FOCUSED STUDY ACTIVITY WORK PLAN

General Information

Work Plan Unique Identifier:	*WL-LTM-E-3-1718*	
Focused Study Activity Title:	Waterfowl Effects-Based Assessment	
Focused Study Category:	Investigation of Cause or Potential Ecological Impact	
Geographic Location (*choose from drop-down menu. If Project Location is in more than one area choose from second drop-down***)**	Remote Sites - Alberta	
Monitoring Site(s) Coordinates *(latitude and longitude)*		
Project Leader:	Stuart Slattery & Joel Ingram	
Organization and contact information:	Slattery: Ducks Unlimited Canada, Box 1160, Stonewall, Manitoba, R0C 2Z0, 204-467-3323, s_slattery@ducks.ca Ingram: Environment and Climate Change Canada, 150 -123 Main St., Winnipeg, Manitoba, R3C 4W2, 204-984-6670, joel.ingram@canada.ca	
Date Study initiated:	May 2015	
Monitoring Category: *(From OSM long-term plan; choose from drop-down menu)*	Biotic Response Monitoring	
Strategic Objective of Focused Study: *(From OSM long-term plan; choose from drop-down menu)*	Objective B1: Detect and report biotic response in relation to Oil Sands Developments	
Hypotheses: *(Briefly outline the specific hypotheses that your focused study is aiming to address)*	*Linear features negatively affect ducks through hydrological changes that reduce wetland quality or increase predation rates on hens, nests, or young.* *Predictions:* 1. *Duck settling (pair numbers) and/or productivity (brood:pair ratios) decrease with increasing density of or decreasing distance to roads, pipelines and seismic lines.* 2. *The potential underlying biological mechanism, i.e. hydrology vs predators, causing negative relationships can*	

	be inferred based on variation in relationships with settling and productivity across different nesting guilds (ground, overwater, and cavity).
Deliverables: *What tangible goal (s) and/or product(s) will the monitoring produce and when?*	1. A technical report including: - Identification of linear features (roads, pipelines, and seismic lines) potentially limiting waterfowl in the oil sands region. These can become focal stressors for monitoring. - Improved understanding of potential causal mechanisms in negative relationships, on which to base further research and monitoring/management decisions. - Recommendations for design of a waterfowl monitoring program. 2. A map depicting waterfowl distribution in the oil sands region, suitable for stratifying waterfowl monitoring efforts. All delivered in March 2018.

Detailed Study Plan

(Please provide detailed information on the specifics of your focused study including – (**keywords, hypothesis and the assumptions and constraints behind your hypothesis**)

Provide a maximum of 10 key words that describe this project. Use commas to separate them:

Waterfowl monitoring, linear features, effects assessment, aerial surveys, settling, productivity

Describe how you will test your hypothesis:

Objectives:

Our objective is to provide information that will enable governments and stakeholders to make more scientifically sound resource allocation decisions for not only the design and implementation of monitoring programs, but also the management of oil sands activities. Results from this work will provide a significant improvement in waterfowl monitoring and landscape management capability above that currently possible based on Waterfowl Breeding Population and Habitat Survey data (Environment Canada 2014). More specifically, this study will enhance science-based monitoring of waterfowl pair abundance and productivity by developing a better understanding of which stressors should be monitored and where breeding waterfowl populations may be most vulnerable to development. By sampling both within and immediately outside the Oil Sands Monitoring area, effectively a treatment and control study design, this project also will provide benchmarks for interpreting future monitoring results. Thus as industrial activities in the Oil Sands Monitoring area intensify or change practices, this study design will permit assessment of both changes in relationships between waterfowl populations and energy sector development, and more clear identification of *in situ* development effects.

Hypotheses

This research will answer the following science questions:

- How does abundance and productivity of duck pairs change with increasing density of or decreasing distance to linear features?
- Do linear feature types differ in their relationships, hence potential relative demographic importance to waterfowl?
- Which biological mechanism(s) likely underlies key negative patterns- hydrologic impairment/reduced food availability, habitat fragmentation/predation or both?

Specifically, we hypothesize that roads, pipelines and seismic lines potentially alter wetland hydrology and fragment the landscape, resulting in reduced quality of waterfowl breeding habitat through decreased food availability or increased predation on females, nests, and/or young (Slattery et al 2011). The net result is reduced abundance of pairs or their productivity in regions with high densities of linear features or in habitats close to roads, pipelines, or seismic lines. We predict that these linear feature types will have different relative importance under wetland hydrology hypotheses compared to predation hypotheses because of the mechanisms of impact, e.g. roads likely impair hydrology more than seismic lines, but these linear features might be equal travel corridors for predators of ducks. Furthermore, we predict that effects of these pathways will also differ among species with different nesting habits (ground, overwater, or cavity), and this variation will alter waterbird community structure in regions of high linear feature density.

Study Design

We are using a dose-response design in this study. From 2013-2016, 2.5 km x 2.5 km grids were randomly selected (n = ~420 total, which contained about 4,800 wetlands) with an even distribution across gradients of individual and cumulative linear features densities. Furthermore, grids were allocated approximately evenly within (treatment) and outside (control) the oil sands region to provide a baseline for future comparison of in situ oil sands development.

Study Area

Our core study area is located in north central Alberta and includes large portions of the oil sands area (i.e. Athabasca and Peace River units). This area has been sampled since 2013, and will provide data on both spatial and temporal variability in relationships between linear features and ducks. Sampling also occurred on sites outside the oil sands area to increase the range of environmental conditions over which cause and effect relationships can be assessed. Oil Sands Monitoring funding to date has only been used to support surveys conducted in the oil sands area plus analyses and reporting. However, the Oil Sands Monitoring program will benefit from results that include the broader assessment region.

Waterfowl Surveys

Breeding pair (May-June) and brood surveys (July-August) were conducted annually between 2013-2016 within survey grids. Breeding pair surveys are timed to coincide with peak presence of locally breeding pairs (Dzubin 1969). Brood surveys are timed to observe ducklings between 20-30 days post-hatch. Most mortality typically occurs before this time (Dzubin and Gollop 1972, Ball et al. 1975, Talent et al. 1983), hence we are sampling when relationships would be evident. Surveys were flown using two Bell 206 (Jet Ranger) helicopters and four observers (two per machine). Waterfowl, coots, grebes, and loons are counted on all open water >20 meters in diameter, using a dependent double-observer protocol (Nichols et al. 2000) to correct for detection bias. All grids were visited once during each survey. However, during brood surveys, ~25% of grids were visited twice on consecutive days to estimate brood availability i.e. probability that a brood present on a wetland was not hidden when we visited the first time. This re-visitation rate is based on precision trade-offs assessed through simulations using pilot data we collected in 2012.

Statistical Analyses

We then use hierarchical modeling (gmultmix function, R package Unmarked; Fiske and Chandler 2011) to examine pair and brood abundance relationships with linear feature density (individual and cumulative). These models allow us to simultaneously account for potential detection errors and habitat effects. Habitat variables include Ducks Unlimited Canada's enhanced wetland classification classes, variables derived from field observations and high resolution imagery, and ecoregion. Species will be pooled into nesting guilds. Breeding success estimates (brood:pair ratios) will then be calculated for each sample grid using the best habitat-only models i.e. model-based predictions uncorrected for linear feature effects, for each guild. We will then use general linear models to examine correlations with linear feature density, while accounting for annual variation in breeding success. At the wetland level, movement of pairs and broods among ponds is likely to produce nonsensical estimates of breeding success. Therefore, we will use relative changes in predicted pair and brood abundances across gradients of linear features as our metric of breeding success at the wetland level, rather than calculated brood:pair ratios.

The best habitat-only models will be used to develop pair and brood abundance maps. To better interpret the biological importance of relationships with linear features, we will then assess potential impacts on regional populations. Duck pair and brood abundance maps will be overlaid with linear features, and then population estimates adjusted based on statistical models of relationships between them. In the future, we anticipate altering development scenarios to better understand implications for regional waterfowl populations. However, that is outside the scope of this work plan.

In addition, and outside the scope of this work plan, we also intend to assess changes in abundance of loons and grebes and in waterbird community structure relative to linear feature densities.

We recently conducted power analyses and concluded that we have adequate sample sizes to detect a 20% change in population size across gradients of linear feature attributes for all but broods in the least abundant nesting guild at the wetland level. More than 2 years of additional sampling would be required to achieve that level of power for this guild. Thus we will not be collecting more field data for this project. Our request for 2017-2018 funding will be to support completing final analyses and developing duck pair and brood distribution maps to assist both stratification of future focal species monitoring efforts and development of scenario planning tools.

Assumptions and Constraints behind the hypothesis and the testing method:

Assumptions

- Linear features are ecologically relevant landscape changes that may result in population level effects on waterfowl.
- Our surveys sampled across a sufficiently wide gradient of linear feature densities to detect relationships with pair settling and breeding success, should such relationships exist.
- Underlying effects pathway(s) can be inferred from patterns of variation in relationships among nesting guilds and linear feature types.

Constraints

Potential project constraint at this stage are:

- Timely development of funding arrangements with Ducks Unlimited.
- Continued support by Ducks Unlimited for analyses and write up phase of project.
- Necessary human and financial resources available do not change mid-year. Analytical skills required for hierarchical modeling are potentially most limiting.
- Attributes associated with spatial data layers, e.g. age, width, construction type, etc. of linear features, will help achieve more robust conclusions, but are not readily available.

References:

Ball, I.J., D.S. Gilmer, L.M. Cowardin, and J.H. Riechmann. 1975. Survival of wood duck and mallard broods in north-central Minnesota. Journal of Wildlife Management 39:776-780.

Dzubin, A. 1969. Assessing populations of ducks by ground counts. Pages 178-230 *in* Saskatoon Wetland Seminar. Canadian Wildlife Service Report Series 6.

Dzubin, A. and J. B. Gollop. 1972. Aspects of mallard breeding ecology in Canadian parkland and grassland. Pages 113-152 *in* Population ecology of migratory birds: a symposium. U.S. Fish and Wildlife Service.Rep. 2.

Environment Canada. 2014. North American Breeding Bird Survey - Canadian Trends Website, Data-version 2012. Environment Canada, Gatineau, Quebec, K1A 0H3. http://www.ec.gc.ca/ron-bbs/P005/A001/?lang=e&m=a&r=3&p=L&t=19368

Fiske, I. J. and R. B. Chandler. 2011. Unmarked: An R package for fitting hierarchical models of wildlife occurrence and abundance. Journal of Statistical Software 43(10). http://www.jstatsoft.org/v43/i10/. Accessed 1 Sep 2012.

Nichols, J.D., J.E. Hines, J.R. Sauer, F.W. Fallon, J.E. Fallon and P. J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from point counts. Auk 117:393–408.

Slattery, S. M., J. L. Morissette, G. G. Mack, and E. W. Butterworth. 2011. Waterfowl conservation planning: science needs and approaches. Pp. 23–40 *in* J. V. Wells (editor). Boreal birds of North America: a hemispheric view of their conservation links and significance. Studies in Avian Biology (no. 41), University of California Press, Berkeley, CA.

Talent, L.G., R.L. Jarvis, and G.L. Krapu. 1983. Survival of mallard broods in south-central North Dakota. Condor 85:74-78.

Data Management

If this work generates data please summarize your project-level data management plan.

Deliverables	Timeframe
Data Collection Period: *Nearly completed*	Start : 2015-05-10 End: 2016-11-30
Data Analysis Period: *Final Quality Assurance/Quality Control (QA/QC) of data, analyses*	Start : 2016-09-14 End: 2017-10-20
Data Release Date: *Metadata and data consistent, complete and meet basic standard format for publication in Open Data; on or linked to OSM portal*	2018-03-30

Reporting and Publications

Provide information on the anticipated reports / publications. (Insert additional rows if needed)

Expected Subject/Titles of Publications or Reports	Short Description of Publication or Report	Expected Year of Publication
Waterfowl Monitoring in the Oil Sands Region	Summary of results for duck settling and breeding success analyses providing recommendation for improved waterfowl monitoring in the OSA	2018
Settling and breeding success of waterfowl in the Western Boreal forest: Potential Stressors and underlying mechanisms	Peer reviewed paper assessing stressor relationships and potential underlying causal mechanisms in ducks (nesting guild level) at both wetland and landscape scales.	2018
Abundance of loons and grebes relative to linear feature development in the oil sands region	Peer reviewed paper assessing linear stressor relationships in loons and grebes at the landscape scale.	2019
Aquatic bird communities and linear development in	Peer reviewed paper assessing changes in waterbird community structure (species level)	2019

the Western Boreal Forest	across the gradient of linear feature densities at both wetland and landscape scales.	

Technical / Professional Roles and Responsibilities

Identify members of the monitoring team/organization, their roles and responsibilities. Identify monitoring organization leads if different from overall monitoring activity lead. (Insert additional rows if needed)

Role	Responsibilities	Resource Name/Organization
Principal investigator	Fundraising, overarching program oversight, reporting, manuscript preparation and review	Stuart Slattery, DUC
Project Collaborator	Co-ordinate with partners/stakeholders, reporting	Joel Ingram, ECCC
Research Biologist	Oversee field operations and logistics, assist database management, reporting, manuscript preparation and review	Howie Singer, DUC
Biologist	Data QA/QC, digitizing imagery, prepare figures	Jared Knockaert, DUC
GIS specialist	Spatial analyses, map making and database management	Susan Witherly, DUC
Analyst	Statistical analyses	Llwellyn Armstrong, DUC

Deliverables **(Year 1)** If your Focus Study is longer than 1 year then complete **Appendix C** for multi-year deliverables breakdown

Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal. This could include: field work, lab work/ analysis, evaluation, data, reports, publications, SOPs etc. Do not define process as your Deliverable e.g. 'fly to Ft. McMurray to conduct fieldwork' or 'seek Director approval for report'.

Deliverable(s) (please provide enough information to support status reporting)
Q1 – April to June
Conduct Analyses; Hierarchical modeling, grid level
Q2 – July to September
Complete Analyses; Hierarchical modeling, wetland level
Q3 – October to December
Map pair and brood abundance estimates
Assess biological relevance of modeling results
Q4 – January to March
Complete report writing

Detailed Financial Breakdown – Year 3 of 3 (2017-2018)

Also complete **Appendix B** for the multi-year financial breakdown

Budget requirements – List areas that require budget expenditures: (ADD OR DELETE BUDGET CATEGORIES AS REQUIRED)	**OS Funding**	**External Funding (*outside JOSM*)**
O&M - Operations and Maintenance:		
None	**$0**	**$0**
Sub-Total	**$0**	**$0**
O&M - Travel		
Conferences (*The Wildlife Society*)	**$0**	**$2,600**
Meeting (*Anticipated OSM meeting*)	**$1,200**	**$**
Sub-Total	**$1,200**	**$2,600**
O&M - External Contracts :		
None	**$0**	**$0**
	$	**$**
Sub-Total	**$0**	**$0**
Salaries:		
Principal Investigator	**$19,300**	**$12,900**
Technical / Professional Assistants	**$99,500**	**$66,400**
Sub-Total	**$118,900**	**$79,300**
Total Salaries	**$118,800**	**$79,300**
Total O&M	**$1,200**	**$2,600**
2017-2018 GRAND TOTAL*	**$120,000**	**$81,900**

Appendix A - Approvals

Project Submitted by:		
Name: Stuart Slattery		
Organization: Ducks Unlimited Canada	Signature: 	Date: 15 November 2016

Project Approved by:		
Dr. Monique Dubé (AEP)		**Dr. Kevin Cash (ECCC)**
Signature 		Signature 
Date		Date

APPENDIX B – Detailed Multi-year Financial Breakdown (Complete the following detailed financial breakdown; add or delete categories as required)

Budget requirements	Year 3 (2017- 2018)		Year X (201X- 201Y)		Year Y (2017- 2018)	
	Cash	In-kind	Cash	In-kind	Cash	In-kind
1) Salaries and benefits						
a) Investigators	$19,300	$12,900				
b) Technical/professional assistants	$99,500	$66,400				
2) Operations and maintenance						
a) Facilities						
b) Equipment						
c) Lab analysis						
d) Data management						
e) Field work						
3) Consumable Materials and supplies						
a)						
b)						
4) Travel						
a) Conferences and meetings	$1,200	$2,600				
b) Field work						
c) Project-related travel						
5) Dissemination & Engagement						

a) Publications/Reports						
b) Translation (if required)						
c) Communications						
d) Stakeholder Engagement						
e) Indigenous Peoples Engagement						
6) External Contracts						
a)						
Grand Total	$120,000	$81,900				