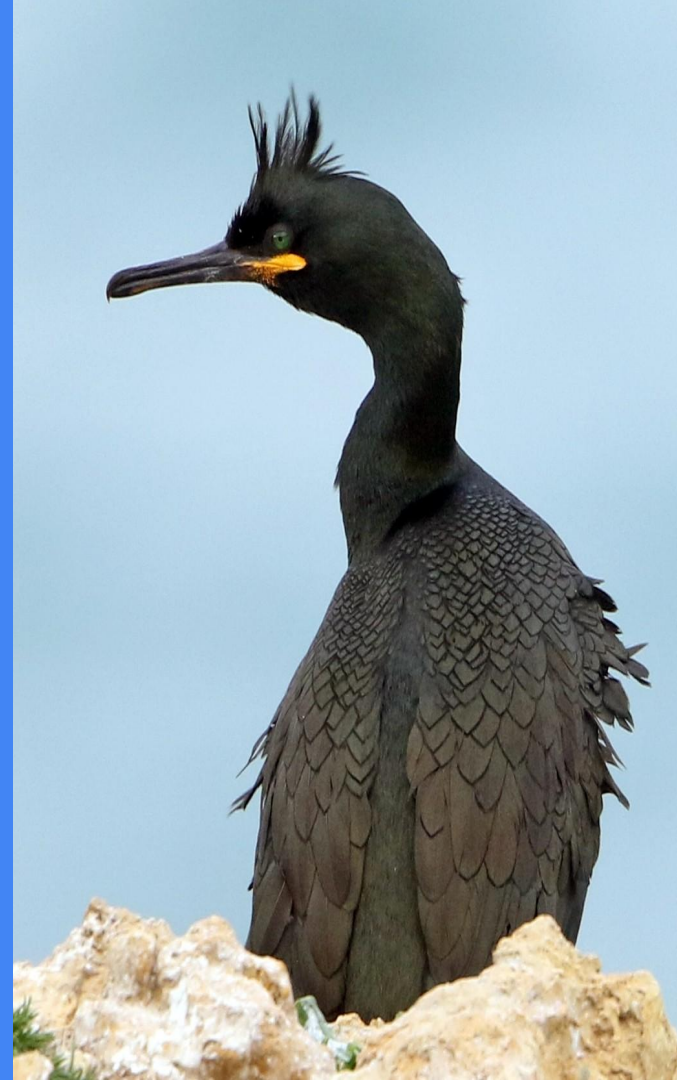


The Use of European Shag Pellets as Indicators of Microplastic Fibers in the Marine Environment

By Aryana DiPippa, William Kish, Tabitha Lenhart



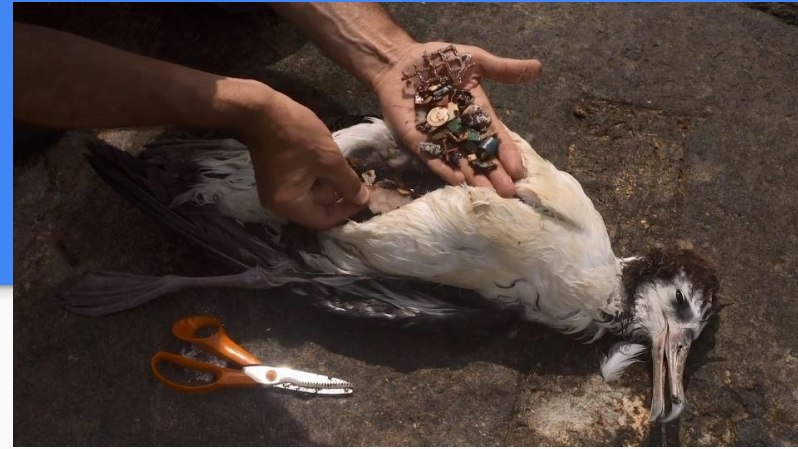
Meet the Authors

- Germa Alvarez- professor at University of EAFIT studies microeconomics and economics of energy
- Alvaro Barros- PhD student at University of Vigo studies conservation biology and seabird ecology
- Alberto Velando- professor at University of Vigo studies evolutionary biology, behavioral ecology, and life history



Introduction

- Seabirds are upper trophic predators and are good indicators for marine environments health
- All seabirds will ingest plastic debris in next few decades
- Plastics in seabirds has been commonly studied by examining the stomach contents of dead birds



Objectives

- To use a non-invasive method for obtaining samples
- Establish and standardized protocol for tracking plastics in the marine environment
- Provide baseline data for the presence of microplastics in European shags pellets collected in Islas Atlánticas National Park (Galicia, NW Spain)

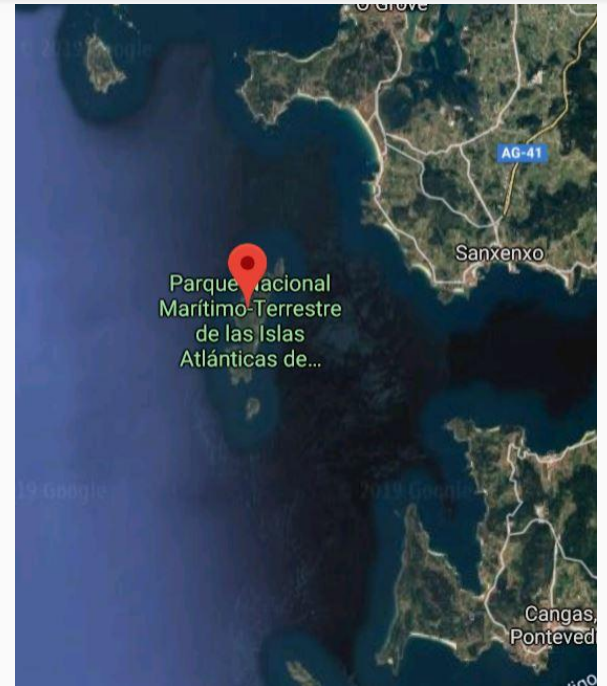
Study Organisms

- Order: Suliformes
- Family: Phalacrocoracidae
- European Shag (*Phalacrocorax aristotelis*) a species of cormorants
- Piscivorous: eats small fish between 5-15 cm
- Found only along the shores
- Dive to catch food from different zones
 - Benthic, Pelagic, and Demersal



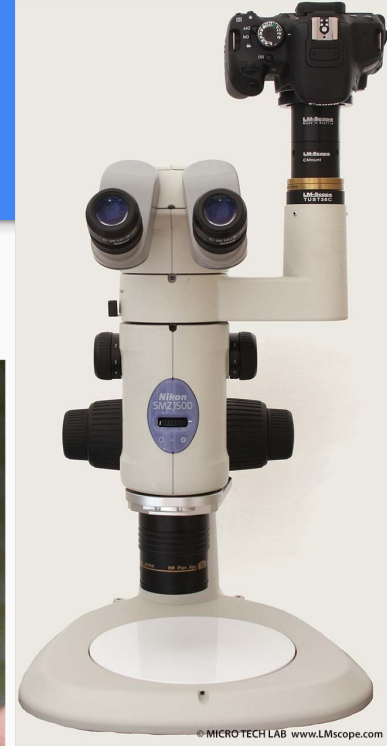
Study Site

- Islas Atlánticas National Park (Galicia, NW Spain)
- Comprised of rocky cliffs and sandy beaches
- 8.480 hectares
 - Longwoods main campus is 36.005 hectares



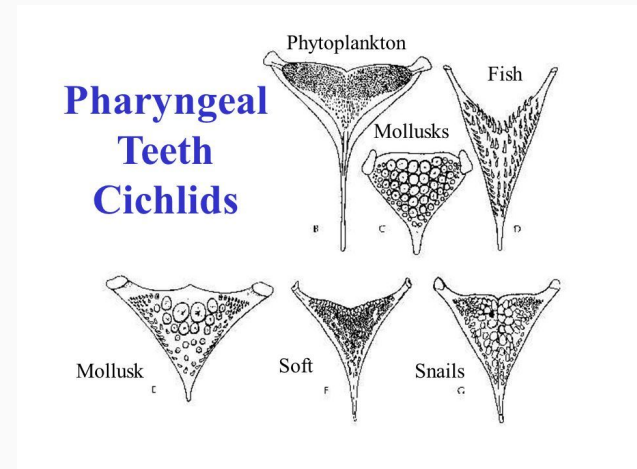
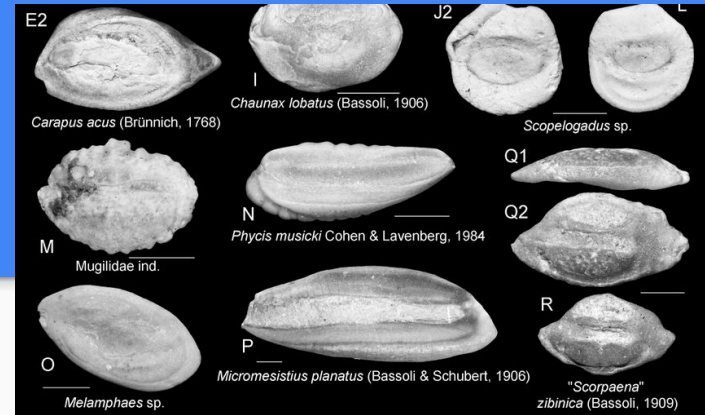
Methods

- Examined regurgitated pellets from the shags
- Looked under photographic microscope
- Identified the type of plastic polymers in the pellets using a Fourier Transform Infrared (FTIR) spectrometer



Methods Continued

- Hard bits from pellets were removed
- Otoliths and pharyngeal teeth were used to identify fish
 - Pharyngeal teeth for diet
 - Otoliths specific to fish species, also determines age



Results

- Microplastics in 26 of 41 pellets (63%)
 - Other pellet studies recorded 3-30% with other seabirds species
- Majority of microplastics nylon
- Four main prey types in pellets

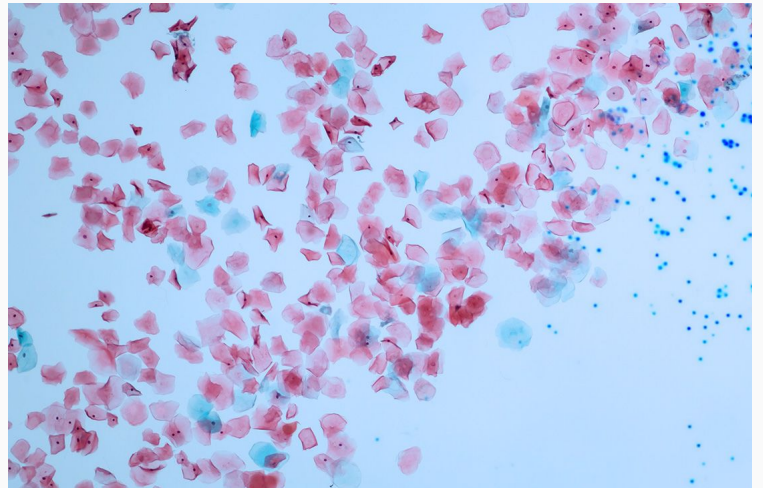
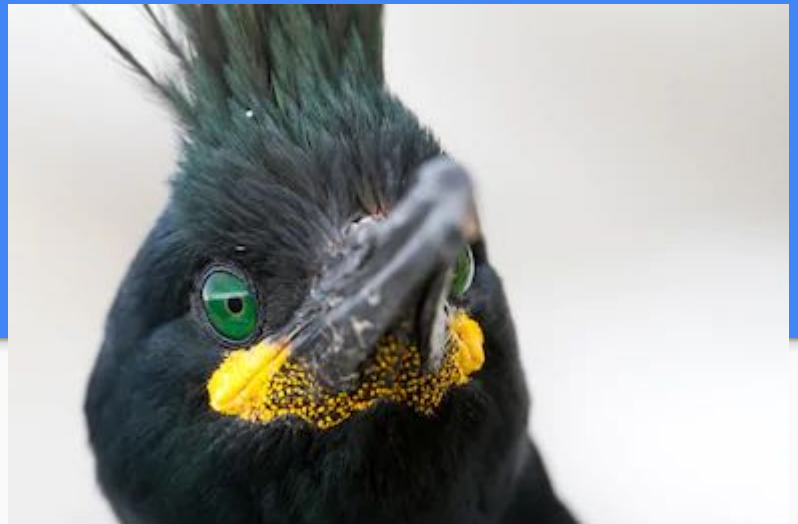


Table 1

Table 1

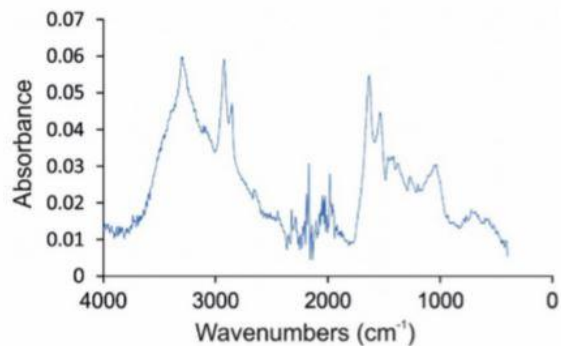
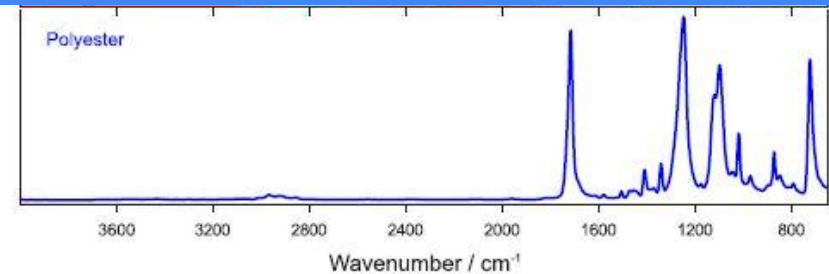
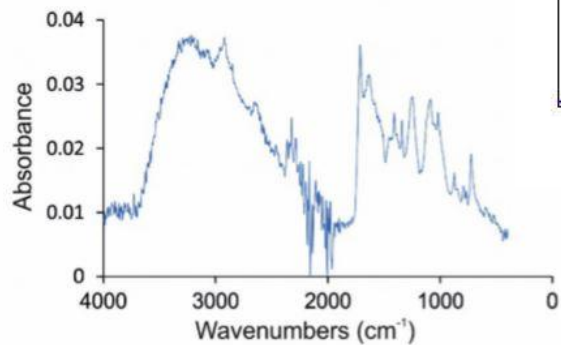
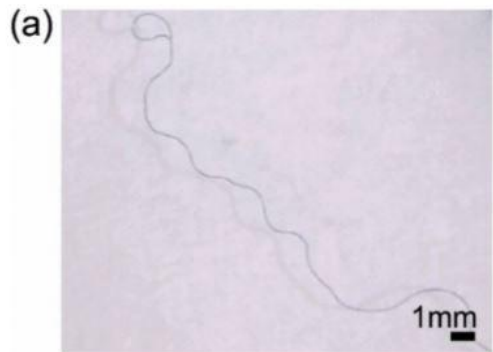
Summary of plastic particles found in fresh pellets from adult European shags during the incubation period.

Type of particle	Mean number of items per pellet \pm SE	Frequency of occurrence ^a	Mean length of particles (mm) \pm SE (n) ^b
Identified (n = 46)	0.88 \pm 0.39	0.24	
polyester	0.07 \pm 0.04	0.07	13.49 \pm 5.50 (n = 3)
rayon	0.05 \pm 0.05	0.03	4.07 \pm 1.07 (n = 2)
nylon	0.70 \pm 0.37	0.15	7.58 \pm 0.82 (n = 32)
ethylene vinyl acetate	0.05 \pm 0.05	0.03	49.50 \pm 20.50 (n = 2)
Unidentified (n = 23)	0.80 \pm 0.3	0.39	
Total (n = 69)	1.68 \pm 0.42	0.63	

^a Proportion of pellets that contained plastic items.

^b Number of plastic measured.

Figure 1



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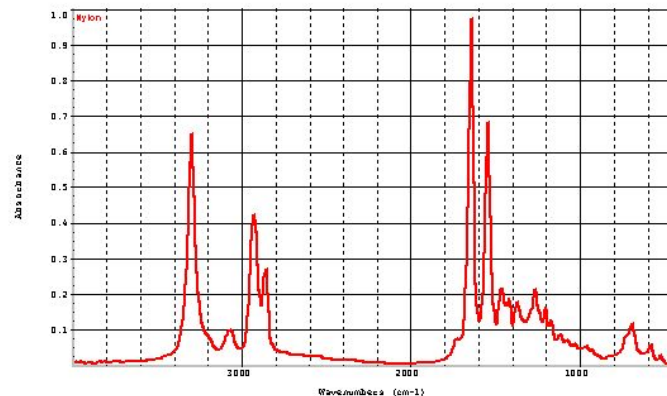


Figure 1

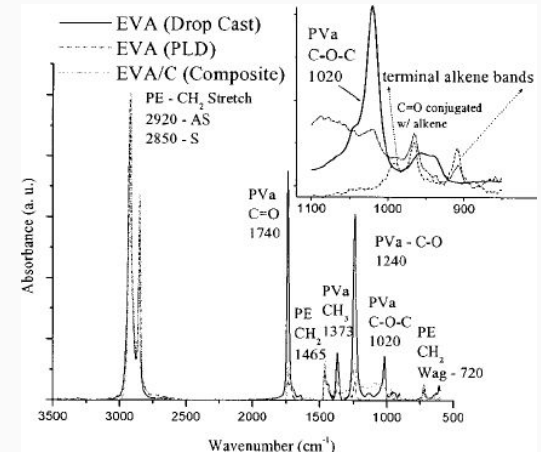
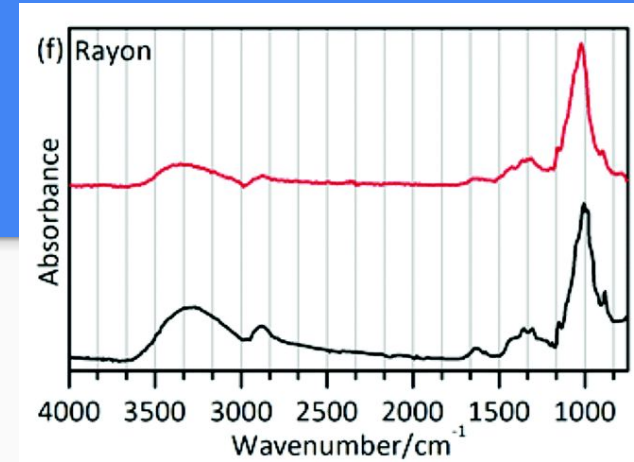
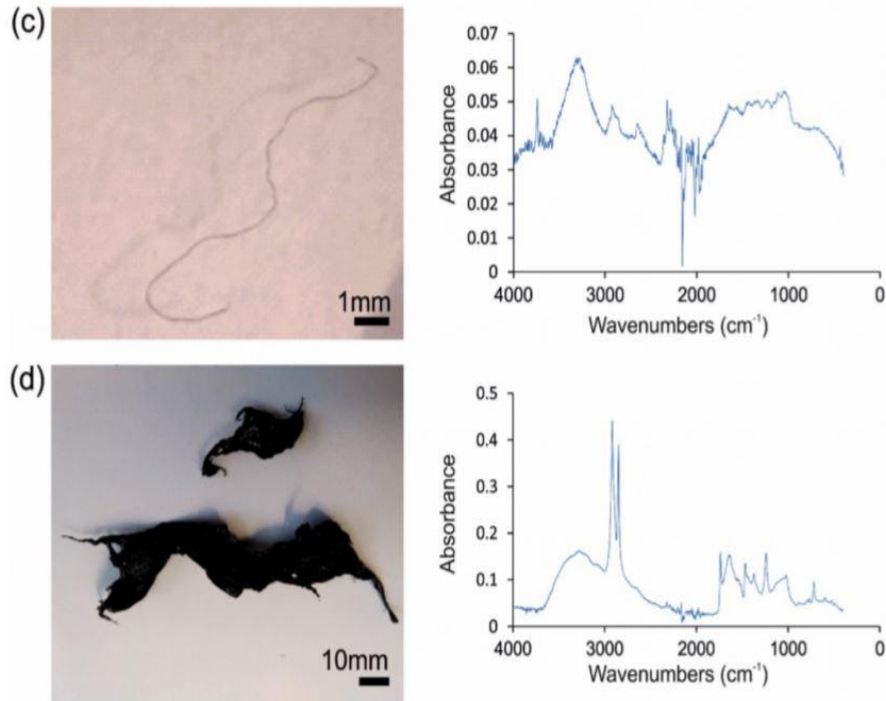


Fig. 1. Examples of the plastic fibers and fragments found in fresh pellets from adult European shags, during the incubation period. In the right panels, the infrared spectra of plastic particles (left panel) identified by FT-IR analysis as (a) polyester, (b) nylon, (c) rayon, (d) ethylene vinyl acetate copolymer.

Table 2

- Pelagic = open ocean
- Benthic = ocean floor
- Demersal = live near the bottom

Table 2

Relative occurrence and frequency of prey fishes found in fresh pellets from adult European shags during the incubation period.

Prey taxon	Prey type	Relative frequency (%) <i>n</i> = 574 prey items	Relative occurrence (%) <i>n</i> = 41 pellets
<i>Atherina presbyter</i>	(Semi) pelagic	21.2	36.6
<i>Gymnammodytes semisquamatus</i>	(Semi) pelagic	11.3	34.1
<i>Gobiusculus flavescens</i>	Demersal	8.8	7.3
<i>Gobius</i> spp.	Benthic	36.0	39.0
<i>Scomber scombrus</i>	Pelagic	2.8	21.9
<i>Trisopterus</i> spp.	Demersal	1.0	9.6
Labridae	Demersal	16.9	65.8
Triglidae	Benthic	0.9	12.19



Gobius sp.



Sand Smelt (*Atherina presbyter*)



Wrasses (Labridae)



Two-spotted goby
(*Gobiusculus flavescens*)



Atlantic Mackerel
(*Scomber scombrus*)



Trisopterus sp.

Figure 2

- Presence of plastic particles in pellets with benthic fish
- More than a 4th (~ 0.28) of pellets contained benthic fish and plastic particles

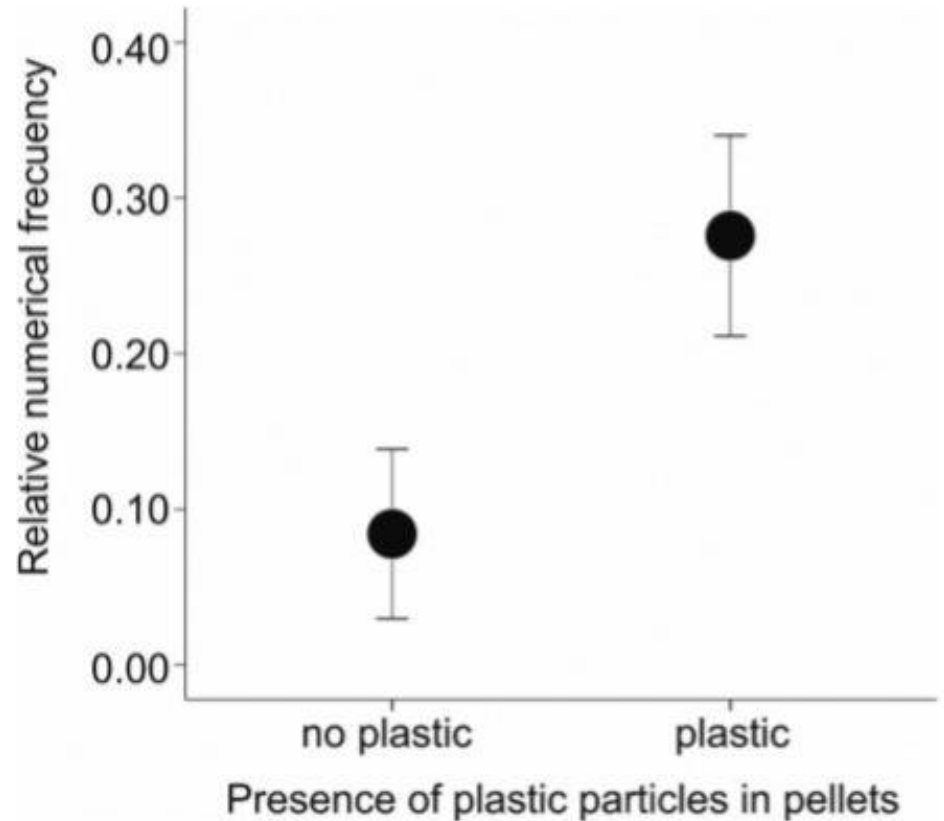


Fig. 2. Relative numerical frequency (proportion) of benthic fish in fresh pellets ($n = 41$) from adult European shags according to the presence of plastic particles in the pellet.

Discussion

- Nets are used to catch mussels
 - The ropes may be depositing nylon microplastics into the water
 - Big business in Spain
- Benthic fishes feed on the ocean floor,, which happens to be where plastics accumulate



Conclusions

- Useful to monitor the presence of different plastics and differences in pollution levels among prey species and/or habitats in the marine environment
- Looking at pellets is a good monitoring strategy anywhere because cormorant species are found all over the world
 - Good way to identify geographic patterns and temporal trends in marine pollution

Questions?

Citations

1. Álvarez, Gema, Álvaro Barros, and Alberto Velando. "The use of European shag pellets as indicators of microplastic fibers in the marine environment." *Marine pollution bulletin* 137 (2018): 444-448.
2. <https://ebird.org/species/eursha1>
3. https://www.spain.info/en/que-quieres/naturaleza/espacios-naturales/parque_nacional_de_las_islas_atlanticas.html
4. Images from google images