The Footprints of GVI

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What is GVI?

If you can't measure it,
you can't manage it.
If you can't characterize
and define landscapes,
you can't manage them."

Barry Adams

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It's a simple enough statement but when it comes to landscape management, characterization and measurement have not always been easy. Landscapes, and the ecosystems that exist upon them, are complex. There are many variables - diverse soil characteristics that develop through deposition and erosional forces, supporting diverse plant communities that vary based on climate, human activities, and the condition of the soils, and diverse wildlife that adapt, evolve, or disappear as the soils and plant communities change around them. Anticipating change is not easy. However, creating a tool that can inform our understanding of the existing landscape conditions, provide a foundation to understand relationships in the biophysical world, and over time allow us to document changes that occur within a single hectare or across an entire region, is a powerful accomplishment.

The Grassland Vegetation Inventory (GVI) is a spatially explicit biophysical classification system, that is an important component in the management of the Grassland Natural Region. It may have it's roots in grassland, but despite its name, GVI is about more than range management, it is a land use inventory. GVI brought together a number of existing classification systems relevant to soils, range sites, and riparian features. It developed a standard classification system that can be used as a routine tool to quickly and inexpensively stratify the landscape, and to provide a common lens through which to understand it and to inform management decisions.

GVI divides the landscape into site types based on the combination of dominant attributes. In total there are fourteen classes of upland types based on the predominant soil. It also includes four classes of wetland (lentic) ecosystems, and four classes of flowing water (lotic) ecosystems. The footprints of various human uses are also classified. These anthropogenic classifications comprise crop management types such as irrigated or dryland crops or perennial forages. Coupled with other data layers , it is able to identify the presence of such things as roads, stream crossings, and homesteads. GVI data provides resolution to identify the location of four lane highways. To access more detailed road and trail information or stream crossing locations the Base Features Access and Hydrography Access layers can be added.

The basic elements of GVI are the polygons. Polygons represent areas that are homogeneous in terms of the site type. The sites can vary in size - as small as five hectares for upland sites, or one hectare for riparian sites. This allows for a precise stratification of the landscape. Where site types are intermingled, up to three additional site types can be characterized for a polygon along with an estimate of what proportion each type occupies in the polygon.

In essence, GVI is a coarse classification system that tells us something about what is on the landscape and where it is located at a relatively detailed level. It can provide input into management decisions within a one hectare site, or it can be rolled up to provide information to manage at a sub-regional or regional level.

What are some of the Challenges in the use of GVI?

The Grassland Vegetation Inventory is estimated to be greater than 90% accurate and has been completed for approximately 2/3 of the Grassland Natural Region. No inventory is perfect but the accuracy of GVI is considerably high. Existing GVI users note some interpretation errors exist but don't consider this to be significant challenge in its use.

Some of the areas where interpretation was a challenge, and inaccuracies may be present, is in the identification of historical cultivated lands. In some areas of the province, during what was called the "sod busting days" a myriad of farmsteads were developed. When the droughts hit in the 1930s many of these were abandoned. Over time the cultivated areas were taken over by other grasses. On the imagery this would often look like native prairie, but on the ground it was clearly developed site of human footprint. This was primarily a challenge in the early mapping of GVI and interpreters were trained to look for these areas.

A more significant challenge for GVI is its complexity in the way data was structured. In the database, information on specific attributes is populated into multiple tables. For the trained individuals who understand the data, are proficient in database use, and have a GIS background, this isn't much of a challenge. For the general user, even those with a strong background, it can be cumbersome and technically difficult to extract information in usable forms. The design team is looking at methodologies to make the user interface more accessible, and are considering what training programs may be necessary.

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What can GVI do?

Everyone has their way of describing what GVI is and how it can be applied. This is its strength. GVI was designed to be useful for multiple purposes.

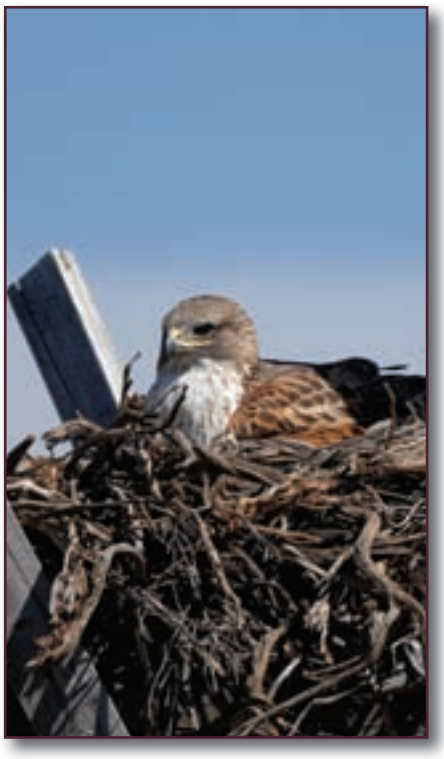
Livio Fent was, in many ways, the visionary behind GVI, though he probably wouldn't describe himself this way. His colleagues credit him with having the foresight to see what GVI could become, and for being a champion in its development along with the Prairie Conservation Forum (PCF). To Livio, GVI is a comprehensive land use vegetation inventory that describes the state of the southern Alberta landscape at the point of interpretation (i.e. when the photo was taken), and it is suitable to a variety of applications. It provides that snapshot of the landscape as described by key environmental variables and it has applications for environmental modeling and decision making.

Barry Adams, Head of the Rangeland Resource Management Program, has been a longtime champion and developer of GVI as well. To Barry, GVI provides the government, the ranching community, industry, developers, and others, with a standardized tool to stratify the landscape so that everyone is looking at it in the same way. This comes into sharp focus in the world of the Land Use Framework and Regional Planning. GVI provided the standardized classification of the landscape and the interface for cutting edge planning tools that enabled "valued landscape planning" in the South Saskatchewan Regional Plan. In other words, GVI provided the physical landscape information that could be integrated with 140 different natural resource related values of that same landscape.

This helped to identify such things as lands to be set aside for conservation areas, locations for expanded development of a certain kind, or important recreational areas. GVI allowed for the production of "value maps" that could be used to communicate the existing conditions blended with the human value layers. The Regional Advisory Council, which was established to provide recommendations to the South Saskatchewan Regional Plan, appreciated the accuracy and utility of GVI and urged Cabinet to quickly complete it to facilitate their regional planning efforts.

Both Barry and Livio would caution us to understand that the utility of GVI is not as a stand alone tool, though it does, for the first time provide a common standardized baseline for landscape planning. In rangeland management, GVI becomes the starting point for range health assessments, but does not remove the requirement for agrologists to walk upon the landscape to fully understand what is occurring. GVI can provide insight into the type of soil and vegetation characteristics that are present, but a trip to the site is required to understand the existing health and function of the plant community, and to distinguish if the community is mature or in some stage of successional development. As Barry says, agrologists must still tuck the Plant Community Guide under their arm and see the site for themselves.

So who is using GVI right now? Well, the list grows longer every day, and that is exactly what the PCF and designers of GVI want to continue to see. GVI is being used by species at risk biologists to develop conservation plans and update habitat models. It's



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being used by Alberta Sustainable Resource Development to undertake cumulative effects monitoring, by urban and rural municipalities in their considerations of development and expansion, and by transportation and utilities to design roads and infrastructure planning. Industry sectors are also utilizing GVI. Upstream oil and gas, and the wind energy sector, are beginning to use it in their pre-site assessments and reclamation planning. It was a core information database for developing the South Saskatchewan Regional Plan, and it continues to serve its function in rangeland management. Watershed planning groups are also looking at ways they can use GVI for improved management of their local watersheds.

Barry believes that the most critical use of GVI will be as a cumulative effects monitoring tool, and that its power to measure, monitor and manage

footprints on the landscape is yet to be fully demonstrated. The Land Use Framework and Regional Planning have provided the context for cumulative effects management but this hasn't been fully operationalized. If GVI could be systematically and routinely used in the assessment of industry applications for approval it would enhance the operationalization of cumulative effects. For instance, GVI could, with Base Features Access, measure the current edge and road densities with respect to natural or anthropogenic landscapes, or quantify the amount of existing disturbance in a polygon. This information could then be compared to known environmental thresholds and provincial outcomes to weigh the application for approval from a cumulative effects perspective. In this way, it could be used to support the government commitment for streamlined and effective approval processes while supporting the commitment to cumulative effects management. GVI is ready, waiting and capable of supporting this.

There are probably more uses than can be named. The provincial government, PCF and landscape planners of a multitude of disciplines will continue to gain a greater understanding of the complex demands that the Grassland Vegetation Inventory can support.

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What is the history of GVI?

The first vegetation inventory for the grasslands and prairie area was the Native Prairie Vegetation Inventory (NPVI) which had been sponsored by the Prairie Conservation Forum (PCF) and produced by provincial government in the early 1990s. It was not a spatial inventory, but rather provided the percentage of vegetation type or landscape features present in a particular quarter section of land. In other words, what proportion of the parcel of land was covered by such things as trees, shrubs, herbaceous plants or waterbodies.

By the late 1990s, the PCF and provincial agencies recognized a need to update the inventory. They wanted to answer questions like: "Had the amount of native prairie changed?"; and, "If so, what were those changes?". After nearly ten years, landscape managers from a wide range of disciplines, were beginning to recognize that the inventory did not provide the necessary information needed for broader landscape planning. Other areas of the province had spatial inventories that could describe where on the landscape a feature existed, for example the Alberta Vegetation Inventory used in forested areas of the province. The PCF and provincial government agencies determined that it was necessary to bring the NPVI up to the spatial standards of the rest of the province. A spatial inventory where landscape polygons were classified and attributed, could improve our understanding of changes on the landscape, and was exactly what was needed in the Grassland Natural Region.

Since they intended the new inventory to consider the Grassland Natural Region landscape in totality, they began to question what other requirements, besides vegetation

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information, would be useful to meet the landscape management needs of a variety of users. They began a wide consultation that included provincial Sustainable Resource Development, Agriculture, and Environment staff, among others, to determine what they needed in an inventory, and at what level of detail. In some cases these needs were very specific. For instance, there was a need to identify minute habitats, such as a tree in the middle of the prairie. In other cases it was the inclusion of a wetland classification system. This "needs assessment" was placed into the context of what was reasonable to achieve using aerial photography and interpretation combined with a structured database.

At the same time there was shift occurring in government where the need for broader landscape planning in a rapidly growing province was recognized. A series of regional pilot studies were undertaken in the southern region to understand the patterns of growth and their pressures on the prairie landscape. It was the beginning of the Land Use Framework and a shift towards cumulative effects management. The Alberta government recognized the necessity of a spatial inventory in the south that could inform regional modeling in the Land Use Framework, this sparked the development of the Grassland Vegetation Inventory.

How was GVI Developed?

Francois Blouin

To develop the Grassland Vegetation Inventory, a new set of aerial imagery was required to provide a snapshot of the landscape for which change could eventually be measured. But conventional black and white or color air photos were insufficient to recognize and classify wetlands. Color infrared photography was necessary to identify the specific wetland features to differentiate amongst wetlands in a prairie pothole landscape.

A primary goal of GVI is to provide a standard interpretation of the landscape so that people of different backgrounds can see the landscape through the same lens and share a common language. Mapping of the inventory relies on the digital stereography of high quality imagery. Individual interpreters make judgement calls about what the are seeing on imagery, and without a standard method this discretion can introduce a high level of interpretation error. The GVI team developed a standard methodology to interpret the imagery, as well as a suite of reference materials and manuals, a workshop lecture series, and a process for certification for qualified and trained interpreters.

The Grasslands Natural Region is a vast area, and it would take a team of qualified interpreters a number of years to cover the entire landscape. The provincial government offered free certification courses to companies and environmental firms who wanted to train their staff on GVI interpretation. In order to bid on provincial contracts for GVI development, consulting companies had to have GVI certified interpreters on staff. This resulted in a robust and highly accurate database.

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What's next?

The Grassland Vegetation Inventory is not yet complete for the entire Grassland Natural Region. The team is working hard to complete this within the next two years. The PCF and Alberta Sustainable Resource Development are currently focused on creating awareness about GVI and getting people to use it. The interest and traction of GVI is gaining momentum, and Barry anticipates the next phase will focus on processes for maintaining and updating GVI.

The team is working to build interest in GVI so that it will become the standard for understanding and communicating about the grassland landscape. To that end, they are considering methods to "flatten" the database so that it is more accessible for users. The current challenge is that the multiple tables must be joined and merged by the user to achieve a desired output. This can be a complex endeavor. With a flattened file the database has only one table and is easier to query and analyse. Each polygon, across the entire GVI dataset, will receive a single line which describes all of the attributes in that polygon. This should make it more intuitive for us non-technical people.

However, flattening the database is only one step. In the meantime it is necessary to consider training users, similar to how the interpreters were trained. At the very least, users need to understand the data held within GVI. For some this may be enough. Others may need more advanced training, or the provision of a simplified mapping tool such as the web map tool currently available through the PCF website. It isn't clear when or in what form this training will occur, but the team is actively promoting GVI awareness. Additionally, some post-secondary institutions in Alberta are already including GVI into their curriculum.

According to the original plan, GVI would be updated every five to ten years, so parts of the Southeast corner of the province, where mapping first began, may already be out of date. The team has yet to determine how GVI will be updated. The time and expense it would take to reinterpret the entire region in the same way it is being mapped is not feasible. The team is considering the use of satellite imagery to detect the change on the landscape. If an area of native prairie was converted to country residential, this would show up as a change in the reflective properties of that site on the imagery. Then, in areas where a satellite image indicates a change may have occurred, it would be possible to target those sites to update GVI and maintain its relevancy.

Another enhancement to GVI that the team is considering is a process for those users of GVI considered to have expert knowledge to provide feedback on the accuracy of the interpretation at a site. So if a user is out on the landscape and notices an inaccuracy between what GVI has indicated would be present, and what is present, this information could be shared for updating.

Livio points out that there are some aspects of the GVI database that are not currently being fully used, but have some potential. This pertains to specific species information to identify what species are present and their abundance in an area. The database does contain some of this information for trees, but is otherwise limited. This portion of the database was designed with the intent that people working in this geographical area could provide this information, or that the GVI database could be linked to other databases that contain this information. The opportunity is there, but it hasn't been fully operationalized.

The province is also working towards developing another inventory, called the Primary Land Vegetation Inventory (PLVI), that will be modeled after GVI. Barry calls it "GVI with trees". It would provide a lower cost alternative to the Alberta Vegetation Inventory (AVI) with more of a birds-eye view of the landscape. PLVI would start where GVI ends, and together these three inventories (AVI, GVI, and PLVI) would provide a landscape classification system for the entire province.

Summary

The Grassland Vegetation Inventory has evolved to be much more than a mapping of vegetation; it has become a landscape and land use inventory. It was designed to provide a standardized tool and a common language for management decisions in the southern Alberta prairies. The intention was that this inventory would be useful not only to the Prairie Conservation Forum and provincial government, but also to industry, ranchers, environmental consultants, municipal planners and anyone else involved in landscape planning. GVI is not yet complete and it is already being used in a variety of applications. Barry says, "if you apply inventory specifications that serve a broad suite of needs, users will come to have those needs served." GVI has the potential to become the standard to facilitate integration across disciplines and landscape interests.