# Non-invasive measures of stress hormones as a potential management tool, using the Arctic fox as a case study

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# Recommendations of the Arctic Biodiversity Assessment

## Improving knowledge and public awareness

16. Research and monitor individual and cumulative effects of stressors and drivers of relevance to biodiversity, with a focus on stressors that are expected to have rapid and significant impacts and issues where knowledge is lacking.

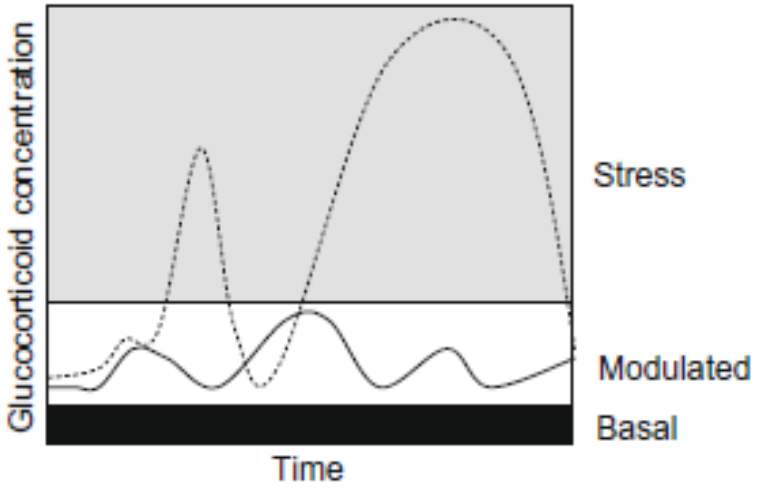
This should include, but not limited to, (…) developing **robust quantitative indicators for stressors** through the Circumpolar Biodiversity Monitoring Program

# Conversation physiology

‘An integrative scientific discipline applying physiological concepts, tools, and knowledge to characterizing biological diversity and its ecological implications; understanding and predicting how organisms, populations, and ecosystems respond to environmental change and stressors; and solving conservation problems across the broad range of taxa’

# Stress hormones as a marker for stress in individuals and populations?

- Physiological stress has adverse consequences in humans and laboratory animals
- Assumption from the biomedical field: stress hormones (glucocorticoids) reflect health or fitness
- Increases in GCs may reflect a more challenging environment
- Measure physiological stress to assess the status and future fate of natural populations and provide earlier detection of environmental stressors
- Hypothesis: measures of stress hormones can be used to document the effects of anthropogenic disturbances on animals and to predict future declines in a population or species




From Wingfield et al. 1997

# Stress hormones and environmental changes

Polar Biol (2013) 36:1525–1529
DOI 10.1007/s00300-013-1364-y

SHORT NOTE

## Polar bear stress hormone cortisol fluctuates with the North Atlantic Oscillation climate index

Thea Ø. Bechshøft · Christian Sonne · Frank F. Rigét · Robert J. Letcher · Melinda A. Novak · Elizabeth Henchey · Jerrold S. Meyer · Igor Eulaers · Veerle L. B. Jaspers · Adrian Covaci · Rune Dietz

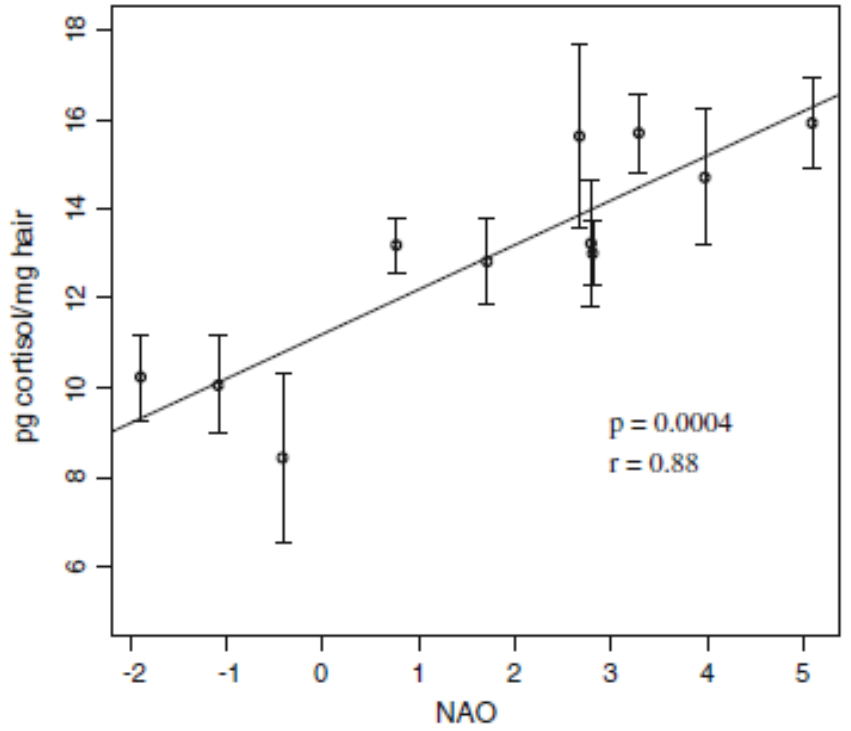



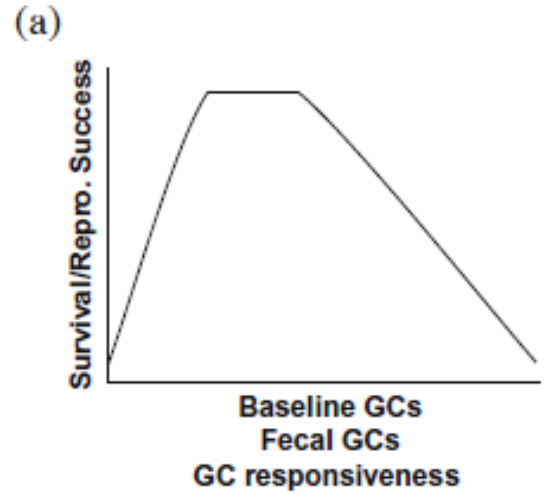

**Fig. 1** Scatter plot of mean annual cortisol concentrations in East Greenland polar bear hair samples (pg $mg^{-1}$ hair) versus NAO winter index values. ($p = 0.0004$, $r = 0.88$, $n = 11$ years/84 individuals). Circles represent the mean annual cortisol concentration ± 1 SE. From *left* to *right*, the years plotted are as follows: 2001 ($n = 7$), 2006 ($n = 14$), 2009 ($n = 7$), 2002 ($n = 2$), 1999 ($n = 13$), 1993 ($n = 7$), 2007 ($n = 7$), 2000 ($n = 8$), 1992 ($n = 9$), 1990 ($n = 6$), 1989 ($n = 4$)

# Stress hormones, individual fitness, and population processes

## Do baseline glucocorticoids predict fitness?

**Frances Bonier[1,2], Paul R. Martin[1], Ignacio T. Moore[2] and John C. Wingfield[3]**

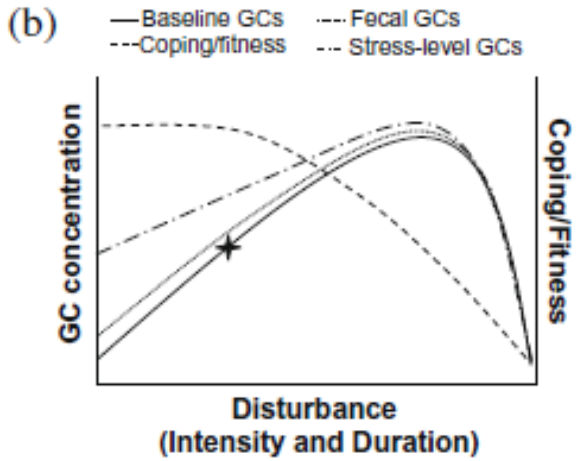
*Trends in Ecology and Evolution* Vol.24 No.11




Physiological stress levels predict survival probabilities in wild rabbits

Sonia Cabezas [a,*], Julio Blas [b], Tracy A. Marchant [b], Sacramento Moreno [a]

Hormones and Behavior 51 (2007) 313–320



# Stress hormones in a conservation context

## Measures of physiological stress: a transparent or opaque window into the status, management and conservation of species?

Ben Dantzer[1,2*], Quinn E. Fletcher[3], Rudy Boonstra[4] and Michael J. Sheriff[5]

Conservation Physiology
Volume 2 • 2014
10.1093/conphys/cou023

## The Need for a Predictive, Context-Dependent Approach to the Application of Stress Hormones in Conservation

CHRISTINE L. MADLIGER * AND OLIVER P. LOVE

*Conservation Biology*
Volume 00, No. 0, 2013

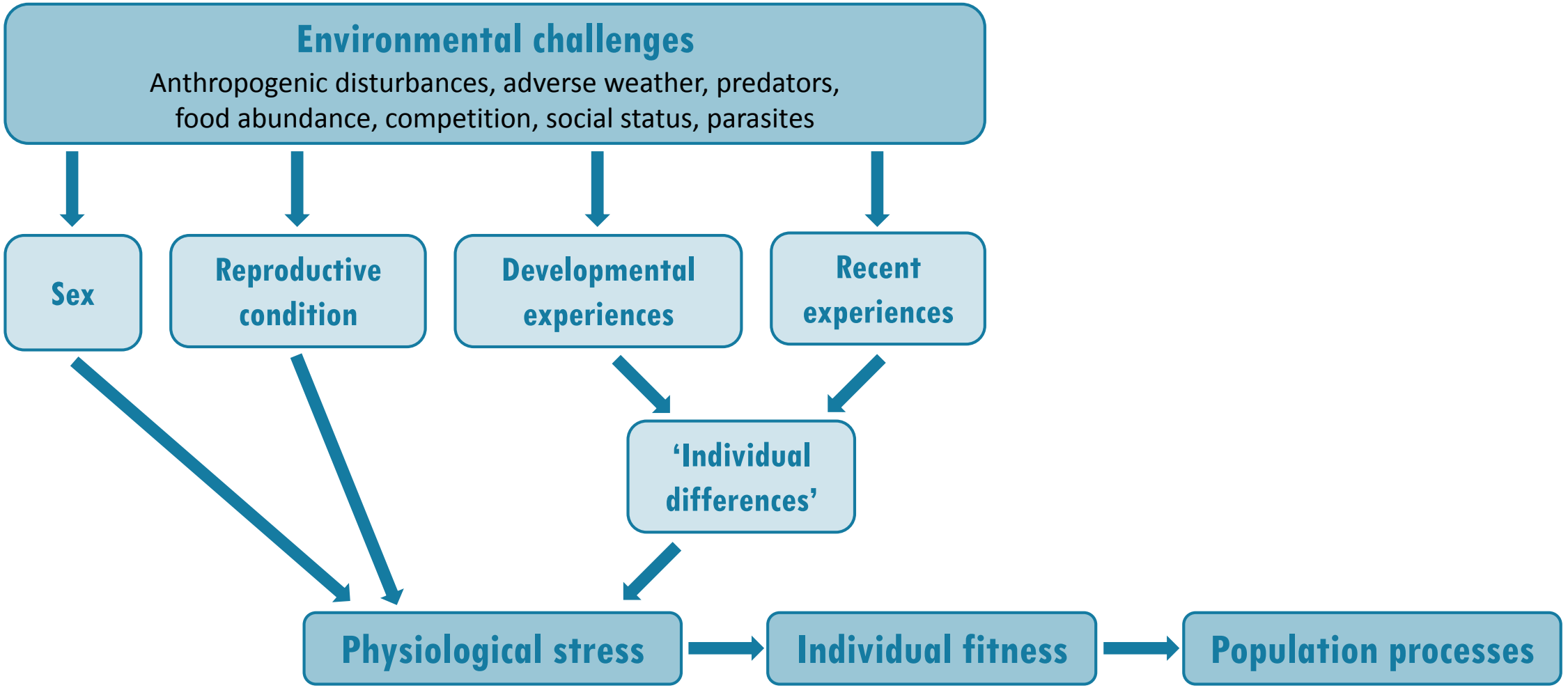
Review

## Stress in a conservation context: A discussion of glucocorticoid actions and how levels change with conservation-relevant variables

D. Shallin Busch [a,b,*], Lisa S. Hayward [a]

Biological Conservation 142 (2009) 2844–2853

# A predictive and context-dependent approach to the application of stress hormones in conservation

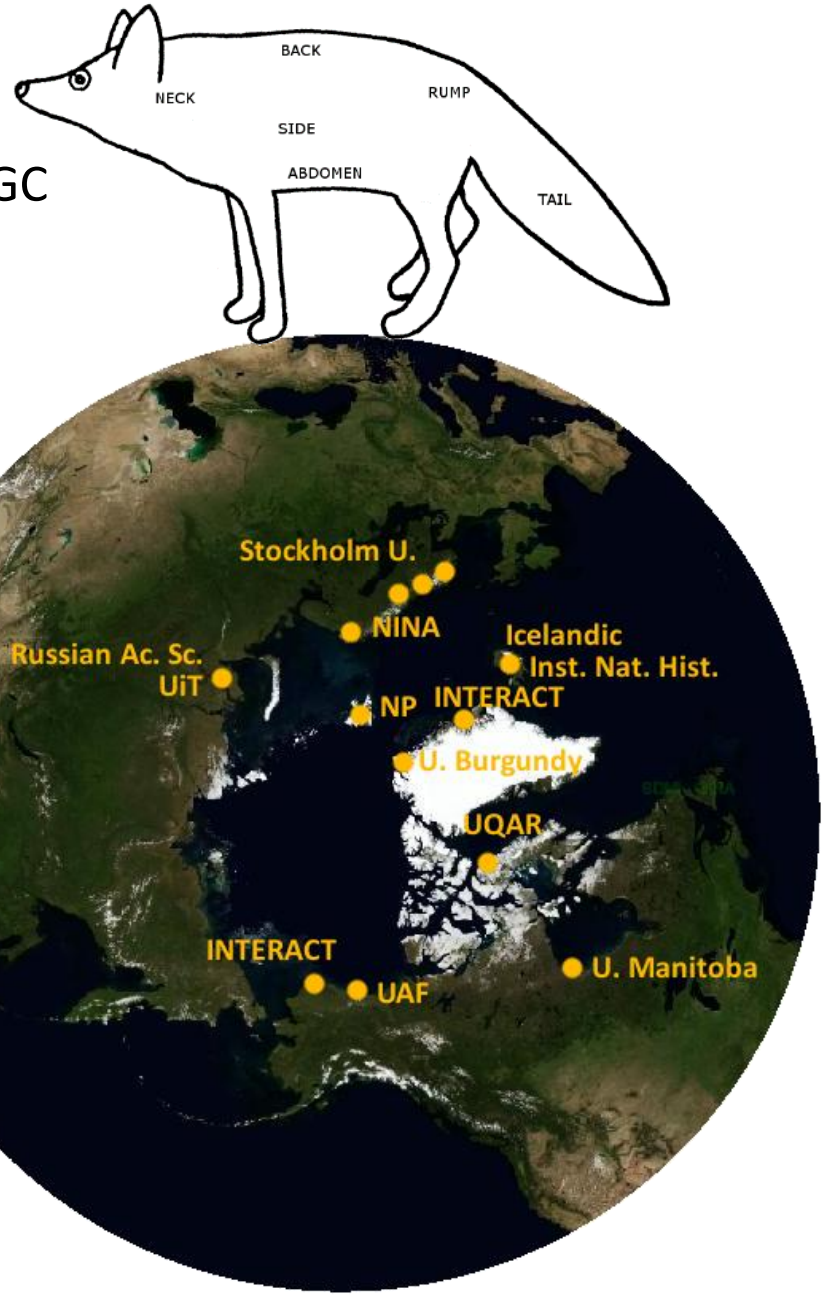



*Adapted from Dantzer et al. 2014, Conservation Physiology*

# Objectives

- Calibrate and validate the use of fecal GC metabolites and hair GC as integrated measures of stress hormones in Arctic foxes

  Methods:
  - Collect fresh feces and freeze as soon as possible
  - Collect hair and store in paper envelopes at room temperature
  - Collect information about the individual (sex, body condition, reproductive status…)
  - Extract hormones from feces and hair
  - Measure hormone levels (e.g. immunoassays)



# Objectives

- Calibrate and validate the use of fecal GC metabolites and hair GC as integrated measures of stress hormones in Arctic foxes
- Determine intra- and inter-individual patterns of variability in physiological stress and investigate their relationships to proxies of fitness at individual and population levels
- Disentangle the effects of changes in food availability, predator and competitor presence, and human-induced disturbance on the physiology and the ecology of Arctic foxes using samples collected on a global scale
- Assess the potential for integrated measures of stress as a practical tool for the conservation of wildlife species

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*Drawings from "Møt fjellreven" by Eide et al. 2013*

# Recommendations of the Arctic Biodiversity Assessment

## Addressing individual stressors on biodiversity

11. Reduce the threat of pollutants to Arctic biodiversity.

**Endocrine-Disrupting Chemicals and Climate Change: A Worst-Case Combination for Arctic Marine Mammals and Seabirds?**

*Bjørn Munro Jenssen*

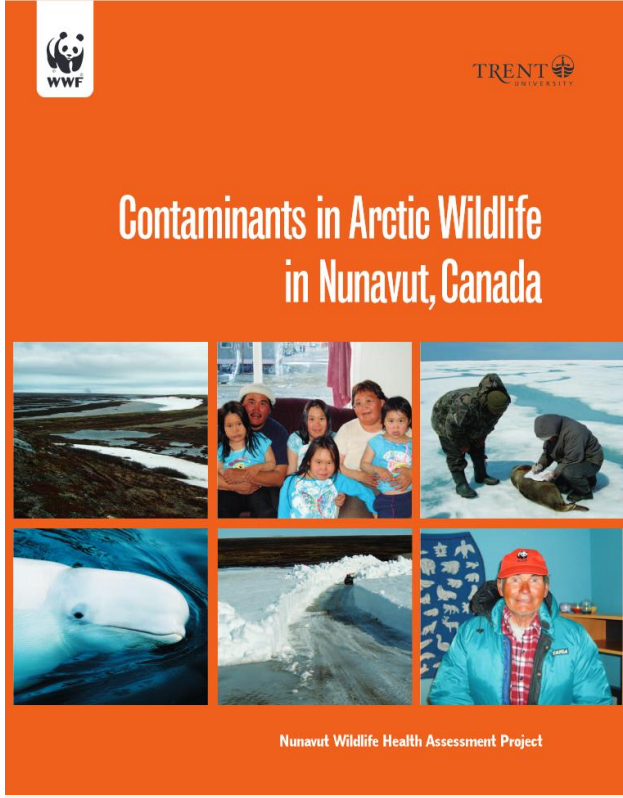
Department of Biology, Norwegian University of Science and Technology, Trondheim, Norway

VOLUME 114 | SUPPLEMENT 1 | April 2006 • Environmental Health Perspectives

The stress of being contaminated? Adrenocortical function and reproduction in relation to persistent organic pollutants in female black legged kittiwakes

Sabrina Tartu [a,*], Frédéric Angelier [a], Dorte Herzke [b], Børge Moe [c], Claus Bech [d], Geir W. Gabrielsen [e], Jan Ove Bustnes [c], Olivier Chastel [a]

Science of the Total Environment 476–477 (2014) 553–560




## TOXIC CHEMICALS - THE HIDDEN TRAVELLERS

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Surprisingly, animals in the Arctic can be subject to very high levels of pollution - one reason being the fact that air and water currents carry contaminants from the south.

Svalbard polar bears in the Norwegian Arctic, through their diet of seals, have been found to absorb very high levels of contaminants, such as PCBs. Females have lower levels because they pass the toxins on to their young through their fat-rich milk. PCBs reduce the ability of the immune system of Svalbard bears to combat common infections such as influenza, reo and herpes viruses.

New chemical threats are also emerging as toxic substances which impact the immune system, disrupt brain development and affect co-ordination also begin to appear in the arctic food chain.

# Key considerations

Opportunity to develop a non-invasive and quantitative tool to assess environmental stressors in Arctic wildlife

Translate knowledge from physiology into real-world tools

Combine within-individual and population-level approaches

Take into account the context-dependency of physiological variables in conservation studies

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