The Harmful Effects of Captivity and Chronic Stress on the Well-being of Orcas

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Characteristics of Orcas

Large and complex brains
- Two and a half times larger than expected for body size (EQ = 2.5)
- More cortical surface area than human brain
- Largest cerebrum relative to whole brain mass among mammals
- Elaborated in areas linking emotion, communication and social awareness
- Highly sensitive complex acoustic capacities

Long distance travel and deep diving
- Routinely swim tens of km/day. In a straight line
- Can dive to > 200 m depth several times a day
- When not foraging or hunting, often traveling by swimming in a consistent direction at a steady pace and frequently engage in synchronized dives

Strong emotional and social bonds
- Lifelong family bonds
- Prolonged close mother-child bonds
- Food sharing/turn-taking
- Epimeletic behavior (care-giving) and standing by
- Grieving for dead infants and other conspecifics

Complex social networks and traditions
- Complex social networks based on acoustics
- Long juvenile period/learning
- Cultural traditions (e.g., dialects, foraging)
- Matrilineal with post-reproductive lifespans

Orcas at Marine Parks

Survivorship and Longevity
- While survivorship in US facilities has improved over time, survival to sexual maturity and reproductive senescence remains poor compared to healthy free-ranging orcas.
- The mean life expectancy for free-ranging orcas is 46 years for females and 31 years for males. Females live an estimated maximum of 80 to 90 years and males an estimated maximum of 60 to 70 years.
- No captive-born orcas at SeaWorld have yet exceeded 35 years of age.

Causess of Death in Captive Orcas
- US records chart a history of disturbing causes of death, especially from opportunistic infections.
  - Fungal, viral and bacterial pneumonia
  - Yeast infections
  - Gastric ulceration
  - Encephalitis and Meningitis
  - Bacteremia

Abnormal Behaviors
- Stereotypies – circling, jaw clapping, grinding teeth
- Self-mutilation – most common is dental grinding, leading to destruction of teeth and systemic infection risk
- Hyper-aggression – towards conspecifics and humans
- Poor parenting
- Depression/Failure to thrive

The Association Between Stress, Disorder, and Death

What is Stress?
- Stress is an organism’s response to a situation that forces a deviation from homeostasis, which involves a correction through physiological and psychological mechanisms.
- The HPA axis and its effects are highly conserved across mammals.

HPA Axis

The Ability to Cope With Stress Depends upon Several Factors
- Allostatic load – the discrepancy between homeostasis and the stress of the situation
- Evolutionary History and Adaptations
- Acute versus chronic stress
- Overall health and behavioral coping mechanisms

“...the type, magnitude and duration of a stress response have a cost to the animal...when stressors are chronic or severe, the accumulated costs associated with the response(s) become an allostatic overload, which can contribute to physiological dysfunction and increase the probability of disease and other pathologies” (p.464; Atkinson et al., 2015).

Shared Effects of Chronic Stress on Orcas and Other Mammals
- Orcas and other cetaceans share brain mechanisms involved in mounting a stress response with other mammals and adhere to the classic HPA model.
- The long list of emotional, psychophysiological, and behavioral changes associated with these neurological responses to stress, in humans and other mammals, includes:
  - Increased anxiety
  - Posttraumatic stress disorder
  - Cognitive impairment
  - Depression
  - Mood dysregulation
  - Changes in brain connectivity patterns

Conclusions
- We have provided empirical support for the argument that the morbidity and mortality of orcas in captive facilities is likely to be attributable to acute, severe, and chronic stress and its association with immune dysfunction, disease, and disorder. Given this evidence, the ethical ramifications of keeping orcas in captivity should be critically evaluated by society and regulators, and the industry should adapt accordingly.

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References
- Please refer to https://doi.org/10.1016/j.jveb.2019.05.005 for references and full papers.