PROJECT REPORT TO PACIFIC SEABIRD GROUP

CHARACTERIZATION OF MARINE DEBRIS IN NESTS OF RED-LEGGED CORMORANT IN NORTHERN CHILE

February 2022

Contact:

Ana M. García Cegarra
Centro de Investigación de Fauna Marina y Avistamiento de Cetáceos (CIFAMAC)
EM: cifamacchile@gmail.com

WEB: https://cifamac-chile.weebly.com/

(1) Brief intro

Marine debris is an important threat for worldwide marine habitats and for species such as seabirds which are affected by ingestion and entanglement in different types of plastic or fishing nets (Thiel et al. 2018). In the last decade the number of negative interactions between marine fauna and marine debris has increased. Just in the marine environment the number of species reported affected by marine debris have increased in 159%, from 267 species in 1995 to 1465 species in 2018 (Laist, 1997; Gall and Thompson, 2015). Seabirds are specially affected by the presence of marine debris and it has been determined that 44% of seabird species ingested or died due to entanglement, or built their nests with marine debris (Laist, 1997). Some species of seabirds such as gulls and gannests in the North Atlantic Ocean made their nests with marine debris and may die entangled in their nests (Bourne 1997; Votier et al. 20111; Bond et al. 2012). Seabirds incorporate marine debris in their nests according to the items available within the vicinity of the breeding colony (Tavares et al. 2016; Luna-Jorquera et al. 2019). Due to the increase of marine debris pollution worldwide it is imminent that seabirds start to build their nests with debris materials in the different ocean bassins. Recently in Mejillones Bay (23º 05' 00.7''S; 70º25'01.9''W) Northern Chile, the presence of Red-legged cormorant (*Phalacrocorax gaimardi*) have been observed building their nests with marine debris in the structure of major seaports (Figure 1). This species is cataloged as "*Near threatened*" by the IUCN Red List of Endangered Species and are endemic of South East Pacific Ocean, inhabiting the coast of Peru, Chile and a nesting population in Argentina. They normally use algae and guano to build their nests. It is unknown the effect that the presence of marine debris in nests of red-legged cormorant could have in their population status.

Figure 1: A couple of red-legged cormorants (*Phalacrocorax gaimardi*) nesting in the iron structure of a major seaport in Mejillones Bay.

(2) Proposed objectives

To characterize marine debris in red-legged cormorant nests and in beaches nearby the nesting colony in Mejillones Bay (Northern Chile).

(3) Proposed activities/actions

1. Imaging analysis of seabird nests with marine debris.
2. Characterization of marine debris in seabird nests.
3. Characterization of marine debris in beaches near the breeding colony.

(4) Actual activities/actions

1. *Imaging analysis of seabird nests with marine debris:* With the use of a GoPro camera we were able to obtain high resolution images of nest in the nesting colony situated in major port structures of Mejillones Bay. We performed two boat surveys: one in June 2019 and other in March 2020. Breeding season starts in austral spring (September) for red-legged cormorant so we sampled nests in winter to decrease the probability to find a chick or egg in the nest. Nests were geolocated and photographed, recording the number of nests, presence of adult pairs and chicks. In the first survey we count 151 nests in the first survey in two major seaports (ENAEX and GNL) and 72 nests in the second survey in TGN seaport. We obtained images and measures of nests and 83.4% of the nests were empty, the other 16.6% of nests contained single adults or pairs. Imaging analysis showed that overall nests contained marine debris.

Figure 2: Empty red legged cormorant nest with marine debris, guano and algae.

2. *Characterization of marine debris in seabird nests:* by boat surveys we approach to the nests in the structures of the major seaports. Nests sampling was performed under the Chilean Agricultural and Livestock Service permit (SAG No. 3101/2019). The permit allowed us to sample a 10% of the total nest. From the top of the boat and using safety harness we removed 10% of the nest divided in 3 spatial distributed pseudo-replicate samples (Figure 3).

Figure 3: Sampling a red-legged cormorant nest containing marine debris.

In the laboratory samples were weighted and placed in 5% sodium hypochlorite for organic matter disintegration during 7 days. Organic matter was cleaned with tap water. Afterward, samples were dried at 37°C during 2 days. The debris were identified and classified according to their type, colour and origin (domestic, industrial and fishing) (Figure 4). We sampled a total of 18 nests in first survey and 16 nests in second survey. The most common marine debris in the nests was bulk bags fibers (35%), followed by plastic bags (33%) and fishing ropes (21%) and smaller proportions of other debris. Regarding colour analysis we found white was the most common colour among marine debris items (46%) followed by grey (26%) and black (10%). White colour correspond to bulk bags fibers as the predominant marine debris type.

The origin of marine debris was industrial (73%), domestic (24%) and fishing (3%). These findings suggest that due to the vicinity of the colony to the industrial area of Mejillones the most predominant marine debris in red-legged cormorant nests arrive from industrial litter.

Figure 4: Laboratory analysis images showing the marine debris contained in sampled nests of red-legged cormorant.

3. *Characterization of marine debris in beaches near the breeding colony:* As the most common item found in nests of red-legged cormorant was bulk bags (industrial origin), we performed analysis of marine debris in beaches near the nesting colony and industrial area in order to assess whether the most common marine debris in beaches correspond to the most common marine debris in nests. If so, red-legged cormorants would be using the most abundant debris item to build their nests instead of having a preference for a certain debris type.

   Beach surveys were performed according to the methodology of the "Cientificos de la Basura" (Bravo et al., 2009) and conducted during austral summer 2019 and 2020. Overall beaches were sandy beaches located nearby industries and nesting colony.

Transects were perpendicular to the coastline from the low tide line to the base of dune. Each transect contained 4 or 5 stations depending on the width of the beach. Each station covered and area of 2m x 2m delimited with a measuring tape (Figure 5). All types of debris were counted and classified. The most common debris items was carbon (43%) followed by small wooden pieces (19%), bulk bag fibers (11%) and small plastic pieces (0-2.5cm) (6%). However types of debris varied among beaches with ENAEX beach containing mostly ropes (23%) and bulk bags fibers (14%), KELAR had mainly carbon (50%), small wooden pieces (19%) and bulk bag fibers (14%), and GNL had carbon (41%), small wooden pieces (26%) and small plastic pieces (10%).

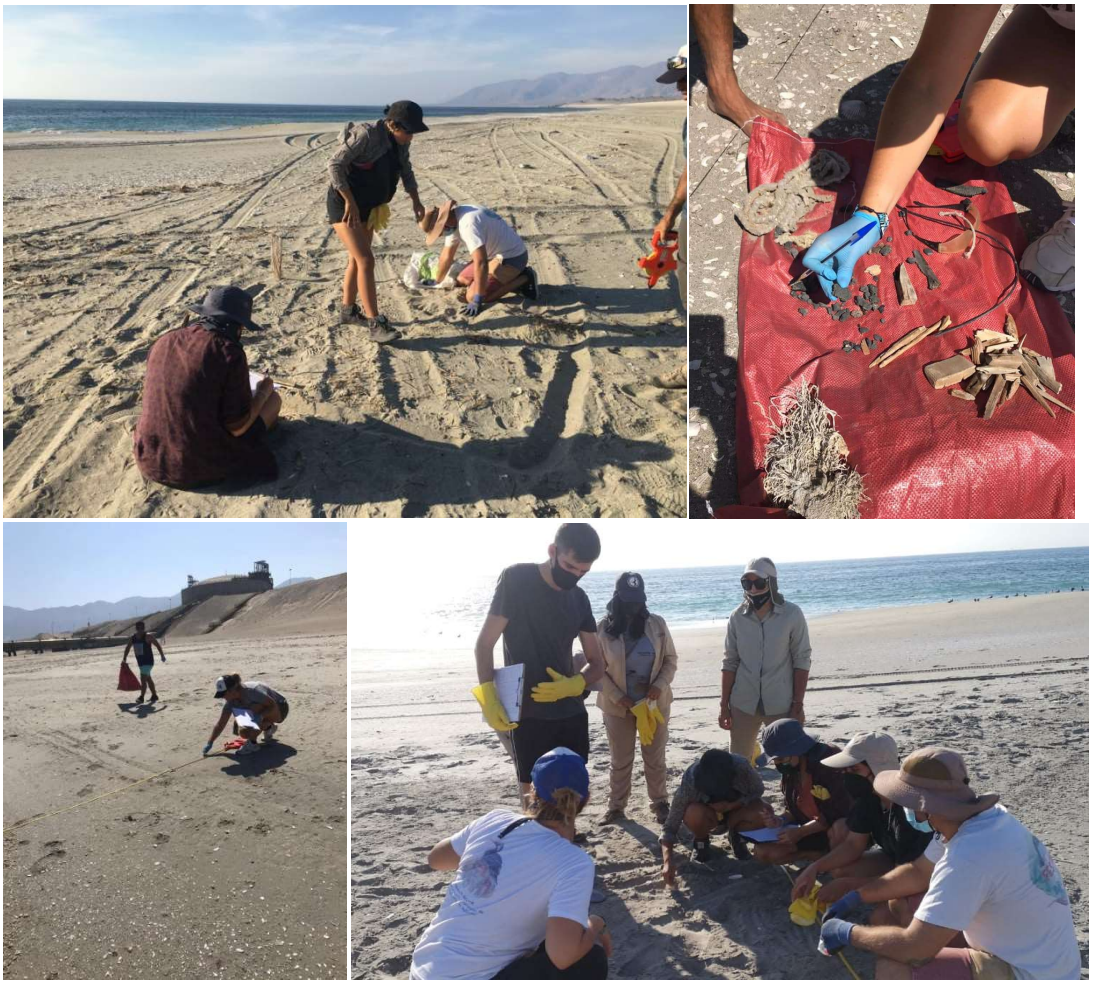

Figure 5: Beach cleaning and characterization of beach debris in transects and stations.

4. *Environmental education talks to children from Mejillones local schools during pandemic*: A total of 3 environmental education talks about marine debris in nests of red-legged cormorants were performed online via zoom to a total of 90 children of 4º, 5º and 6º grade of Julia Herrera School in Mejillones (Figure 6).

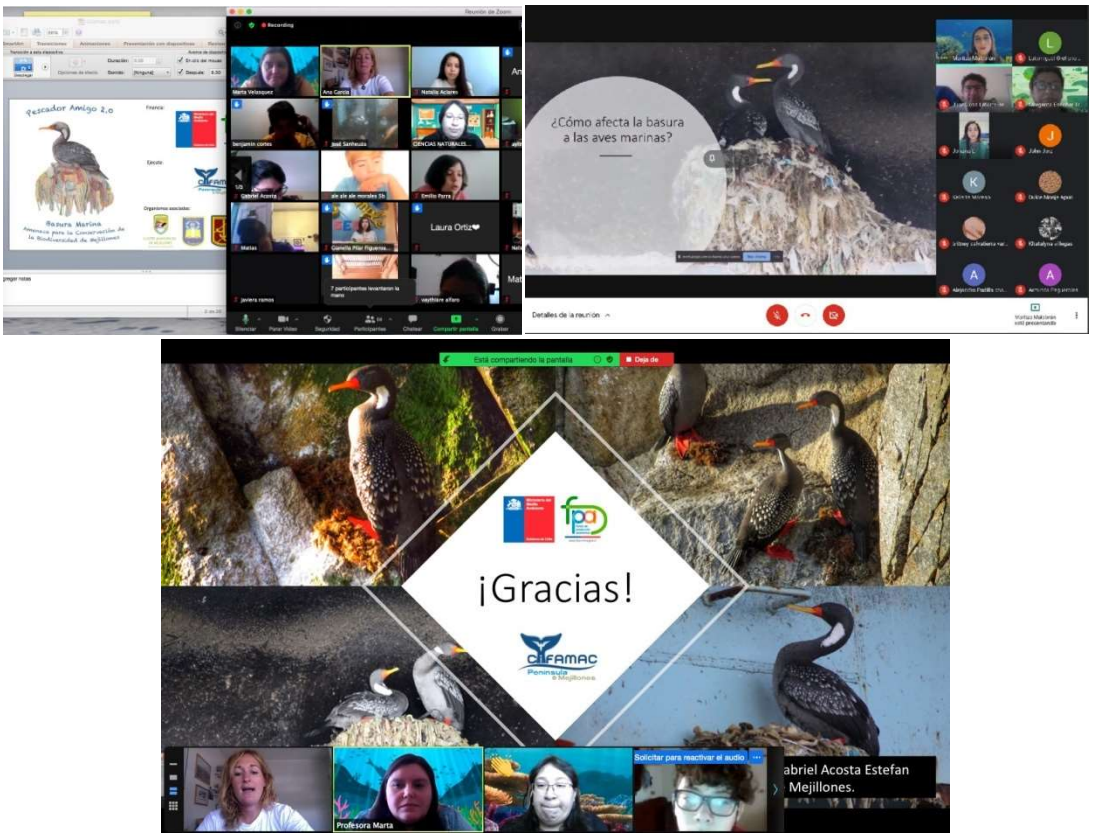

Figure 6: Screen shots of environmental education talks to children from Mejillones local school Julia Herrera during pandemic regarding the use of plastic by red-legged cormorant to build their nests.

(5) Subjective/objective evaluation of the effectiveness of their actions in conserving seabirds, including detailed quantitative information, when possible (e.g., "discovered and censured XX seabird colonies," with numbers of each bird species and locations of seabird colonies provided in the report).

- A total of 223 red-legged cormorant nests in four major seaport structures of Mejillones bay (Northern Chile). The four ports corresponded to: Puerto Mejillones, GNL (Liquid Natural Gas); ENAEX (Explosives National Company); TGN (Terminal de Graneles del Norte) (Figure 7). If we compare with the previous study of Frere eta al., (2004), they contabilized 68 nests in natural reefs of Mejillones Peninsula. In the year 2003 the industry started in Mejillones building major seaports for shipping of minerals. The construction of seaports allowed red-legged cormorant to find a new surface to build their nests and as a consequence the nesting colony increased in the last 20 years.

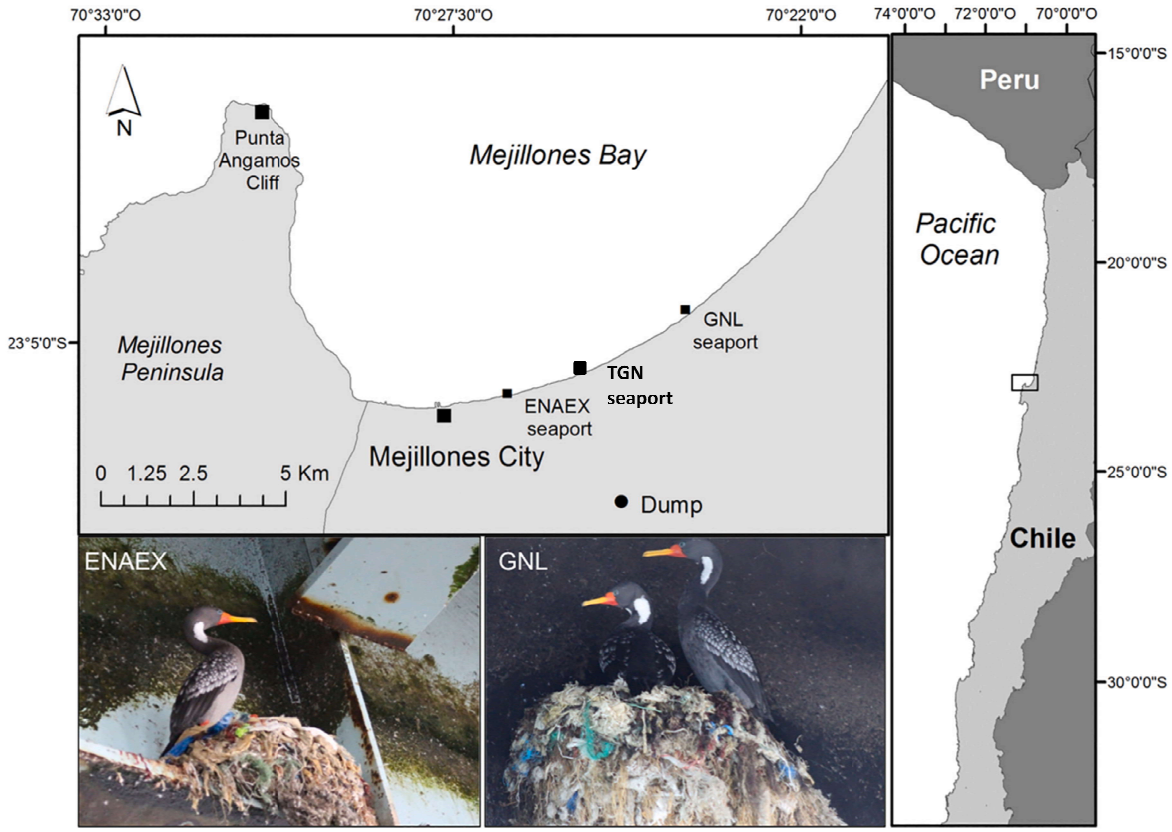

Figure 7: Location of the three major seaports containing nests of red-legged cormorant and sampled in the current study.

- Imaging analysis was performed in three seaports (GNL, ENAEX and TGN) and unfortunately it showed that overall nests (100%) contained marine debris.
- We were able to sample a total of 34 nests in the three seaports (GNL = 10 nests; ENAEX = 13 nests; ENEL = 11 nests) and to characterize the marine debris contained in the nests.
- We characterized the debris in the 34 nests in collaboration with the laboratory of Aquatic Toxicology at the University of Antofagasta (Chile) and the laboratory of Toxicology of the Faculty if Veterinary Medicine at the University of Murcia (Spain). One undergraduated student form Chile and a Master student from Spain participated in the analysis of marine debris from red-legged cormorant nests and performed their bachelor and master thesis with this study.
- We obtained 16 feathers of chicks and adults which are being analyzed for heavy metals in the University of Murcia (Spain).
- Off the 34 nests, the most common type of debris was bulk bags fibers (24%), plastic bags (23%) and fishing ropes (21%).
- Colour analysis showed that the most common colour found in the plastics of the nests was white (46%) followed by grey (26%) and black (10%). This corresponds with the types of plastics as bulk bags and most plastic bags are white colour.

- Origin of debris found in the nests was industrial (73%), domestic (24%) and fishing (3%).
- A total of three beach cleaning activities were performed near the nesting colony of red-legged cormorant (ENAEX, GNL and KELAR). One technical student from Mejillones Institute of Profesional Formation performed her trainning with this study.
- A total of 1626 debris items were collected and categorized.
- The most common debris found was carbon (43%) followed by small pieces of wooden (19%) and bulk bags (11%) (Figure 8).

Figure 8: A bulk bag buried in sandy beaches of Mejillones bay after its uses by the industry in the building of seaports.

- We publish the preliminary results of the study in Marine Pollution Bulletin: https://www.sciencedirect.com/science/article/abs/pii/S0025326X20307505
- We also publish the study in national and international news:
- https://www.nbcnews.com/science/environment/coast-chile-bird-nests-show-scars-plastic-pollution-n1241361
- https://laderasur.com/articulo/preocupacion-por-cormoranes-que-fabrican-nidos-con-plastico-en-mejillones-usan-maxisacos-bolsas-y-articulos-de-pesca/
- https://www.emol.com/noticias/Nacional/2019/09/11/960942/Aves-nidos-plastico.html

Actualidad

EL MERCURIO DE ANTOFAGASTA | Martes 15 de septiembre de 2020 | 9

Mejillones: aves están fabricando nidos con plásticos

MEDIOAMBIENTE. *Estudio confirma que cormoranes están usando residuos de maxisacos, bolsas y nylon de pesca.*

CIFAMAC

CORMORANES QUE HABITAN EN LOS MUELLES DE MEJILLONES UTILIZAN DIVERSOS PLÁSTICOS PARA FABRICAR SUS NIDOS.

Tamara Miranda Varela
tamara.miranda@mercurioantofagasta.cl

Un estudio titulado "caracterización de la basura marina en nidos de cormorán lile en la costa del Desierto de Atacama" elaborado por Cifamac de Mejillones en colaboración con el Laboratorio de Toxicología Acuática (Aquatox) de la Universidad de Antofagasta, confirmó que las aves de esta bahía fabrican sus nidos con maxisacos (utilizados por las empresas como rompeolas), bolsas de plástico y nylon de pesca.

El estudio fue publicado en la revista científica Marine Pollution Bulletin.

Según informó Ana García, de Cifamac, el estudio determinó que existe una colonia de 151 nidos de cormoran lile (especie vulnerable endémica de la corriente de Humboldt) que están anidando en tres terminales portuarios de Mejillones.

"Esta colonia ha aumentado y parece que la estructura de los puertos es perfecta para que aniden estas aves, lo cual ha aumentado su abundancia. Sin embargo están utilizando basura para fabricar sus nidos, cuando en realidad deberían usar algas. Muestreamos nidos y nos dimos cuenta que todos tienen basura en su contenido, al comparar con estudios mundiales vimos entonces que los de Mejillones son los más contaminados, porque el 100% de los nidos tienen basura".

> "Los usan como rompeolas (maxisacos) para la fabricación de muelles pero estos se rompen y se deshilachan quedando como basura en la orilla, luego van al mar y las aves los ocupan"
>
> **Ana García**
> investigadora de Cifamac

García explicó que entre la basura analizada un 35% corresponde a trozos de maxisacos, 33% eran bolsas de plástico de uso domiciliario y un 10% eran cabos, redes o nylon de pesca.

Según el informe, los tipos de plástico difieren entre los puertos marítimos. Por ejemplo, dice el texto, el puerto marítimo de ENAEX (Compañía Nacional de Explosivos) ubicado cerca de la zona urbana, contenía bolsas de plástico como material predominante, mientras que el puerto marítimo de GNL (Compañía de Gas Natural Líquido) ubicado cerca del área industrial, contenía fibras de maxisacos.

EMPRESAS

Al ser consultada sobre la responsabilidad de las empresas, Ana García dijo que éstas tienen las aves como huéspedes de su infraestructura, "no sé hasta qué punto les puedan molestar pues creo que las empresas hacen estos muelles para facilitar que las aves hagan sus nidos y así recuperar la especie, eso es una buena iniciativa, lo malo es que usan basura para fabricar los nidos. Estos cormoranes bucean y deben coger el plástico que flota o que está hundido en el agua".

Indicó que lo que sí le atañe a las empresas es el uso de maxisacos. "Los usan como rompeolas para la fabricación de muelles pero estos se rompen y se deshilachan quedando como basura en la orilla, luego van al mar y las aves los ocupan. No hay ningún estudio que indique que ahora hay menos alga pero lo que sí estamos seguros es de que hay más plástico que hace 10 años", comentó la experta. CS

(5) A comparison of proposed and actual expenditures of money/use of donated materials;

Activity	Proposed	Actual
Boat rent and captain	1296	1200
Trap camera*	0	400
Shipping samples from Chile to Spain Fedex	0	300
Design Graphical Abstract for publication	0	60
Fuel for beach cleaning	0	40
Total	**1296**	**2000**

* We bought the trap camera but we have not used it yet due to we are waiting of the permit to implement it in a seaport structure.

(6) Suggestions for further work or improvements to the completed project design.

In further work we aim to implement a trap camera in the seaport structure where nests are place and be able to obtain high quality videos of the behaviour of red-legged cormorants building their nests with marine debris. These videos will be used to show local authorities the problem of marine debris in industrial beaches of Mejillones Bay and start a campaing against the use of bulk bags during the construction of seaports.

We aim to reduce the bulk bags use in the insutry or allow the industry to use it during the construction of maritime seaports but obligate them to remove it after use.

Further work should sampled the floating marine debris nearby the nesting colony to assess whether plastic came from the sea or from the beaches. As cormorants are good divers, they use algae to build their nests, we hypothesize that the plastic that they are using to build their nest came from underwater. We also hypothesize that the underwater plastic is entangled in the algae and cormorants pick up the algae with the plastic entanlged on it. To assess this hypothesis we need to perform underwater cleaning and count the plastic underwater by scuba diving.