Effects Of Pigeon Excreta On Copper And Its Alloys

Summary

Pigeons have been a common nuisance in the many cultural sites of Kathmandu valley. Due to presence of easy food availability, building ledges and low level of predator the number of pigeons have raised and with it, the problems associated with it has also increased. Beside health, economic and beauty issue caused by the pigeon excreta it also helps in damaging of the materials including the metals like copper and its alloy used in Nepalese architecture. The major objective of this proposal is to find a concentration of uric acid concentration in pigeon excreta and the effects of it on the metal with its implications in the monuments of Kathmandu valley and determine the composition of its excreta and compare before and after change in the metal sample. The excreta will be collected from the four cultural sites of Kathmandu. Different metal samples will be collected. The excreta samples will be dried and homogenized in distilled water and the samples of metals will be dipped inside it and different analysis will be done regarding cases like staining, weight loss and corrosion etc. It is expected that there will be negative effects of the pigeon excreta on the metal sample of copper and its alloy.

1. Introduction

1.1 Background

Pigeons have become well adapted to live in a modern city and are becoming a nuisance to the urban areas. Especially in the region of Kathmandu valley due to the presence of different cultural heritage sites like temples, stupas, monasteries and people freely providing foods to them, has created a type of conflict in the surrounding area of cultural sites. According to the theory of ideal free distribution, the choosing of a bird habitat is affected by factors including potential predators, food density, and cover (Fretwell 1969). The availability of building ledges, over hangs low level of predators, easy food availability with high protein content has helped in creating ideal place for pigeon to live (Spennemann et al. 2018)

Besides health, economic and beauty issue caused by the pigeon excreta it also helps in damaging of the materials used in cultural sites. The metal monuments is exposed to physical, chemical and biological threat and it has damaged the beauty appeal and integrity of the metals too (Bernardi et al. 2009). Due to need and importance of cultural heritage site and different monuments found there, there have been many studies in understanding the different hazards that can damage it and how to prevent it. The environmental effects on stone surface have been studied in the past but the direct and indirect effect of the pigeon excreta on the metal has not been properly done and there is a gap in research regarding this topic.

Copper alloy are used for the making of the pinnacle, statues, idols, roof of many cultural sites of Nepal. It is very malleable and ductile as metal. Pigeon can damage the copper structure by many ways like by visual staining the surfaces, chemical damage by acids and soluble salts, deposition of nutrients helping in biodegradation by different microorganisms (Spennemann et al. 2018).

1.2 Statement of the problem

Kathmandu has many cultural heritage sites and infestation of pigeons has created many problems in the metal monuments. This study is needed to know whether the pigeon excreta deteriotes the metal surface or not and if it does so, then how it does it and how to reduce its effects.

1.3 Objectives of the study

The general objective of this study is to find the effects of pigeon excreta on the metal monuments of cultural importance in Kathmandu valley. The specific objectives of the research are:

1. To determine the uric acid concentration of the fresh pigeon droppings from cultural sites in Kathmandu.
2. To analyse the different metal characterization of the metal sample used in the experiment using X-ray diffraction
3. To determine the weight loss rate of the metals used in monuments construction under the influence of pigeon excreta.
4. To compare the differential effects of pigeon excreta in different metals and alloys of monuments at various exposure durations.

1.4 Research hypothesis

The study is conducted on the base hypothesis that “There is adverse effect of pigeon excreta on the metals monuments”

1.5 Significance of the study

Many researches have already been carried out on the effect of bird excreta on different surface including stones, bridges, outdoor statues. But study of effects of pigeon excreta on metal surface is required to known about its negative impact on cultural monuments. Since, pigeons have become a major pest in the urban area of Kathmandu and their activities are mostly seen in the heritage sites this study will give the degree of effect of pigeon excreta on metals used in heritage sites and the extent of deterioration it can cause in the future. This can be implicated for making further decision for preserving of metal monuments and different steps to be applied for decreasing its effect.

2. Literature Review

Copper and its alloys specially bronze and brass are very good metals for the construction of statues and cultural monuments. The long term exposure of copper alloy is affected by atmospheric environment (Knotkova and Kreislova 2007).

According to Ray, the most common technique used in Kathmandu for monument construction was old technique called as ‘retardataire’, but he also confirmed that ‘lost wax’ technique was also known to the Newar craftsmen of Kathmandu (Ray 1973), they used metal alloys composed of five metal or eight metal i.e. Pancha Dhatu and Astha Dhatu respectively

consisting of metals like copper, bronze, brass, zinc, lead, iron, gold and silver (Bonapace and Sestini 2003).

In the study of effect of pigeon excreta done in Romania by Adrian Vasiliu and Daniela Buruliana in 2010 found that the uric acid present in the pigeon excreta had negative influence in the copper alloy metal and confirmed significant damage in statue and monuments considering cultural heritage (Vasiliu and Buruiana 2010). An experiment was conducted to see the effect of uric acid on outdoor copper and bronze (Bernardi et al. 2009). They studied the transformation of uric acid before and after excreting out. They found that before excretion uric acid is converted to ammonia and after the excretion with external environment contact is nitrified and this can cause damage to the copper and bronze metal by tarnishing it and water plays important role in accelerating the deterioration process of metal (Bernardi et al. 2009).

Ramezanzadesh et al. (2009) in Iran found that the effect of bird excreta had irretrievable effect on visual appearance on clear coat of metal, before and after the introduction of the bird dropping. Ali et al. (2015) at historical site Al-Namrud in the north of Iraq found that the bird dropping seem to be an active factor of the structural, textural damage in some stone monuments.

3. Materials And Methods

3.1 Study area

The study area is four cultural heritage sites- Kathmandu Durbar Square, Bhaktapur Durbar Square, Patan Durbar Square and Swayambhunath Temple. The durbar squares dates back to as early as the Licchavi period in the third century although they have gone intensive renovation and nothing physical remains from that period. Extensive constructions and development took place during the Malla Dynasty. But these sites were heavily devastated by 2015 earthquake.

Syambhunath was founded by the great-grandfather of king Manadeva (464-505 CE), King V?sadeva, about the beginning of the 5th century CE which is among the oldest religious sites. The Swayambunath complex also suffered damage in the April 2015 Earthquake.

3.2 Materials

Different tools will be required during excreta collection and experimental analysis like

- a) Plastic bags
- b) Spatula
- c) Gloves
- d) Mask
- e) Beakers
- f) Measuring instruments
- g) Different chemicals
- h) Microscope etc.

3.3 Excreta collection

Four cultural sites- Kathmandu Durbar Square, Bhaktapur Durbar Square, Patan Durbar Square and Swayambhunath Temple will be selected for the dry and wet excreta sample. One each site, from the central point, a circular quadrate will be made with radius of 200m and fresh as well as dry pigeon excreta will be collected. For the collection of the fresh excreta the feeding ground will be selected and the feed will be dispersed and the available excreta will be collected with plastic spatula. For the dry excreta they will be directly scrapped out by the wooden or plastic pliers.

3.4 Experimental design

The laboratory-based work will be performed in the lab of Central Department of Zoology T.U. The uric acid concentration will be determined by spectrophotometric method (Hodoson 2009) on the freshly collected excreta sample as well as for the dry sample. Ph of the samples will also be measured for each sample at different interval of experiment time period. For the analysis of different metal alloys, X-ray diffraction method will be used in the NAST facility. The contamination from the dried pigeon excreta samples will be removed by passing it through sieve. It will be then homogenized in distilled water and equal volumes of sample prepared will be kept in different beakers. For wet fresh sample it will be directly collected in the plastic bag. Supplementary metals of copper and its alloy of similar composition as used in the monuments will be collected from the surrounding area where the craftsmen still make the monuments with the ancient technique. The metals sheet will be cut and made into many small pieces of equal dimension. The metal samples would be cleaned properly and external contaminations would be removed. Metal samples would be dipped by placing the metals and tied with thread so that the metal doesn’t get attach to the glass. They will be kept in different excreta sample solution. Before and after analysis of the metal will be done at different time interval, in cases like staining, ph change, weight loss in metal and corrosion etc. For proper analysis the different samples of chemicals will be prepared as control, like different uric acid concentration solution, water, sterile soil, fine sand, organic paste at room temperature etc. To find if the damage is due to uric acid present in the pigeon excreta or due to other reasons, the experiment would be replicated with other samples too, so that proper result is obtained from the observation.

The original weight of the metals will be recorded and the loss of the weight will be determined by measuring the weight at different time interval of 3 days, 7 days, 14 days, 28 days, 56days, and 112 days.

3.5 Data analysis and interpretation

Data obtained from the observation of before and after introduction of metal in pigeon excreta will be compared by using ANOVA test analysis.

4. Expected Outcomes

This research will benefit in fulfilling the knowledge gap regarding the pigeon excreta and amount of damage it can cause in our copper monuments.

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