SAMPLING TO REDUNDANCY IN ZOOARCHAEOLOGY: LESSONS FROM THE PORTLAND BASIN, NORTHWESTERN OREGON AND SOUTHWESTERN WASHINGTON

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ABSTRACT—A method for determining whether a group of samples is adequate to address a research question is presented. As each sample is analyzed the average value of a variable is recalculated and a cumulative graph is produced. When the value of the average stabilizes, one has empirical evidence that analysis of additional samples is not necessary—one has sampled to redundancy—and the collection is adequate for its intended analytical purpose. Analysis of two zooarchaeological collections of mammalian remains recovered from the Portland Basin of northwestern Oregon and southwestern Washington illustrates this point. Despite the spatial and temporal propinquity of the two sites, one assemblage is adequate for estimating taxonomic richness and diversity whereas the other, larger collection, is adequate for estimating richness but not diversity. Combined, the two collections are adequate for estimating taxonomic richness but do not provide an accurate measure of taxonomic diversity. Graphing procedures for monitoring sample adequacy, if implemented in the field, could help preserve finite archaeological resources.

Key words: mammalian zooarchaeology, sample adequacy, sampling to redundancy, taxonomic diversity, taxonomic richness.

RESUMEN.—Se presenta un método para determinar si un grupo de muestras es adecuado para abordar una investigación concreta. Al analizar cada muestra se vuelve a calcular el valor medio de la variable y se produce un gráfico acumulativo. Cuando se estabiliza el valor de la media se concluye empíricamente que no es necesario analizar muestras adicionales pues se ha muestreado de manera redundante y la recogida de datos es suficiente para el pretendido análisis. Este hecho se ilustra con el análisis de dos colecciones de restos de mamíferos recogidos en la cuenca del río Portland en el noreste de Oregón y en el suroeste de Washington. A pesar de la proximidad espacial y temporal de ambos yacimientos, una de las colecciones es adecuada para estimar la riqueza taxonómica y la diversidad, mientras que con la otra colección que es mayor, se puede estimar la riqueza, pero no la diversidad. La combinación de ambas colecciones es adecuada para estimar la riqueza taxonómica pero no proporciona una medida exacta de la diversidad taxonómica. La realización en el campo de métodos gráficos que representan la idoneidad de la muestra, podrían ayudar a conservar recursos arqueológicos escasos.

RÉSUMÉ.—Nous présentons une méthode permettant de déterminer si un ensemble d'échantillons est suffisant pour répondre à une problématique de recherche.
**INTRODUCTION**

As the world’s population continues to grow, the need for sustainable practices becomes increasingly apparent. One such practice is the development of renewable energy sources. The conversion of organic waste into biogas using anaerobic digestion is a promising method for achieving this goal. However, the efficiency of this process can be significantly improved by optimizing the conditions under which it occurs. This study aims to investigate the effects of different factors on the performance of an anaerobic digestion system.

**METHODOLOGY AND MATERIALS**

The specific method used in this study was a laboratory-scale anaerobic digestion system. The system consisted of a batch reactor with a total volume of 50 liters. The reactor was operated at a temperature of 35°C and a pH of 7.0. The influent consisted of a mixture of cattle manure and kitchen waste, with a carbon-to-nitrogen ratio of 25:1. The system was fed with a constant inflow of 5 L/day and was allowed to operate for 30 days. The biogas produced was collected and analyzed for its composition.

**RESULTS**

The results of the study showed that the system achieved a biogas production rate of 0.9 L/day. The methane content of the biogas was found to be 65%. The analysis also revealed that the system was able to remove 85% of the organic matter present in the influent. These findings suggest that the system has the potential to be a cost-effective solution for waste management and renewable energy production.

**DISCUSSION**

The results of this study demonstrate the potential of anaerobic digestion as a viable method for converting organic waste into biogas. However, further research is needed to optimize the process and improve its efficiency. This could be achieved by exploring the effects of different factors such as temperature, pH, and reactor design on the performance of the system. Additionally, the integration of the system with other waste management strategies could further enhance its sustainability and impact.
RESULTS

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In addition, there is no significant correlation for either the between the annual

The results of the analysis are presented in Table 1, which shows the number of specimens collected at each site over the years. The data includes the number of collected specimens (NSP) and the cumulative richness and diversity of the specimens collected. The table also includes the annual sample totals for each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>NSP</th>
<th>Cumulative richness</th>
<th>Cumulative diversity</th>
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<tbody>
<tr>
<td>1983</td>
<td>516</td>
<td>318</td>
<td>12.9</td>
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<tr>
<td>1988</td>
<td>519</td>
<td>315</td>
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Table 2—Number of collected specimens (NSP) for each site and field season at the site (BCC09).
null
CONCLUSION

The effect of the power tool, the product of the industry, on the consumer behavior and the market demand is significant. The analysis of the data from the survey indicates that the use of power tools in various industries has increased, leading to a positive impact on the economy. The findings suggest that the adoption of power tools has led to increased productivity, reduced labor costs, and enhanced quality of work. These factors have contributed to the growth of the power tool market, driving innovation and technological advancements.

The study also highlights the importance of consumer education and training programs to ensure safe and efficient use of power tools. With the increasing demand for these tools, there is a need for ongoing support and training to address safety concerns and promote best practices. The collaboration between manufacturers, retailers, and end-users is crucial for the sustainable growth of the power tool industry.

In conclusion, the power tool market continues to evolve, driven by technological advancements and changing consumer preferences. To remain competitive, manufacturers must focus on innovation, sustainability, and user-centric design to meet the diverse needs of the marketplace. The study provides valuable insights into the dynamics of the power tool industry and offers a framework for future research and industry strategies.