REACTIVE OXYGEN SPECIES DAMAGE AND FUNCTIONAL CONSEQUENCES IN THE HIBERNATING 13-LINED GROUND SQUIRREL

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1. Ischemia-reperfusion and the Thirteen lined ground squirrel

- Cardiac output increases 65-fold during arousal from torpor[1]
  - Analogous to ischemia reperfusion, which produces ROS, and damages lipids and proteins, altering mitochondrial respiration rates?
- Ground squirrels are more resistant to ischemia-reperfusion, especially in winter[2]
- Less ROS damage? Greater ROS detoxification?

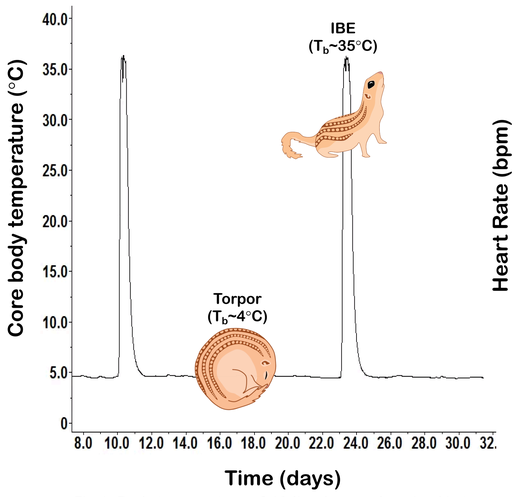


Fig 1. Body temperature of 13-lined ground squirrel in torpor and interbout euthermia (IBE)

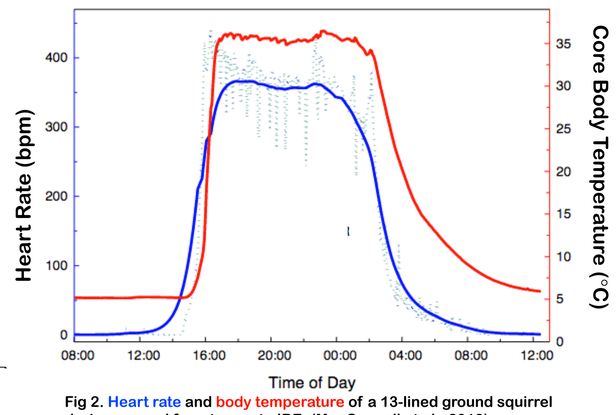
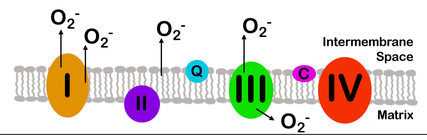


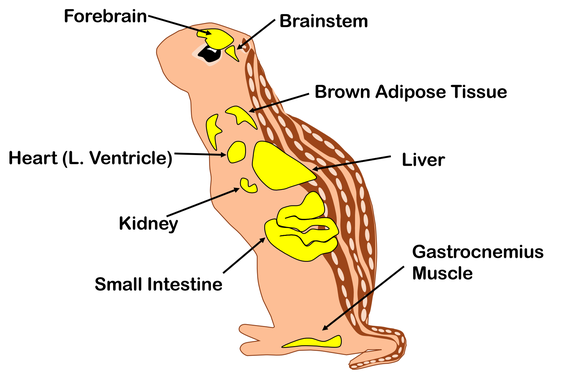
Fig 2. Heart rate and body temperature of a 13-lined ground squirrel during arousal from torpor to IBE. (MacCannell et al., 2018)



Research Questions:

1) Does tissue ROS damage differ among hibernation states?
2) Does anoxia/re-oxygenation differentially affect liver mitochondria respiration among hibernating states?

2. Lipid peroxidation, protein carbonyls and total antioxidant capacity



	Torpor	IBE	Summer
Lipid Damage (MDA)	Moderate	High	Low
Protein Damage (Carbonyl)	High	Low	tbd
Total Antioxidant Capacity (TAC)	Moderate	Low	High

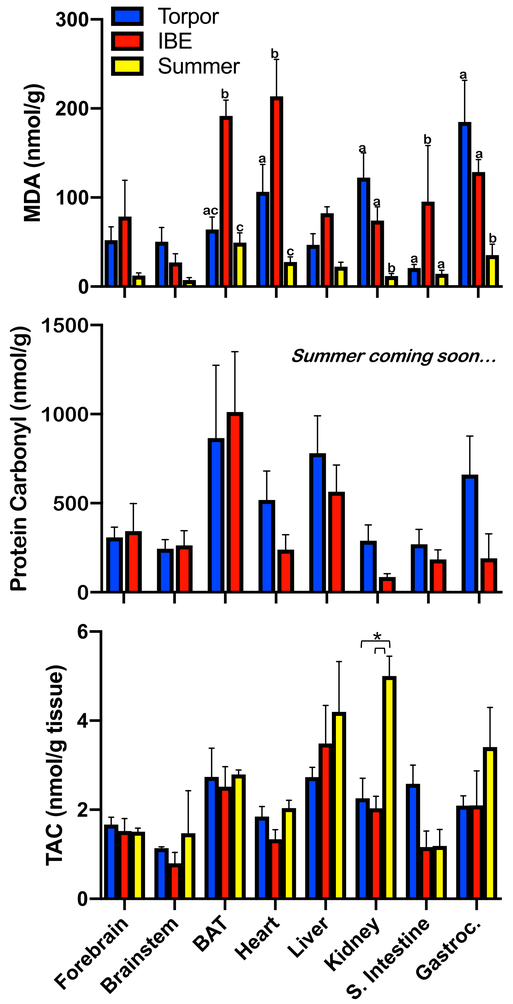
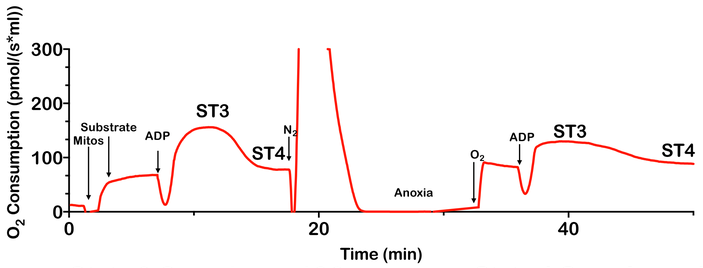
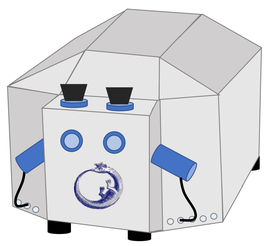
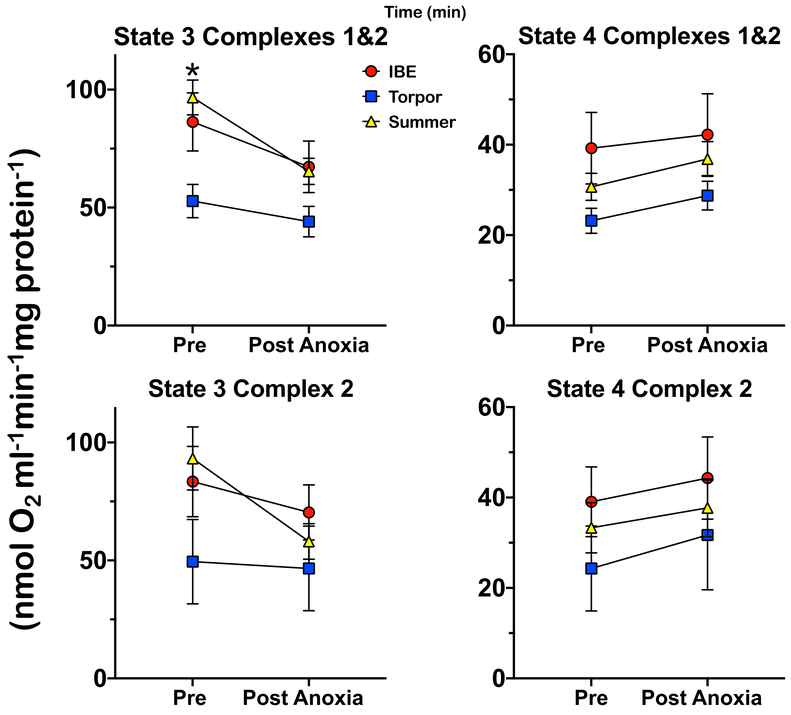


Fig 3. Markers of ROS damage in 13-lined ground squirrel

3. Anoxia-reoxygenation damage to liver mitochondria







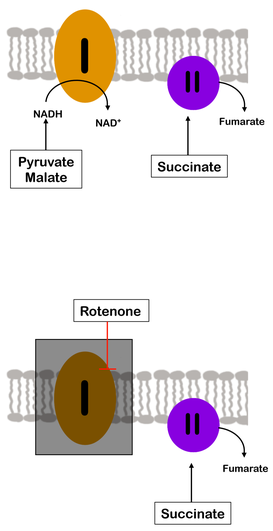


Fig 4. O_2 consumption in complex 1 and 2 (pyruvate, malate, succinate) and complex 2 only (rotenone, succinate), pre and post anoxia-reoxygenation

4. Conclusions

1. Lipid peroxidation is highest in IBE, especially heart, forebrain and brown adipose tissue
   - More unsaturated lipids in winter?
   - More ROS production in IBE?
2. Mitochondrial respiration least affected by anoxia/reoxygenation in torpor especially when complex 1 is inhibited
   - ROS production from reverse electron transport is lower in torpor?

Next Steps

- Would introduction of antioxidants (MitoQ), H_2S mitigate mitochondrial damage following anoxia-reoxygenation?
- Does oxidative damage differ in isolated mitochondria among hibernation states?

References

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