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Entomological indicators of ecosystem health: A focus on pollution detection

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Abstract
Bioindicators have garnered significant attention in environmental pollution research due to their ability to reflect ecological disturbances. The main goal of bioindicator research is to identify species that can consistently reflect environmental changes and their effects on biodiversity and ecosystem health. Insects, in particular, are valuable bioindicators for evaluating the impacts of human activities on atmospheric, aquatic, and terrestrial ecosystems. Their constant interaction with environmental media- air, water and soil makes them highly responsive to toxic substances and pollutants. This review emphasizes the role of insects as vital tools in monitoring environmental pollution and evaluating pollutant levels. Special focus is placed on insects such as honeybees, beetles, butterflies and ants, which are especially sensitive to minor environmental fluctuations. Their utility in detecting changes in air, water, and soil quality underlines their importance in ecological monitoring and conservation efforts.

Keywords: Bioindicators, environmental pollution, insects, ecosystem monitoring, biodiversity, anthropogenic impact

Introduction
Living organisms such as plants, plankton, animals, and bacteria are known as bioindicators and are used to evaluate the health of natural ecosystems. (Parmar *et al*. 2016 [1]; Khatri *et al*. 2017) [2]. They are utilized to assess, monitor, and indicate the condition of the environment and detect changes in ecosystem health. A bioindicator is any species or group of species whose population, function, or condition can reveal the qualitative state of the environment. Due to their sensitivity, insects aid in the identification of environmental changes resulting from many sources. They also serve as a useful biotic indicator of changes in environmental quality (Khatri, Tyagi, and Rawtani 2016) [3] (Figure 1), (Table 1).
Since insects are the most prevalent and extensively dispersed species found in all habitat's aerial, aquatic, and terrestrial we have focused on examining insect indicators in this review paper. Insects affect human existence in a variety of ways, both positively and negatively. These creatures have a variety of functions, including those of pollinators, defoliators, decomposers, recyclers, silk producers, bio-controllers, and pollutants' monitors. (Kumar *et al*, 2011) [4]. Various living things are extremely sensitive to changes in their surroundings, which can affect their essential functions such as development, metabolism, and reproduction (David 1989) [5]. Animal biotic indicator species are employed to track and determine the environment's health and qualitative state (Kumar *et al.* 2011) [4]. According to reports, there is no better monitoring method than the use of a biomonitoring agent (David 1989) [5]. An effective bioindicator provides insight into the presence of contaminants and the level of environmental exposure. Indicator species are living things and their habitats easily observed environmental conditions (Landres, Verner, and Thomas 1988) [6] (Figure 2).

1. Insects as a Sign of Air Contamination
Bioindicators are becoming a viable and cost-effective substitute for direct ambient air measurements in the monitoring of air pollution. The impacts of air pollution on insect populations have been linked to both primary (direct) and secondary (indirect) effects. In the former instance, airborne contaminants are directly linked to insect population reduction and toxicity.

a. Lepidopterans as a biomarker
They serve as environmental markers for the concentration of carbon dioxide and heavy metals in areas around factories and even in cities. The presence of iron, cadmium, nickel, copper, and other fertilizer-related elements was investigated using pupae from various Geometridae and Noctuidae species, the Species count of Eriocraniidae, the length of the cycle, and the mortality rate of newly hatched larvae from butterflies (Family Nymphalidae), which consume plants exposed to elevated CO_2 concentrations (Renato *et al*. 2010) [7].

b. The honeybee as a biomarker
The honeybee serves as an environmental bioindicator in two ways: either by detecting high death rates caused by harmful substances in the environment or by detecting heavy metal residues in larvae, honey, and pollen. Bees have been seen as an indication of the environmental radioactive nuclide strontium 90, Because of nuclear detonations in the atmosphere (Asif, Malik, and Chaudhry 2018) [8].

c. Syriphidfly as a biomarker
These flies are members of the Syrphidae family, which is one of the biggest Dipteran groups. They may develop naturally, however occasionally they need laboratory conditions to finish their life cycle. It has wide distribution

worldwide and well- known taxonomy. These flies are used to evaluate impact of different agriculture practices e.g. integrated management, no till age and also, Strong fliers linked to vegetation complexity, syrphid flies are employed as a bioindicator of forest management techniques at the landscape level (Abdul, Maeto, and Ishii 2009) [9].

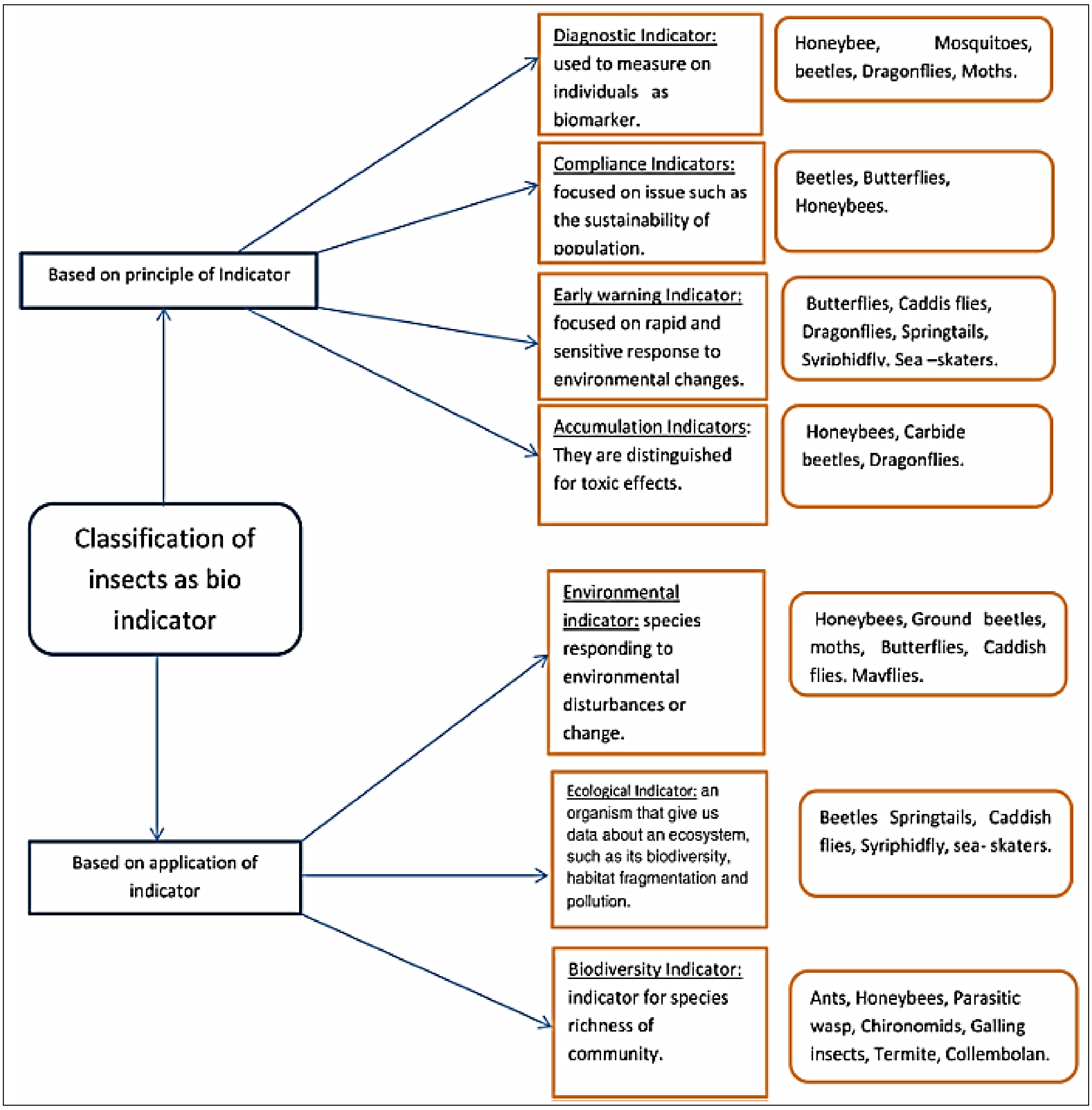

Fig 1: Insect classification as a bioindicator

Table 1: Taxonomic Classification of Insects Utilized as Bioindicators with Corresponding Habitats and Matrix

Sr. No.	Insect's images with names	Habitat	Matrix	Sr. No.	Insect's images with names	Habitat	Matrix
1	 Lepidopteran	Land and air	Pupae	10	 Tiger beetle	Land	Beetles
2	 Honeybee	Air	Larvae, pollen	11	 Cerambycidae	Land	Beetles
3	 Syriphidfly	Air	Larvae	12	 Dung beetle	Land	Beetles

4	 Aquatic beetle	Aquatic	Beetles	13	 Butterfly	Land	Butter-flies
5	 Dragonfly	Aquatic	Dragon-flies	14	 Termites	Land	Termit-es
6	 Sea-skater	Aquatic	Tissues of Sea-skaters	15	 Ant	Land	Ants
7	 Chironomid	Aquatic	Larvae	16	 Collembolan	Land	Soil
8	 Mayfly	Aquatic	Mayfli-es and water	17	 Syrphid fly	Air	Larvae
9	 Stonefly larvae	Aquatic	Mayfli-es and water				

2. Aquatic Insects as a Bioindicator

Aquatic insects have been used as bioindicators and are one of the most often used groups in biological evaluations of water quality worldwide (Afzan *et al*. 2018) [10]. They provide a variety of reactions to varying environmental stress levels and evolve throughout time. The quality of the location from which aquatic insects are gathered is reflected in the quantity and variety of aquatic bug species found in particular water bodies (Metcalfe 1989) [11]. According to certain research, aquatic insects are excellent at identifying habitat quality and human disturbance (Shafie *et al*. 2017) [12]. Their susceptibility to several causes that cause variations in water quality is the reason behind this. Aquatic insects belonging to the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally biomarkers of high-water quality, but Diptera (midges) are very good at identifying situations of poor water quality (Metcalfe 1989) [11]. According to Bhadrecha, Khatri, and Tyagi (2016), Using aquatic insects to biomonitor the health of aquatic environments has various advantages [13]. Afzan *et al*. (2018) [10] noted that because of their long lifespans and generally sedentary lifestyles, these organisms have the potential to identify variations in the quality of the water both during and before sampling. Indicators of water pollution and quality are aquatic insects. The ratio of tolerant to intolerant species in the orders Plecoptera, Ephemeroptera, and Trichoptera is used to assess the quality of water (Fikri, Wong, and Hee 2013) [14]. Additionally, several of these species are employed in early phases of toxicological studies (Metcalfe 1989) [11]. Ponds, springs, streams, and rivers with varying salinities, pH levels, and other features are home to a diverse array of aquatic insects.

a. Aquatic beetles as a biomarker

Aquatic beetles are excellent biological indicators and environmental monitors. The varied collection of aquatic beetles is a great way to measure habitat loss, habitat quality, naturalness, and age. Since they satisfy the majority of the requirements often needed in the process of selecting indicator taxa, they serve as an indication of biological variety and habitat features (Renato *et al*. 2010) [7]. Certain environments, such as wood and wetland ponds, salty lagoons and coastal areas, and peat bogs, are particularly beneficial to the beetles.

b. Dragonflies as a biomarker

Dragonfly (Order Odonata) is an aquatic insect. In water and riparian systems, they are regarded as the finest ecological indicators. When heavy metals build up, they react quickly and sensitively. According to Shafie *et al*. (2017) [12], It is believed that dragonflies are especially susceptible to habitat disturbance in flooded drainage regions and lakes. They serve as a reliable ecological indicator of the health across land and water ecosystems, and their existence in any body of water attests to its status as free of synthetic pollution (Azam *et al*. 2015) [15].

c. Sea-skaters as a biomarker

Sea-skaters are an excellent bioindicator of the spread of cadmium in marine surface waters (Cheng, Baldes, and Harrison 1984) [16]. Sea-skaters from tropical seas have been shown to contain high levels of cadmium in their tissues (Cheng, Alexander, and Franco 1976) [17].

d. Chironomids as a biomarker

Chironomids (Diptera: Chironomidae) are widely considered the best indicators of spring water quality, typically comprising the majority of spring fauna in both species richness and abundance (Lindegaard). Their larvae respond strongly to organic matter and trace-metal levels in sediments, making them highly effective gauges of surface-water and shallow-groundwater conditions. Researchers have assessed spring chironomid communities with multivariate tools such as canonical correspondence analysis and non-metric multidimensional scaling (Lencioni, Marziali & Rossaro 2012) [18].

e. Mayflies as a biomarker

Because they are sensitive to the lack of oxygen in moving water, mayflies are widely recognized across the world and are frequently employed as bioindicators in monitoring programs.

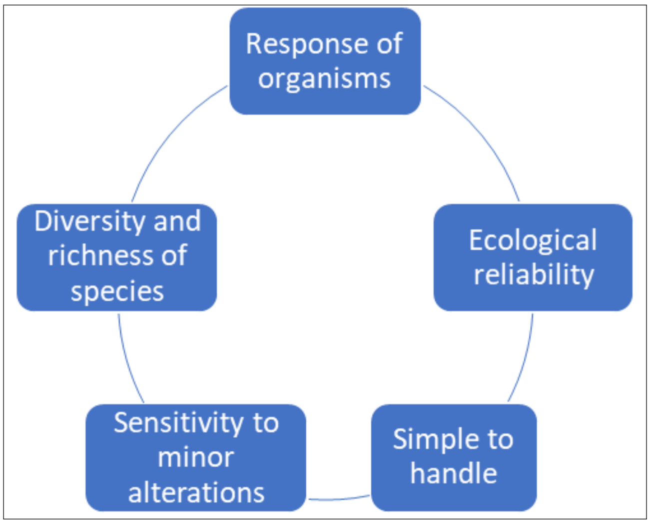

Fig 2: Bioindicator characteristics

f. Larvae of stoneflies as biomarker

Only pure or uncontaminated aquatic environments are suitable for their survival; these flies are a sign of high oxygen levels [19].

3. The Bioindicator of Terrestrial Pollution

Insects as a significant component of terrestrial species richness and biomass, insects are crucial to the health of ecosystems (Mcgeoch 1998) [20]. Many species, habitats, and environmental conditions have been studied utilizing the idea of employing terrestrial insects as biomarkers (Kremen *et al*. 1993) [21]. The single species, higher taxa, assemblages, and communities of, for example, dragonflies, ground beetles, tiger beetles, moths, butterflies, sawflies, and ants have been used in urban areas, forests, grasslands, sand dunes, soils, and mine sites to identify destruction, habitat alteration, rehabilitation, and contamination, climate change, vegetation succession, and species diversity (Coope and Lehmdahl 1996) [22].

a. Beetles as a biomarker

Beetle's important predators, Beetles are members of the Carabidae family and the Coleopter order. They are important for biological monitoring and biological control of pollution from CO_2, pesticides, radioactive elements, and heavy metals.

- **Species of beetles for metal contamination**

Concentrations of trace metals in insects have a major effect on the distribution of hazardous elements in the biosphere in terms of trophic levels because insects are essential connectors between metal transport networks, or the place an organism holds in a food chain. There have been several studies on the bioaccumulation of heavy metals by beetles. (Ghannem, Touaylia, and Boumaiza 2017) [23]. Carabid beetles (Coleoptera: Carabidae) are commonly utilized for ecotoxicological investigations because they are easily found in many sorts of terrestrial habitats and have drawn a lot of interest as possible bioindicators, as demonstrated by Simon *et al*. (2016) [24]. With a research of P. oblongopunctatus, he discovered high BAF (bioaccumulation factor) values for Cu and Zn, suggesting that this species is preferred in the evaluation of metal pollution. Additionally, he proved that Parallelomorphus laevigatus, a carabid, is a reliable tool for identifying hazardous elements. According to Ghannem, Touaylia, and Boumaiza (2017) [23], Chlaenius olivieri is also an excellent indication of heavy metal exposure.

- **Species of beetles for ecological observation**

According to Ghannem, Touaylia, and Boumaiza (2017) [23], bioindicators are considered to be helpful tools for monitoring and recording environmental changes. According to Lindenmayer, Margules, and Botkin (2000) [25], the use of indicator species is a crucial and useful method for defining sustainable management to assess the effects of natural and man-made disturbances in forests. The order Coleoptera has important roles in maintaining soil quality, managing the population of other invertebrates, controlling energy flow, and influencing the chemistry of soil formation (Ghannem, Touaylia, and Boumaiza 2017) [23]. According to Niemela, Langor, and Spence (1993) [26], beetle species (Coleoptera: Scarabaeidae) have a great potential as environmental indicators in forest regions and/or agricultural crops.

- **Species of beetles for early change detection (tropics, grasslands, and forests)**

Carabids react rapidly to grazing, habitat fragmentation, forest cutting, and fertilization, according to management techniques in grasslands and forests. This is due to their sensitivity to environmental elements as temperature, vegetation, temperature, forest patch size, and humidity (Niemela *et al*. 1994) [27]. However, different species have different ecological needs, and as a result, certain species exhibit greater susceptibility to changes in their habitat than others (Niemela, Langor, and Spence 1993) [26].

Tiger beetles: In the tropics, this species is the best indicator because it is specialized to specific habitat types and is a suitable indicator taxon for identifying regional patterns of biodiversity due to its stable taxonomy and easy observation and manipulation of individuals in the field (David and Cassola 1992) [28]. The effects of forest disturbance on beetles in Brazil and Cameroon shown that total clearance has detrimental effects on the variety of beetle species (Lawton *et al*. 1998) [29].

Cerambycidae: A variety of variables, including canopy cover, tree species composition, litter, and dead trees, affect the diversity of cerambycid beetles. Accordingly, their disturbance and abundance may be impacted by changes in land use, such as logging and timber exploitation in the woodland (Thome *et al*. 1987) [30]. Since beetle larvae mostly inhabit twigs and bark, a polyculture area with comparatively few branches, decaying wood, canopy cover, and a moderate degree of disturbance encourages a high cerambycid diversity. This finding confirmed that longhorn beetle larvae, which consume dead wood or dying plants, contribute significantly to wood deterioration. Because of their reliance on dead wood supply and sensitivity to forest conditions, Cerambycid beetles are biological markers of forest areas based on their eating behavior (Rainio and Niemela 2003) [31].

Dung beetles: In addition to being susceptible to forest fragmentation, the diversity and abundance of dung beetle species were positively connected with the amount of forest fragmentation. Different forest types have different dung beetle relative abundances. A steady decline from continuous forest to agricultural forest was seen, 15% of dung beetle individuals were captured in a forest fragment habitat, 29% in a mosaic setting, and 56% in a continuous forest (Rainio and Niemela 2003) [31]. As dung beetles' abundance decreases with increasing intensity and degree of separation from main forests, in dry forests and tropical rainforests, they can act as biomarker of habitat disruptions caused by fragmentation (Andersen 1999) [32].

b. Butterflies as a biomarker

One of the most endearing and recognized insects in the Lepidopteran order is the butterfly. Their biology and life history are well described, and their taxonomy is quite established (Sharma and Sharma 2017) [33]. They are among the most successful animals on the planet because of their capacity to adapt to almost any environment. They are regarded as crucial flagships for the conservation of insects (Smetacek 1996) [34]. Due to their significant contribution to the evaluation of environmental quality in the terrestrial environment, they are receiving more attention globally. They are regarded as one of the many insects that might serve as an ecological indicator of the health of a forest. According to Landres, Verner, and Thomas (1988) [3], It is thought that indicator species either employ changes in their own abundance or presence to transmit chemical or physical changes in the environment, or they use changes in the abundance of other species to signify their presence. Quantitative evaluations of their behavioural characteristics including light, temperature, and habitat needs have been conducted (Smetacek 1996) [34]. Due to their susceptibility to even the slightest change in environmental factors, butterflies have been portrayed as important indicator species. A healthy ecology is shown by their habitat.

Hesperiidae butterflies were found to be the least prevalent in Gir forest, whilst Danaidae and Nymphalidae butterflies were the most prevalent. Compared to natural thick forests, butterfly diversity has been shown to be greater in wildfire-disturbed forests and thinned, thinned, and burned forests. Because butterflies interact most in disturbed woods, it was found that their numbers were higher there. As a result, Butterflies are said to be among the finest ecological markers of climate change (Sharma and Sharma 2017) [33].

Due of their sensitivity to climatic factors, butterflies are frequently utilized to investigate the consequences of climate change. Throughout their life cycles, butter flies are significantly impacted by temperature. There is evidence that temperature influences oviposition site selection, egg-laying rates, larval growth and survival rates, and range expansions and shifts, either directly or indirectly (Sharma and Sharma 2017) [33].

Due to their high correlations with habitat characteristics including sunny circumstances, meadows, hilly regions, forest borders, and an abundance of herbaceous plants, they are also utilized as markers of healthy ecosystems (Niemela, Langor, and Spence 1993) [26]. It has been discovered that plant diversity, understory herb cover, and flowers are the primary factors that enhance their ecological variation (Kitahara, Yumoto, and Kobayashi 2008) [35]. The presence of semi-natural conditions can be detected by tracking their abundance. The likely reason for this is because their species richness is linked to the species richness of vascular plants, herbaceous plants, and nectar plants (Sharma and Sharma 2017) [33]. Butterflies are also sensitive to alterations to their habitat's quality and exhibit ecological loyalty since Renato *et al*. (2010) [7] reported.

Butterflies are also delicate toward changes in the quality of their habitat and exhibit ecological loyalty. These insects have been successfully used as bioindicators for heavy metal and environmental pollution around industrial areas and even within urban areas (Khatri and Tyagi 2015 [36]; Khatri *et al*. 2017a [37]; Khatri *et al*. 2020) [38]. Certain butterfly species can be used as markers of changes in the environment, including altitudinal shifts, as the highest species have been observed at lower elevations (Kumar *et al*. 2011) [4].

c. Termites as a biomarker

One typical bug species that serves as a bioindicator of soil fertility is termites. Termites are important for soil mobility, nutrient movement, acetogenesis, methanogenesis, and nitrogen fixation. Additionally, termites are crucial to the movement, transportation, and recycling of nutrients in soil. By creating mounds that increase the amount of organic carbon, nutrients and clay, termites act as ecological engineers. Erosion redistributes the mound soil, influencing fertility and soil microstructure. Termites are gregarious insects that are part of the Isopteran group, it has over 3000 species, 75% of which are soil-feeding (Nithyatharani *et al*. 2018) [39]. Since termites are decomposers, their primary food source is plant detritus. Termite's guts have been altered and adapted to increase oxygen, pH, and hydrogen-all of which are critical for changes in the chemical and physical makeup of soil (Leonard and Rajot 2001) [40].

d. Ants as a biomarker

With their ability to perform tasks including pollination, seed dispersal, nutrient cycling, litter decomposition, soil erosion, and drainage, ants are vital to the health of ecosystems. Ants are an excellent bioindicator of soil quality and are essential to the restoration of degraded and reforested regions (Majer 1983) [41]. They are very sensitive to human influence and can be used as environmental indicators in a variety of environments (Majer and Nichols 1998) [42]. Depending on the degree of environmental change, many species go extinct at a location, which encourages the growth of dominant, aggressive, and generalist species that might be bioindicators of disturbed ecosystems. Ants are highly resistant to industrial and radioactive toxins since only 20% of them fall outside the nest and are subject to the harmful effects of pollution (Jose *et al*. 2010) [43]. According to Majer and Nichols (1998) [42], In agro-ecosystems, some ants are helpful biological indicators of crop management, soil atmosphere, and plantation assessment systems.

Ants are frequently used as effective disturbance bioindicators for the restoration of biodiversity and ecosystem management (Underwood and Fisher 2006) [44], in light of their significance for eco-functional purposes (Tibcherani *et al*. 2018) [45], as well as susceptibility to ecological disruptions brought on by species invasion, grazing, forest fragmentation, forest conversion, forest thinning, and other disturbances (Renato *et al*. 2010) [7]. Ants have been effectively employed as bioindicators in Australia where their abundance is linked to microbial activity in mining sites that have been restored. They have also been utilized as markers of pollution, range land quality, and forest health (Andersen 1999) [32]. According to Majer and Nichols (1998) [42], Ants respond differently to changes in the land. Given that species richness, assemblage, and abundance are correlated with cropping techniques, soil characteristics, and management factors, they may be able to provide insight into the management and condition of the soil in agro-ecosystems. Additionally, ants contribute to minimal ecological impact agricultural methods and are crucial to the ecosystem due to their capacity to improve aeration, soil drainage, and nutrient supply. Ants may be found in many different parts of the world and are highly sensitive to a multitude of factors, such as the physical and chemical properties of the soil. For example, ant species are much more prevalent in humid areas and much less common in arid ones, suggesting that species richness is impacted by large variations in humidity and is lower during the dry season (Tibcherani *et al*. 2018) [45]. Ants are also significantly impacted by vegetation. For example, species that live in warmer, open spaces may benefit from reduced vegetation cover, while species found in closed, cooler areas may suffer from it. Additionally, species found in open, warmer areas may benefit from increased vegetation complexity, which increases group diversity and density (Jose *et al*. 2010) [43].

e. Collembolan as a biomarker

Collembolan are insects that affect soil fertility by stimulating microbial activity, influencing the dispersal of fungal spores, and preventing the action of bacteria and fungi that cause plant illnesses (Jose *et al*. 2010) [43]. They are quite susceptible to soil changes and a decline in biodiversity, which might indicate contamination from chemicals and organic waste. In entomological research, (Kumar *et al*. 2011) [4] evaluated how contaminants affected the diversity and quantity of Collembolan in the urban soils of three Bucharest parks. They discovered that the numerical densities varied depending on the study location. He discovered that although certain animals can withstand pollution and predominate in polluted habitats, the location with the highest levels of contamination had the lowest species richness.

f. Syrphid flies as a biomarker

Syrphid flies have the potential to be useful bioindicators due to their broad geographic distribution and varying environmental needs for larval stages (Sommaggio 1999) [46]. (Sueyoshi *et al*. 2003) [47] recognized the potential bioindicator usefulness of syrphid flies in assessing the biodiversity of different forested environments by observing that they responded differently in mixed forests, old-growth forests and young secondary forests. Syrphid fly species diversity and richness are positively correlated with ground layer vegetation and vertical stand structural complexity, making them markers of habitat structural characteristics on a small scale. According to Abdul, Maeto, and Ishii (2009) [9], syrphid fly diversity rises immediately following clear-cutting but falls with stand age. The greatest tool for assessing biodiversity at the landscape level is the fly because of its excellent adult mobility (Sommaggio 1999) [46].

g. The honeybee as a biomarker

A unique member of the biological kingdom, bees play a vital part in ecosystems and networks of biodiversity. In all, there are about 25,000 species, such as bumble bees, honey bees, and solitary bees, which are known as Apis mellifera in Europe. Bees are able to acquire a variety of atmospheric substances and respond to a variety of ecological conditions. The honey bee is regarded as a bioindicator and biomonitoring agent for environmental quality because of its nature.

Since honey bees can collect and retain contaminants, live in a variety of habitats, involving ones that are anthropogenically polluted, and cover large areas of useful plants, many researchers have identified them as superior markers of the degree of pollution in their living spaces. Additionally, an excellent biomarker is the honeybee. because they are widely distributed and sensitive to environmental changes over areas that are several square kilometers away from the hive. They were highly effective in ground surveys because of their exceptional mobility. They are mostly employed to track environmental pollution caused by radioactive materials, heavy metals, and pesticides. The main cause of honey bee death is pesticide residues, and residues of pesticides and other pollutants including heavy metals and radionuclides can be found in honey bee carcasses or in products from bee hives, which can be identified through appropriate laboratory analyses, are two indicators of the environment's chemical disturbance in which they live (Barganska *et al*. 2016) [48].

- **Honeybees as a pesticide toxicity indicator**

The presence and length of bloom among cultivated or spontaneous plants, the active substance employed (LD50), and the presence of honeybees at the location and during the chemical treatment, the method of pesticide distribution, wind, etc. are the main factors that determine a pesticide's toxicity to bees. After coming into touch with pesticide, a large number of bees perish in the field or on their way back. The others serve as a clear signal as they will eventually perish in the hive. The honeybees serve as an indirect signal for less hazardous substances and will report residues that they have encountered (Kumar *et al*. 2011) [4].

- **Honeybee as a marker of heavy metal contamination**

Among the highest significant and possibly dangerous contaminants is heavy metals. In the Aswan district of Egypt, 192 samples (48 flower, 48 honey, and 96 soil samples) were taken from contaminated areas (Edfu and Kom Omb towns) and unpolluted areas (Esna and Aneeba cities). Of these, nine heavy metals - Co, Pb, Cd, Cr, Cu, Ni, and Zn were identified. An atomic absorption spectrophotometer was used to test the amounts of metals. The findings showed that compared to honey from unpolluted areas, honey from polluted areas had greater amounts of Cu, Pb, Fe, and Zn. This has to do with the pollution that comes from industrial operations in contaminated regions. According to a study on metal concentrations in flowers, flowers have higher quantities of the metals under investigation than honey. These metals presence in matching honey was found to be connected with their occurrence in plant blooms. Polluted locations appear to have greater heavy metal concentration factors for honey and flowers than unpolluted ones. The honey under investigation has element concentrations within the acceptable baseline range for human consumption. According to the findings, honey might be a valuable environmental indicator for determining whether heavy metal contamination is present. (El-Haty, Mohamed, and Rashed 2009) [49].

Conclusion

Monitoring the environment requires the use of indicator species as ecological indicators. Reliability, ecological fidelity, fragility to minor environmental changes, ease of handling, cost effectiveness, species richness and variety, and ease of assessing environmental changes are the primary attributes of a bioindicator. They are all found in the class Insecta. As a result, insects serve as an essential indicator of alterations in the standard of the air, water and soil. Although choosing and identifying a particular indicator, as well as how the indicators are linked to their specific purposes, might be difficult, these changes affect the physiological characteristics and abundance of many species. We may utilize this insect to discourage pollution in the air, water, and soil, which will help us regulate pollution and stop habitat loss in the coming days. Its potential as an indicator species is also highly significant.

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