Space-based monitoring to support EC’s wildlife mandate

Jason Duffe
Wildlife and Landscape Science Directorate
National Wildlife Research Centre
Ottawa, ON

Outline
• Experience with object based analysis
• Overview of Space for Habitat project
• Specific objectives & projects
• Potential for collaboration

Object-based analysis - eCognition
• Cormorant impacts on habitats on western Lake Erie
  • CIR airphotos over time to show decline of forest with increased birds
  • Data was successfully used in Zoocheck v. Environment Canada
• Wildlife habitat in agricultural ecosystems
  • Biodiversity on organic vs conventional farms
  • CIR airphotos to classify small habitat features (hedgerows, woodlots, wetlands)
• Forest structure from high resolution satellite imagery
  • Mapping bird habitat requires knowledge of forest structure
  • Collaboration with Provincial forestry agencies
  • To improve bird habitat modelling, provide solutions for FRI updates

Project Overview - Space for Habitat
• Funded by Canadian Space Agency (GRIP)
• Collaboration between Wildlife Enforcement, S&T, CWS
• Space-based remote sensing for monitoring and enforcement of Environment Canada’s wildlife mandate
• Pilot project to demonstrate proof of concept

Partnerships
Environment Canada: Wildlife Enforcement, National Wildlife Research Centre, CWS (Mg. Birds & Habitat Programs), CBD Office & Boreal Conservation Initiative.
Canadian Space Agency: Government-Related Initiatives Program.
Natural Resources Canada: Canada Centre for Remote Sensing, Canadian Forest Service.
Parks Canada: Ecological Integrity Branch.
Provincial Governments: ON MNR & BC MoE.
Forest Products Association of Canada.
Nature Canada, Bird Studies Canada.
Canadian Forest Products (BC), Tolko Industries (BC) & Abitibi Consolidated (ON).
Academic links: UBC, Uvic, Carleton U, U of A.
International links: Brazil (IBAMA), Mexico (CONAFOR-PROFEPA), CEC.

Vision: A Three-Tiered EO-supported Monitoring System for Wildlife Habitat
To support implementation of Federal wildlife conservation responsibilities and related partner mandates:
Medium Resolution – multi-temporal (MODIS, MERIS)
For prioritization and planning purposes
Every Five Years Mid-Resolution (SPOT, Landsat)
For more detailed planning, enforcement, conservation actions.
Annual Targeted, Mid- and High-Resolution
For high priority applications, eg. Protected Areas, SAR, High-risk areas, etc.

Links to on-the-ground results and enforcement response is important
IBAMA - Brazil

Image acquisition & analysis

Communication - Deforestation maps

Enforcement Response

Federal Wildlife Mandate - Legislative Context

• 3 Acts to protect habitat for Canadian species:
  • Canada Wildlife Act
  • Migratory Birds Convention Act (MBCA)
  • Species at Risk Act (SARA)

• Effective protection of Critical Habitat

Canada Wildlife Act

Protected Areas

• Develop national landcover monitoring plan
  • Spatial and temporal resolution informed by pilot study
  • Including data acquisition and analysis protocols

• Build effective capacity to use geospatial technologies
  • Train and equip field officers to use products
  • Build database of ground/field observations
  • Investigate applicability of technologies to other enforcement activities

• Budget 2008 - $1.1 million (2 years) for geomatics support of enforcement in Protected Areas

• ~65 officers, ~12 million ha., in addition to CITES, hunting patrols, etc
• Average distance of nearest officer: ATL: 300km (15-700) QC: 800km (0-1700) ON: 400km (150-1200) PNR: 450km (5-2000) PYR: 350 (0-1000)
• Officer visits each PA once every 10 years on average
• Little enforcement presence in NWA’s (Auditor General 2008)

Many large, northern Protected Areas
• Officer patrols are impractical and expensive
• Development activities are increasing
• Satellite monitoring will be most effective

Boundary Incursions

• Cranberry farming in region encroaching the NWA boundary, highway development, logging
  all change land cover composition and structure

Portobello Creek Time 1 (1989) Portobello Creek Time 2 (2001)

IKONOS 1m NCC

Cranberry farming in region encroaching the NWA boundary, highway development, logging
all change land cover composition and structure
Developed 3 day GWE seminar in cooperation with Smithsonian Institute - National Zoological Park
Intro to GIS, GPS and Remote Sensing – ESRI ArcPad
Hosted at Carleton University GIS computer labs

Protected Areas – sub-projects
- EO acquisition plan – optical/radar (NWRC)
- Technology transfer – field data collection (NWRC)
- Implement enterprise geospatial data mgt (NWRC)
- Radarsat-2 quad-pol for change detection (Carleton)
- Wetland mapping/classification (M. Grenier, CCRS)
- Biodiversity monitoring of wetlands – RAMSAR (UBC, CFS)

Migratory Birds Convention Act
Incidental Take
- Provinces have mandate for natural resources & land management (forestry, mineral extraction, development etc)
- Each jurisdiction has different guidelines, regulations, planning requirements
- Focus on riparian integrity, provincial species, general wildlife habitat provisions
- Environment Canada developing new regulations under MBCA to mitigate & manage incidental take from industrial activities
- S4H evaluating use of space-based monitoring for planning, monitoring and enforcement of new regulations
- Focus on BCR plans, priority & focal species
- Working with forestry industry to begin – companies in Ontario & British Columbia

Advantages of Earth Observation based national system
- Easily updated – new imagery
- Not limited by jurisdiction or ownership
- Potential to incorporate cumulative impacts (fire, development, insects, oil and gas etc)
- Incorporate natural and anthropogenic changes
- Same data can be used for both habitat models and compliance monitoring

MBCA – sub-projects
- Priority species modelling at BCR level with EO (NWRC)
- Develop suite of attributes in Bird Conservation Plans to monitor using EO data
- IT Regulatory implementation using EO data – bird conservation plans (NWRC)
- Develop medium resolution protocols for national monitoring (landcover, change, etc) (CCRS, CFS)
- Radarsat-2 (quad-pol) for wetland mapping/classification (CCRS, CWS)
- Airborne LIDAR and Hyperspectral for improved habitat models (UVIC, UBC)
- Modelling waterbird occurrence using EO data – focus on rare birds – model based sampling (CWS, UOttawa)
Species at Risk Act - Critical Habitat

Boreal Caribou

- Ecological niche modelling for predicting woodland caribou habitat – 1km MODIS
- Model based sampling to improve surveys, population estimates
- Identify habitat for potential rehabilitation
- Next steps – effective protection, monitoring compliance
- S4H – develop monitoring protocols to maintain integrity of protected Critical Habitat
- Large areas that may be difficult to monitor on the ground
- Evaluate management implications for biodiversity

SARA – sub-projects

- Ecological niche modelling (ENM) for model based sampling (OMNR, CFS)
- ENM vs. RSF – sources of bias, model errors (U Montana)
- Develop change detection protocols to monitor compliance with Critical Habitat (NWRC)

International Projects

Canada-Mexico partnership – Wildlife Enforcement capacity building
- Jaguar conservation in southern Mexico – habitat modelling/mapping/monitoring
- Monarch Flyway Protection
- Technology transfer – provide GWE for Mexican Wildlife Officers

Summary

- Landcover, Landuse, structure – refinements for improved habitat modelling
- Change detection – natural vs anthropogenic
- Focus on operational use – limitations, standardization, repeatability

jason.duffe@ec.gc.ca – www.spaceforhabitat.ca