CSQ-59 Summary

Question	Knowledge Advancement Objectives	Geophysical Observables	Measurement Requirements	Tools & Models	Policies / Benefits
How can we leverage EO data from tracking animal counts and behavior?	A) Demonstrate the use of EO date for animal counting in different ecozones and types of fauna (i.e. large mammals, penguins, cows)	• Various detection options for different types of animal individuals and environments	• Very-high resolution satellite data (<1 m) • New sensing concept by new space actors and sensing concepts (i.e. constellations, thermal etc.)	• Statistical and AI approaches for detecting and counting individuals	- UNCBD - IPBES - National action plans/policies - Animal conservation efforts
	B) New approaches for tracking animal behavior to understand species–environment interactions and for generating and analyzing animal movement data	• Ecosystem structure and conditions • Climate/environmental characteristics • Related dynamics over time	• Link with animal tracking networks • Landsat, Sentinel 2 time series, • Very high resolution data • ROSE-L, BIOMASS, GEDI • ENMAP/CHIME • S1/SMOS • Several ECV products	• Various EO time series analysis methods • Interoperability • Integration with animal tracking data	

CSQ-59 Narrative

How can we better leverage satellite data from tracking animal counts and behavior?

The accurate estimation of animal populations and their behavior using ground-based or conventional methods has its challenges and require considerable investment in resources and time. Aerial surveys have been demonstrated as an alternative approach to detect large mammal populations and generate statistical estimates of their abundance in open areas and are commonly used to detect wildlife such as elk or deer. In developing countries with their large share of endangered and threatened fauna and in remote areas (i.e. the Arctic) it is particularly relevant to develop alternative approaches for conducting accurate and timely wildlife population counts using satellite data as potential source (Xue et al., 2017). Satellite remote sensing for detecting and counting animals has its challenges and have mostly been working well in small area studies and/or in homogenous (background) environments such as sea ice. Major limitations seen in other studies are the relatively low accuracy of automated detection techniques across large spatial extents, false detections, and the cost of high-resolution data (Hollings et al. 2018). With the increasing availability of high-quality remote sensing data and analysis methods, there are opportunities to improve detection capabilities and population counting efforts.

In addition, satellite technologies are a relevant tool for studying animal behavior providing ecologists with the means to understand species–environment interactions in combination with generating and analyzing animal movement data. Satellite are useful in different ways. Data from GNSS systems are critical for animal tracking devices and provide quality space-time data of individuals and their dispersal and migrations. Satellite are also very relevant to characterizing habitat characteristics and changes that can relate animal behavior to context and track critical changes related in environments due to land use change (e.g., deforestation and expansion of agriculture) or wildlife management actions (e.g., reintroductions and translocations), and to keep track large migrations (i.e. insects) and any shifts in migration patterns.

Using satellite data towards detecting and monitoring “individuals” requires high-resolution satellite data. Such sensor data are currently provided by commercial data providers with spatial resolutions less than 1 m, with different constellations allowing for more detailed temporal coverage and for developing different sensing concepts (i.e. thermal, hyperspectral) at higher resolution. For animal tracking the use of quality GNSS data is important. General ecosystem characterization and environmental conditions takes advantage of many remote sensing sensing data streams.

References:

Hansen et al., 2021. Toward monitoring forest ecosystem integrity within the post-2020 Global Biodiversity Framework, Conservation Letters, 14,: 4, DOI: (10.1111/conl.12822)

IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S.

Hollings, T. M. Burgman, M. van Andel, M. Gilbert, T. Robinson, A. Robinson (2018). How do you find the Green Sheep? A critical review of the use of remotely sensed imagery to detect and count animals, Methods in Ecology and Evolution, https://doi.org/10.1111/2041-210X.12973

Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

Jaureguiberry et al. (2022) The direct drivers of recent global anthropogenic biodiversity loss, Science Advances, 8, eabm9982

Junker et al., (2023). List and specifications of EBVs and EESVs for a European wide biodiversity observation network, https://doi.org/10.3897/arphapreprints.e102530

Moersberger et al., (2023). Europa Biodiversity Observation Network: User and Policy Needs Assessment, https://doi.org/10.3897/arphapreprints.e84517

Senf C. (2022). Seeing the System from Above: The Use and Potential of Remote Sensing for Studying Ecosystem Dynamics, Ecosystems 25: 1719–1737, https://doi.org/10.1007/s10021-022-00777-2

Skidmore, A. et al., (2021). Priority list of biodiversity metrics to observe from space, Nature Eco Evo, 5, 896–906, https://doi.org/10.1038/s41559-021-01451-x

Ustin & Middleton (2021). Current and near-term advances in Earth observation for ecological applications, Ecological processes 10:1, https://doi.org/10.1186/s13717-020-00255-4

Verbesselt J. et al. (2016). Remotely sensed resilience of tropical forests. Nature Climate Change 6:1028–1031.

Xue, Y, Wang, Y., & A. Skidmore (2017) Automatic Counting of Large Mammals from Very High Resolution Panchromatic Satellite Imagery, Remote Sens. 2017, 9(9), 878; https://doi.org/10.3390/rs9090878