The background image shows two dark-colored seabirds, possibly boobies, standing on a rocky, mossy shore. One bird is in the foreground, and another is slightly behind it. The birds have distinctive tufts of feathers on their heads. The overall scene is dimly lit, suggesting a natural, outdoor environment. The text is overlaid on this image.

# Plastic Marine Debris: It's what you don't see that could be harming seabirds

Veronica Padula  
University of Alaska

College of Fisheries and Ocean Sciences

# Humans use LOTS of Plastic

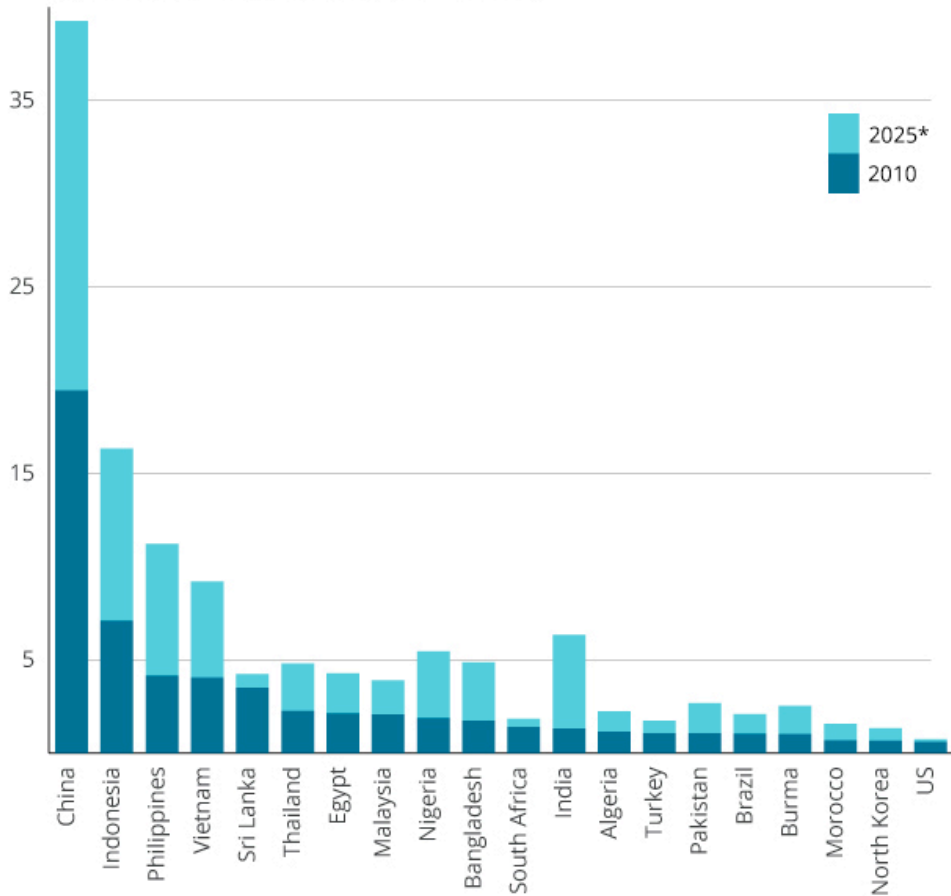
- Americans discard more than **30 million tons** of plastic a year
- Only **8%** gets recycled
- Most plastic waste ends up in landfills, is incinerated, or becomes **litter**



# With **no action**...

## Plastic Pollution Is Growing

Total annual output of mismanaged plastic waste by coastal populations, top-ranked countries by billions of pounds



\*Projection

Source: Jambeck et al, Science, 2015

CLIMATE DESK

Over 150 million tons of plastics in the ocean today

Expected to contain 1 ton of plastic for every 3 tons of fish by 2025

**By 2050, more plastics than fish (by weight)**

DID YOU KNOW? PLASTIC PIECES  
ON THE OCEAN'S SURFACE NOW  
OUTNUMBER SEA LIFE 6 TO 1.

#OPENYOUREYES



Are we  
creating a  
“plastic  
ocean”?



Marine organisms  
get tangled in or  
ingest plastic debris



“A ghost net, entangling 17 deceased sea turtles, was discovered days after a storm off the coast of Bahia, Brazil”

[http://www.npr.org/sections/thesalt/2016/09/28/495777033/whales-sea-turtles-seals-the-unintended-catch-of-abandoned-fishing-gear?utm\\_campaign=storyshare&utm\\_source=twitter.com&utm\\_medium=social](http://www.npr.org/sections/thesalt/2016/09/28/495777033/whales-sea-turtles-seals-the-unintended-catch-of-abandoned-fishing-gear?utm_campaign=storyshare&utm_source=twitter.com&utm_medium=social)<sup>6</sup>



One jar  
contains  
plastic  
bags...

The other  
contains  
sea jellies...



How plastic ends up in our seafood:

Dr. Chelsea Rochman found plastic and fibrous debris in 25% of fish sold in Indonesian and California markets

<http://phys.org/news/2016-09-plastic-seafood.html>





Large pieces  
of plastic  
debris are only  
part of the  
problem

Microplastics  
Fragments  
<5mm in size



# Seabirds and plastic ingestion



## Nearly Every Seabird on Earth Is Eating Plastic

Plastic trash is found in 90 percent of seabirds. The rate is growing steadily as global production of plastics increases.

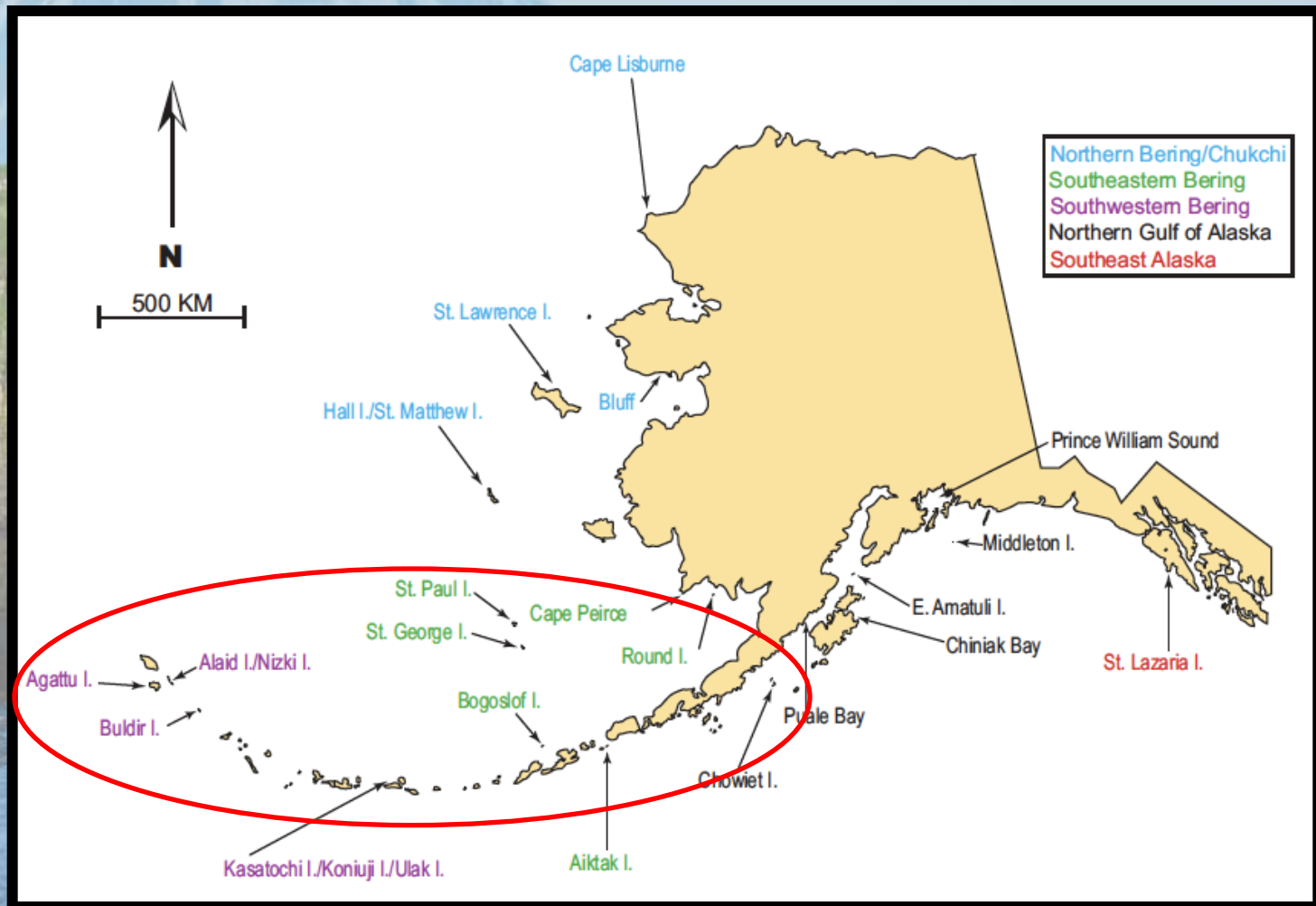


Juvenile Herring Gull, *Larus Argentatus* with plastic rubbish in its beak, Newquay, Cornwall, UK.

PHOTOGRAPH BY EDUCATION IMAGES, UIG/GETTY

Seabirds are  
important  
indicators of  
marine  
ecosystem  
health

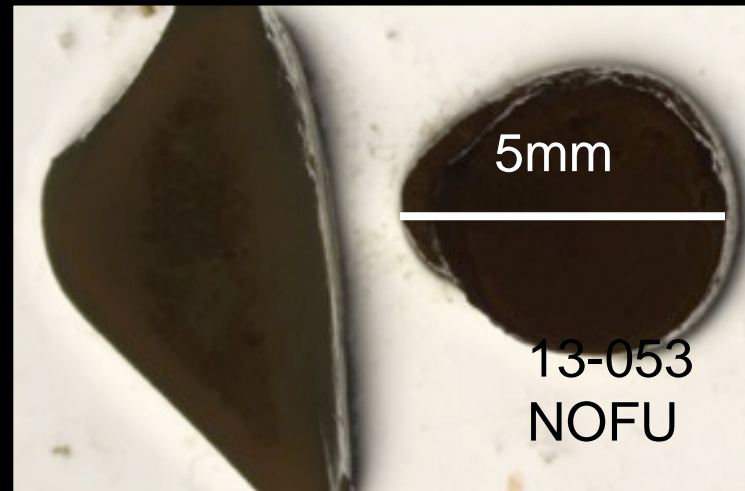
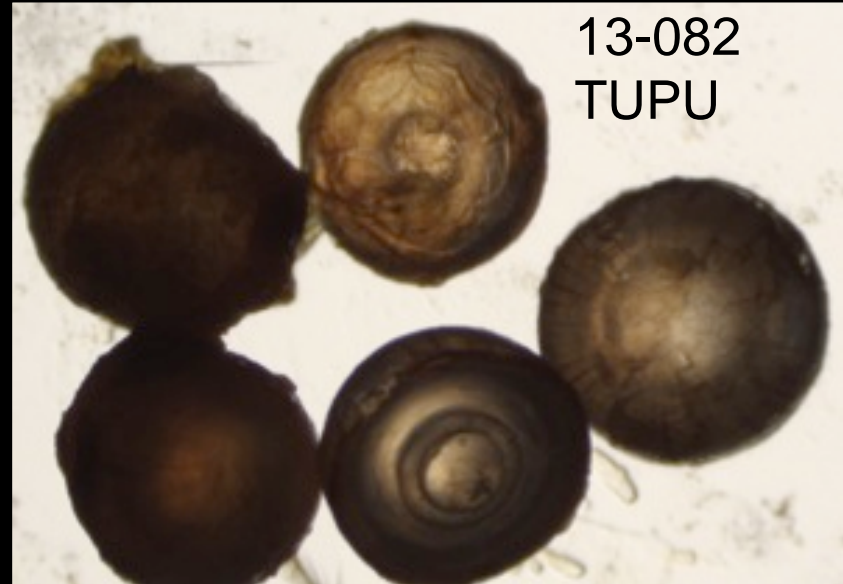
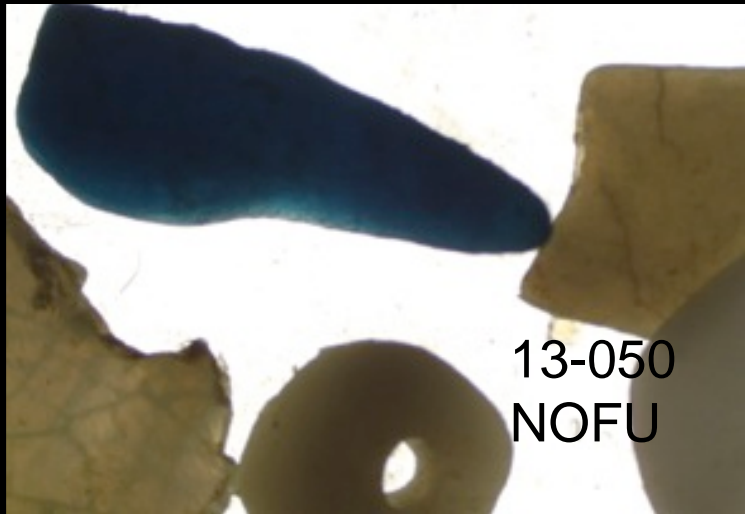
# Alaska Maritime National Wildlife Refuge





**Are seabird  
populations  
in the Bering  
Sea impacted  
by marine  
debris?**

# Stomach Content Analysis



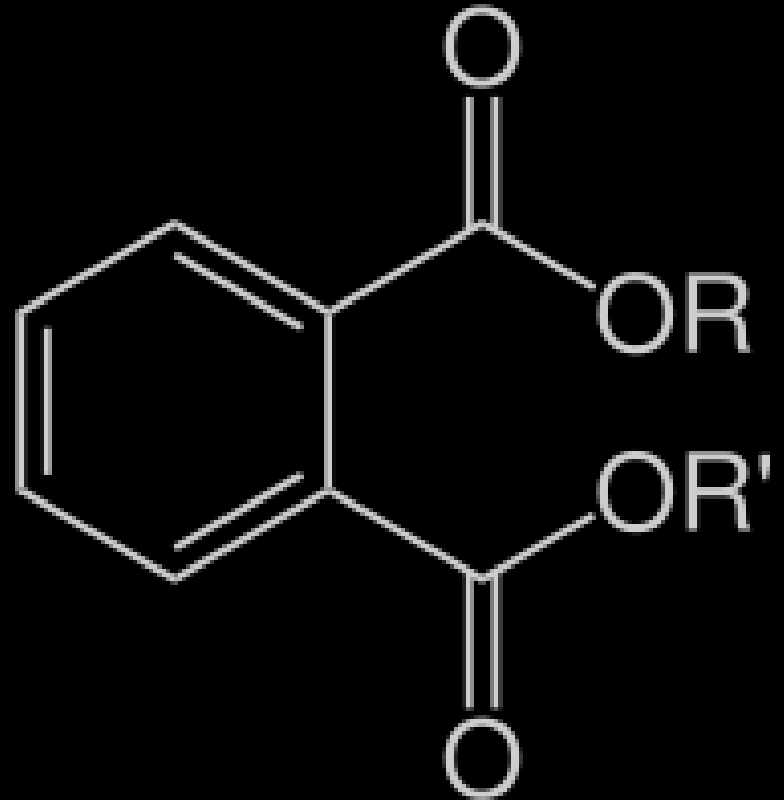
# Contaminants in the Environment

- Approximately 60,000 - 80,000 chemicals on the market today
- Not tested for safety to humans, animals or the environment, under existing law
- About 80% are polymers and plastics
- Health and science authorities estimate approximately 1 in 5 cases of cancer caused by chemicals and environmental exposure

# Phthalates:

## Our Target Chemicals

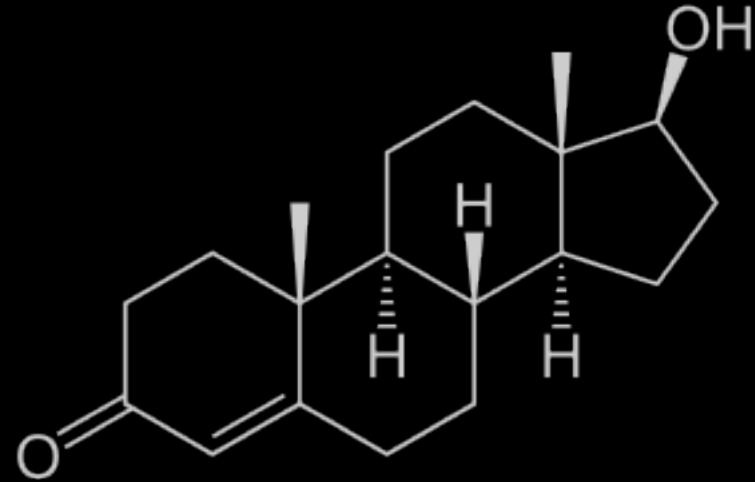
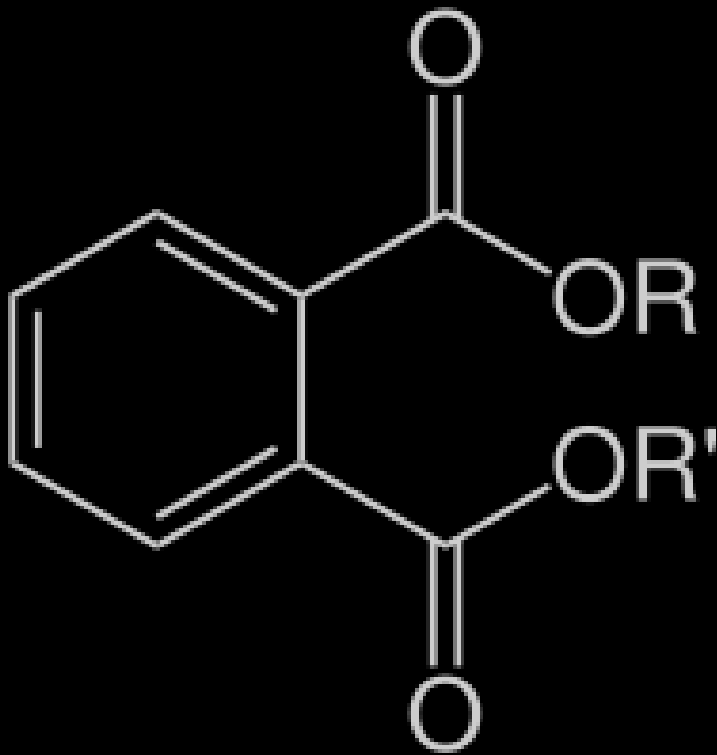
- Esters of phthalic acid
- Additive chemicals in plastics
- Not bound to plastic polymer matrix
- Susceptible to leaching



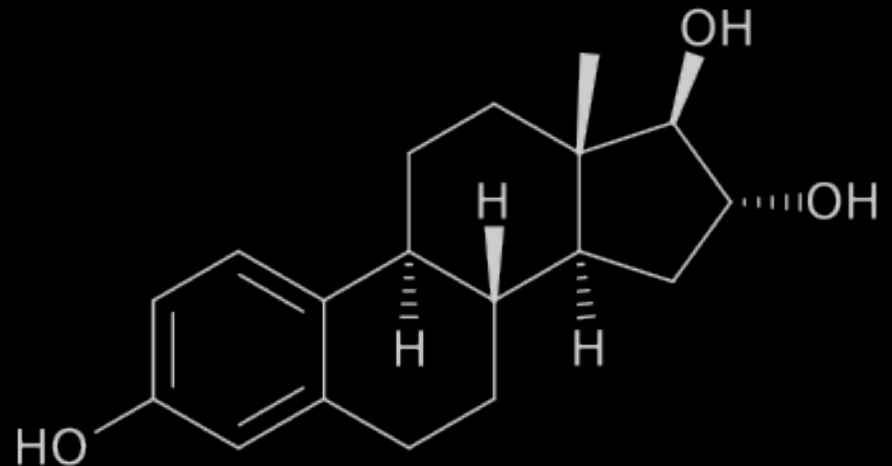


**Phthalates are  
Endocrine Disrupting  
Compounds (EDCs)**

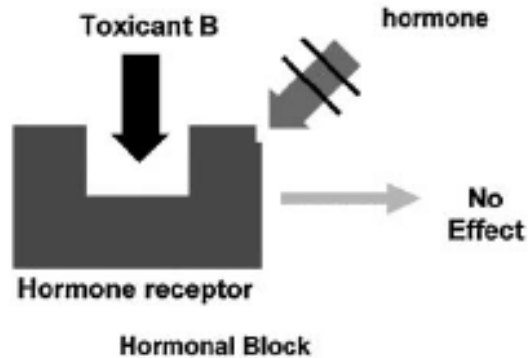
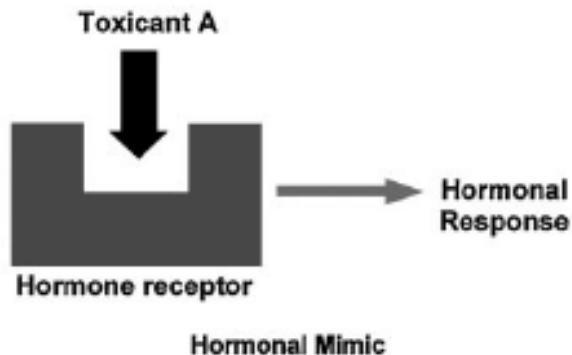
# Similar Structures



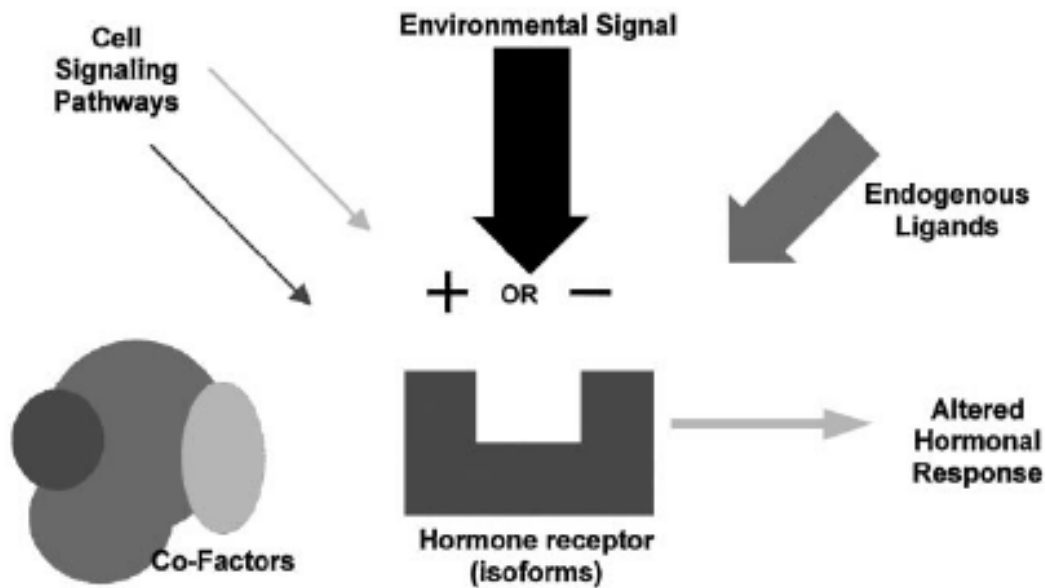
Testosterone



Estrogen



EDCs  
interrupt  
hormone  
receptors



# Negative Impacts

Affect ovarian and oviduct function

Reduced fertility

Proliferation of uterine tissue and breast tissue

Carcinomas and increased breast cancer risk

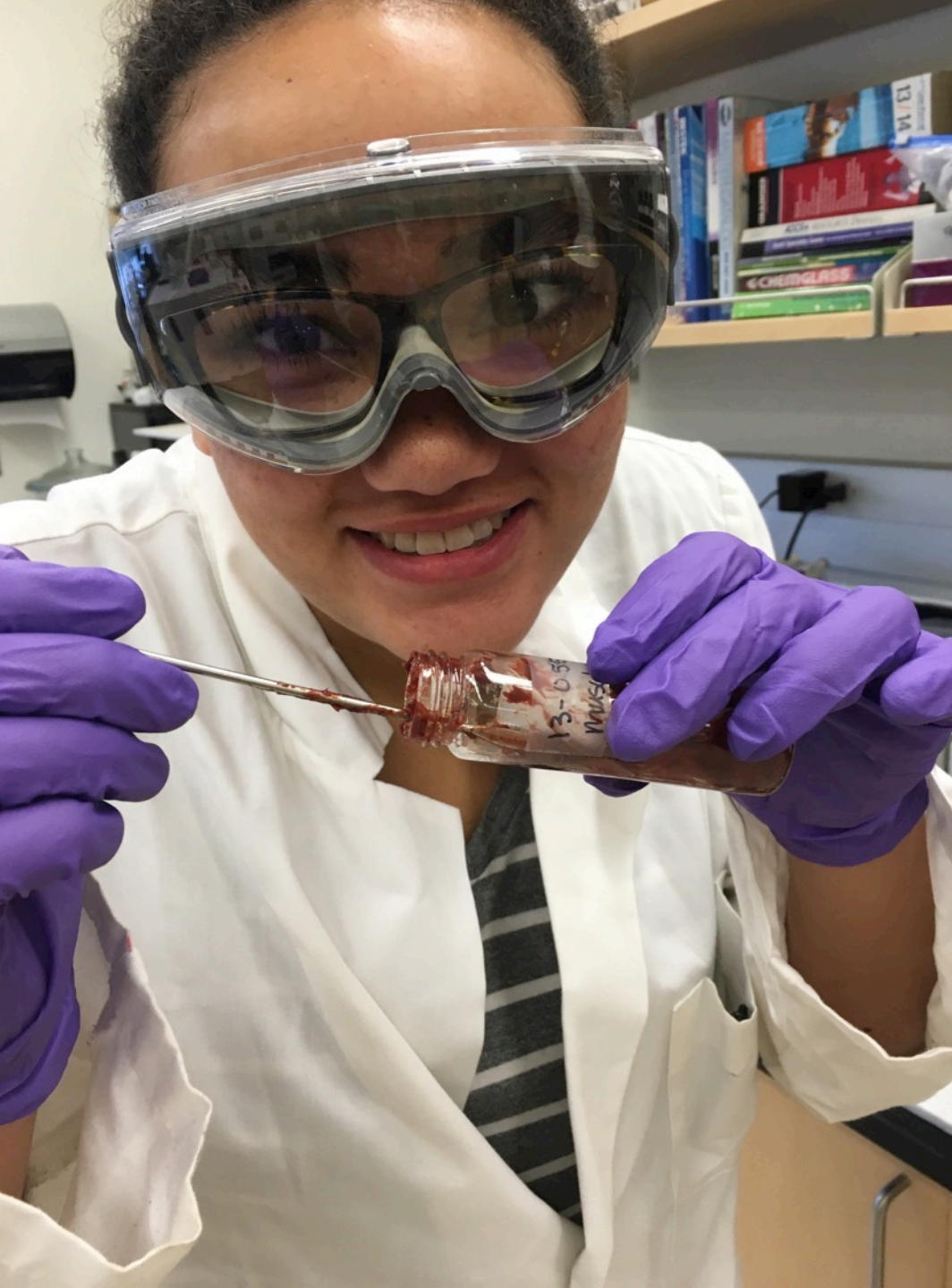
Reduced numbers and/or function of Sertoli and

Leydig cells

Reduced gonadal function

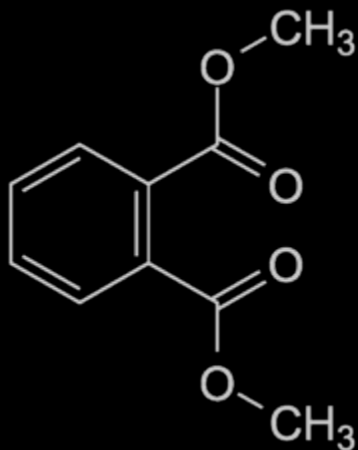
Are seabirds  
from the Bering  
Sea exposed  
to phthalates?



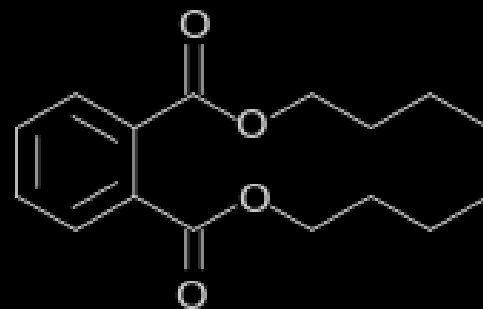


Chemical  
analysis to  
determine  
exposure

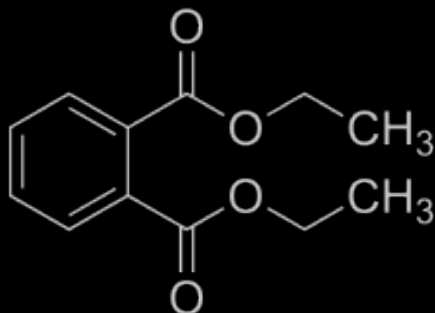
**Dimethyl  
phthalate  
(DMP)**



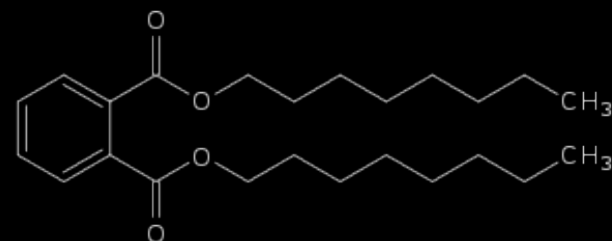
**Di-n-butyl  
phthalate  
(DBP)**



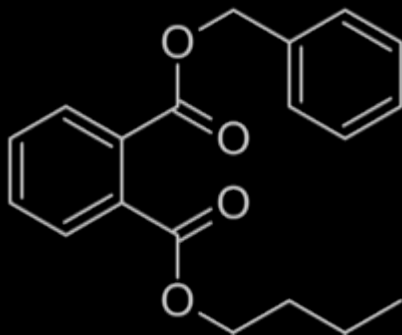
**Diethyl  
phthalate  
(DEP)**



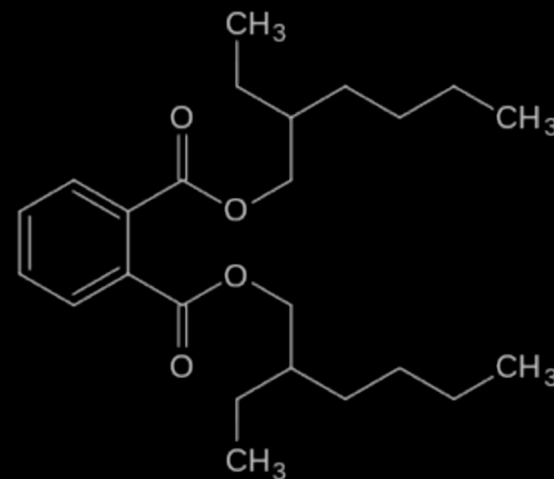
**Di(n-octyl)  
phthalate  
(DnOP)**



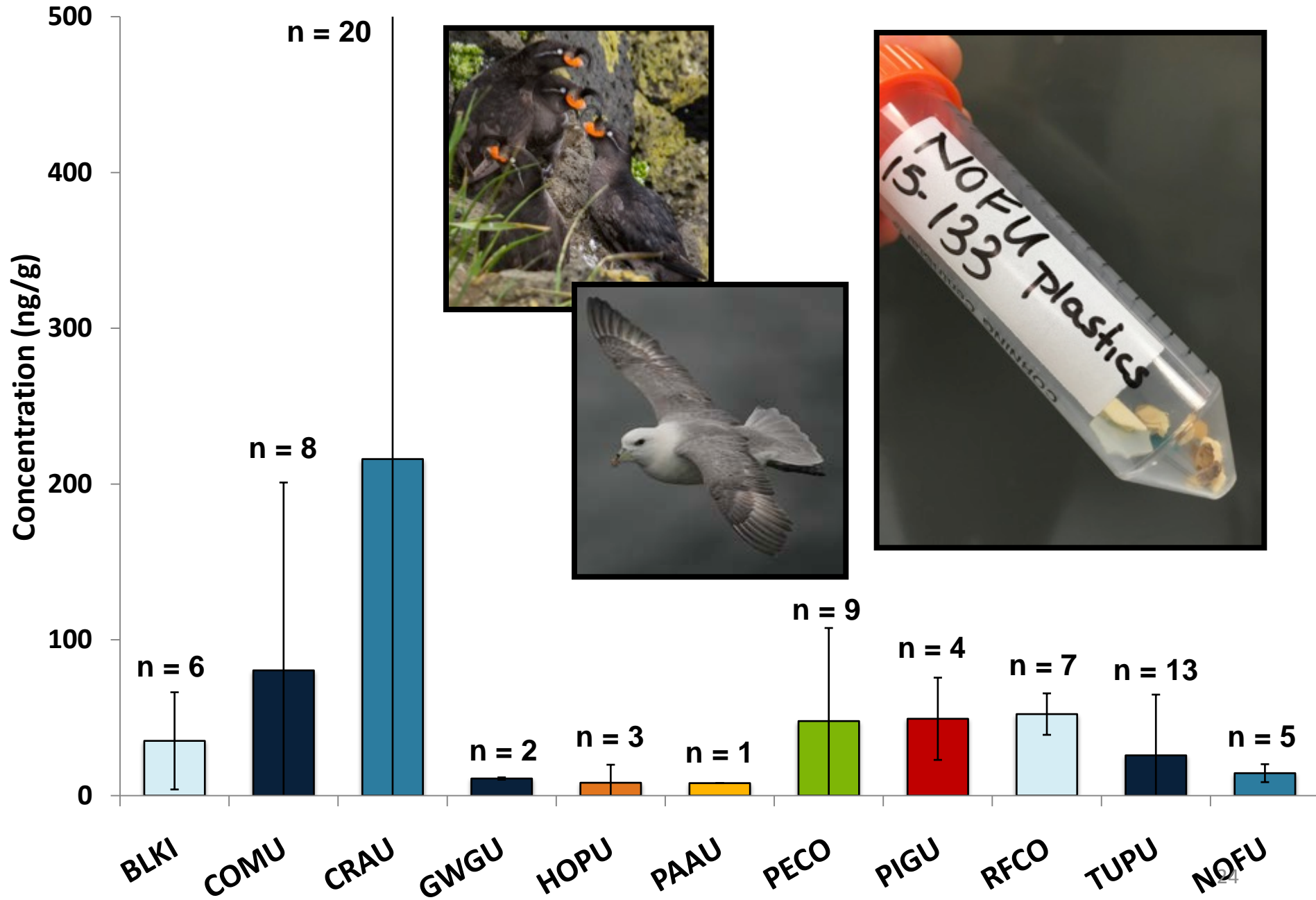
**Butyl benzyl  
phthalate  
(BBP)**



**Di(2-ethylhexyl)  
phthalate  
(DEHP)**



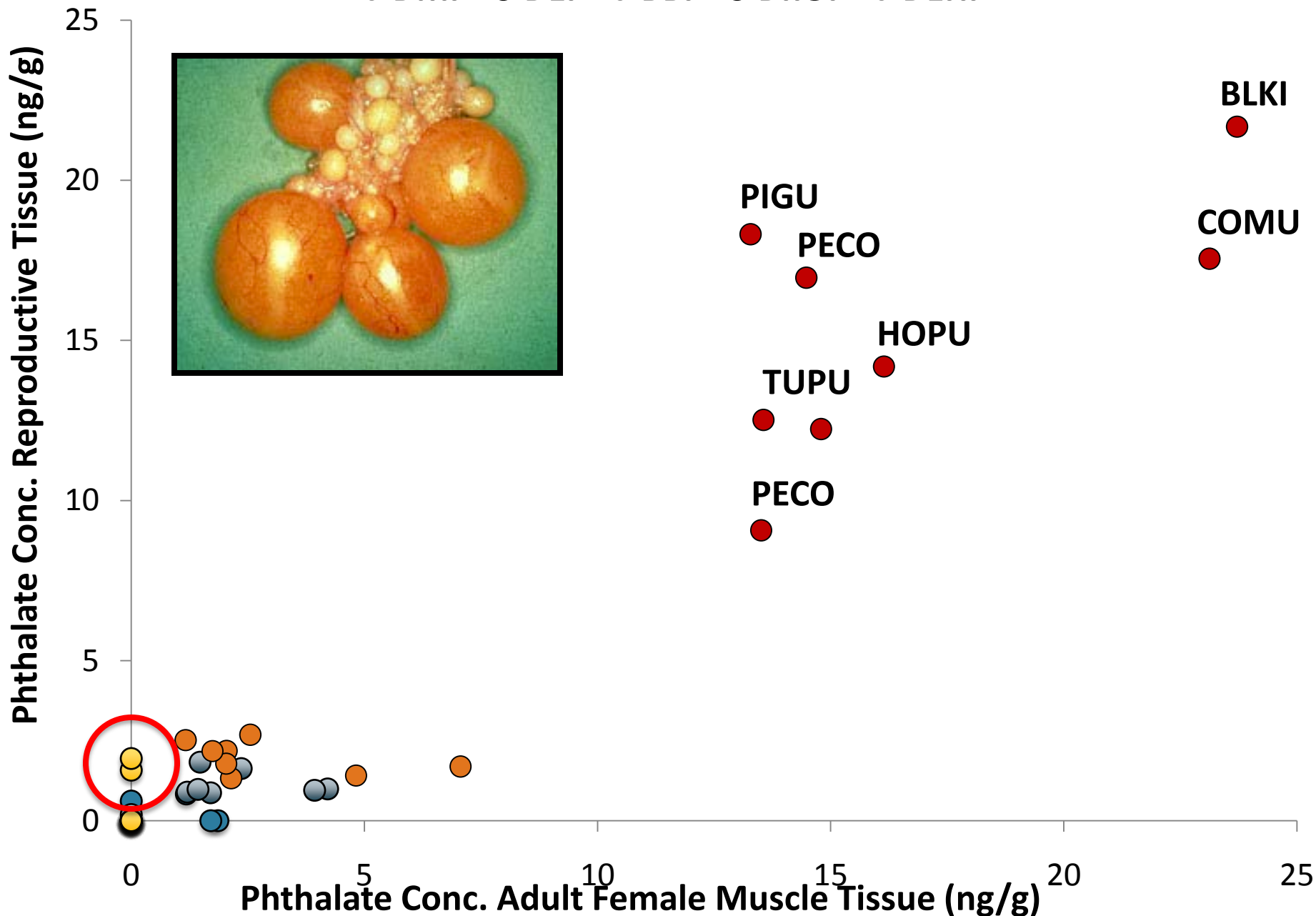
# $\Sigma$ Phthalate Concentrations in **Muscle** Tissues





# Adult Female Birds vs. Reproductive Tissue (n=11)

● DMP ● DEP ● BBP ● DnOP ● DEHP



How will phthalate exposure during development impact seabird chicks?



# Reduced Hatching Success and Birth Defects in Experiments

**Table 1**

Percent hatching, incubation length and congenital malformation in chicks with pre-hatch exposure to DEHP or DBP.

| Prehatch exposure                          | Control    | DEHP mg/kg |                 |                   | DBP mg/kg       |                 |
|--|------------|------------|-----------------|-------------------|-----------------|-----------------|
| Dose (mg/kg)                               | 0          | 5          | 20              | 50                | 100             | 100             |
| % Hatching<br>(number of eggs incubated)   | 80<br>(40) | 64<br>(11) | 62<br>(13)      | 68<br>(19)        | 68<br>(9)       | 57<br>(14)      |
| % Late hatching<br>(of those that hatched) | 16         | 14         | 13              | 54                | 17              | 38              |
| % Defects of those* that hatched           | 0          | 0          | 13 <sup>G</sup> | 15 <sup>G,0</sup> | 33 <sup>0</sup> | 13 <sup>G</sup> |

**A) Normal Chicks (Control)**



**Normal**

**B) 20 mg/kg DEHP**



**Gastroschisis**

**D) 100 mg/kg DEHP**



**Omphalocele**

**C) 50 mg/kg DEHP**



**Omphalocele**

**E) 100 mg/kg DBP**



**Gastroschisis**



**Gastroschisis**

**Fig. 1.** Gastroschisis and omphalocele (see text) after pre-hatch exposure to phthalates in chicks that failed to hatch (ID 22).

# Impacts on human health: Are harvesters of seabird eggs at risk of phthalate exposure?



# Thank you!

*Tiglax* crew and AMNWR Biologists: Billy Pepper, John Ferris, Heather Renner, Marc Romano, Jeff Williams

Field crew: Michele Craig, Marin Lee, Misty Libby, Jeff Libby, Ashley Stanek

ASET Lab: Ben Applegate

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