Final Evaluation Report

Your Details	
Full Name	Winfred Espejo Contreras
Project Title	Microplastic in excreta and nesting grounds of the Humboldt Penguin (*Spheniscus humboldti*) along the Chilean coast
Application ID	31749-1
Date of this Report	November 2022

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Collection of samples of excreta and nesting areas of different colonies of Humbolt penguins.		■		Due to the pandemic, we had to overcome several difficulties and reschedule some of the field activities. Some of the islands could not be reached on the planned date due to too much swell.
Extraction of plastic and microplastics from excreta collected from nesting areas of different colonies of Humbolt penguins.			■	We use the methodology used in previous research.
Plastic and Microplastics identification			■	
Plastic and characterization of microplastics		■		
Communication of the results obtained in scientific publications, scientific congresses and general public.			■	A scientific article (see appendix), two national congress, and seven newspaper articles.

2. Describe the three most important outcomes of your project.

a). We added new data on emerging contaminants (rare earth elements) that may be affecting Humbolt penguins. The results indicated that a slight increase in the concentrations of REEs (Ce, La, Nd and Pr) and Nb was observed in the soils around the penguin colonies (Chañaral Island and Pande Azucar Island), indicating that these protected species are exposed to these chemicals. These data are being published in Latin American Journal of Aquatic Research (see Appendix).

b). We conducted the first evaluation of contaminants in soils in the nesting area of the Pajaro Niño island colony. This colony has been threatened by nearby anthropogenic activities. The assessment of contaminants in this colony will serve to highlight the importance of its conversation (these data are pending to be published in an indexed scientific journal).

c). We have achieved the first identification and quantification of microplastics in excreta and nesting areas of Humbolt penguins. The presence of plastics and microplastics in the most important nesting colonies of Humboldt penguins was evaluated. Detecting the presence of plastics in the colonies of Humboldt penguins nesting in the Pajaro Niño island (these data are pending to be published in an indexed scientific journal).

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

The development of the project faced some difficulties due to the COVID-19 pandemic, with restriction of mobility and prevention of entry to protected wildlife areas. Additionally, the austral summer 2021-2022 presented too many swell events during the nesting time of Humboldt penguins (the most favourable for sampling on land), thus the conditions for crossing to the islands were unfavourable. To overcome this problematic situation, we used excreta samples collected in previous field campaigns, along with adding a new a new sampling site where Humbolt penguins also nest, which was not affected by swells: Pajaro Niño Island (29°55'60" S, 71°22'0" W), Chile. In consequence, the presence of plastic and microplastics was evaluated according to those samples. At the same time, the analysis of rare earth elements, chemical substances for which it is not known whether they really pose a risk to Humboldt penguins, was included.

4. Describe the involvement of local communities and how they have benefitted from the project.

During the pandemic period it was difficult for us to carry out activities with the local communities. However, we are planning meetings with the local community about the importance of the conservation of the Humboldt penguin (a species endemic to Chile) and the impacts of emerging contaminants on them.

5. Are there any plans to continue this work?

Yes, we plan to continue investigating the effects of emerging contaminants on the conservation of the Humbolt penguin. We will perform another method of extracting microplastics from excreta to evaluate whether microplastics can be detected in this way.

6. How do you plan to share the results of your work with others?

We will share the results of the project through scientific articles (indexed and open access), scientific conferences, newspaper article and talks to local communities and schools.

7. Looking ahead, what do you feel are the important next steps?

The most important next steps are to continue with research and monitoring programs concerning contaminants as a menace to Humbolt penguins. In addition,

we want to promote Humbolt penguin conservation programs to consider emerging contaminants as an important threat to wildlife.

8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, we have used the logo in congress presentations. I have personally recommended (word of mouth) to colleagues and NGOs interested in wildlife conservation.

9. Provide a full list of all the members of your team and their role in the project.

Dr. José E. Celis, researcher at the Animal Science Department of the Universidad de Concepción, Chile, who supported the project about data analysis and preparation of the scientific article.

Dr. Marco Sandoval, supported the soil analysis of the samples collected**.**

Paulina Arce DMV, supported with the permits and field activities.

10. Any other comments?

The results of this project will be used as a basis for further studies to continue applying for grants to assess the impacts of contaminants on Humbolt penguins.

Links to press releases mentioning Rufford Foundation acknowledgements.

Página V: https://paginav.cl/2022/10/18/investigan-influencia-del-pinguino-de-humboldt-sobre-presencia-de-elementos-de-tierras-raras-en-suelos-donde-anidan-estas-especies/

Noticias UdeC: https://noticias.udec.cl/investigan-influencia-del-pinguino-de-humboldt-en-presencia-de-elementos-de-tierras-raras/

Chillán UdeC: https://www.chillan.udec.cl/investigan-influencia-del-pinguino-de-humboldt-sobre-presencia-de-elementos-de-tierras-raras-en-suelos-donde-anidan-estas-especies/

Portal Agro Chile: https://www.portalagrochile.cl/2022/10/18/investigan-influencia-del-pinguino-de-humboldt-sobre-presencia-de-elementos-de-tierras-raras-en-suelos-donde-anidan-estas-especies/

Diario La discussion online: https://www.ladiscusion.cl/investigan-influencia-de-pinguino-de-humboldt-en-la-presencia-tierras-raras/

Diario La discussion papel Digital: https://papel.ladiscusion.cl/papeldigital/2022/octubre/20102022/

Agronomia UdeC: http://www.agronomiaudec.cl/investigan-influencia-del-pinguino-de-humboldt/

Appendix

Fig 1. Some pictures of the sample collection.

Fig 2. Some pictures of the presence of plastics at Pajaro Niño Island Algarrobo, Chile.

SoTox
Sociedad de Toxicología de Chile

III CONGRESO DE TOXICOLOGÍA

Otorga el presente certificado a:

José Celis, Marco Sandoval, Winfred Eliezer Espejo Contreras, Daniel González-Acuña

Por haber participado en calidad de EXPOSITOR(A) en el III Congreso de Toxicología, realizado entre los días 16 y 27 de Noviembre del 2020. Con el trabajo titulado:

Microplásticos en pingüinos

(Sesión Posters)

Dra. María Fernanda Cavieres F.
Presidenta comité científico

SOCIEDAD TOXICOLOGICA SOTOX CHILE

Alejandra Vozmediano A.
Secretaria SoTox

Valdivia, 24 de octubre 2022

Estimados autores,

Junto con saludar muy cordialmente a ustedes tenemos el agrado de informar que el trabajado:

"**ASSESSING THE INFLUENCE OF HUMBOLDT PENGUIN BY EXCREMENTS ON THE LEVELS OF RARE EARTH ELEMENTS IN THE SOIL**"

Ha sido aceptado en la modalidad (**poster**) para ser presentado en el **XIV Congreso Nacional de la Ciencia del Suelo** en la ciudad de Valdivia, Chile, del **22 al 25 de noviembre**.

Las posibles observaciones sobre el resumen, serán comunicadas en los próximos días.

Esperando poder tener la posibilidad de encontrarnos en el Congreso, le saludan atentamente,

José Dörner F.
Presidente
Comité Organizador

Mónica Antilén L.
Presidenta
Sociedad Chilena de la Ciencia del Suelo

Assessing the influence of Humboldt penguin (*Spheniscus humboldti*) by excrements on the levels of trace and rare earth elements in the soil

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INTRODUCTION

Rare earth elements (REE) and some transition metals (e.g. Nb) are a group of chemicals that have recently been widely used in industrial processes due to the increasing demand for new technologies. As a result, these chemicals are increasingly being released into the environment, which could mean that these pollutants could modify marine and terrestrial ecosystems. Seabirds, such as penguins, can biotransport pollutants and nutrients from the sea to land through excreta. However, there is no information about the role of the Humboldt penguin (*Spheniscus humboldti*) in bio-transporting emerging contaminants such as REE.

This study aimed to assess any possible contribution of Humboldt penguins to the geochemical composition of some terrestrial areas.

RESULTS

The results showed that this species tends to contribute to soil enrichment with REE (Ce, La, Nd, and Pr) and Nb through excreta, as well as with some nutrients (N, P, and K).

The following relations among REE levels were found in nesting sites: Pr > Nd > Ce > La > Y > Nb. In the control sites, the relations were: Nd > Pr > La > Ce > Y > Nd

DISCUSSION and CONCLUSIONS

Evidence shows that heavy metal contamination can promote bacterial resistance in marine and terrestrial environments (Baker-Austin et al. 2006, Espejo et al. 2017c). Similarly, the enrichment of soils with REE might enhance bacterial resistance to certain elements, a topic that needs to be investigated deeper.

Additionally, certain interactions between REE and other emerging contaminants (e.g. microplastics) could cause potentially more risky combined impacts on ecosystem health (Cao et al. 2021). Thus, more research should be conducted to assess the ecological and human health risk related to the presence of REE in soils is required.

MATERIALS AND METHODS

Surface soil samples were collected from the top (5 cm) during January 2016. using disposable plastic spatulas directly from nesting sites (manured soils) and control sites (non-manured soils, adjacent to the colonies but unaffected by birds, distant about 30 m). For analytical procedures, 15 soil samples from nesting sites and 15 from reference sites (control) were taken from each site.

The samples were analyzed using a portable battery-operated energy dispersive X-ray fluorescence spectrometer (Thermo Scientific Niton XL3t 950 He GOLDD+) according to the EPA method 6200 at the Chemical Laboratory of the Faculty of Agronomy, Universidad de Concepción (Chile).

Statistical analyses were done using SPSS version 15.0 software.

Elements	Nesting site		Control site	
	Mean ± SD	Max-Min	Mean ± SD	Max-Min
Ce	164.3 ± 62.1[a]	280.8 - 126.9	143.2 ± 82[a]	238.6 - 121.9
La	165.6 ± 81.3[a]	252.7 - 235.5	122.1 ± 94.9[a]	238.7 - 110.3
Nb	6.1 ± 2.0[a]	8.8 - 3.0	5.6 ± 1.5[a]	8.3 - 3.5
Nd	284.2 ± 99[a]	444.5 - 217.1	195.1 ± 201.3[a]	541.6 - 235.7
Pr	320.8 ± 98.7[a]	518.8 - 206.7	273.1 ± 123[a]	492 - 158.9
Y	23 ± 2.8[a]	28.7 - 17	26.3 ± 4.4[a]	32.7 - 19.1

Figure 1. Concentrations of trace and rare earth elements (µg g-1 dw) in surface soils (n = 15) from Chañaral Island, northwestern Chile (nesting site: ornithogenic soils; control site: soils not having birds). Different letters between collecting sites indicate significance at P < 0.05. Ce: cerium, La: lanthanum, Nb: niobium, Nd: neodymium, Pr: praseodymium, Y: yttrium. SD: standard deviation.

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