An Integrated Planning Approach for Selecting Conservation Offsets in Northern Alberta

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Introduction

Efforts to implement a conservation offset program in Alberta have been gaining momentum in recent years, largely in the context of offsetting the impacts of oil sands development. The general idea is to offset conservation losses due to intensive industrial development in one area by achieving conservation gains somewhere else. Readers are referred to Dyer et al. (2008) and Croft et al. (2011) for a summary of the various offset program options being considered for implementation in Alberta.

In this report I consider the question of how to select the sites that will serve as offsets, drawing on recent research into optimized resource allocation (Schneider et al., 2011). My recommendations are most applicable to an offset program based on the conservation banking approach applied at regional scale (e.g., Alberta's boreal region). I take the perspective that the funds placed into the conservation bank represent an investment in conservation and that the objective is to achieve the greatest possible return on this investment. I recognize that this "greatest good" approach represents a departure from the strict equivalency approach that is often associated with offset programs. But I believe the idea has significant merit and is worth considering as the development of Alberta's offset program proceeds.

In the return on investment approach the selection of sites is based on two fundamental criteria: ecological value and cost effectiveness. Ecological value is a function of habitat composition and conservation design. Conservation gains will be greatest if selection is focused where the need is greatest – filling gaps in ecosystem representation – versus seeking to achieve strict equivalency to the lands disturbed by companies funding the conservation bank. Selection must also take into account design issues such as minimum size, connectivity to other conservation areas, and intactness. The danger of focusing just on representation is that many of the offsets selected are likely to be small and isolated. Such sites represent poor value, regardless of their habitat composition, because they are unlikely to maintain natural ecological processes over the long term.

Cost effectiveness means making each dollar in the conservation bank go as far as possible. All else being equal, sites that are cheaper to acquire and manage are preferable to sites that are expensive. Trade-offs between ecological value and cost need to be considered because the spatial distribution of these two factors is unlikely to be identical. Such trade-offs can be effectively addressed using optimization models, such as Marxan.

Integrated Planning

The potential benefits of an offset program will be increased if it is integrated into Alberta's regional land-use planning program. There are several reasons for this:

1. The logical spatial scope for offsets related to oil sands development is Alberta's boreal region. Most of this region is comprised of public lands which are under government control and unavailable for direct purchase.
2. The purchase of private land does not provide control over future oil and gas development (i.e., disturbance) because land ownership in Alberta does not extend to subsurface rights.

3. Integrated planning involving both conservation offsets and the conservation areas established under regional plans would facilitate optimization of the overall conservation design and provide opportunities for synergy, thereby maximizing conservation gains. Integrated planning would also provide the control required to ensure that long-term conservation outcomes are achieved within offset sites (e.g., under a regional plan new petroleum leases could be prohibited within offset sites).

The role of the offset program in an integrated system would be to augment the scope and effectiveness of the government's conservation area initiative. Although the selection of the government's conservation areas has been guided by a coarse-filter approach (GOA, 2009), the sites that have been identified to date leave substantial gaps in terms of ecosystem representation (Appendix 1). Some of these gaps could be filled if the support and financial resources provided by an offset program were brought to bear (e.g., for purchases of private land or compensation of lease holders). In addition, funds from the offset program could be used to improve the ecological integrity of conservation areas through targeted ecosystem restoration efforts (e.g., reclamation of linear features). Indeed, if funding for restoration is limited it makes most sense to allocate it where conservation is the priority rather than in areas where restoration is likely to be undermined by future development.

What is currently lacking in the regional planning process is a transparent, science-based approach for selecting conservation areas. The first step should be an objective analysis that prioritizes lands in terms of their potential value as conservation areas. This analysis should utilize an optimization approach that considers cost, ecological representation, and conservation design. I provide an example in Appendix 1. The actual designation of conservation area boundaries and the articulation of management objectives for each site would occur as part of the development of each regional plan (i.e., this is where the societal trade-off decisions are made). Some areas, presumably those that are ranked highest, would be designated as conservation areas and fully protected. Other areas with high conservation value would be designated as special management zones, where the level of protection could be augmented through the offset program. It is worth noting that development of the conservation offset program could proceed in parallel with the development of the regional plans, as long as both processes are working with the same map of conservation priorities.

In conclusion, there is much to be gained through integration. The offset program brings needed conservation resources and regional plans provide the control over land management required to achieve long-term conservation outcomes. The linchpin of this integration is a shared understanding of conservation priorities across Alberta's boreal region based on an objective science-based process. The data layers and computer models needed to generate such a map are currently available (Appendix 1). The next step is for proponents of the offset program and the regional planning initiative to establish a forum for deciding on inputs and commissioning the development of the map of conservation priorities.

Appendix 1. Using optimization for the selection of conservation areas in northern Alberta

In this appendix I provide an assessment of the relative value of lands in northern Alberta for use as conservation areas and conservation offsets. I recognize that my approach does not include all of the factors that are likely to be of interest to land-use planners and proponents of an offset program. But my approach is well grounded in conservation theory and should serve as an appropriate starting point.

Detailed methodology for my analysis is available in Schneider et al. (2011). Here I provide a synopsis of the main points. I used optimization, via the Marxan conservation planning software, as the basis for our assessment. The optimization was focused on three key factors:

1. Cost
2. Habitat composition
3. Conservation design

My assessment of cost was based on the net present value of oil and gas and forestry resources (Hauer et al., 2010). Net present value represents the total potential revenue stream from the resources in a given area, minus the cost of production and a discount rate on revenue that is not realized until the future. Net present value is not equivalent to the actual cost of protecting a piece of land, but it is correlated to it. The important thing is that it provides a robust basis for differentiating planning units (townships) on the basis of cost so that Marxan can successfully minimize the overall cost of the conservation system.

For habitat composition I employed the coarse-filter approach to ecosystem representation. The idea is that the habitat requirements of most species can be met if the conservation system includes representation of all major ecosystem types. If some protected areas already exist, then conservation gains will be greatest if the selection of new sites is focused on filling gaps in ecosystem representation. In my analysis I incorporated ecosystem representation at two scales: natural subregions and forest patch type. Marxan was required to achieve specified targets for each of these representation elements.

The final factor in my optimization was conservation design. Here the objective was to maximize the ecological value of the conservation system by incorporating well-established conservation principles, including intactness, minimum size, and connectivity. I incorporated intactness by requiring Marxan to minimize the density of linear features within the conservation system. I incorporated size and connectivity at the final stage of the analysis by eliminating any planning units selected by Marxan if they were small and isolated.

I explored two scenarios: one that locked in all existing protected areas and a second that also locked in the conservation areas proposed under the Land-use Framework (LUF) regional planning process (locked in = forced into the Marxan design). The results of the first scenario suggest that in northeastern Alberta the conservation areas selected through the regional planning process are very close to optimal (Fig. 1). The only significant deficit is that effective connectivity between Wood Buffalo National Park (WBNP) and Birch Mountains Wildland Park is lacking. There is also a bottleneck in the connecting corridor between WBNP and Marguerite River Wildland Park that should be eliminated.

The correspondence between the proposed conservation areas and the optimal design is much poorer in northwestern Alberta (Fig. 1). On the positive side, the proposed conservation areas adjacent to the southwest corner of WBNP overlap with the optimized design and have very high ecological value because of their large size and connectivity with WBNP. On the negative side, none of the proposed sites address the critical gap in representation of the Dry Mixedwood Subregion, which is best achieved in the northern Peace Country. Furthermore, the proposed conservation areas along the NWT border have essentially no overlap with the optimized design.

It is worth noting that the proposed conservation areas along the NWT border do have substantial value in terms of protecting caribou habitat (Fig. 2).

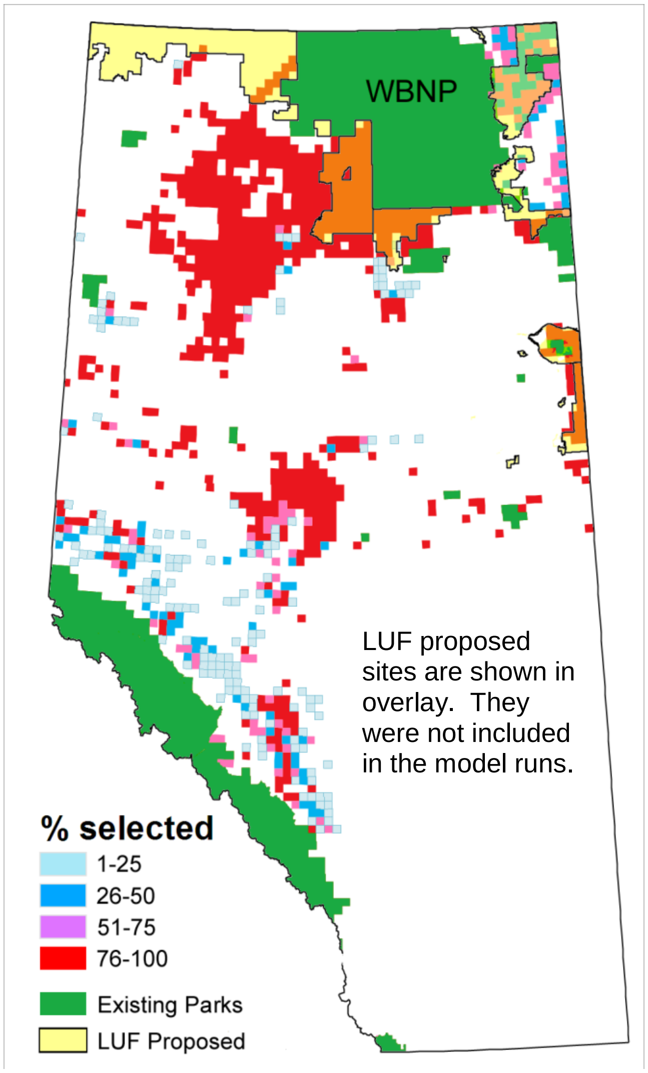

Fig. 1. Probability of planning unit selection over 200 Marxan runs. Model included a 25% ecosystem representation target and minimized cost and linear features. Minimum size and connectivity were not included.

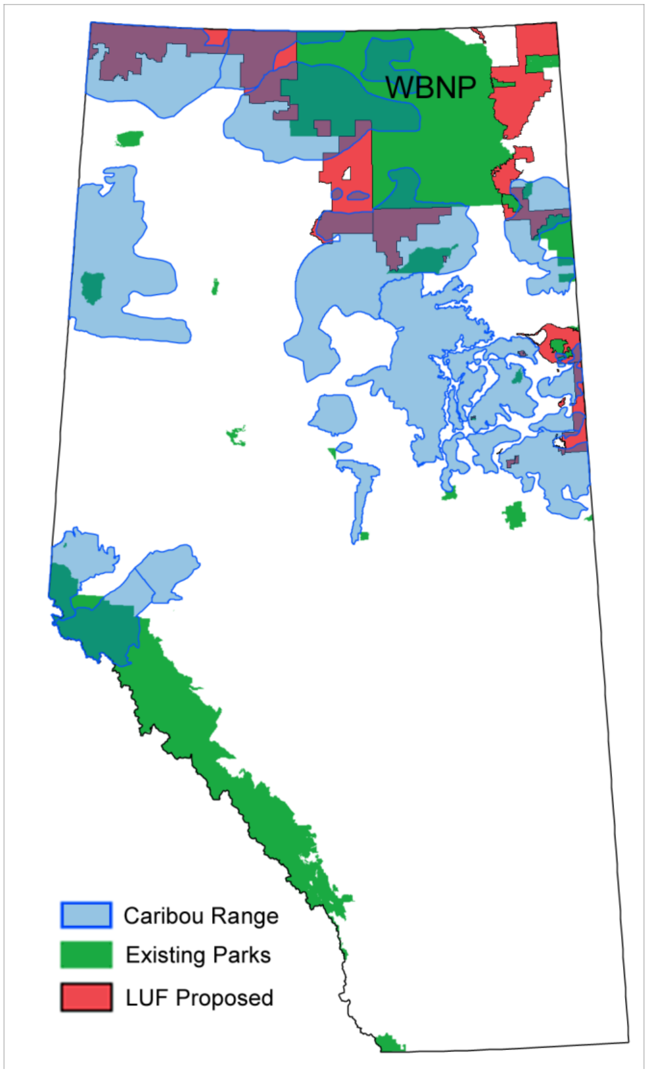

Fig. 2. Overlay of caribou ranges and conservation areas proposed under LUF regional planning process.

In my second scenario the proposed LUF conservation areas were forced into the model. In theory, these conservation areas should have helped achieve coarse-filter representation targets, thereby reducing the need for protection elsewhere. But there was little evidence of this in the model output, except to the east of WBNP (Fig. 3). This is because the proposed conservation areas along the NWT border contain ecosystem types that are already well represented, whereas other ecosystem types (especially Dry Mixedwood) remain unrepresented.

I also ran a variation of the second scenario in which Marxan was required to protect 50% of caribou range in addition to the ecosystem representation target (Fig. 4). Changes to the optimized design were again relatively minor. The most notable difference was the addition of high-priority planning units within the range of the Richardson herd, and to a lesser extent, within the range of the Caribou Mountains and Bistcho herds.

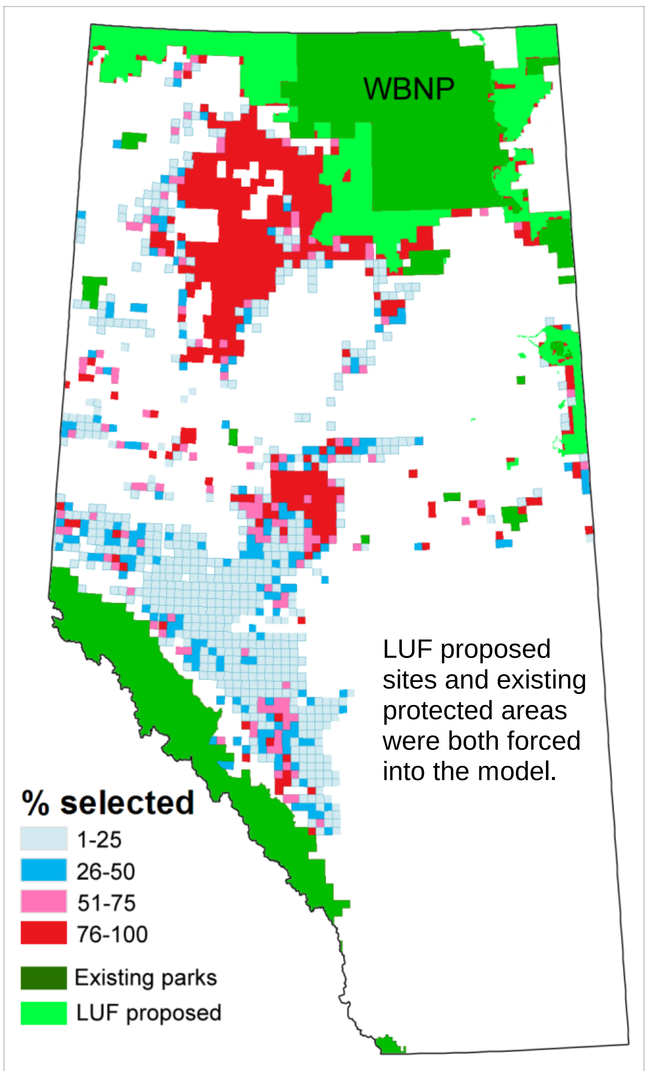

Fig. 3. Probability of planning unit selection over 200 Marxan runs. Model included a 25% ecosystem representation target and minimized cost and linear features. Minimum size and connectivity were not included.

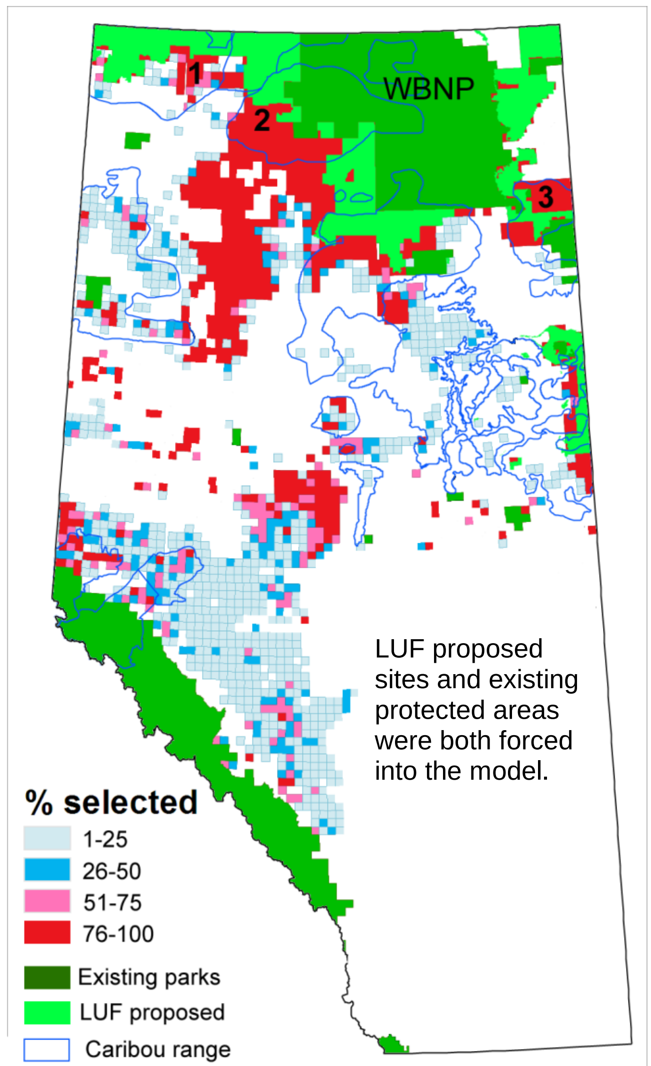

Fig. 4. Same as Fig. 3, but the model also included a 50% caribou range target. The three ranges mentioned in the text are labeled: 1 = Bistcho; 2 = Caribou Mountains; 3 = Richardson.

In the final stage of the analysis I filtered the Marxan output shown in Fig. 4 to identify and illustrate the regions with the highest priority for conservation, taking size and connectivity into account (Fig. 5). I eliminated planning units that had a less than 75% probability of selection as well as units that were small and isolated. Recognizing the coarse scale of our analysis I also softened the boundaries of the priority areas. These areas, individually labeled in Fig. 5, represent the sites with the highest priority for conservation according to design criteria I specified.

Although my findings are coarse scale, they do provide strategic guidance for an offset program. For example, one can say, based on my results, that locating offsets outside of the priority areas

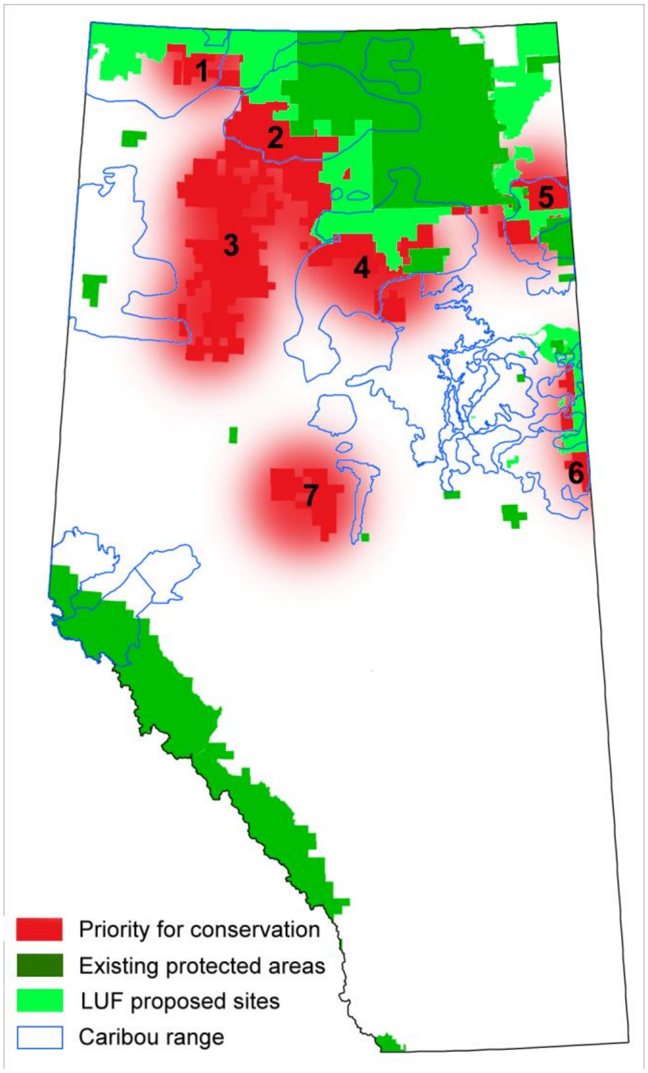

Fig. 5. Priority regions for conservation based on a combination of: coarse-filter ecosystem representation, protection of caribou range, minimization of cost and linear feature density, size, and connectivity.

Rationale for Selection

1. Primarily for the representation of caribou range.

2. Combination of coarse-filter targets and caribou range.

3. Fills a key gap in ecosystem representation – the Dry Mixedwood Subregion.

4. Combination of coarse-filter targets and caribou range. It also helps achieve connectivity between WBNP and the Birch Mountains Wildland Park.

5. Primarily for the representation of caribou range, but also helps to improve connectivity between WBNP and the Marguerite River Wildland Park.

6. Combination of coarse-filter targets and caribou range, though it is unlikely to meet the caribou range size requirements needed to counteract high edge effects to the west.

7. Centered on the Swan Hills, this area fills another key gap in ecosystem representation – the Foothills Natural Region. It is worth noting that Marxan also consistently selects Foothills habitat adjacent to the mountain parks, but no single area stands out.

identified in Figure 5 would represent a suboptimal use of conservation capacity. That is, the program would achieve less for each dollar in the conservation bank than it otherwise could. Within the list of optimal areas the top priority is arguably the Dry Mixedwood Subregion in the northern Peace Country (area 3 in Fig. 5), because of its role in filling a critical gap in ecosystem representation.

It is unlikely that the offset program will have the capacity to utilize all of the priority areas I have identified. Therefore, a key challenge for the program will be to identify offset sites at a finer scale – sites that are within the priority areas and are large enough and sufficiently connected to other conservation areas to be ecologically effective. It seems unlikely that this can be achieved solely through the purchase of private land. Even in the northern Peace Country, where private land exists, the prospects for finding enough contiguous land (and sellers) to achieve minimum size requirements are poor. I believe the solution lies in a hybrid approach that involves both the purchase of private land and the establishment of offsets on public land through the buy-back of resource rights. As discussed earlier, the viability of this approach is linked to integration with the regional planning process. In particular, the prospective offset area needs to be zoned as a special management area where new lease sales are prohibited.

Consideration should also be given to using the conservation bank for uses other than land acquisition. If the general objective is to offset conservation losses in one region by achieving conservation gains in another area, then ecosystem restoration would seem to be a valid use of the funds in the conservation bank. As a case in point, targeted reclamation of linear features could be undertaken across the priority areas we have identified. Again, the benefits would be increased if these efforts were integrated into regional plans by way of management directives that ensured that intactness would be maintained once it was achieved.

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