations. (Table VIII).

Table VIII: Demogenetic tests

Countries	Demographic Parameters						Genetic Diversity	
	D of Tajima	Fs of Fu	R^2	H of Fay and Wu	SSD	Rg	Hd	Pi
Senegal	-0,781 (0.217)	0,717 (0.668)	0,162 (0,50)	-0,170 (0,34)	0,056 (0.120)	0,118 (0,090)	0,784 (0,083)	0.011 (0.002)
Mali	0,000 (1,000)	0,000 (1,000)	----	----	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Niger	-0,418 (0,341)	1,232 (0.720)	0,161 (0,53)	0,041 (0,33)	0,049 (0.500)	0,080 (0,530)	0,844 (0,103)	0,011 (0,002)
Burkina Faso	0,528 (0.730)	-0,341 (0.375)	0,162 (0,23)	----	0,077 (0.150)	0,218 (0,060)	0,867 (0,007)	0,013 (0,003)
Guinea Conakry	-0,842 (0.215)	0,223 (0.552)	0,161 (0,53)	-0,007 (0,32)	0,037 (0.180)	0,134 (0,530)	0,711 (0,117)	0,003 (0,001)

Hd= Haplotypic diversity, Pi= Nucleotidic diversity, SSD= Sum of Squared Deviation, Rg=Happending's Raggedness.

Mismatch distribution curves are multimodal for all countries. But it is particularly bimodal for Guinea Conakry. (Figure II).

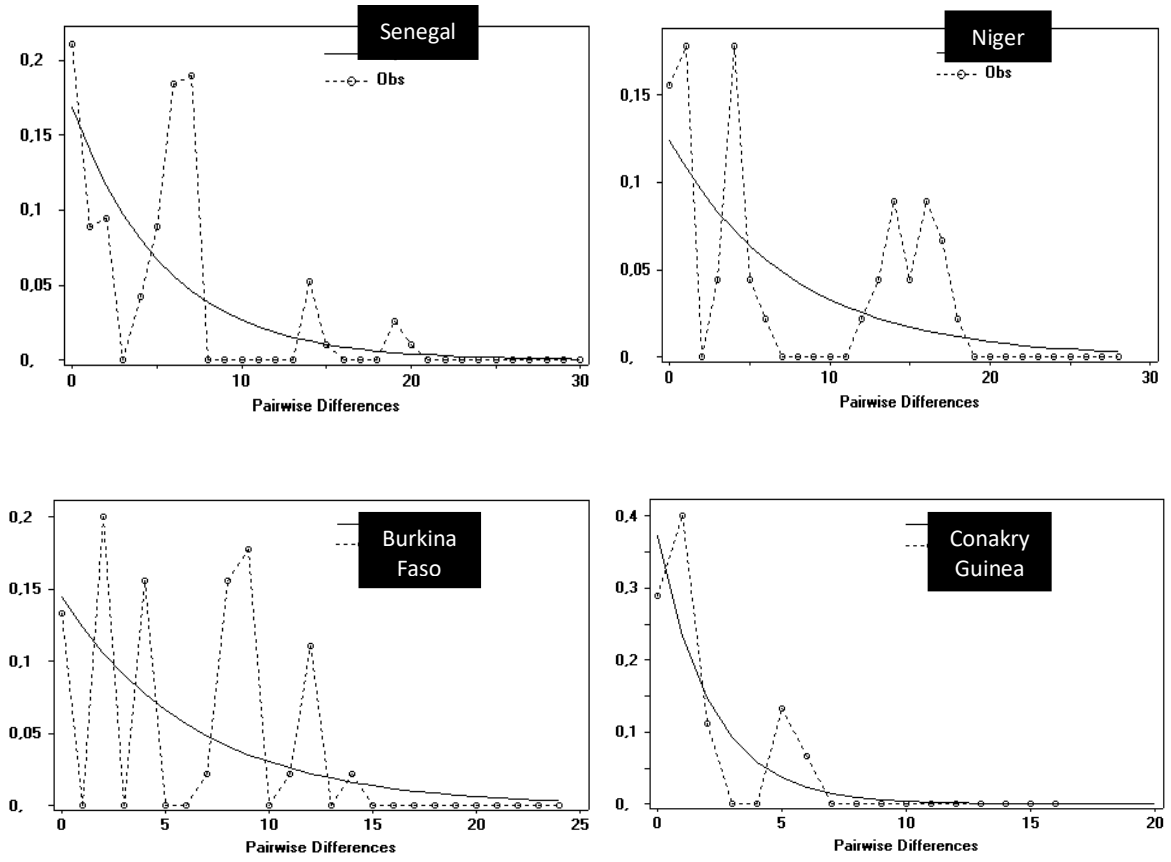

Figure II: Mismatch distribution

Phylogenetic trees constructed according to the maximum likelihood method and the maximum parsimony method mainly highlighted a single clade supported by strong Bootstrap values (57% and 74%). (Figure III). This clade includes all the haplotypes encountered in the countries of the semi-arid zone, except 2 haplotypes deprived of Niger (H11, H9).

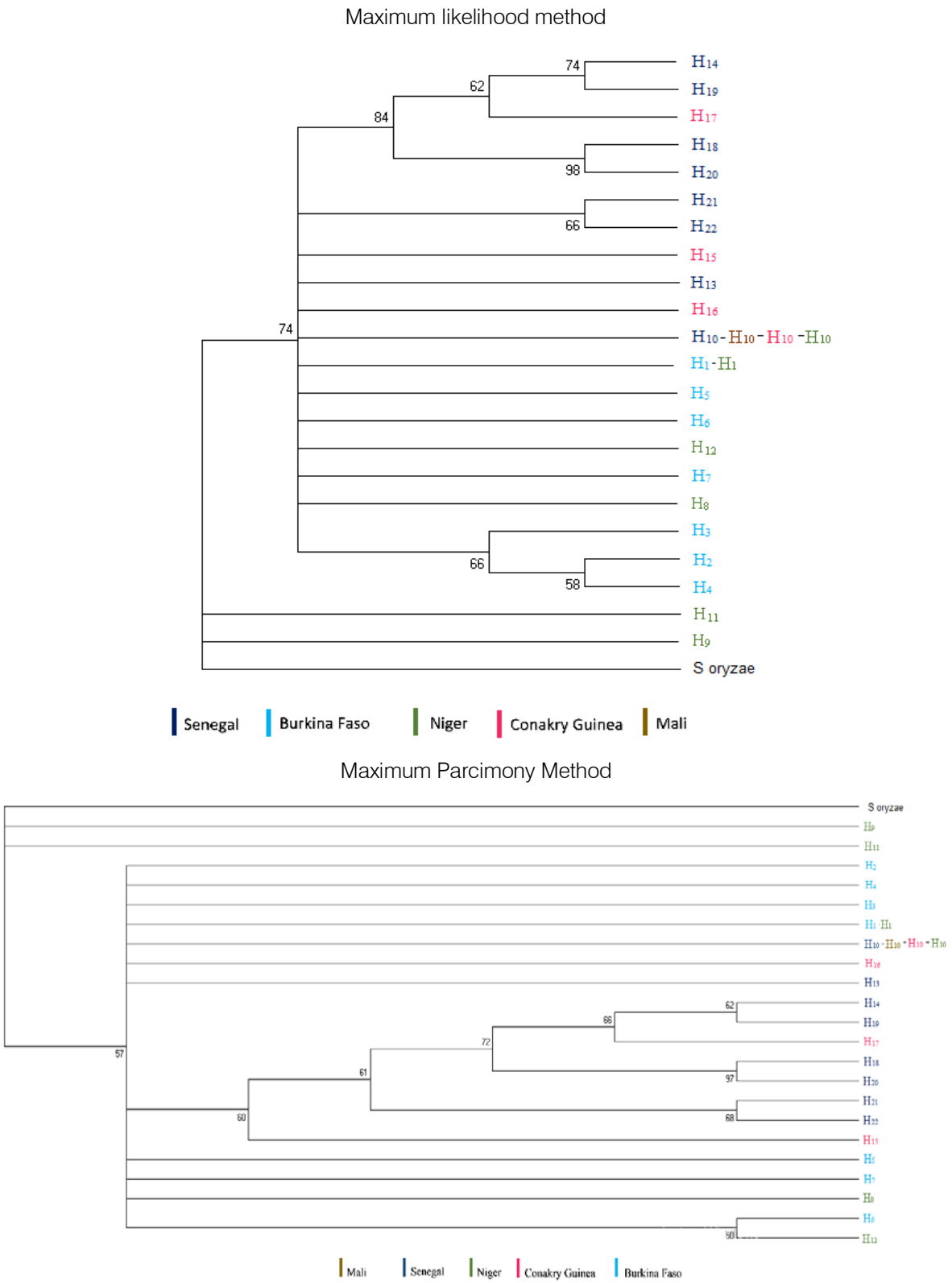

Figure III: Phylogenetic Trees

b) Discussion

The objective of the article was to study the demographic and phylogenetic evolution of the populations of *S. zeamais* in 5 countries of West Africa sharing the same climate (semi-arid zone), but also to research a possible genetic structure of the insect according to these countries.

Genetic differentiation parameters (DG, Fst) and the AMOVA Test have highlighted a genetic distribution of individuals of *S. zeamais* according to these countries. A genetic structure of this insect in Senegal and Guinea Conakry has already been highlighted with fairly similar values by Ndong et al [14]. Other insect pests have also been the subject of genetic differentiation according to localities. This is the case of the main millet pest in Senegal, *Tribolium Castaneum*[9], the corn stalk pest in Benin *Busseola Fusca* (Fuller) [19].

The share of genetic variation of individuals within populations is greater than that of populations between countries. This state of affairs indicates that anthropogenic activities such as agricultural practices, systems of conservation of harvest stocks, commercial activities would influence the genetic structure of the insect more than the intrinsic ecological characteristics of the countries. The work of Ndong et al [14]is likely to confirm this hypothesis. Indeed, they revealed in an agroclimatic zone a genetic structuring of the insect according to storage means. The genetic differentiation here is not due to the geographic distance between countries based on the results of the Mantel Test, as has been the case in other studies. Bossart and Prowell[2] suggest that genetic isolation may be due to a different factor than geographic distance. These researchers state that the ecological heterogeneity of a species' habitat often involves dispersion barriers.

The demographic evolution of *S. zeamais* populations in the countries was apprehended by demographic parameters. The multimodality of the mismatch distribution curves of the populations of Senegal, Niger and Burkina Fasso, which is not however confirmed, due to the non-significance of the SSD and Rg values, indicates that the corresponding populations are in demographic expansion. In Senegal and Niger, this demographic expansion is in line with negative Tajima's D values for these populations, which are not, however, significant. Thus the non-significance of the values of D of Tajima and Fs of Fu and the high values of haplotypic diversity and low of nucleotide diversity in Senegal, Niger and Burkina Fasso suggest stability or moderate demographic expansion. In fact, a high haplotypic diversity and a low nucleotide diversity can be the result of a rapid population growth from an ancestral population with a small population and for which there is not enough time elapsed to find a high diversity between haplotypic[4]. The bimodal distribution of Guinea Conakry not confirmed by the values of SSD and Rg and the non-significance of the values of D of Tajima and Fs of Fu suggest a demographic stability of this population. The negative values of H of Fay and Fu, of D of Tajima of Guinea de Conakry and of Senegal even if they are not significant suggest that the populations of these countries underwent a positive selection. On the other hand, the very homogeneous population of Mali has undergone negative selection or a bottleneck.

Phylogenetic trees according to the maximum likelihood and maximum parsimony methods highlighted a single clade grouping together almost all the insects of the semi-arid zone. These insects would come from Niger according to the high genetic diversity which characterizes this country compared to others and the percentage (100%) occupied by the ancestral and sub-regional H10 haplotype in this country. Indeed, there is a direct probabilistic relationship between the frequency of an allele and its age [22]because the most frequent haplotype is on average the oldest. The transversality of this haplotype in the 5 countries is the fruit of trade. Indeed, the rural populations of the West African sub-region are characterized by a commercial dynamism through grain exchanges. This transfer of grain from one country to another could be accompanied by the transfer of larvae, egg-laying cocoons or even adults [8]. But this transfer did not have a substantial impact on genetic isolation because it involved a single haplotype.

IV. Conclusion

The study highlighted a genetic structure of *S. zeamais* according to the 5 countries of the Sahelo-Sudanian zone of West Africa, a common origin of insects which would be the Niger and models of demographic evolution mixed. Since the countries present genetically different individuals, studies can relate to the genetic diversity of *S. zeamais* in each of them, to apprehend the capacities of adaptation of the insects in the countries, because the genetic diversity of an individual is positively linked to its adaptive potential.

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Diversity of Butterflies (Lepidoptera: Rhopalocera) of Jhargram, Paschim and Purba Medinipur Districts, West Bengal, India

By Saurav Dwari & Amal Kumar Mondal
Vidyasagar University

Abstract- Butterflies are one of the most attractive insects in the world, and they have been able to attract all kinds of peoples by their various features. This present documentation records the butterfly diversity of the three districts Jhargram, Paschim Medinipur, and Purba Medinipur, which formed the former Medinipur district. A total of 139 species belong to 94 genera and six families have been recorded. Among all families, Lycaenidae and Nymphalidae are the most abundant. Among the three districts, most species were found from Jhargram district. Fluffy Tit, Angled Pierrot and Common Lascar are the first time recorded from southern West Bengal. Rapid urbanization, deforestation, uncontrolled developmental works, and changing the character of Coastal zone is some of the threats to butterflies in these areas. So it was a great need to prepare a list of butterflies by which the past changes in the species diversity and number of butterflies in the future able to understand.

Keywords: *butterflies, jhargram, paschim medinipur, purba medinipur, west bengal, india, lycaenidae, nymphalidae, urbanization, deforestation.*

GJSFR-C Classification: *FOR Code: 270499*

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Saurav Dwari [α] & Amal Kumar Mondal [σ]

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I. Introduction

Insects has major contributors in the world biodiversity basically more than half of the world's species diversity and play an important role in maintaining the productivity and stability of the entire ecosystem [1, 2, 3, 4]. Butterflies are pollinators, food chain components as well as indicators of the health of the ecosystem, it is essential to identify them and prepare a list and protect their larval host plants and habitat [5, 6]. Butterflies help maintain the community structure of the flora of the tropical region [7]. Due to the decaying quality of butterflies' natural habitat and urbanization, the diversity and number of species are gradually declining [8, 9, 10, 11]. Butterfly research in India started in the nineteenth century with the assistance of various researchers [12]. Mega diversity country like India has also large depositary in respect of butterflies which is about one fifth in the World biodiversity respect [13]. In India 1501 species of butterflies recoded [13, 14, 15] however some have mentioned 1318 species in the Indian subcontinent [16]. Many researchers explored the diversity of butterflies in various parts of India [17, 18, 19, 20, 21, 22]. A decent number of investigates on butterflies got from different places of West Bengal. The state West Bengal archived four hundred fifty-two species [23], although a researcher has likewise referenced 330 species [24]. Butterfly research in West Bengal is nearly contemporary with India, different analysts at various occasions propelling butterfly study of the southern division of this state [25, 26, 27, 28, 29, 30, 31]. Major research on butterflies found from Purba Medinipur among three districts of study area [32, 33, 34]. A unique field study from Paschim Medinipur district point outs that 82 species of butterflies present in the urban area of Midnapore [7]. In any case, no past exploration obtained from the immense locale outside the urban area of Paschim Medinipur and entire Jhargram District. Nonetheless, due to differing territory and rich forest area and being part of Chotanagpur plateau, there is a great chance of new species being encountered, that were not earlier found in South Bengal [35]. Documentation was comprehending the adjustments in the diversity and quantities of butterflies as anthropogenic movements expanded, and forest cover diminished. In the past, Jhargram, Paschim, and Purba Medinipur were part of undivided Medinipur district, so Purba Medinipur additionally incorporated for the survey alongside the other two districts.

Author α σ: Plant Taxonomy, Biosystematics and Molecular Taxonomy Laboratory, UGC-DRS-SAP Department, Department of Botany & Forestry, Vidyasagar University, Midnapore-721 102, West Bengal, India. e-mails: saurav.dwari@gmail.com, amalcaebotvu@gmail.com

II. Material and Methods

a) Study area

Jhargram, Paschim Medinipur and Purba Medinipur, located in the south-west of West Bengal, have been formed by breaking up the former Medinipur district at different times (Fig.1). Medinipur district first divided into Paschim and Purba Medinipur in 2002. Later in 2017, the Jhargram district was formed by separating from the Paschim Medinipur district. In other words, the three places of the study area were one district in the past. Headquarter of Jhargram lies at 21.4550° N latitude, and 86.9974° E longitude and the district covers 3037.64 km^2. Headquarter of Paschim Medinipur lies at 22.4257° N latitude, and 87.3199° E longitude and the district covers 6308 km^2. Headquarter of Purba Medinipur lies at 22.2858°N latitude, and 87.9189° E longitude and the district covers 4736 km^2. Jhargram district is deceit between the Kangsabati River

in the north and the Subarnarekha River in the south. This district surrounded by Paschim Medinipur, Bankura, Purulia districts, and Odisha, Jharkhand states. Jhargram, Purba Medinipur, Bankura, Hoogly, Howrah districts, and Odisha states surrounded Paschim Medinipur district. Paschim Medinipur, Howrah districts, and Odisha state surrounded Purba Medinipur district. Purba Medinipur is bounded on the south by the Bay of Bengal, on the east by the river Hoogly and the northeast by the Rupnarayan River. Jhargram district is a part of Chotanagpur Plateau, which steadily slopes down on the way to the east. The altitude of the Kankrajhore area of this district is near about 300 meters. The average rainfall of this district is about 1400mm. This district is full of dry deciduous forests, which are the home of diverse life forms. Paschim Medinipur is one of the largest districts of the state, West Bengal. Western parts of this district are part of Chotanagpur Plateau and packed with lateritic soils. The landscape of this district modifies from dense, dry deciduous forests in the west to marshy wetlands in the east with an alluvial type of soil. The average rainfall of this district is about 2111mm. Purba Medinipur district is part of lower Gangetic and eastern coastal plains. This district has approximately 60 km coastline, which is about 27% of the shoreline of West Bengal. The average rainfall of this district is about 1700mm. The different natural habitats within the study area are also represented (Fig.2).

b) Sampling techniques and species identification

Diverse habitats of these districts have been surveyed from 2014 to 2019 through the Pollard's line transect method. Different information about butterflies collected through observation from 7 am to 11 am and from 2 pm to 6 pm. Transects were walked once a month in each district to follow Pollard Walk Method for documenting the butterflies [36, 37]. A slow 180-degree visual sweep carried out during walking. Along with that, Visual encounter assessment and Opportunistic survey, methods are also applied during the study period. Modifications of the line transect count used to find out butterfly richness and abundance [38]. In this method 10 permanent 300 meter lines transects were arrangement in each districts. Transects in every group was slowly crossed at a consistent speed during excellent weather period (no heavy rain or strong winds). Butterfly species recorded approximately a radius of five-meters from the observer covering either side, above, and front. All individuals were identified in the field using standard guides and field guide books [23, 39, 40]. Identification and classification of butterflies completed with these literature [41, 42, 43, 44, 45].

c) Data analysis

Data analyses were done through PAST software Version 3.02 [46].

i. *Measurement of diversity*

The kind of diversity used here is α-diversity, which is the diversity of species within a community or habitat. We calculated the diversity index by using this index [47].

- Diversity index = H = – ΣPi In Pi, where Pi = S / N
- S = numeral of entities of one species
- N = sum total number of every individuals in the sample
- In = logarithm to base e

ii. *Measurement of species richness*

Species richness calculated through Margalef's index [48].

- Margalef's index = (S – 1) / In N
- S = sum number of species
- N = summation of individuals in the sample
- In = natural logarithm

iii. *Measurement of evenness*

For calculating the evenness of species, the Pielou's Evenness Index (e) used [49].

- e = H / In S
- H = Shannon – Wiener diversity index
- S = summation of species in the sample

iv. *Dominance and Simpson Index*

- D = Σ (ni/n) ^{2} where ni is number of entities of taxon i.
- Dominance = 1-Simpson index. Varies from 0 (all taxa are uniformly there) to 1 (one taxon dominates the community entirely).
- Simpson index 1-D. It calculates the 'evenness' of the community from 0 to 1. Dominance and Simpson indices frequently used interchangeably.

v. *Species Accumulation Curve*

Species accumulation curve is an approach by plotting the cumulative number of species collected against the sampling effort (sample unit). From the year 2014, the species accumulation curve for the three districts sampled individually increased from first to the last sampling though the number of new species included slowly.

vi. *PCA (Principal Component Analysis)*

Principal components analysis (PCA) finds hypothetical variables (components) accounting for as much as possible of the variance in multivariate data [50, 51]. Principal coordinates analysis (PCO) is a different ordination method, also known as Metric Multidimensional Scaling. Two variables were selected based on higher variance and the Eigen value scale. Density and frequency plotted as component 1, and component 2 respectively.

III. Results

During the study period, 139 species of 94 genera belonging to 6 families from three districts have been recorded (Table 1). Lycaenidae family is dominant among all families, followed by Nymphalidae, Hesperiidae, Pieridae, Papilionidae, and Riodinidae. 44 (31.65%) species of Lycaenidae family, 38 (27.33%) species of Nymphalidae, 28 (20.14%) species of Hesperiidae, 17 (12.23%) species of Pieridae, 11 (7.91%) species of Papilionidae and only one species (0.71%) of Riodinidae have been found (Fig.3). Our study shows that 66 genera represent only one species, and 28 genera represent more than one species. Junonia is the largest genus with six species followed by Papilio, Eurema, Graphium, Rapala, Spindasis, Chilades, Danaus, and Pelopidas. Depending on the availability of butterflies, 66 species categorized as very common, 38 as common, 20 as less common, eight as rare, and seven species as very rare (Fig.4). The species accumulation curve is shown in fig.5. There are some Less Common (LC) species were Crimson Rose, Spot Swordtail, White Orange Tip, Small Salmon Arab, Three Spot Grass Yellow, Large Oakblue, Grass Jewel, Black Rajah, Common Sergeant, Water Snow Flat, Moore's Ace, Forest Hopper, Conjoined Swift, Variable Swift, and Plain Palm Dart, etc. The Rare (R) species of this district were Fivebar Swordtail, One Spot Grass Yellow, Indigo Flash, Malayan, Tawny Rajah, Tricolour Pied Flat, and Golden Angle, etc. The Very Rare (VR) species of this district were Spotless Grass Yellow, Angled Sunbeam, Redspot, Fluffy Tit, Angled Pierrot, Common Nawab, and Common Lascar. Of the three districts of the study area, most species were found in Jhargram (136 species), then in Paschim Medinipur (125 species) and least in Purba Medinipur (117 species) (Fig.6). Jhargram also had the highest number of exclusive species. Restricted species of Jhargram were Spot Swordtail, Fivebar Swordtail, Spotless Grass Yellow, Angled Sunbeam, Fluffy Tit, Indigo Flash, Angled Pierrot, Malayan, Common Nawab, Tawny Rajah, Common Lascar, and Golden Angle. Restricted species of Jhargram and Paschim Medinipur were Spot Swordtail, One Spot Grass Yellow, Indian Oakblue, Large Oakblue, Purple Leaf Blue, Common Hedge Blue, Baronet, and Tricolour Pied Flat. Restricted species of Purba Medinipur were Small Salmon Arab, Redspot, and White Tiger. Measurements of diversity-related indices are represented in table 2. Principal component analysis (PCA) of butterfly of these three districts, West Bengal based on Density and Frequency data (these two variables are taken based on higher Variance and Eigen value scale) presented in fig.7, 8 & 9. In both the cases, X-axis (component 1), i.e. Density and on the Y-axis (component 2), i.e. Frequencies are plotted, which show similarities between different species. So, there are six different families that are separated by principal component analysis, and species are separated on PCA analysis based on these two variables. The families represented by the following colors - Papilionidae + cross red, Pieridae circle o, Lycaenidae triangle, Riodinidae square, Nymphalidae filled square, Hesperiidae filled triangle. The PCA analysis showing family Nymphalidae widely distributed among the middle of the plot represented by filled square pinkish. PCA results indicate that two families occupy larger range, family Lycaenidae is forming its range inside the family Nymphalidae, and family Pieridae ranges between Nymphalidae and Lycaenidae. This overlapping distribution might be because of the same habitat preferences and availability of host plants. In figure 10 and 11, Normal Probability distribution of Density and Frequency are presented. Figure 12 showed Matrix plot with Number, Density, and Frequency of butterfly species. Correlations of Density and Frequency of butterfly species are showing in figure 13. Fig.14. correspond to Cluster analysis of three districts viz. Jhargram (1), Paschim Medinipur (2), Purba Medinipur (3) based on various diversity indices. Observed butterfly species photographed by Canon EOS 550 D, and represented in fig.15-23.

IV. Discussions

Among the three districts of the study area, no butterfly documentation made earlier from Jhargram district. As there is no research work on butterfly in the past, it cannot compare with the present study. However, nearly similar findings showed in previous studies of neighboring Bankura and Purulia [31, 52]. The main reason is the similarity of landscape, weather, and flora's composition of these districts. Many rare species Obtained by Mukharjee and Mondal [31] in Bankura district such as Common Shot Silverline, Tailless Lineblue, Angled Sunbeam, Gaudy baron, Painted Lady, Black Rajah, Common Nawab, Tawny Rajah, Common Banded Peacock, Spotless Grass Yellow, Indian cabbage White, Golden Angle, Water Snow Flat, and Tricoloured Pied Flat also found in Jhargram district. Some other species found in the Bankura district are likely to be found in Jhargram; they are Scarce Shot Silverline, Bright Babul Blue, Double Branded Crow, Chocolate Albatross, and Common Small Flat, etc. Some of the rare species of Purulia [52], which also found in Jhargram viz. Indigo Flash, Common Red Flash, Black Rajah, Common Nawab and Fivebar Swordtail, etc. A research has been done from earlier in Paschim Medinipur district, based on this subject mainly the urban areas adjacent to Midnapore Sadar city and recorded 82 species [7]. At present, this study has found 125 species from the entire Paschim Medinipur District. The most research on butterfly documentation has been from the Purba Medinipur district [32, 33, 34]. The primary documentation finished from the Contai

(Kanthi) region, then the major research was done from the entire coastal area of this district and afterwards from the Haldia industrial zone. Overall 120 species recorded in these three studies from Purba Medinipur. The present status from our study reveals that about 117 species were found in entire Purba Medinipur District. Earlier in this district, Small Palm Bob (Very Rare), Giant Redeye (Very rare), Palm Redeye (Rare), Straight Swift (Common), Large branded Swift (Not Rare), Bevan's Swift (Rare) and Glassy Tiger (Very Rare) obtained by Payra et al. was not found in our present study. Small Cupid, Double Branded Crow, Bengal Spotted Flat, Small Branded Swift obtained by Pahari et al. was also not found in our study. In our current study, Redspot, Peacock Royal, Black Rajah, Gaudy Baron, Water Snow Flat, Paintbrush Swift, and Common Dartlet first time recorded from Purba Medinipur district. The documented result shows that the overall diversity of butterflies in the three districts of the study area is satisfactory. Some of these butterflies found from South Bengal for the first time. Fluffy Tit, Angled Pierrot, and Common Lascar butterflies first time recorded from South Bengal (24, 39). Redspot, a rare butterfly, was recorded second time from South Bengal which, was previously recorded only from Kolkata and North Bengal [53]. Some butterflies found from the coastal area of Purba Medinipur district, confined to that area only among the three districts. They are Redspot, Small Salmon Arab, and White Tiger. There are several butterflies in the elevated and forested environment of Jhargram district which are not found anywhere else in the three districts of the study area. They are Fivebar Swordtail, Spotless Grass Yellow, Angled Sunbeam, Fluffy Tit, Angled Pierrot, Common Lascar, Common Nawab, Tawny Rajah, Golden Angle, etc. The butterflies found in the coastal region of Purba Medinipur are likely to be found in the coastal region of South 24 Pargana, and the Butterflies found in Jhargram are likely to be found in Purulia, Bankura due to similar weather and geography. The butterfly diversity of a region is directly related to the larval host plants found in that region. Diversity of larval host plants of Jhargram district is more varied than the other two districts. Although most of the Paschim Medinipur similar to Jhargram district but presence of the less elevated regions, uncontrolled development work, and deforestation are the main reason of its less number of butterflies. However, the parts of Jhargram and Paschim Medinipur districts yet not illuminated in the light of such research for dense forests, inaccessibility, and political instability, which indicates the possibility of more new butterflies, will recorded in the future. Grass jewel, the smallest butterfly of India [54], found in good numbers in Jhargram and Paschim Medinipur but absent in Purba Medinipur district. Blue Mormon, the largest butterfly in South Bengal, is quite affordable in all the three districts. Small salmon Arab and White tiger are found only in the coastal areas of Purba Medinipur. The number of Crimson Rose in the coastal region is higher than in other regions. The main reason for the good sighting of Gaudy Baron in the Shal forest area is the predominance of hemiparasitic taxon like *Dendropthe falcata* (Loranthaceae) as the larval host plant of the butterfly in this forest. This hemiparasitic plant also used as a larval host plant by Peacock royal, Broadtail Royal, Common Jezebel, etc. Different forms of several butterflies of the same species observed in all the three districts. They are Cyrus, Stichius, Romulus of Common Mormon and Dissimilis, Clytia of Common Mime, etc. In Ghatal Sub Division, Gram Blue, Pea Blue, Forget Me Not butterflies are predominant because of the abundance of leguminous vegetables in this region. Double-banded Judy, Bamboo Treebrown, and other shade lover butterflies can be seen commonly in shady places of forest or bush areas throughout the study region. All six species of Junonia found in India are also found in the study area. However, Yellow and Chocolate Pansy were more noticeable in the red soil forest area of Jhargram and Paschim Medinipur districts. Some butterflies of The Hesperiidae family such as Golden angle, Water snow flat, Tricoloured pied flat were found more in the forest areas.

V. Conclusion

Our study will considered as baseline data for Jhargram and Paschim Medinipur districts, which will later help in finding out the changes of distribution, diversity of butterflies, and their possible causes in these two adjacent districts. It will also be easier to document new butterflies in these two districts using this inventory in future. In the case of the Purba Medinipur, the current study is more or less supporting the previous studies of that district. The addition of a few new butterflies that not documented from Jhargram and Paschim Medinipur districts previously indicates that there is a possibility of getting more new butterflies from these two districts in the future. At the same time, it is comprehensible that the diversity of butterflies depends on forest areas, which might be directly affected by future deforestation. Similarly, uncontrolled constructions in the coastal regions will be adversely affected bioindicators and pollinating agents like butterflies.

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Table 1: List of butterflies recorded from The District Jhargram, Paschim and Purba Medinipur districts, West Bengal, India

Family	Sl No.	Common name	Scientific name	Jhargram	Paschim Medinipur	Purba Medinipur	Status
Papilionidae	1	Common Mormon	*Papilio polytes* (Linnaeus, 1758)	+	+	+	VC
	2	Blue Mormon	*Papilio polymnestor* (Cramer, 1775)	+	+	+	C
	3	Lime Butterfly	*Papilio demoleus* (Linnaeus, 1758)	+	+	+	VC
	4	Common Mime	*Papilio clytia* (Linnaeus, 1758)	+	+	+	VC
	5	Common Banded Peacock	*Papilio crino* (Fabricius, 1793)	+	+	+	C
	6	Common Rose	*Pachliopta aristolochiae* (Fabricius, 1775)	+	+	+	VC
	7	Crimson Rose	*Pachliopta hector* (Linnaeus, 1758)	+	+	+	LC
	8	Common Jay	*Graphium doson* (C and R. Felder, 1864)	+	+	+	VC
	9	Tailed Jay	*Graphium agamemnon* (Linnaeus, 1758)	+	+	+	VC
	10	Spot Swordtail	*Graphium nomius* (Esper, 1793)	+	+		LC
	11	Fivebar Swordtail	*Graphium antiphates* (Cramer, 1775)	+			R
Pieridae	12	Psyche	*Leptosia nina* (Fabricius, 1793)	+	+	+	VC
	13	Common Gull	*Cepora nerissa* (Fabricius, 1775)	+	+	+	VC
	14	Yellow Orange Tip	*Ixias pyrene* (Linnaeus, 1764)	+	+	+	C
	15	White Orange Tip	*Ixias marianne* (Cramer, 1779)	+	+		LC
	16	Common Jezebel	*Delias eucharis* (Drury, 1773)	+	+	+	VC
	17	Striped Albatross	*Appias libythea* (Fabricius, 1775)	+	+	+	VC
	18	Indian cabbage White	*Pieris canidia* (Linnaeus, 1768)	+	+	+	C
	19	Common Wanderer	*Pareronia valeria* (Cramer, 1776)	+	+	+	VC
	20	Pioneer	*Belenois aurota* (Fabricius, 1793)	+	+	+	C
	21	Small Salmon Arab	*Colotis amata* (Fabricius, 1775)			+	LC
	22	Common Emigrant	*Catopsilia Pomona* (Fabricius, 1775)	+	+	+	VC
	23	Mottled Emigrant	*Catopsilia pyranthe*(Linnaeus, 1758)	+	+	+	VC
	24	Common Grass Yellow	*Eurema hecabe* (Linnaeus, 1758)	+	+	+	VC
	25	Three Spot Grass Yellow	*Eurema blanda* (Boisduval, 1836)	+	+	+	LC
	26	One Spot Grass Yellow	*Eurema andersoni* (Moore, 1886)	+	+		R
	27	Spotless Grass Yellow	*Eurema laeta* (Boisduval, 1836)	+			VR
	28	Small Grass Yellow	*Eurema brigitta* (Stoll, 1780)	+	+	+	C
Lycaenidae	29	Indian Sunbeam	*Curetis thetis* (Hubner, 1819)	+	+	+	C
	30	Angled Sunbeam	*Curetis acuta* (Moore, 1877)	+			VR
	31	Falcate Oakblue	*Mahathala ameria* (Hewitson, 1862)	+	+	+	VC
	32	Indian Oakblue	*Arthopala atrax* (Hewitson, 1862)	+	+		C
	33	Large Oakblue	*Arthopala amantes* (Hewitson, 1862)	+	+		LC
	34	Silverstreak Blue	*Iraota timoleon* (Stoll, 1790)	+	+	+	C
	35	Common Guava Blue	*Virachola isocrates* (Fabricius,	+	+	+	C

			1793)				
	36	Purple Leaf Blue	*Amblypodia anita* (Hewitson, 1862)	+	+		C
	37	Redspot				+	VR
	38	Peacock Royal	*Tajuria cippus* (Fabricius, 1798)	+	+	+	C
	39	Broadtail Royal	*Creon cleobis* (Godart, 1824)	+	+	+	C
	40	Fluffy Tit	*Zeltus amasa* (Hewitson, 1865)	+			VR
	41	Yamfly	*Loxura atymnus* (Cramer, 1782)	+	+	+	C
	42	Monkey Puzzle	*Rathinda amor* (Fabricius, 1775)	+	+	+	VC
	43	Indian Red Flash	*Rapala iarbus* (Fabricius, 1787)	+	+	+	LC
	44	Slate Flash	*Rapala manea* (Hewitson, 1863)	+	+	+	VC
	45	Indigo Flash	*Rapala varuna* (Hewitson, 1863)	+			R
	46	Common Silverline	*Spindasis vulcanus* (Fabricius, 1775)	+	+	+	VC
	47	Common Shot Silverline	*Spindasis ictis* (Hewitson, 1865)	+	+	+	C
	48	Long- banded Silverline	*Spindasis lohita* (Horsfield, 1829)	+	+	+	LC
	49	Common Pierrot	*Castalius rosimon* (Fabricius, 1775)	+	+	+	VC
	50		*Tarucus* sp. (Moore, 1881)	+	+	+	VC
	51	Angled Pierrot	*Calida decidia* (Hewitson, 1876)	+			VR
	52	Zebra Blue	*Leptotes plinius* (Fabricius, 1793)	+	+	+	VC
	53	Apefly	*Spalgis epeus* (Westwood, 1851)	+	+	+	C
	54	Common Lineblue	*Prosotas nora* (Felder, 1860)	+	+	+	C
	55	Tailless Lineblue	*Prosotas dubiosa* (Semper, 1879)	+	+	+	VC
	56	Common Cerulean	*Jamides celeno* (Cramer, 1775)	+	+	+	VC
	57	Dark Cerulean	*Jamides bochus* (Stoll, 1782)	+	+	+	C
	58	Common Ciliate Blue	*Anthene emolus* (Godart, 1823)	+	+	+	C
	59	Pointed Ciliate Blue	*Anthene lycaenina* (C. Felder, 1868)	+	+	+	VC
	60	Forget Me Not	*Catochrysops strabo* (Fabricius, 1793)	+	+	+	VC
	61	Pea Blue	*Lampides boeticus* (Linnaeus, 1767)	+	+	+	VC
	62	Dark Grass Blue	*Zizeeria karsandra* (Moore, 1865)	+	+	+	C
	63	Pale Grass Blue	*Pseudozizeeria maha* (Kollar, 1848)	+	+	+	VC
	64	Lesser Grass Blue	*Zizina otis* (Fabricius, 1787)	+	+	+	C
	65	Tiny Grass Blue	*Zizula hylax* (Fabricius, 1775)	+	+	+	VC
	66	Grass Jewel	*Chilades trochylus* (Freyer, 1845)	+	+		LC
	67	Common Hedge Blue	*Acytolepis puspa* (Horsfield, 1828)	+	+		R
	68	Malayan	*Megisba malaya* (Horsfield, 1828)	+			R
	69	Quaker	*Neopithecops zalmora* (Butler, 1870)	+	+	+	VC
	70	Gram Blue	*Euchrysops cnejus* (Fabricius, 1798)	+	+	+	VC
	71	Plains Cupid	*Chilades pandava* (Horsfield, 1829)	+	+	+	VC
	72	Lime Blue	*Chilades lajus* (Cramer, 1782)	+	+	+	VC
Riodinidae	73	Double-banded Judy or Twospot Plum Judy	*Abisara bifasciata* (Moore, 1877)	+	+	+	C
Nymphalidae	74	Blue Tiger	*Tirumala limniace* (Cramer, 1775)	+	+	+	VC
	75	Plain Tiger	*Danaus chrysippus* (Linnaeus,	+	+	+	VC

			1758)				
	76	Striped Tiger	*Danaus genutia* (Cramer, 1779)	+	+	+	VC
	77	White Tiger	*Danaus melanippus* (Cramer, 1777)			+	LC
	78	Common Crow	*Euploea core* (Cramer, 1780)	+	+	+	VC
	79	Brown King Crow	*Euploea klugii* (Moore,1858)	+	+	+	C
	80	Common Nawab	*Polyura athamas* (Drury,1773)	+			VR
	81	Black Rajah	*Charaxes solon* (Fabricius, 1793)	+	+	+	LC
	82	Tawny Rajah	*Charaxes bernardus* (Fabricius, 1793)	+			R
	83	Common Evening Brown	*Melanitis leda* (Linnaeus, 1758)	+	+	+	VC
	84	Bamboo Treebrown	*Lethe europa* (Fabricious, 1787)	+	+	+	C
	85	Common Palmfly	*Elymnias hypermnestra* (Linnaeus, 1763)	+	+	+	VC
	86	Common Bushbrown	*Mycalesis perseus* (Fabricius, 1775)	+	+	+	VC
	87	Dark Brand Bushbrown	*Mycalesis mineus* (Linnaeus, 1758)	+	+	+	C
	88	Common Five Ring	*Ypthima baldus* (Fabricius, 1775)	+	+	+	VC
	89	Common Four Ring	*Ypthima huebneri (*Kirby, 1871)	+	+	+	VC
	90	Common Duffer	*Discophora sondaica* (Boisduval, 1836)	+	+	+	C
	91	Tawny Coster	*Acraea violae* (Fabricius, 1775)	+	+	+	VC
	92	Common Leopard	*Phalanta phalantha* (Drury, 1773)	+	+	+	VC
	93	Commander	*Moduza procris* (Cramer, 1777)	+	+	+	VC
	94	Angled Castor	*Ariadne ariadne*(Linnaeus, 1764)	+	+	+	VC
	95	Common Castor	*Ariadne merione* (Cramer, 1777)	+	+	+	VC
	96	Common Sailer	*Neptis hylas* (Linnaeus, 1758)	+	+	+	C
	97	Chestnut - streaked Sailer	*Neptis jumbah* (Moore, 1857)	+	+	+	VC
	98	Common Sergeant	*Athyma perius* (Linnaeus, 1758)	+	+		LC
	99	Common Lascar	*Pantoporia hordonia* (Stoll, 1790)	+			VR
	100	Common Barron	*Euthalia aconthea* (Hewitson, 1874)	+	+	+	VC
	101	Gaudy Barron	*Euthalia lubentina* (Cramer, 1777)	+	+	+	LC
	102	Baronet	*Symphaedra nais* (Forster, 1771)	+	+		VC
	103	Painted Lady	*Vanessa cardui* (Linnaeus, 1758)	+	+	+	C
	104	Blue Pansy	*Junonia orithya* (Linnaeus, 1758)	+	+	+	VC
	105	Yellow Pansy	*Junonia hierta* (Fabricius, 1798)	+	+	+	C
	106	Chocolate Pansy	*Junonia iphtia* (Cramer, 1779)	+	+	+	C
	107	Lemon Pansy	*Junonia lemonias* (Linnaeus, 1758)	+	+	+	VC
	108	Grey Pansy	*Junonia atlites* (Linnaeus, 1763)	+	+	+	VC
	109	Peacock Pansy	*Junonia almana* (Linnaeus, 1758)	+	+	+	VC
	110	Great Eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	+	+	+	VC
	111	Danaid Eggfly	*Hypolimnas misippus*(Linnaeus,	+	+	+	VC

			1764)				
	112	Brown Awl	*Badamia exclamationis* (Fabricius, 1775)	+	+	+	C
	113	Common Banded Awl	*Hasora chromas* (Cramer, 1780)	+	+	+	C
	114	Common Snow Flat	*Tagiades japetus* (Stoll, 1782)	+	+	+	VC
	115	Water Snow Flat	*Tagiades litigiosa* (Moeschler, 1878)	+	+	+	LC
	116	Tricolour Pied Flat	*Coladenia indrani* (Moore, 1866)	+	+		R
	117	Golden Angle	*Caprona ransonnetii* (Felder, 1868)	+			R
	118	Indian Skipper	*Spialia galba* (Fabricius, 1793)	+	+	+	C
	119	Bush Hopper	*Ampitta dioscorides* (Fabricius, 1793)	+	+	+	VC
	120	Moore's Ace	*Halpe porus* (Mabille, 1876)	+	+	+	LC
	121	Forest Hopper	*Astictopterus jama* (Felder and Felder, 1860)	+	+	+	LC
	122	Chestnut Bob	*Iambrix salsala* (Moore, 1865)	+	+	+	VC
	123	Indian Palm Bob	*Suastus gremius* (Fabricius, 1798)	+	+	+	VC
	124	Grass Demon	*Udaspes folus* (Cramer, 1775)	+	+	+	VC
	125	Tree Flitter	*Hyarotis adrastus* (Cramer, 1780)	+	+	+	VC
	126	Banana Redeye or Banana Skipper	*Erionota torus* (Evans, 1941)	+	+	+	C
	127	Common Red Eye	*Matapa aria* (Moore, 1865)	+	+	+	VC
	128	Ceylon Swift	*Parnara bada* (Moore, 1878)	+	+	+	VC
	129	Evan's Swift	*Parnara ganga* (Evans, 1937)	+	+	+	LC
	130	Rice Swift	*Borbo cinnara* (Wallace, 1866)	+	+	+	C
	131	Obscure Branded Swift	*Pelopidas agna* (Moore, 1865)	+	+	+	VC
	132	Conjoined Swift	*Pelopidas conjuncta* (Herrich-Schaeffer, 1869)	+	+	+	LC
	133	Variable Swift	*Pelopidas mathias* (Fabricius, 1798)	+	+	+	LC
	134	Paintbush Swift	*Baoris farri* (Moore, 1878)	+	+	+	C
	135	Common Grass Dart	*Taractrocera maevius* (Fabricius, 1793)	+	+	+	C
	136	Common Dartlet	*Oriens gola* (Moore, 1877)	+	+	+	VC
	137	Common or Pale Palm Dart	*Telicota colon* (Fabricius, 1775)	+	+	+	C
	138	Dark Palm Dart	*Telicota bambusae* (Moore, 1778)	+	+	+	VC
	139	Plain Palm Dart	*Cephrenes acalle (*Hopffer, 1874)	+	+	+	LC

[VC- Very Common, C- Common, LC- Less Common, R- Rare, VR- Very Rare]

Table 2: Diversity Indices
(Through PAST software Version 3.02)

Diversity Indices	Jhargram	Paschim Medinipur	Purba Medinipur
Taxa_S	136	125	117
Simpson_1-D	0.9918	0.9915	0.9908
Dominance_D	0.008183	0.008523	0.009192
Shannon_H	4.847	4.795	4.719
Evenness_e^H/S	0.9368	0.9668	0.9579
Margalef	15.02	13.83	13.03
Fisher_alpha	23.27	21.13	19.75

[Based on Diversity, Frequency and Numbers]

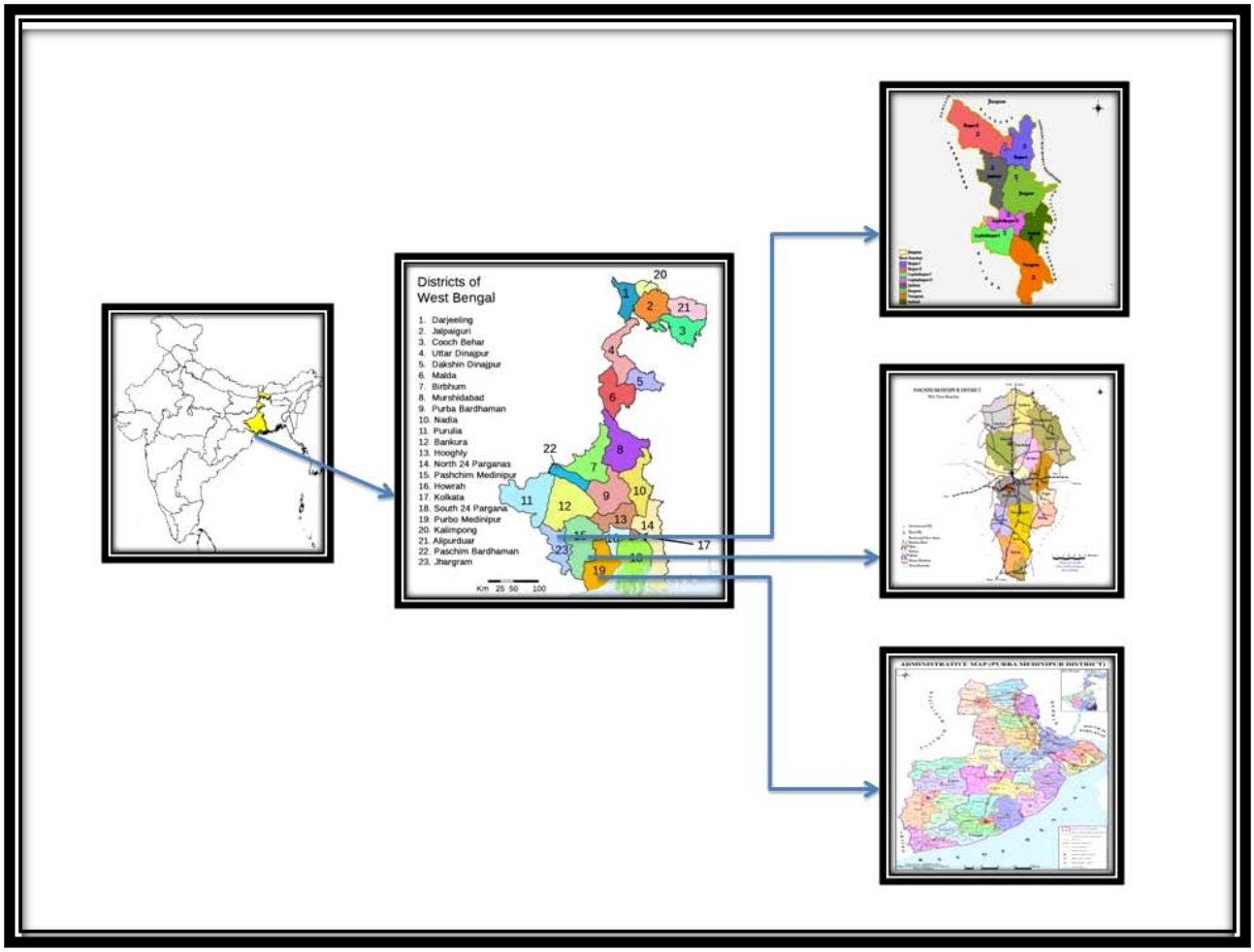

Figure 1: Study Area (A: West Bengal in India, B: West Bengal, C: Jhargram district, D: Paschim Medinipur district, E: Purba Medinipur district

Figure 2: Habitats of Butterflies. A –H) Different habitats of district Jhargram. I –L) Different habitats of district Paschim Medinipur. M –P) Different habitats of district Purba Medinipur

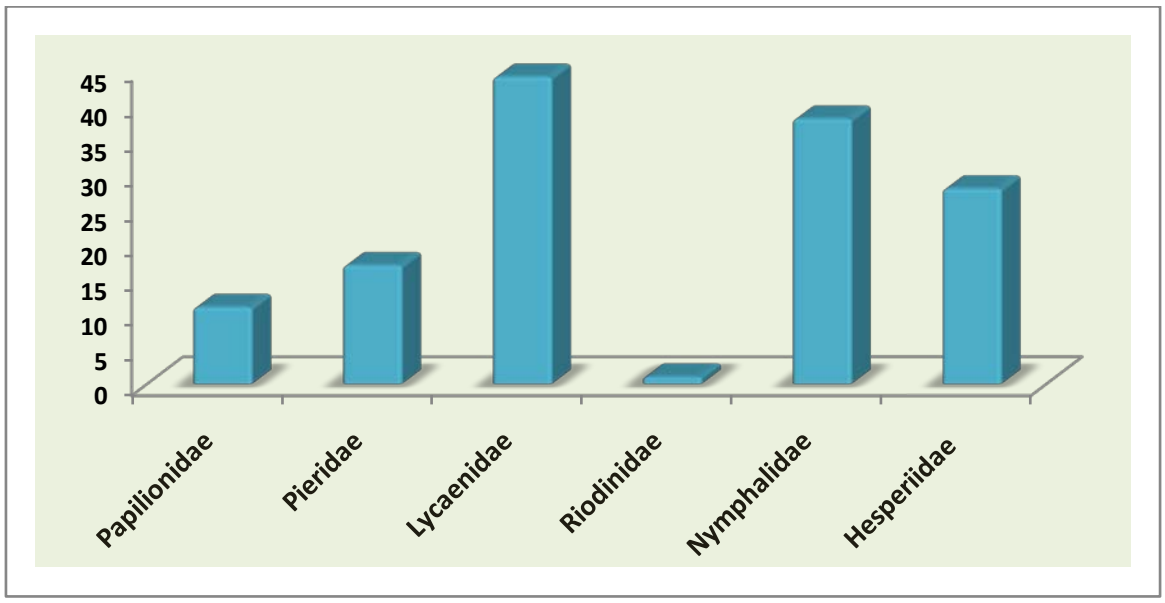

Figure 3: Number wise graphical representation of butterfly species

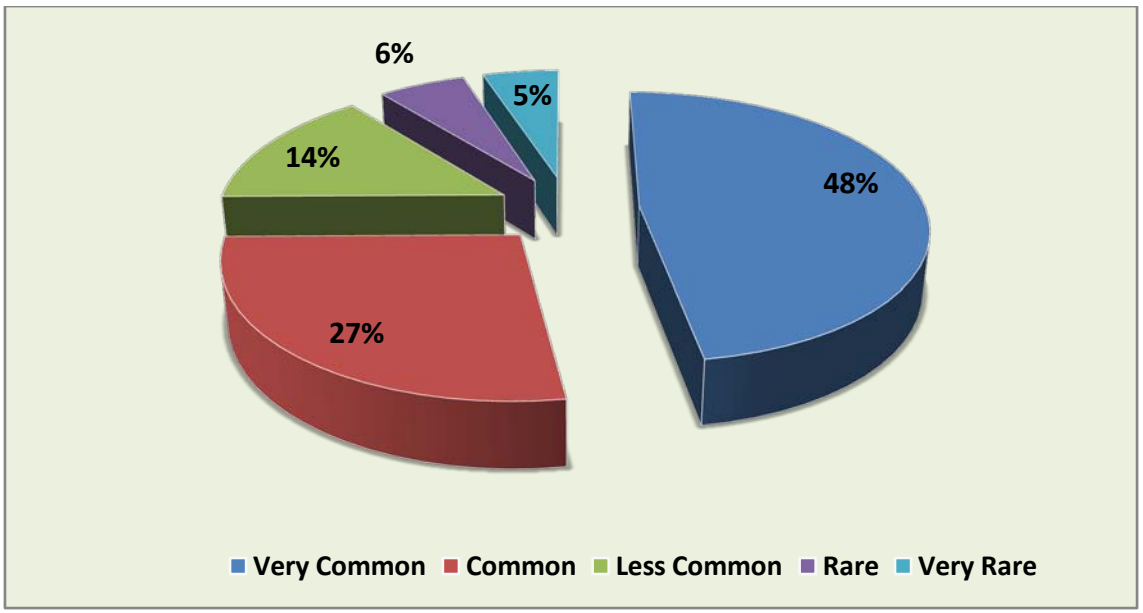

Figure 4: Status wise graphical representation of butterfly species

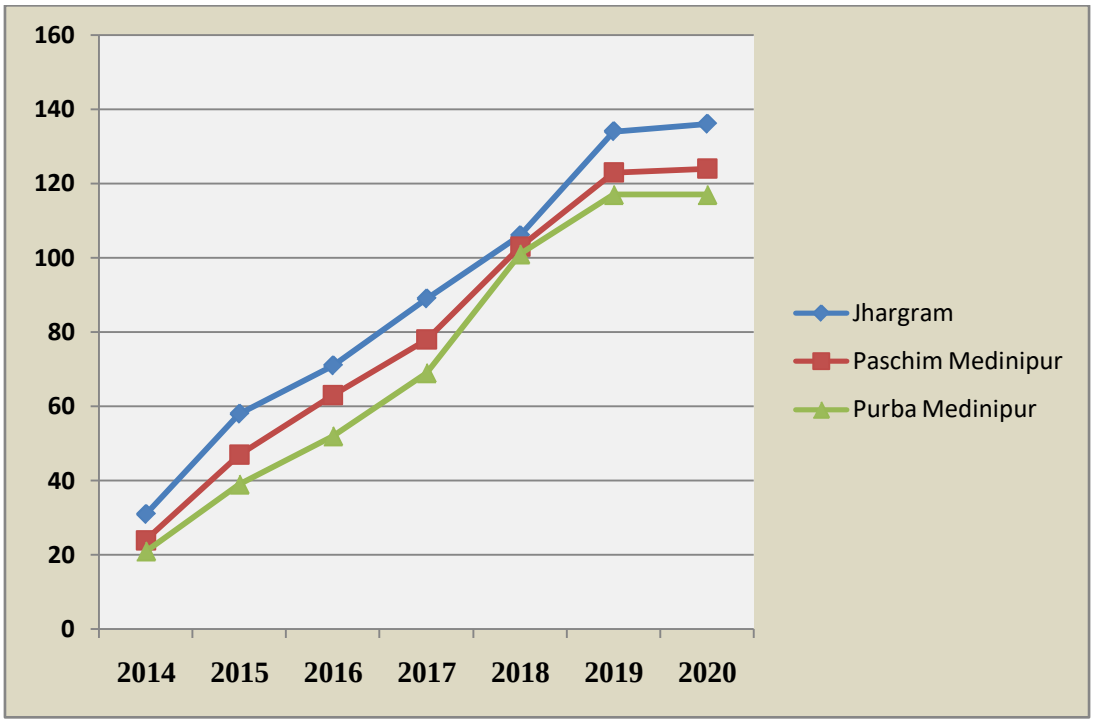

Figure 5: Species Accumulation Curve

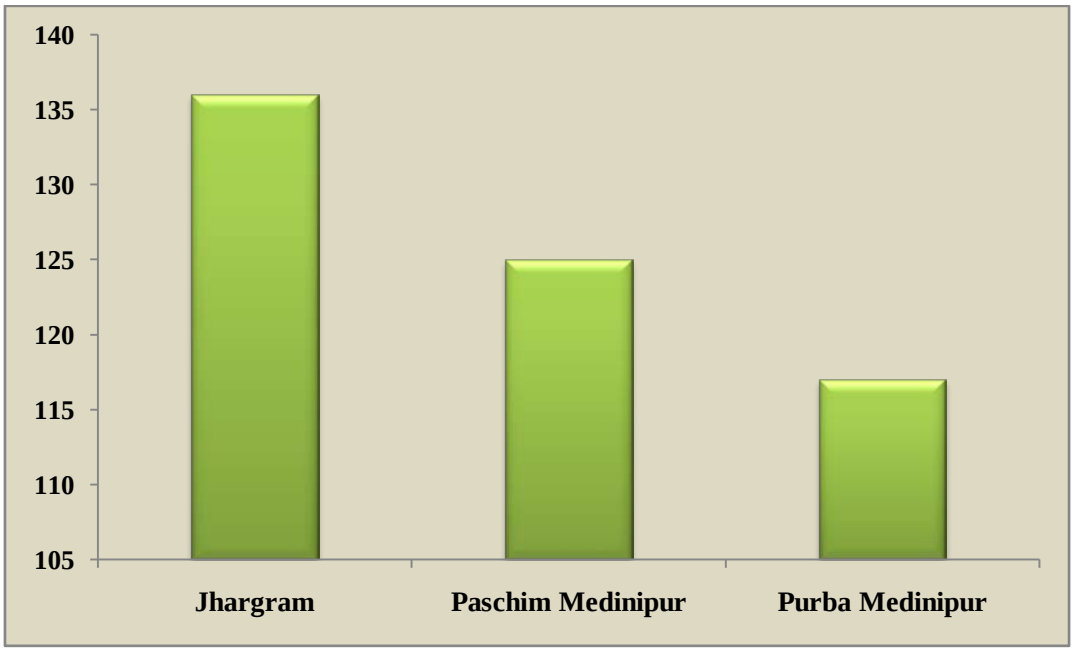

Figure 6: District wise graphical representation of butterfly species

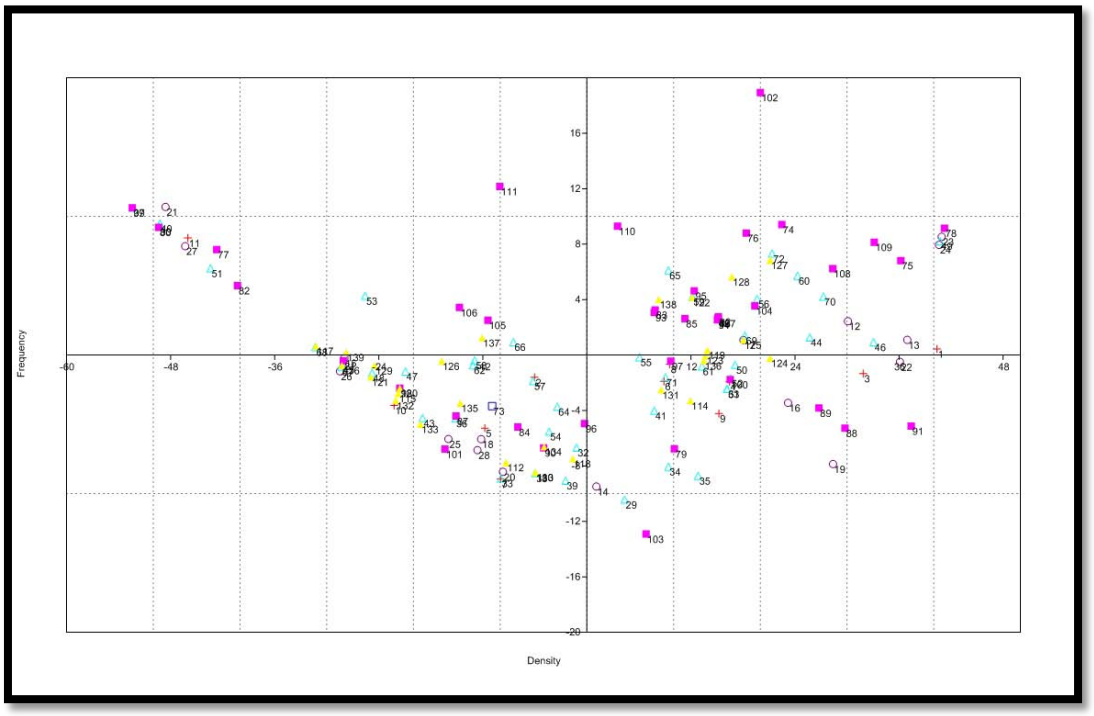

Figure 7: Scatter View of Principal component analysis (PCA)

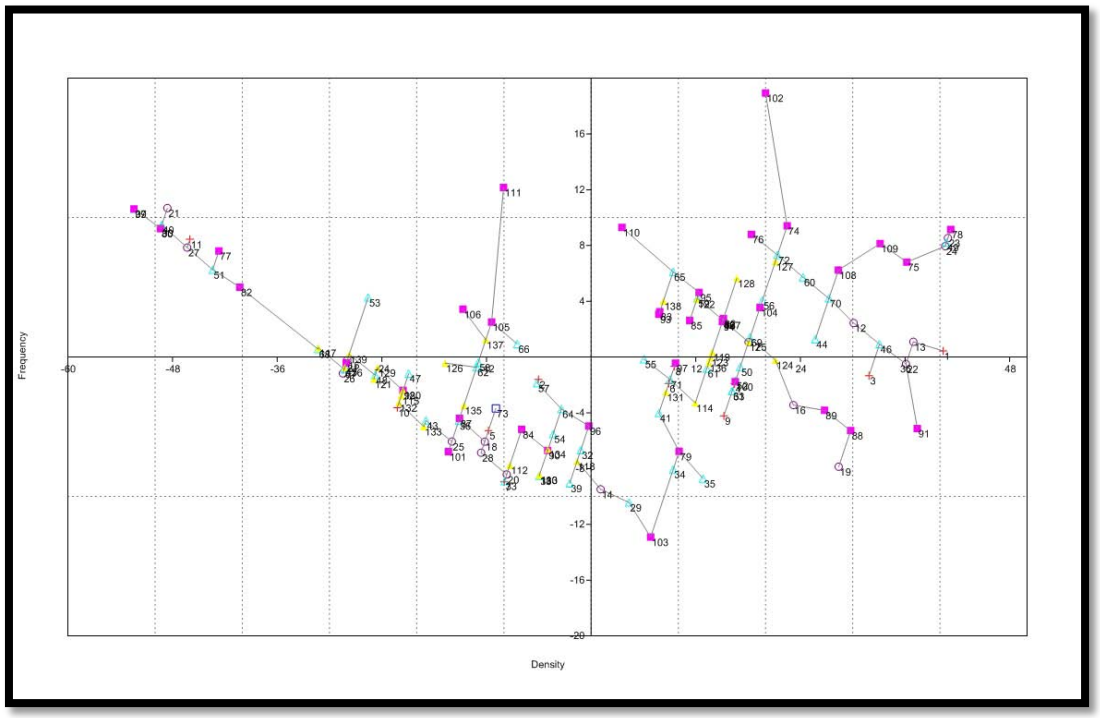

Figure 8: Scatter View of Principal component analysis (PCA) with span

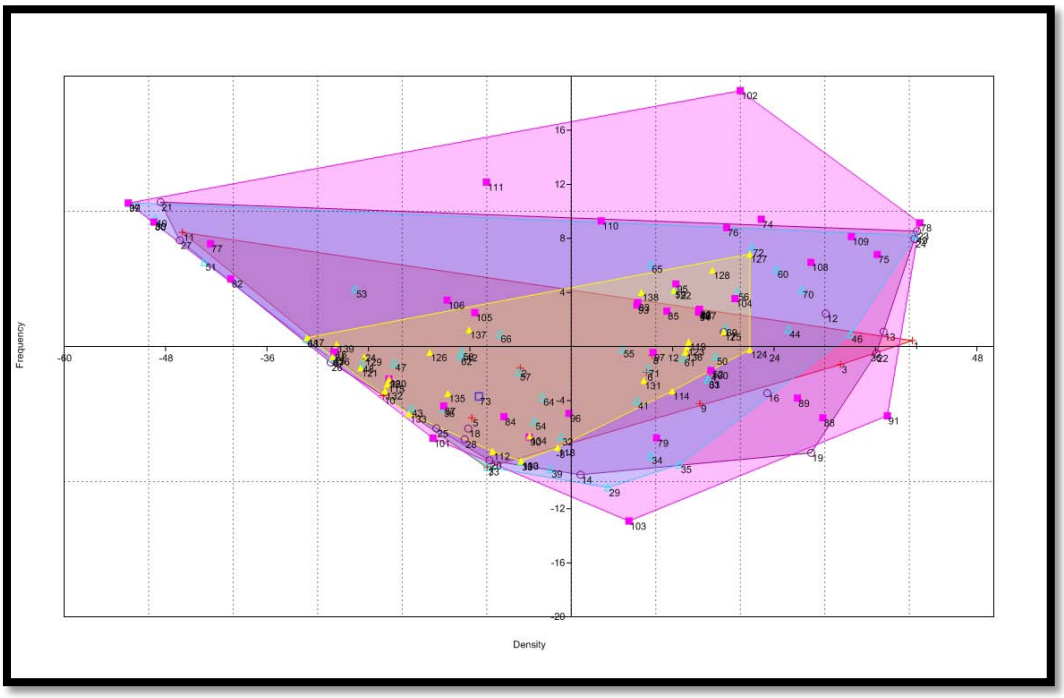

Figure 9: Scatter View of Principal component analysis (PCA) showing extension region

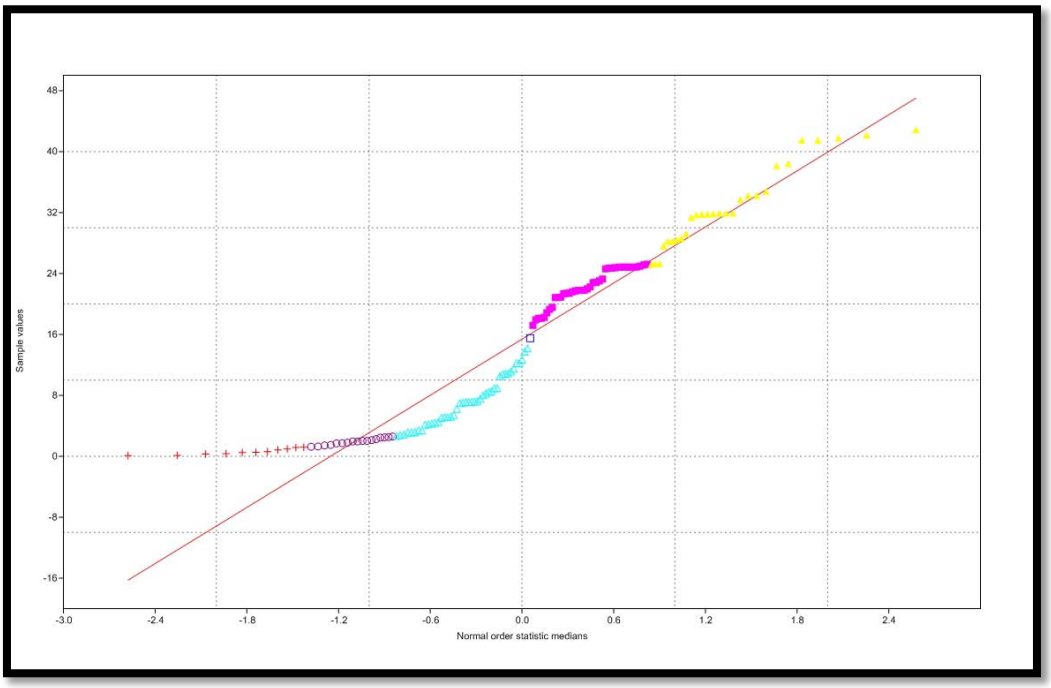

Figure 10: Normal Probability distribution of Density

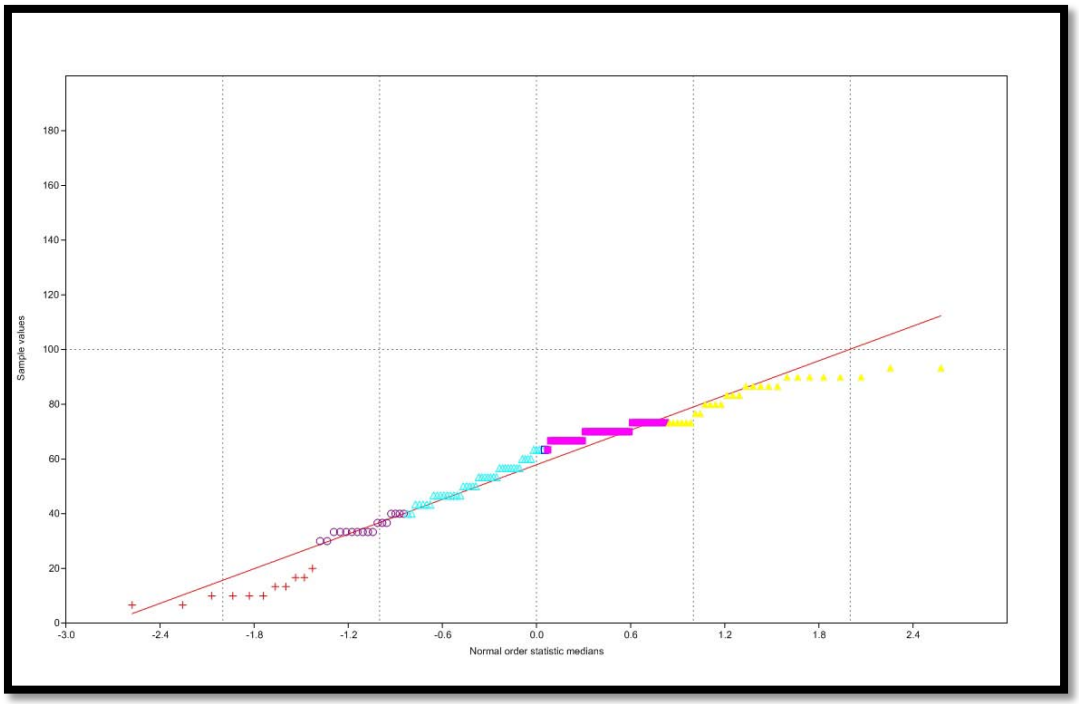

Figure 11: Normal Probability distribution of Frequency

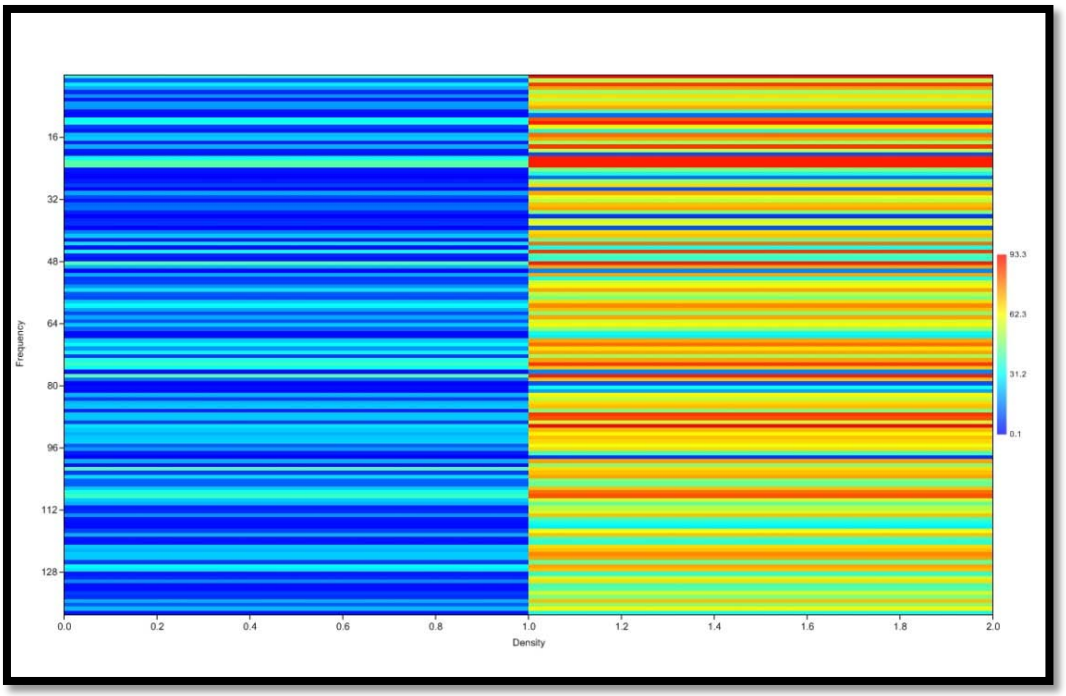

Figure 12: Matrix plot with of Number, Density and Frequency of butterfly species

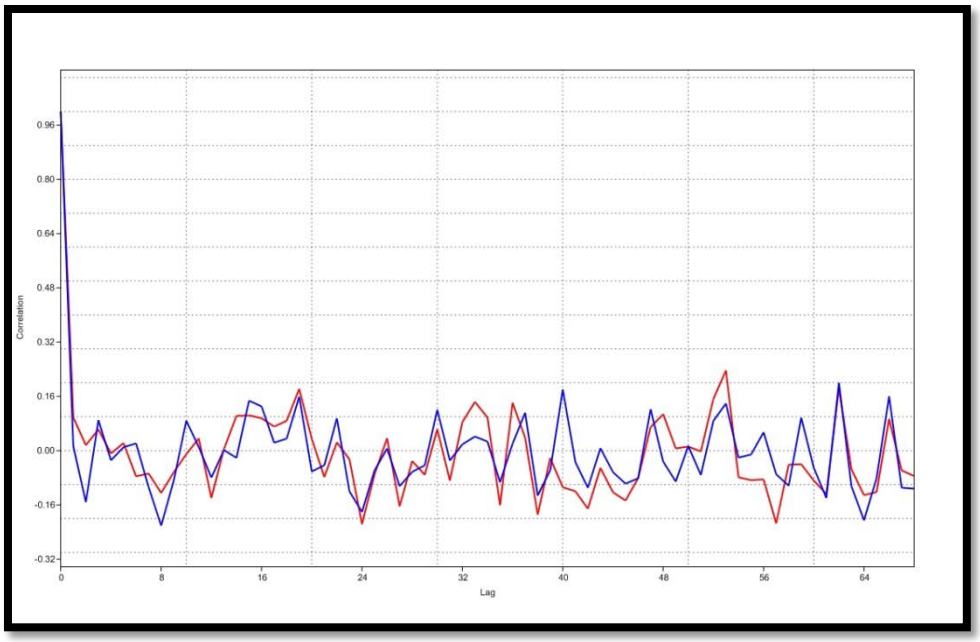

Figure 13: Density and Frequency of butterfly species showing Correlation

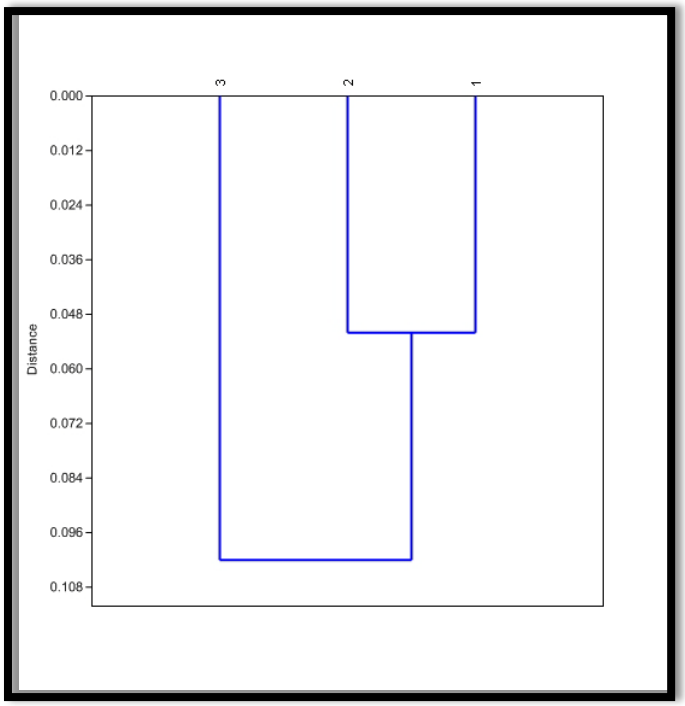

Figure 14: Cluster analysis of three districts (1: Jhargram, 2: Paschim Medinipur, 3: Purba Medinipur) on the basis of various diversity indices

Figure 15: A) Common Mormon, B) Blue Mormon, C) Lime Butterfly, D) Common Mime, E) Common Banded Peacock, F) Common Rose, G) Crimson Rose, H) Common Jay, I) Tailed Jay, J) Spot Swordtail, K) Fivebar Swordtail, L) Psyche, M) Common Gull, N) Yellow Orange Tip, O) White Orange Tip, P) Common Jezebel

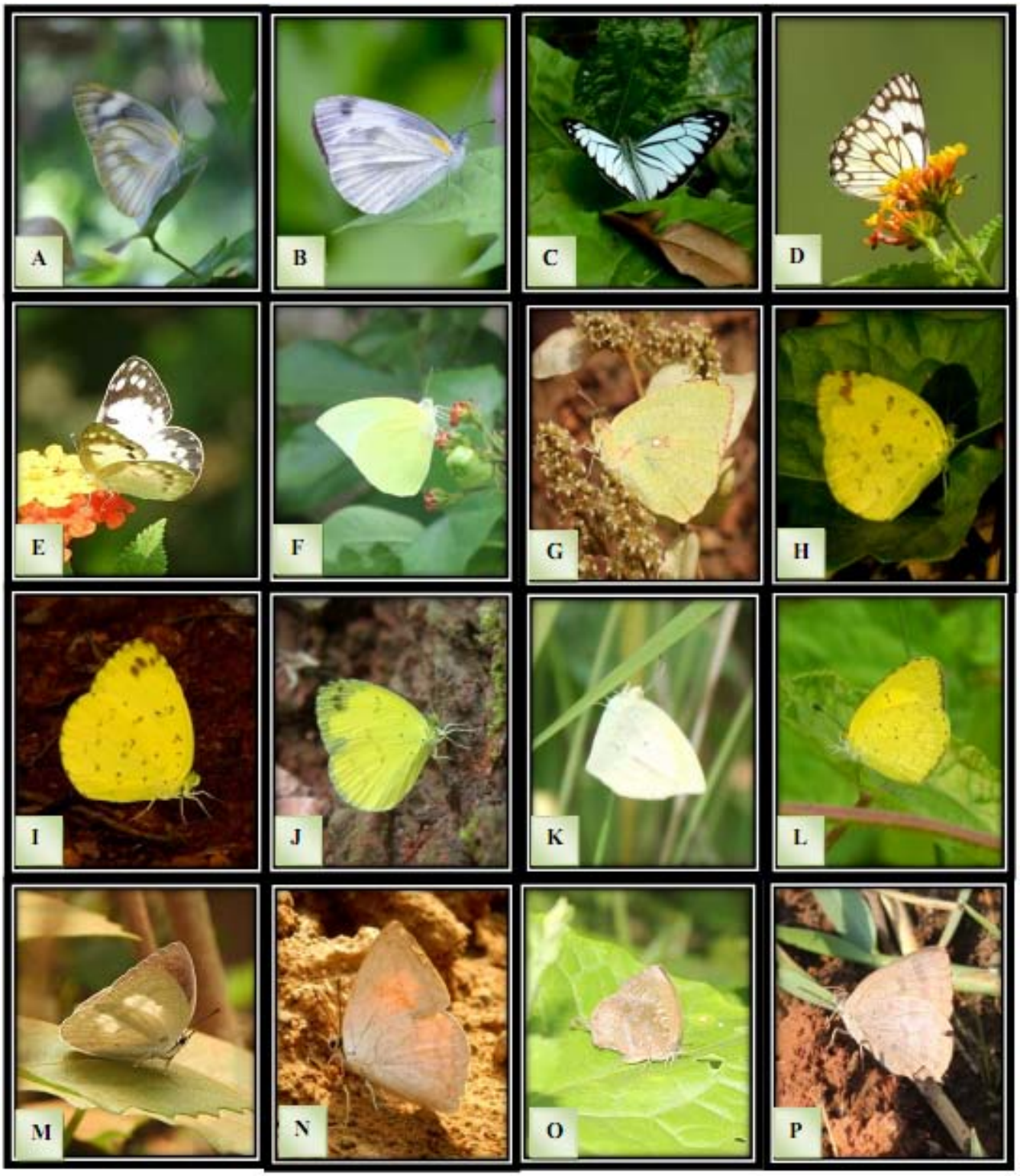

Figure 16: A) Striped Albatross, B) Indian Cabbage White, C) Common Wanderer, D) Pioneer, E) Small Salmon Arab, F) Common Emigrant, G) Mottled Emigrant, H) Common Grass Yellow, I) Three Spot Grass Yellow, J) One Spot Grass Yellow, K) Spotless Grass Yellow, L) Small Grass Yellow, M) Indian Sunbeam, N) Angled Sunbeam, O) Falcate Oakblue, P) Indian Oakblue

Figure 17: A) Large Oakblue, B) Silverstreak Blue, C) Common Guava Blue, D) Purple Leaf Blue, E) Redspot, F) Peacock Royal, G) Broadtail Royal, H) Fluffy Tit, I) Yamfly, J) Monkey Puzzle, K) Indian Red Flash, L) Slate Flash, M) Indigo Flash, N) Common Silverline, O) Common Shot Silverline, P) Long- banded Silverline

Figure 18: A) Common Pierrot, B) *Tarucus* sp., C) Angled Pierrot, D) Zebra Blue, E) Apefly, F) Common Lineblue, G) Tailless Lineblue, H) Common Cerulean, I) Dark Cerulean, J) Common Ciliate Blue, K) Pointed Ciliate Blue, L) Forget Me Not, M) Pea Blue, N) Dark Grass Blue, O) Pale Grass Blue, P) Lesser Grass Blue

Figure 19: A) Tiny Grass Blue, B) Grass Jewel, C) Common Hedge Blue, D) Malayan, E) Quaker, F) Gram Blue, G) Plains Cupid, H) Lime Blue, I) Double-banded Judy, J) Blue Tiger, K) Plain Tiger, L) Striped Tiger, M) White Tiger, N) Common Crow, O) Brown King Crow, P) Common Nawab

Figure 20: A) Black Rajah, B) Tawny Rajah, C) Common Evening Brown, D) Bamboo Treebrown, E) Common Palmfly, F) Common Bushbrown, G) Dark Brand Bushbrown, H) Common Five Ring, I) Common Four Ring, J) Common Duffer, K) Tawny Coster, L) Common Leopard, M) Commander, N) Angled Castor, O) Common Castor, P) Common Sailer

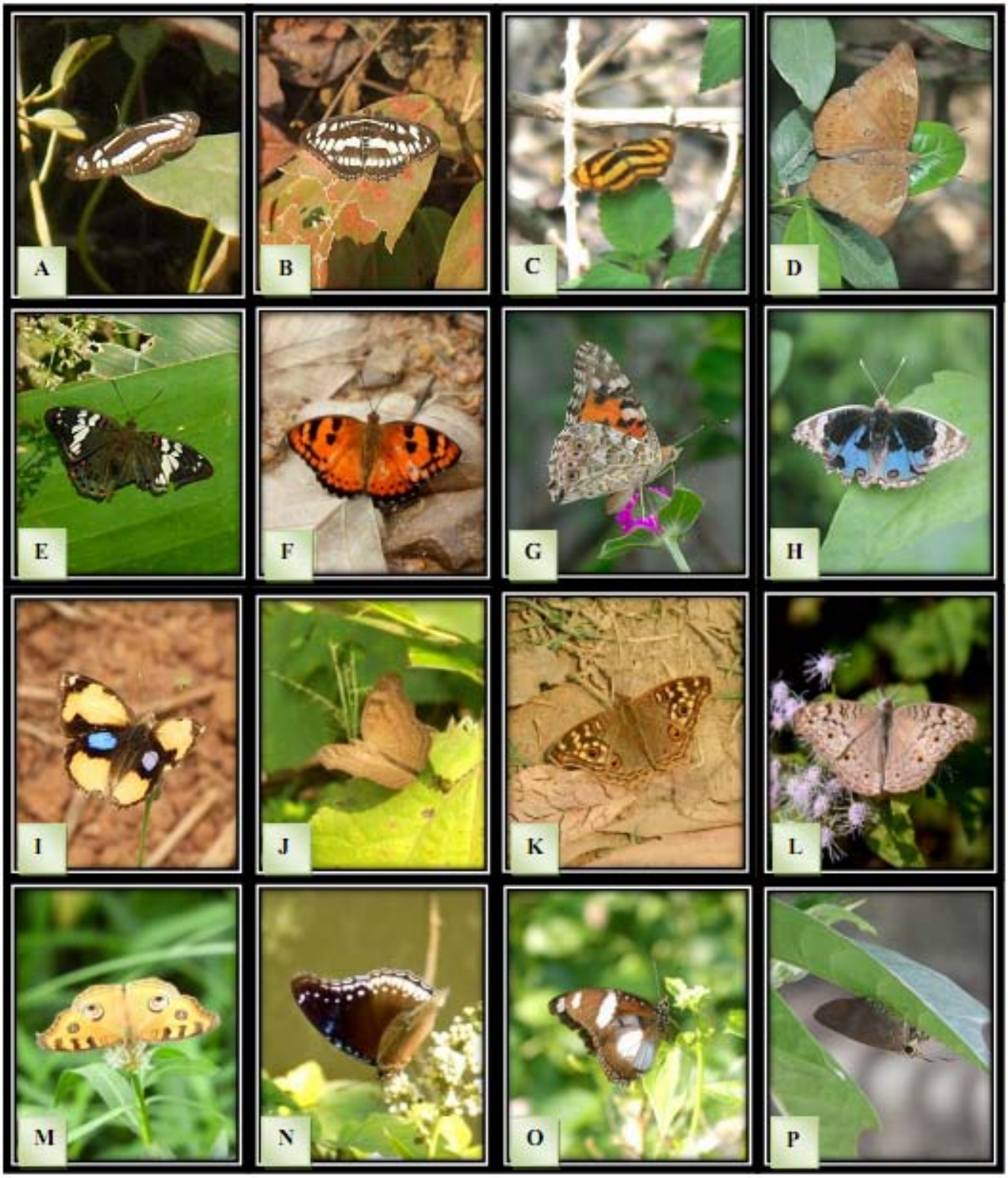

Figure 21: A) Chestnut-streaked Sailer, B) Common Sergeant, C) Common Lascar, D) Common Barron, E) Gaudy Barron, F) Baronet, G) Painted Lady, H) Blue Pansy, I) Yellow Pansy, J) Chocolate Pansy, K) Lemon Pansy, L) Grey Pansy, M) Peacock Pansy, N) Great Eggfly, O) Danaid Eggfly, P) Brown Awl

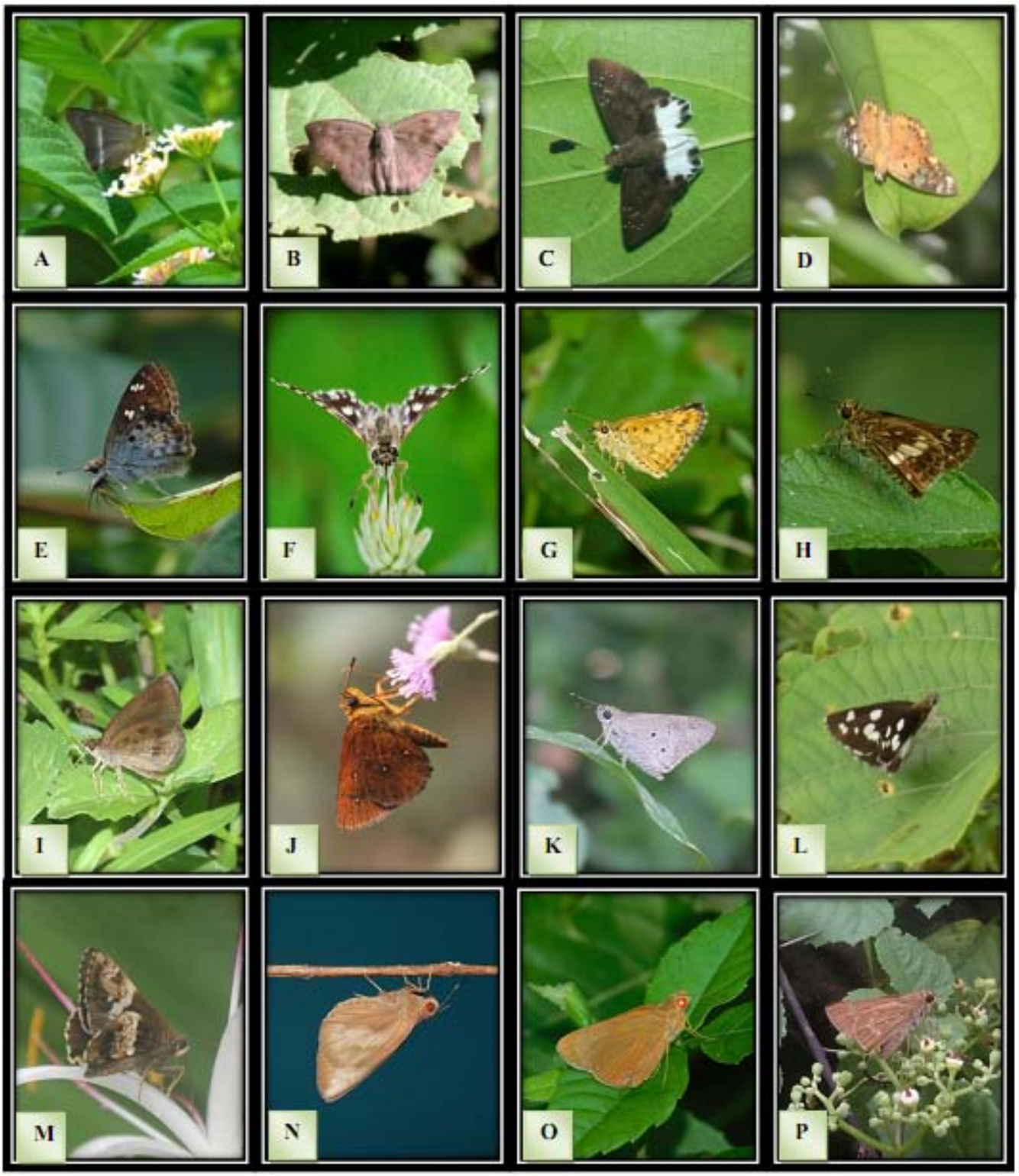

Figure 22: A) Common Banded Awl, B) Common Snow Flat, C) Water Snow Flat, D) Tricolour Pied Flat, E) Golden Angle, F) Indian Skipper, G) Bush Hopper, H) Moore's Ace, I) Forest Hopper, J) Chestnut Bob, K) Indian Palm Bob, L) Grass Demon, M) Tree Flitter, N) Banana Redeye or Banana Skipper, O) Common Red Eye, P) Ceylon Swift (Underwing)

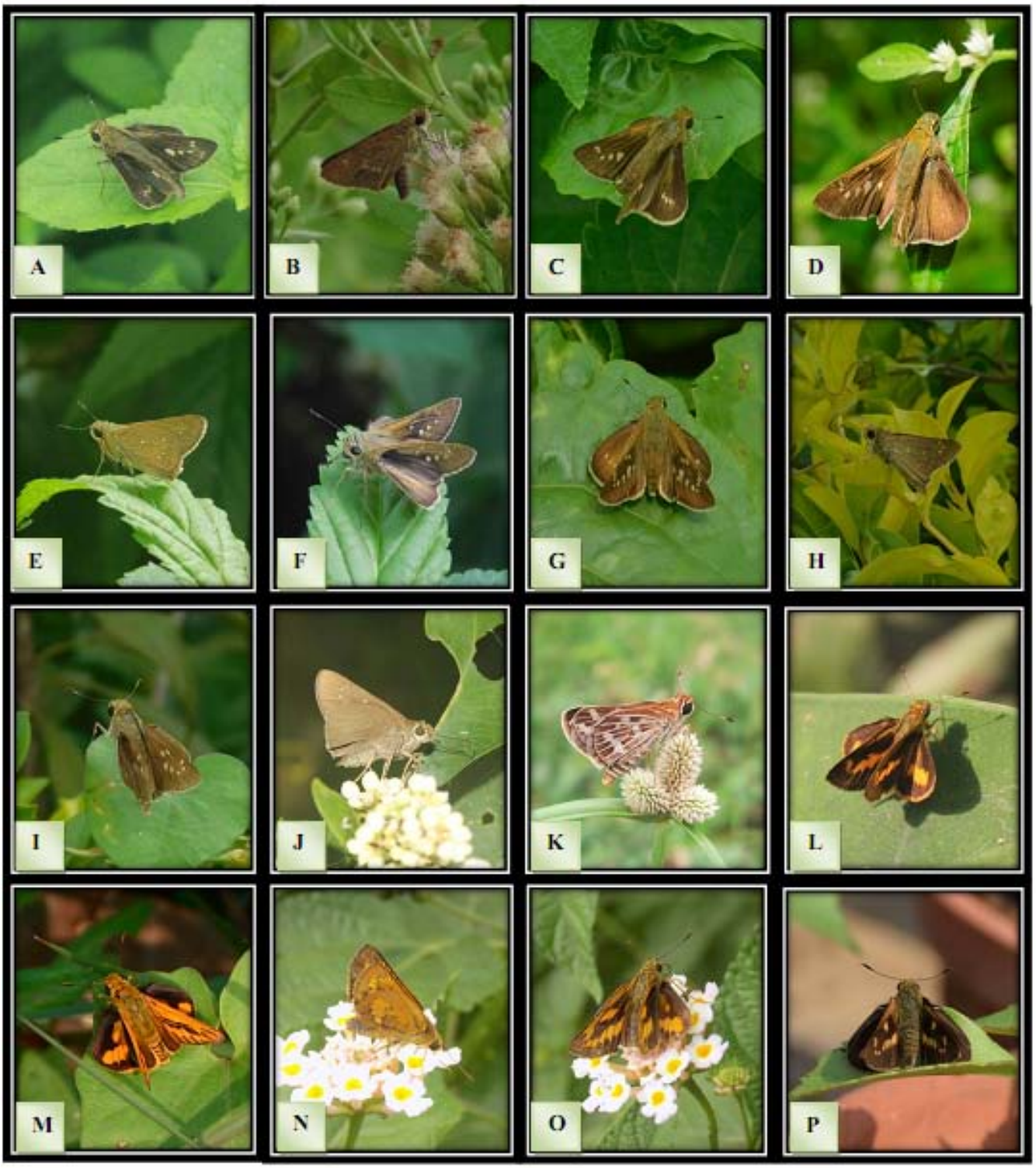

Figure 23: A) Ceylon Swift (Upperwing), B) Evan's Swift (Underwing), C) Evan's Swift (Upperwing), D) Rice Swift, E) Obscure Branded Swift (Underwing), F) Obscure Branded Swift (Upperwing), G) Conjoined Swift, H) Variable Swift (Underwing), I) Variable Swift (Upperwing), J) Paintbush Swift, K) Common Grass Dart, L) Common Dartlet, M) Common or Pale Palm Dart, N) Dark Palm Dart (Underwing), O) Dark Palm Dart (Upperwing), P) Plain Palm Dart

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Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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or email us at helpdesk@globaljournals.org

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