

NORWEGIAN BIODIVERSITY AND GENOMICS CONFERENCE
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Gene loss in the chemical defensome of marine mammals

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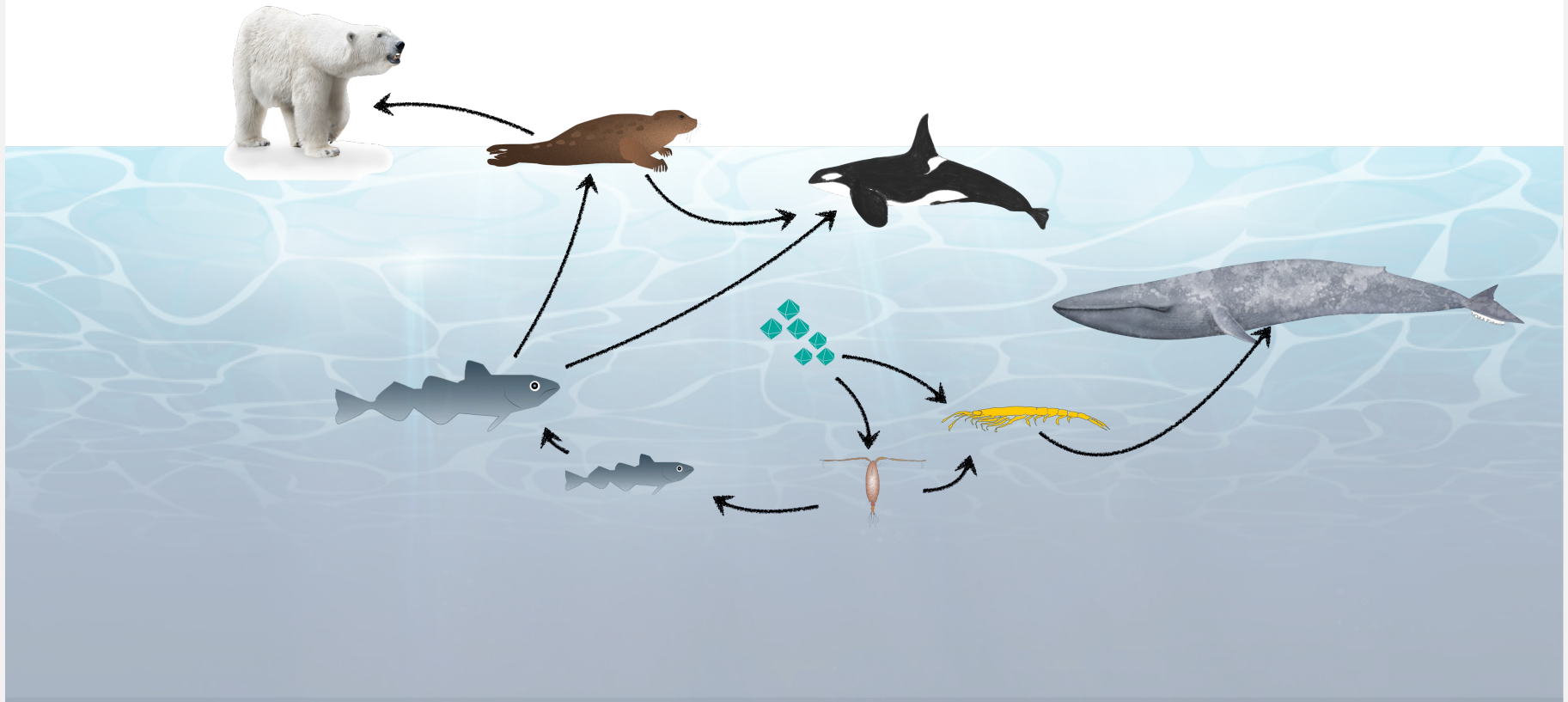
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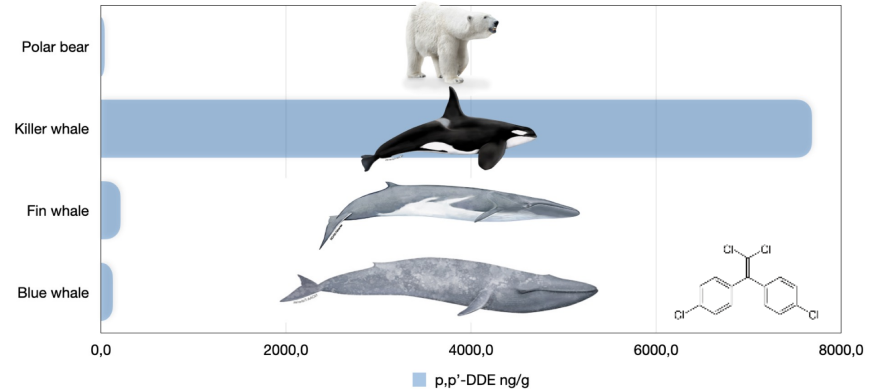
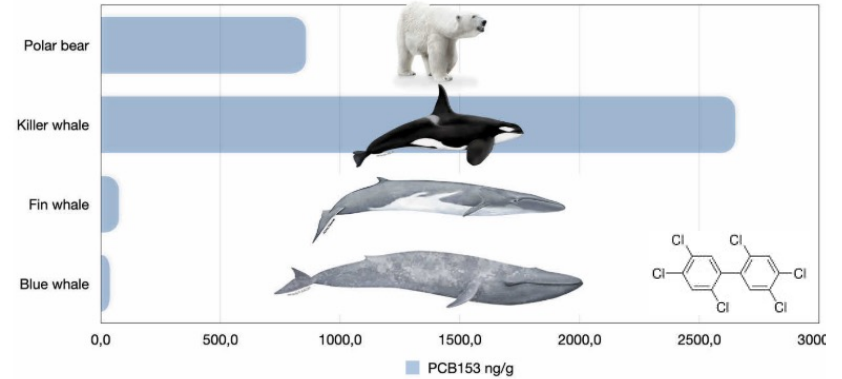
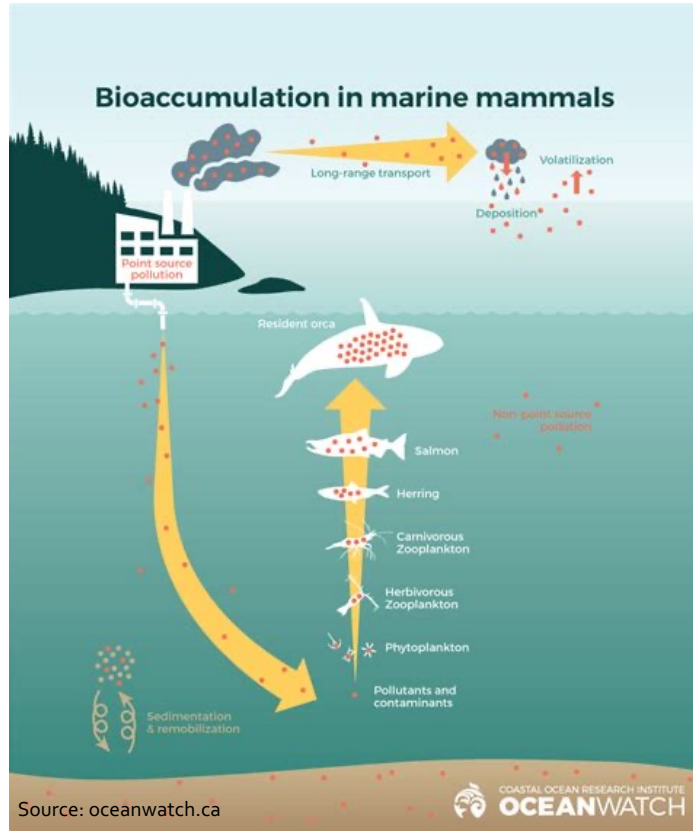
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Marine (arctic) food web



Contaminant accumulation

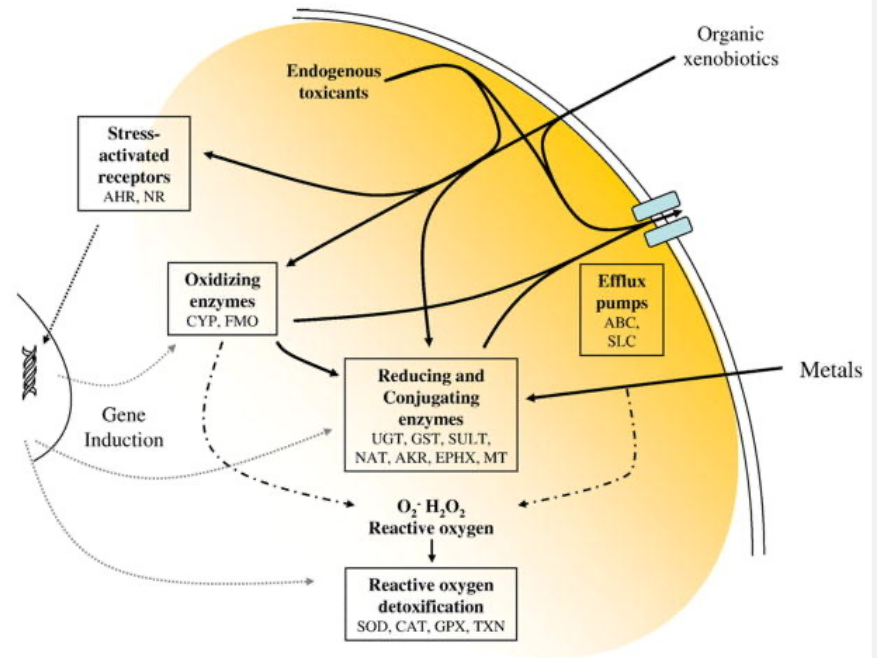


The Chemical Defensome

“Gene families thought to protect against chemical stressors”



Purple sea urchin; Jerry Kirkhart



Goldstone *et al.*, *Dev Biol.* (2011)

PXR & CAR – Key regulators

NR1I2 = PXR

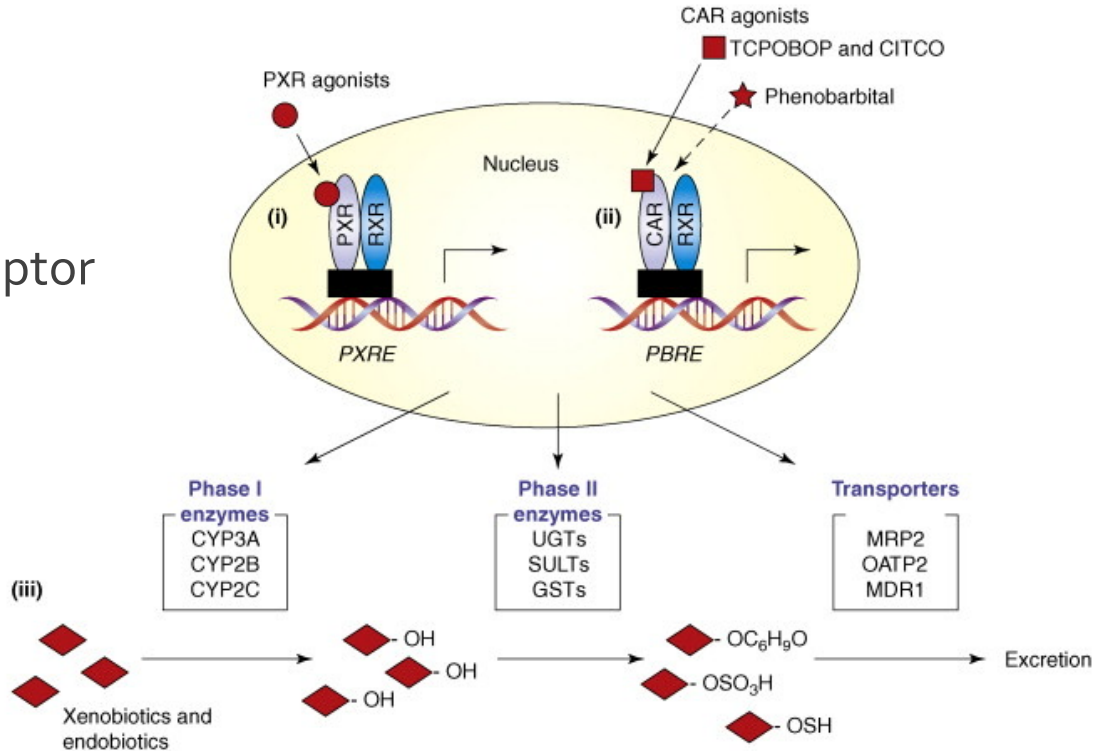
Pregnane X receptor

NR1I3 = CAR

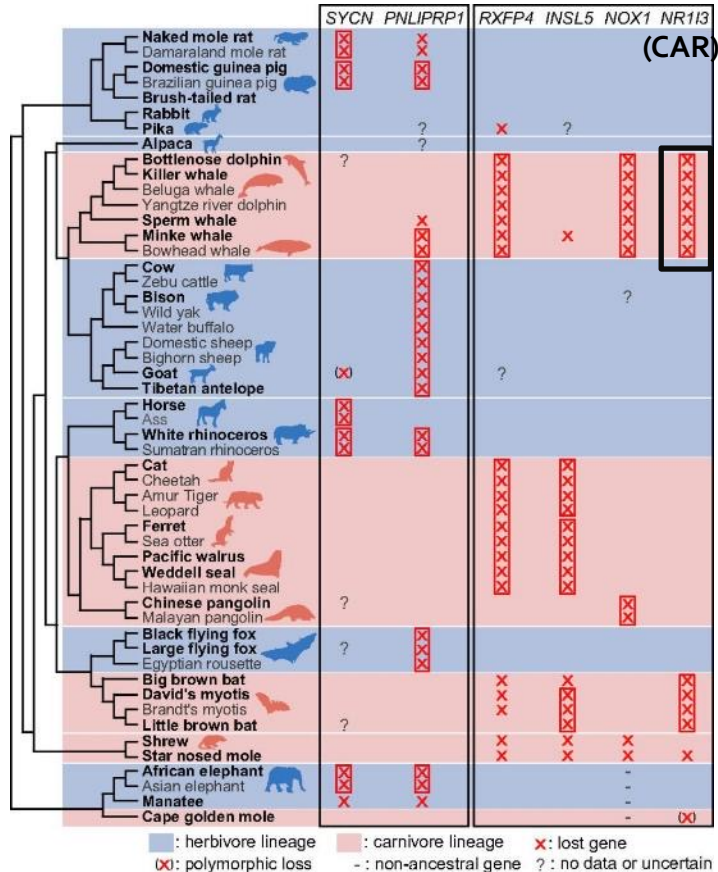
Constitutive androstane receptor

Nuclear receptors:

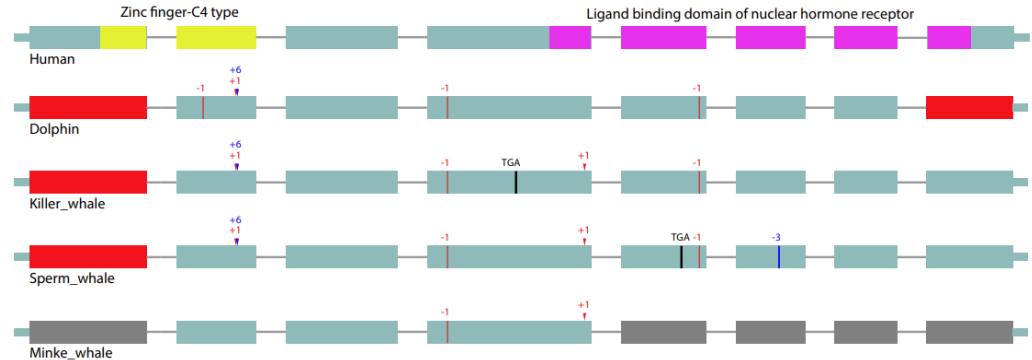
- Ligand binding domains
- DNA-binding domain



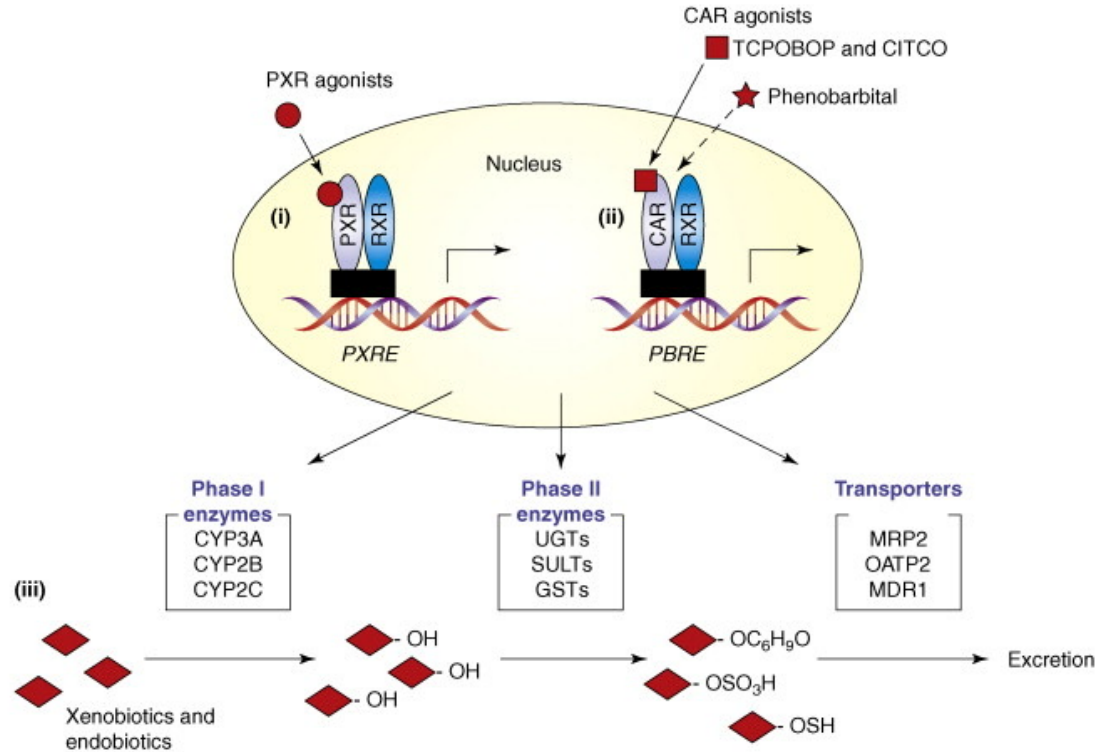
Loss of PXR & CAR in whales



NR1l2 (PXR)



What about other defensome genes?

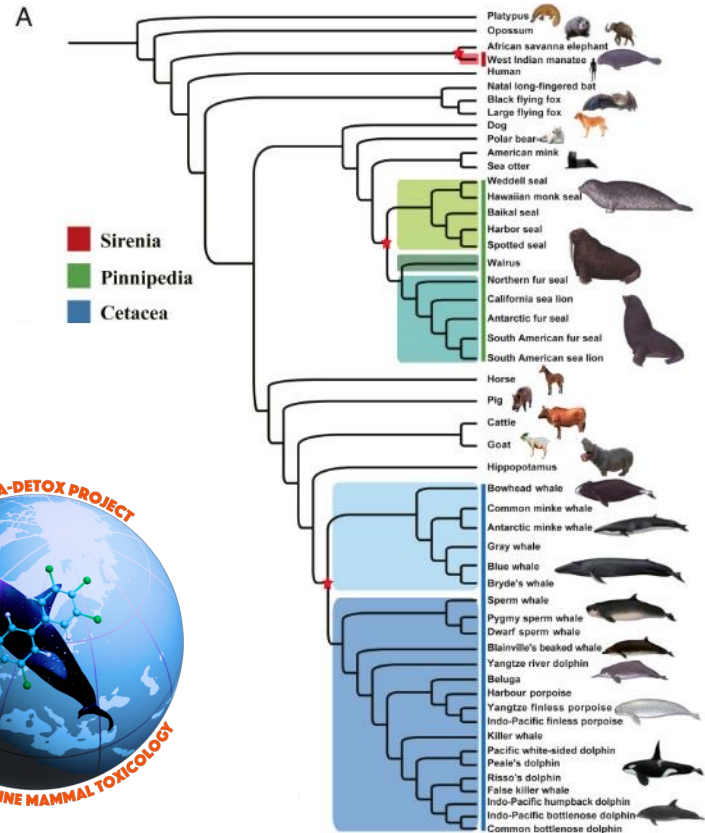
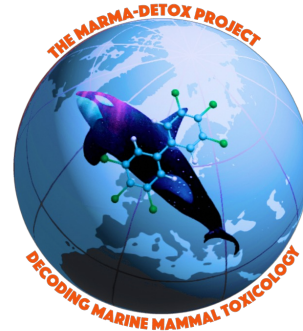


Analysis of the marine mammal defensome

- Identify chemical defensome in marine mammals
- Compare between lineages
- Compare with toxicological assays

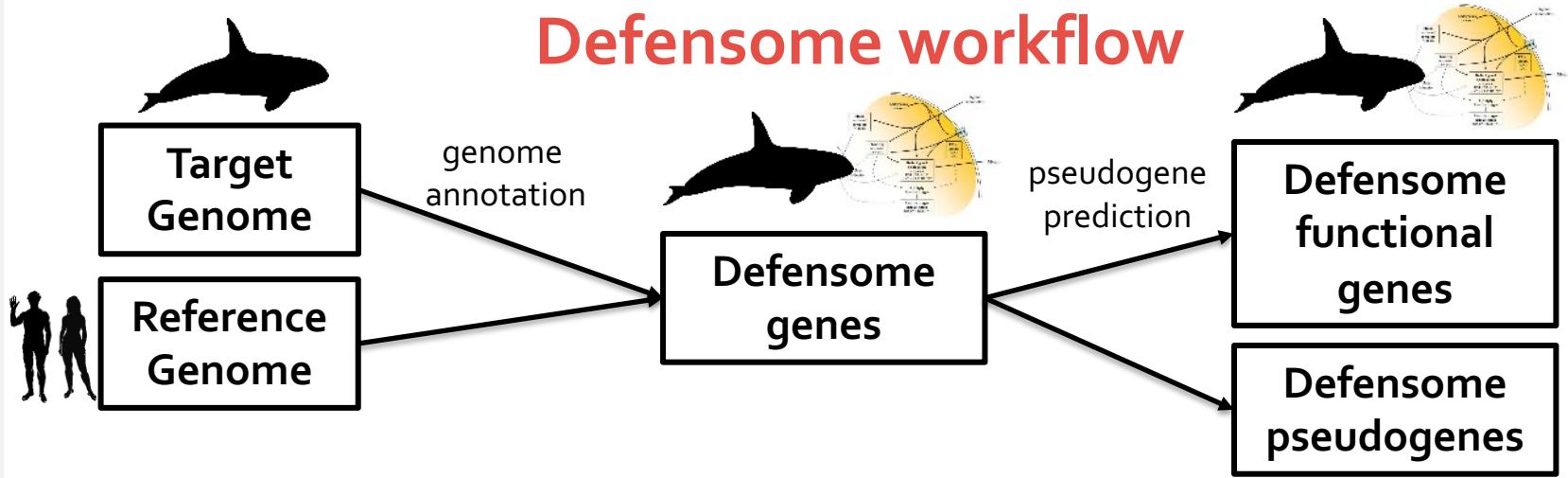
Part of the MARMA-DETOX project

Anders Goksøyr (BIO – UiB)

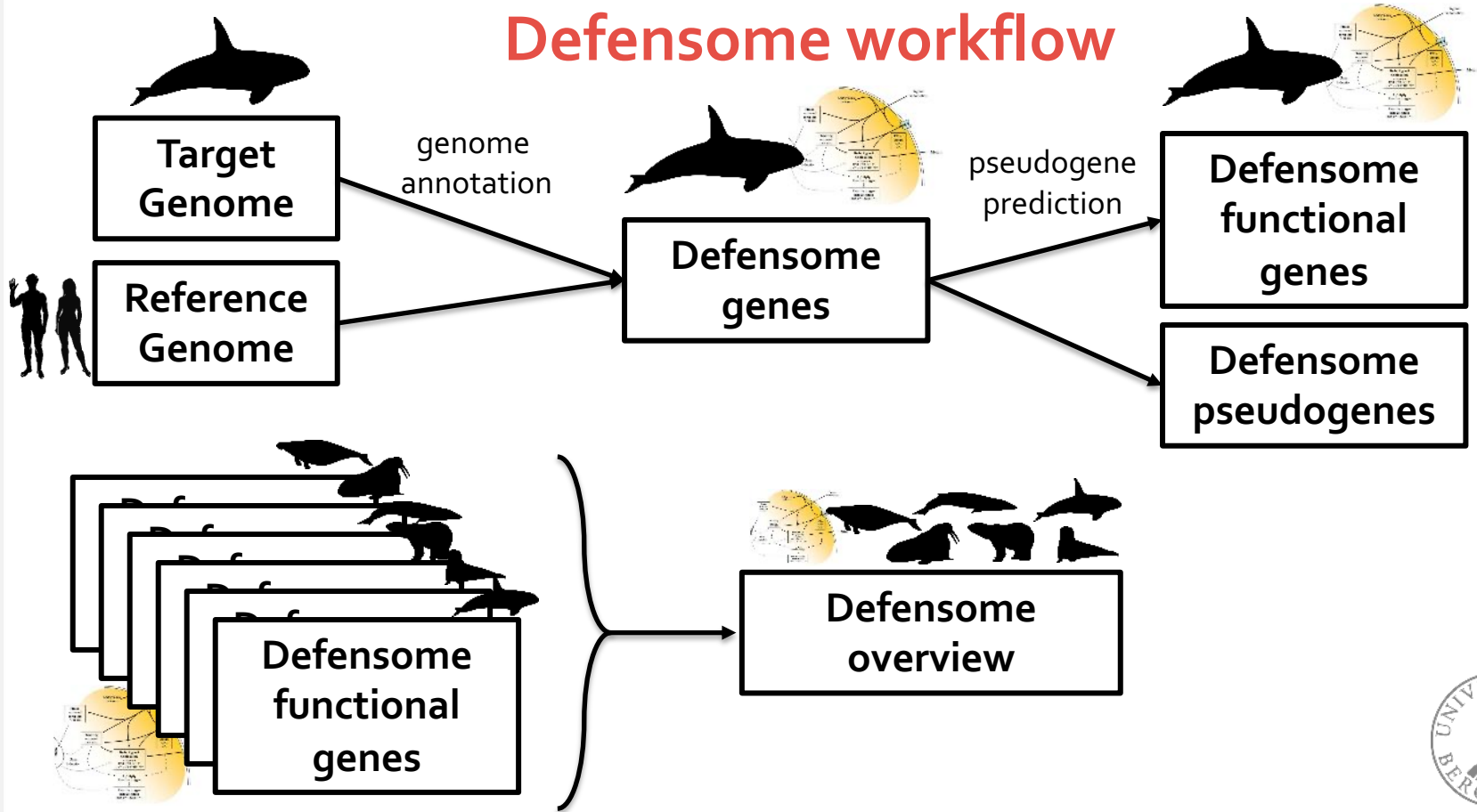


Yuan *et al.*, PNAS (2021)

Defensome workflow

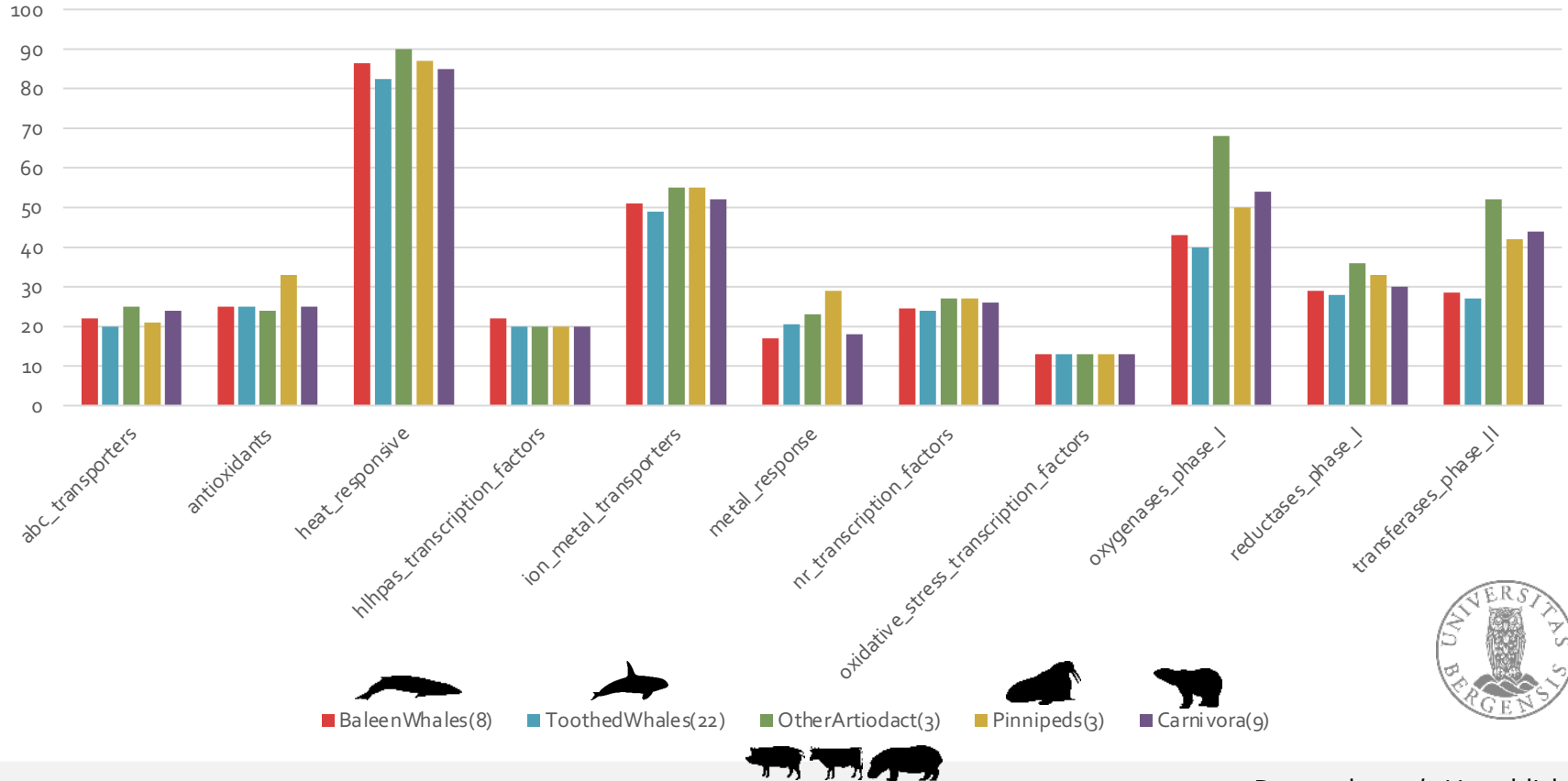


Defensome workflow



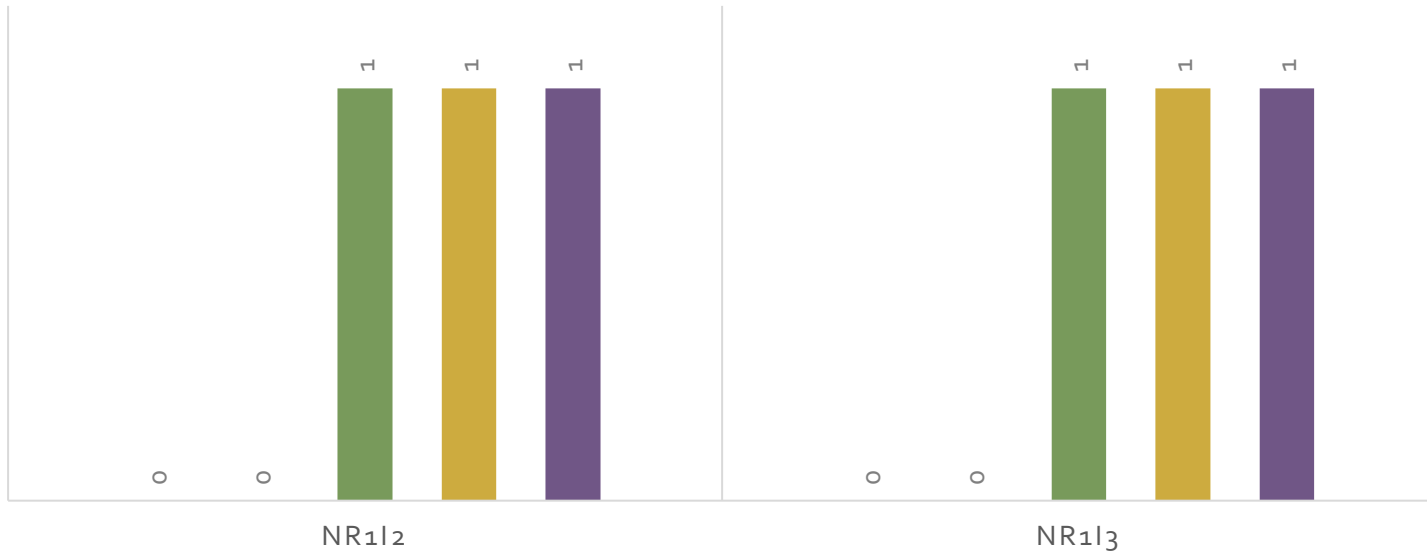
Marine mammal defensome

Median
Gene
Counts



PXR/NR1I2 – CAR/NR1I3

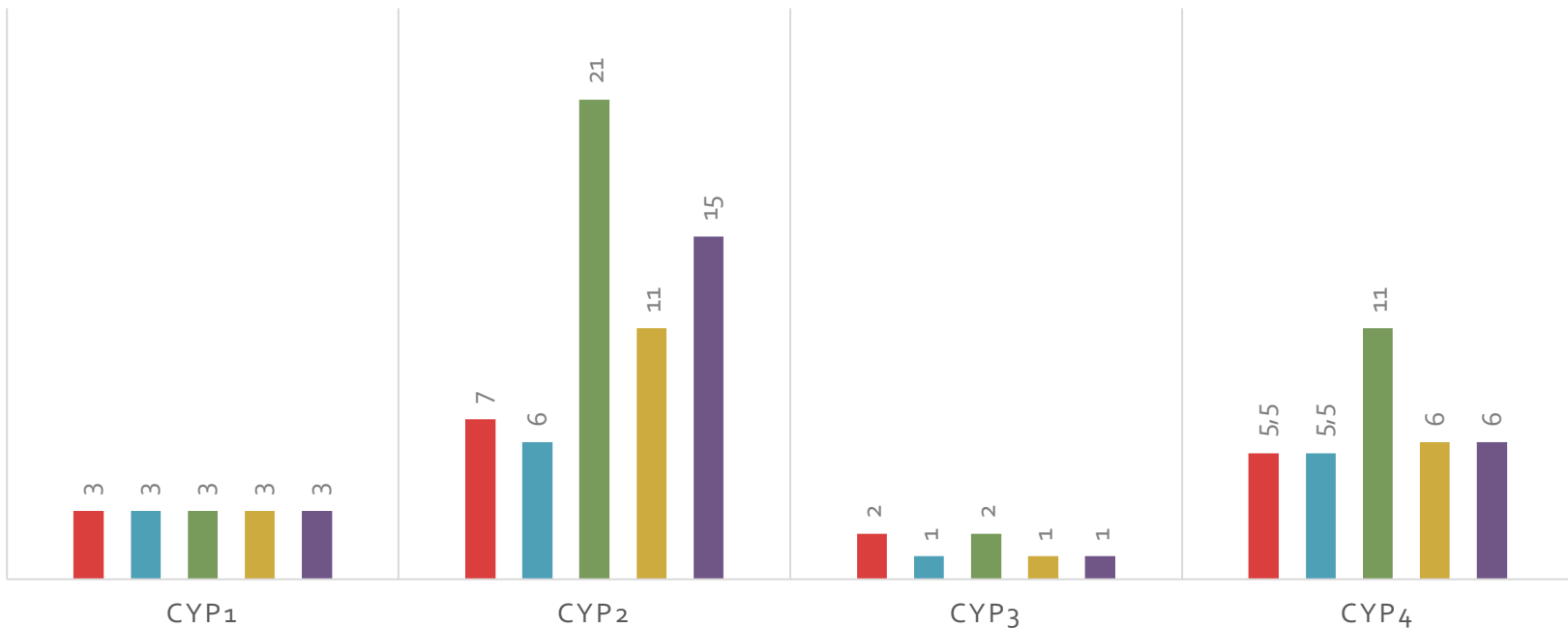
■ BaleenWhales(8) ■ ToothedWhales(24) ■ OtherArtiodact(3) ■ Pinnipeds(3) ■ Carnivora(9)



Loss of NR1I2 and NR1I3 in whales

CYTOCHROME P₄₅₀ - CYP

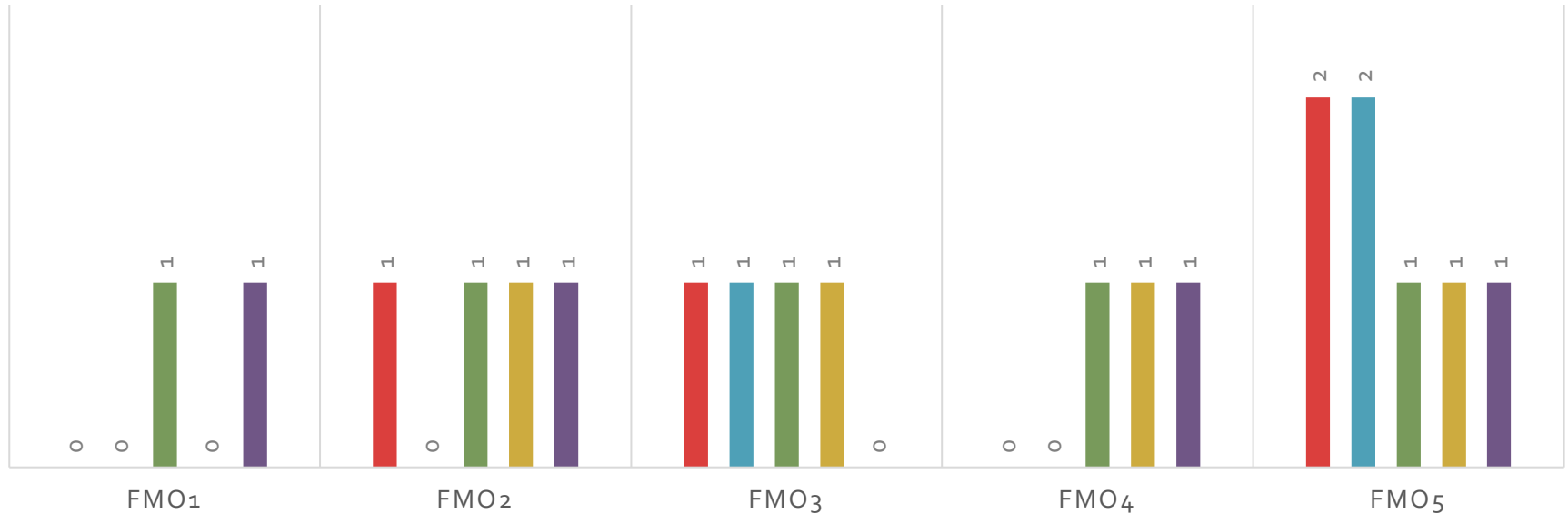
■ BaleenWhales(8) ■ ToothedWhales(24) ■ OtherArtiodact(3) ■ Pinnipeds(3) ■ Carnivora(9)



Contraction of CYP₂ & CYP₄ in whales
Contraction of CYP₂ in pinnipeds

FLAVIN-BINDING MONOOXYGENASE - FMO

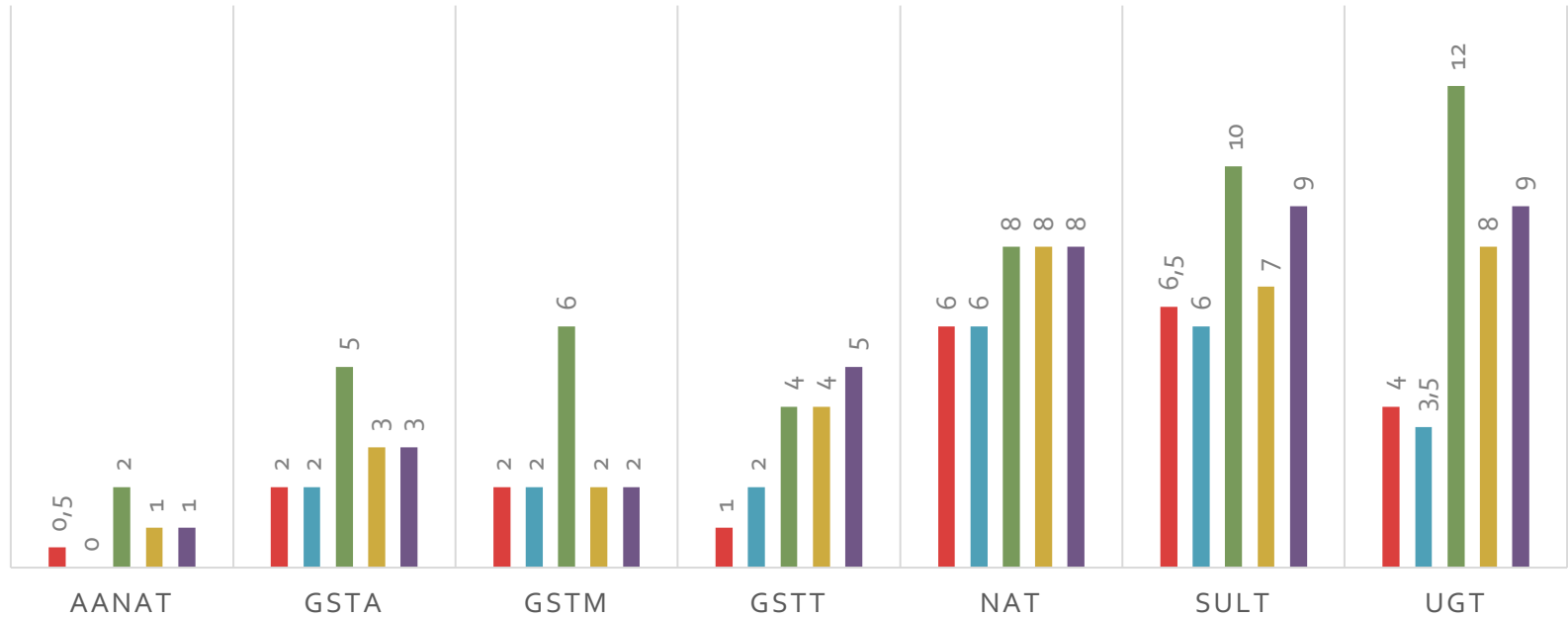
■ BaleenWhales(8) ■ ToothedWhales(24) ■ OtherArtiodact(3) ■ Pinnipeds(3) ■ Carnivora(9)



Loss of fmo1 & 4 in whales; loss of fmo2 in toothed whales; duplication of fmo5 in whales
Loss of fmo1 in pinnipeds

TRANSFERASES

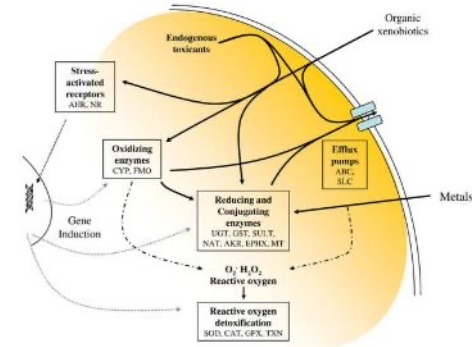
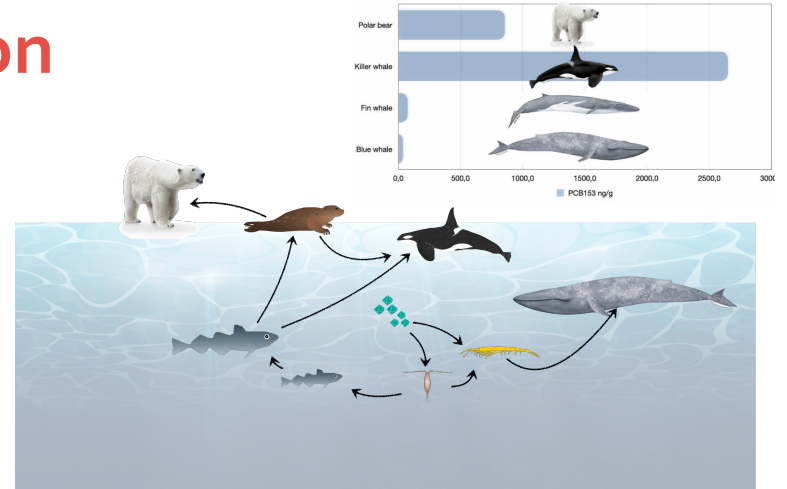
■ BaleenWhales(8) ■ ToothedWhales(24) ■ OtherArtiodact(3) ■ Pinnipeds(3) ■ Carnivora(9)



Drastic loss of multiple transferases in whales; Limited losses in pinnipeds

Conclusion

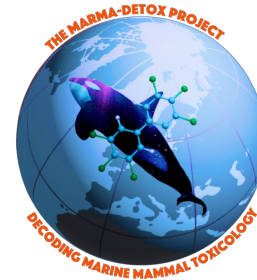
- High levels of toxic chemicals in certain marine mammal species
- Significant losses of defensome genes in whales and dolphins
- Only few defensome losses in pinnipeds



Acknowledgements

The Marma-Detox Project

Funded by the Research Council of Norway, project 334739



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