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A Review of on Environmental Pollution Bioindicators

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ABSTRACT: Qualitative status of the environment is signaled by a group of indicators, known as bioindicators, several of which are responsible for showing progressive impacts of different types of pollutants. Having addressed the influence of various bioindicators in environmental pollution, it has been revealed that bioindicators are sensitive to any disturbance in any environment. With regards to the pollution, the quality of an ecosystem can be judged by an organism, which is actually an indicator and play a key role in monitoring its changes. A reliable and cost effective way to evaluate the changes in the environment is possible by means of indicator species as ecological indicators, yet selecting a specific indicator poses a real challenge, followed by its identification as well as relation among indicators and their particular applications. As a result, environmental, ecological, and biodiversity indicators fulfill their goal of monitoring environmental quality. The current situation requires cost effective bioindicators along with their reliability to detect and mitigate the impacts of pollution in our environment.

Keywords: Bioindicators, Indicator Species, Environmental Pollution

INTRODUCTION

Bioindicator is given to a living entity or group of organisms that shows the information, either based on the environment or a constituent of it (Wilkomirski, 2013). Keeping this definition in mind, the current study aims to select different types of bioindicators such as microorganisms, lichens, animals, or plants which under environmental alterations tend to produce certain molecular signals (Posudin, 2014). There have been New fields of research due to the invasion of a wide range of individual components in the environment in toxicological, chemical, and ecological terms (Merian et al., 2008).

Complete monitoring of the whole area is possible by bioindication, which indicates various living systems with simple data (Mueller, 1980). The effect of external factors on ecosystems can be assessed by reliable procedure of bioindication (Markert, 2008). Living organisms that can be examined without any difficulty and environmental conditions of their habitat can be regarded as indicator species (Landres et al., 1988; Cairns and Pratt, 1993; Bartell, 2006; Burger, 2006). Environment renders indicator species sensitive to its alterations, whereas detection of ecosystem by assessing an efficient incentive of a single population is believed to be more useful and cheaper (Spellerberg, 2005). Short-term stress conditions or long-term events predict future situations and alterations by

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identifying the variations in indicator species (Cairns & Pratt, 1993).

Several restrictions on indicator species have been described, despite their increased popularity (Lindenmayer et al., 2000; Lindenmayer & Fischer, 2003; Morrison, 2009; Lindenmayer & Likens, 2011). Environment complexity with single population rarely occurs and have subjective selection criteria for indicators according to initial restrictions (Ahmed et al., 2016). In addition, differing environmental indicators respond to various environmental alterations, e.g. ecological indicators demonstrate the changes in living systems' environment, whereas diversity coexists with the overall community diversity ecosystem for taxonomic groups of biodiversity indicators (Mc Geoch, 1998). Therefore, monitoring goals are separated by three categories, with regards to the changes in either physical or chemical changes of the environment along with biodiversity and ecological procedures (Holt & Miller, 2011). The present study shall discuss the impact of various bioindicators in environmental pollution.

Bat as Bioindicator of Environment Health Assessment

Human population is increasing at a frightening rate. Currently, population of over 7 billion humans helped as well as deteriorative effects against the balance of living entities and humans is devastating the earth,(Barnosky et al., 2012). To attain a balanced living environment, bioindicators such as bat play a vital role to lessen human impact for monitoring environmental health (McGeoch, 1998).

Among most diverse vertebrate groups, bat is one with more than 1300 species, sensitive to habitat deterioration and land use (Fenton & Simmons, 2014). Bats are cost effective, responsive to environment stressors, and stable taxonomically, providing a wide range of services from pollination to pest control in the ecosystem (Jones et al., 2009; Jones, 2012).

A key character of appropriate bioindicators like bat is to respond to alterations in an ecosystem, e.g. the ones in drought events (Amorim et al., 2015), agricultural practices (Park, 2015), urbanization (Ancillotto & Russo, 2015), light pollution (Stone et al., 2015), and heavy metals (Zukal et al., 2015).

Tourist Disturbance, Indicated by Birds and Fish

The basic factors to affect biodiversity of freshwater environments include over exploitation and pollution (Cooperrider & Noss, 1994; Curtis et al., 1998) with tourism being an important source of chaos in these environments (Palacio et al., 2007). Similar responses cannot be delivered by various indicators (Duelli & Obrist, 2003).

Although most common characters are shared by bioindicators such as fish (Pyrovetsi & Papastergiadou, 1992; Browder et al., 2002) and birds (Heino et al., 2005; Fu et al., 2003), like being short lived species after disturbance, some tourist activities may affect these groups as well as bioindicators of relative human disturbance (Tershy et al., 1997; Higginbottom et al., 2003; Newsome et al., 2004).

Freshwater Mussels as Biological Indicators

Changes in water and habitat have been recorded from the use of feasible indicator acts as environmental logbooks which are the properties of freshwater mussels (Ortmann 1909; Wurtz 1956; Bedford et al., 1968; Simmons & Reed, 1973; Imlay, 1982; Neves, 1993; Naimo, 1995).

Alterations in habitat are promoted by humans, an ordered damming of creeks and rivers has had the most significant effect on freshwater mussels (Bogan, 1993; Neves, 1993; Yeager, 1993). The physical, chemical, and biological attributes of numerous rivers have changed from shallow flowing habitats to long linear pools drastically (Ellis, 1942; Bates, 1962; Coon et al., 1977; Yeager, 1993; Hughes & Parmalee, 1999).

Sedimentation is another process with harmful impacts on freshwater mussel communities. Soft, cohesive substrates, and suspended fine sediments are deleterious for most species and may affect respiration, feeding, and growth (Marking & Bills, 1979).

Honey Bee as Bioindicator of Environment Quality

Likely to be used to determine environmental quality for bioindication, honey bee is an efficient bioindicator that reacts quickly to various external factors (Crane, 1984; Bilalov et al., 1992; Jeliazkova et al., 2001; Jeliazkova et al., 2002; Porrini et al., 2003; Zhelyazkova et al., 2004; Fakhimzadeh et al., 2005; Stanimirovic et al., 2005; Bianu & Nica, 2006; Gallina et al., 2006; Spodniewska & Romaniuk, 2006).

Cases of environmental pollution and atmospheric air which have contributed imbalanced health level, life status, and quality of the population in the past few years, have been monitored (Berberova et al., 2008; Takuchev, 2011). The existing problem in the environment is monitored by determining the traces in plant and animal origins along with honey bees and humans (Eneva & Todorova, 2004; Berberova et al., 2008; Petkov et al., 2010).

As a consequence of atmospheric nuclear testing, bee has been monitored as an indicator of radionuclide strontioum 90 in the environment (Svoboda, 1962). Since 1970, in territorial and urban surveys, environmental pollution is caused by heavy metals (Cavalchi & Fornaciari, 1983; Crane, 1984) and pesticides in rural regions (Atkins et al., 1981).

Earthworm as Bioindicator of Soil Pollution

Both environment and human life are in danger, due to high levels of pesticides and heavy metals, which cause soil pollution, (Caroline et al., 2001) with the exposed organisms being the greatest invaders of such kind of complex effects (Svendsen et al., 2004). Among soil species, in most soils, a huge part of invertebrate biomass is formed by earthworms (Haeba et al., 2013).

All biological agent, crusher, moisture retainer, aerator, and nature's plough are both composting agents and biofertilizers, at the same time (Eguchi et al., 1995). Predators play a key role in the assimilation of contaminated earthworm tissues increase the level of harmful chemicals in food chain and in this way soil health is indicated by these biological indicators with their particular behavior in toxic soils (Caroline et al., 2001). By means of 'earthworm acute toxicity test' possible risk of environmental pollutants on invertebrates of soil has been examined (Anonymous, 1984).

Lichen as Bioindicator of Metal Pollution

Pb, Ni, Cu, Cr, and Cd are some metals in cement dust, generated by cement industry (Alkhasman & Shawabkeh, 2006). Wind and rain cause spread cement dust and its related chemicals usually found in lichens, soils, animals, and plants (Schuhmacher et al., 2009). To detect air pollution, lichens are likely to be used as indicators (Yazici & Aslan, 2006; Cicek et al., 2008; Bingol et al., 2009). Due to their sensitivity to different factors of environment, lichens are considered to be the most appropriate biomonitors of air quality during last 30 years (Conti & Cecchetti, 2001; Brodo, 1961; Rossbach & Lambrecht, 2006).

Lichens are considered the most reliable biomonitors according to their specific physiological, morphological, and anatomical characteristics (Battal et al., 2004). Changes in air quality can be detected by air pollutant sensitive epiphytic lichen species (Showman, 1988). It is compulsory for the judgment of an area that it should have enough species of lichen to monitor air pollution (Calvelo & Baccala, 2009).

Phytoplankton as Bioindicator for Water Quality

There is a relation between aquatic organisms and pollution as aquatic organisms are considered to be the indices of pollution (Kolkwitz and Marrson, 1908). Several methods have been proposed to locate organisms, able to monitor the quality of water (Knopp, 1954; Zelinka & Marvan, 1961; Sladecek, 1973). In some streams of Taiwan, microorganisms, fish, and macroinvertebrates have been used to monitor water quality (Hau et al., 1976; Hong, 1979; Lee et al., 1967).

Both anthropogenic activities and industrialization are behind the hazardous materials and the pollutants, increasingly discharged in the environment (Ghorbanli et al., 2007; Raabe, 1999; Bakand et al., 2005; Hayes et al., 2007). Biomonitoring capacity of roadside plant leaves can be measured by their exposure to air pollutants as well as their reaction as stressor against them (Pandey et al., 2005; Sharma et al., 2007), yet in an industrial area the response from several growing plants has been monitored biochemically and physiologically through proper investigation (Joshi et al., 2009; Gupta et al., 2009; Sharma and Tripathi, 2009; Gupta et al., 2011).

CONCLUSION AND RECOMMENDATIONS

The use of indicator species as ecological indicators is reliable and cost-effective to assess the changes in environment, though it is quite challenging to select a specific indicator and then identify it as well as the relation among the indicators and their particular applications. The future usefulness of indicator species will strictly depend on selected indicator groups that present the environment in actually, showing efficient relations between the indicator species and under lying processes of interest.

Furthermore, extensive surveys, search of literature, and research is required on various bioindicators as well as their particular role in determination of environmental health including novel approaches to human interference that creates disturbance in the environment, causing pollution and leading to the loss of ecosystem services such as plant pollinators, drinking water, and clean air.

Environmental pollution has major impacts on the disturbance of ecosystem. Although it is very difficult to make our environment free from pollution, it can be reduced by releasing chemical liquids from factories into water bodies after treatment, using vehicles with less fuel combustion, and using pesticide spray in a controlled manner. Moreover, further studies are required in this aspect to prevent living beings from suffering damages that play vital role in the maintenance of ecosystem.

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