

Meta-Analysis of Oxidative Stress in Urban Birds

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Background

Urban and rural habitats differ in many respects including human disturbance, noise and chemical pollution, and food and water availability.

Urban conditions may affect urban organisms' oxidative status and promote deleterious oxidative stress, but urban-adapted organisms may compensate for these effects through physiological adjustments.

If so, we predicted the following in urban birds as opposed to non-urban birds:

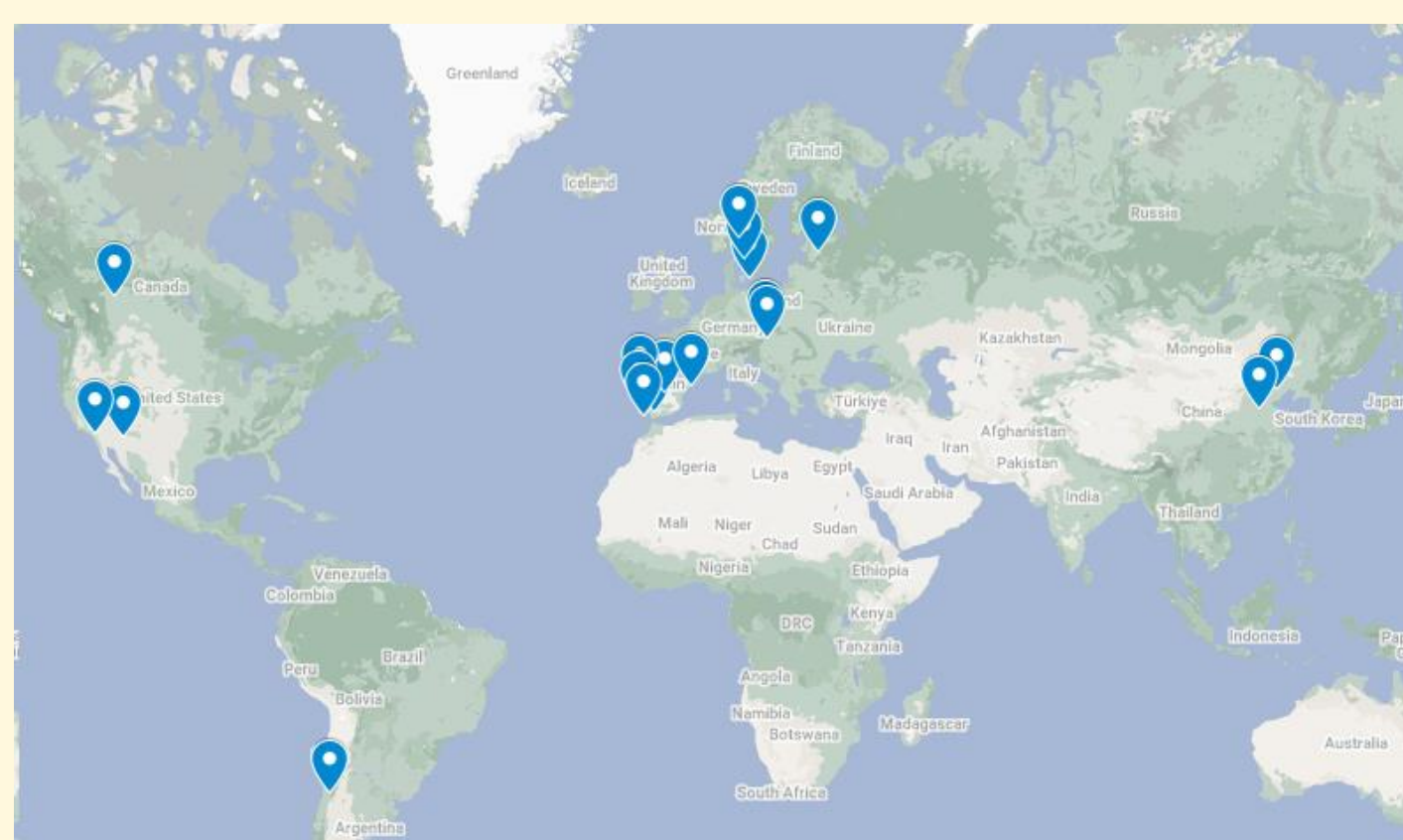
- Higher oxidative damage and dietary pro-oxidants**
- Higher antioxidant capacity and endogenous antioxidants**
- Lower dietary antioxidants**

Methods

We compared urban and non-urban avian populations by meta-analysis, using the results of 30 independent studies measuring oxidative balance parameters.

We determined the overall effect size for each category of oxidative parameters, plus an overall estimate for oxidative stress (damage = positive sign, antioxidants = negative sign).

Within oxidative damage, we produced estimates for major species and season categories.

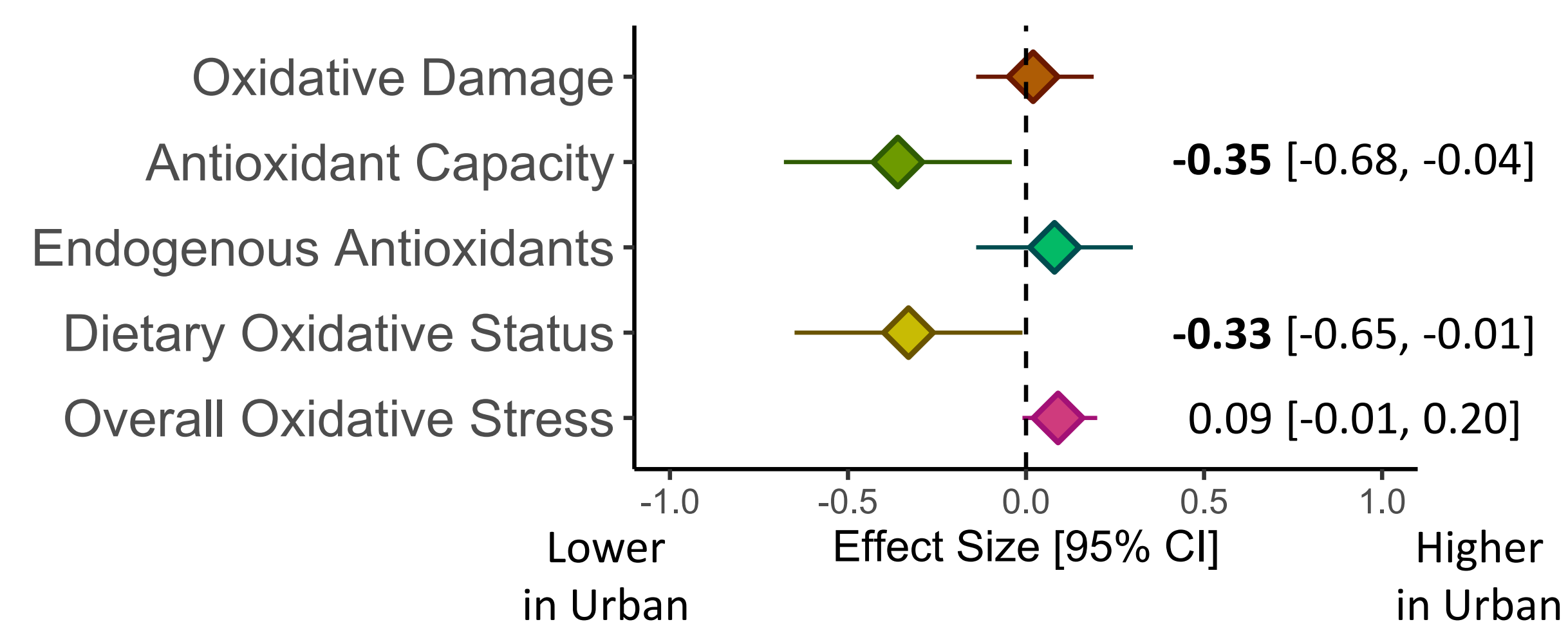


Locations represented in meta-analysis

Antioxidant capacity lower in city birds

No trend in endogenous antioxidants, but high between-study variance suggests that effects depend on city/location.

Overall oxidative stress tended to be higher in urban bird populations, but the confidence interval overlaps zero.

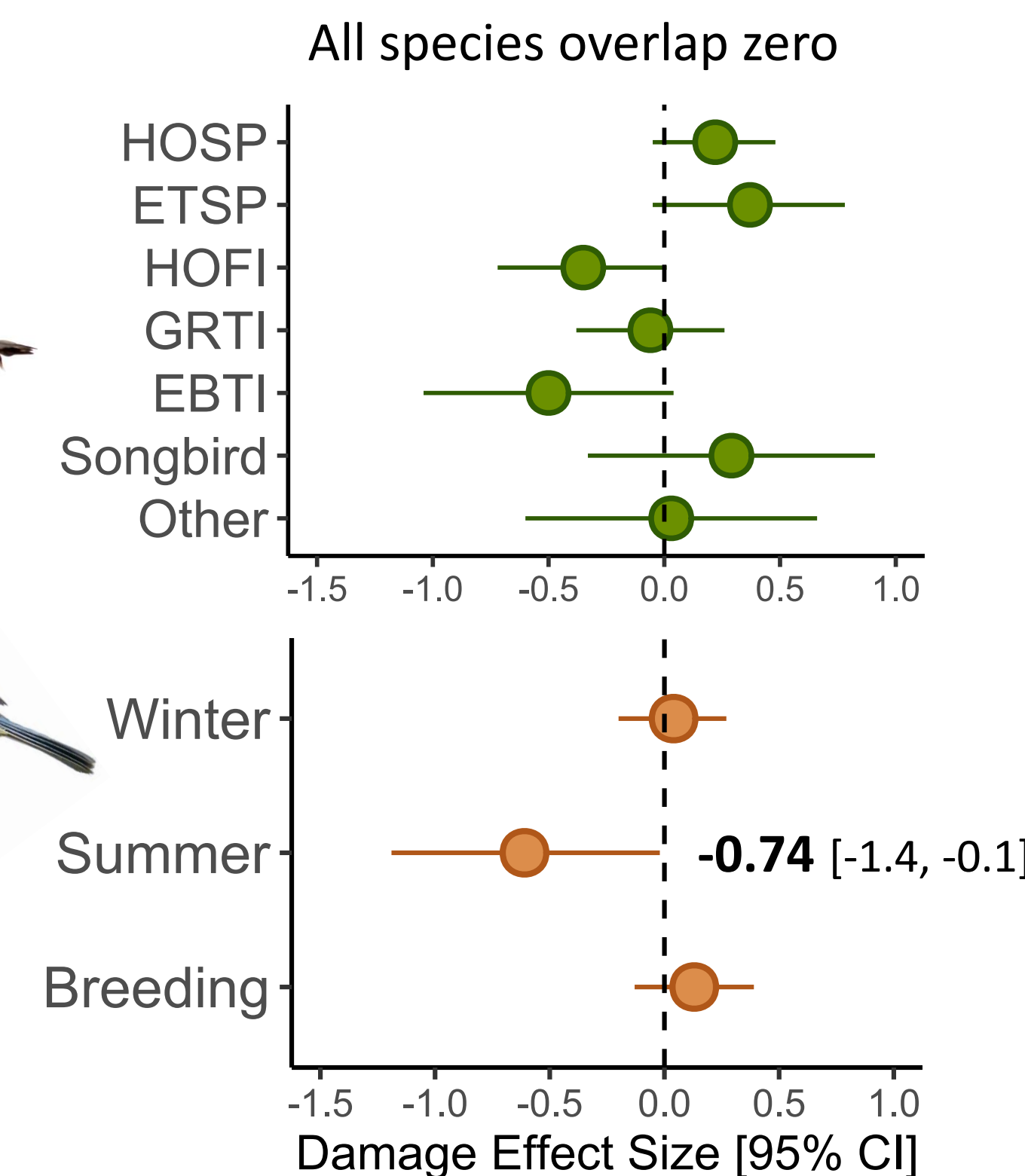


Oxidative damage varies by category

The five most sampled species differed in oxidative damage.



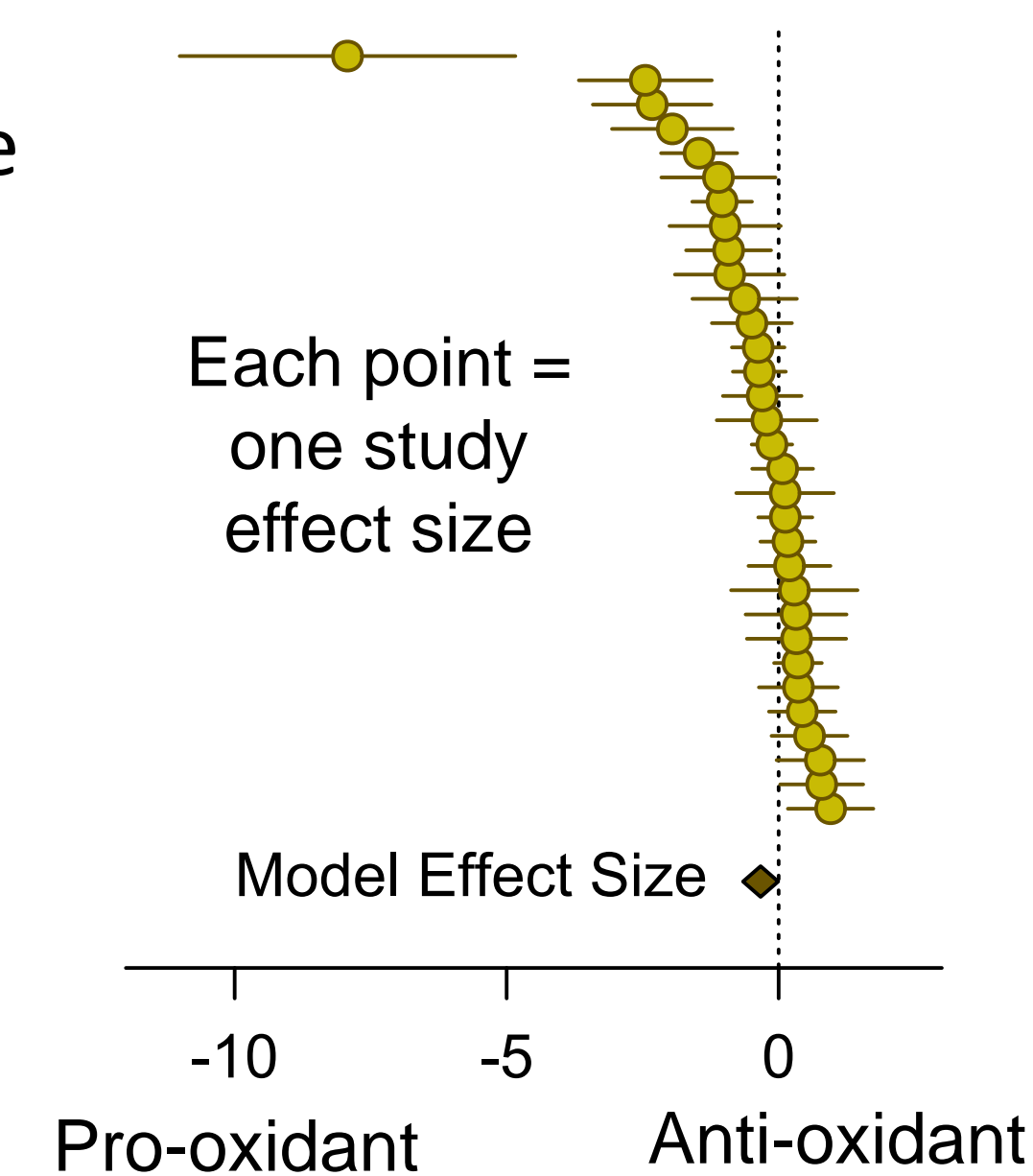
Urban birds sampled in summer had lower oxidative damage compared to non-urban populations.



Urban diets negatively affect oxidative balance

We combined dietary antioxidants and pro-oxidants in the same model (pro-oxidants = negative sign, antioxidants = positive sign) and observed an overall negative effect.

- Higher omega-6 to omega-3 fatty acid ratio in urban birds (pro-oxidant, associated with inflammation).
- Lower levels of antioxidants (circulating carotenoids, vitamin A, and vitamin E) in urban birds.
- Model estimate = **-0.33** [-0.65, -0.01], df=31, p = 0.045



Conclusions

- Urban birds have lower antioxidant capacity than rural birds.
- This difference may relate to dietary differences between urban and rural populations.
- Near-significant overall tendency for higher oxidative stress in urban bird populations.
- All "summer" season samples were taken in arid regions, suggesting that urban habitats provide refuge from hot, arid environments.

Acknowledgments

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