Population monitoring and management

Real-time monitoring of brown bear behaviour: integrating Deep Learning pose estimation with remote hair snare sampling in the Catalan Pyrenees

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Advances in wildlife monitoring technologies have made identifying animal species, individuals, and tracking their movements more efficient and cost-effective. Camera traps and hair snares are widely used noninvasive tools in wildlife conservation, particularly for monitoring and studying bear populations. However, in remote areas where 4G-connected camera traps are unavailable, conservationists often rely on inefficient methods, such as blindly visiting traps, risking cross-contamination of samples and wasting valuable time and resources. In recent years, an increasing number of researchers are turning to Machine and Deep Learning (ML; DL) to monitor biodiversity. Pose estimation tools based on DL can allow conservationists to estimate animal postures and infer behaviours such as rubbing.

Here, we propose a DL-based pose estimation model trained from 1,326 images of brown bear (*Ursus arctos*) collected in the Catalan Pyrenees. It is based on the YOLOv11 pose estimator and is intended to be integrated into edge devices with satellite communication capabilities monitoring hair snares in remote areas. This real-time system has the potential to enhance the collection of samples by guiding conservationists solely to visited snares and reducing the delay between visits and sample collection, making the monitoring practices in remote areas much more efficient.