

**Adaptive Management Strategy for the
Decision Support Tool to Address Invasive Species
In Garry Oak and Associated Ecosystems**

Prepared for the

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¹ The Habitat Stewardship Program for Species at Risk is a partnership-based conservation initiative sponsored by the Government of Canada. The Program is managed cooperatively by Environment Canada, the Department of Fisheries and Oceans and Parks Canada, and administered by Environment Canada.

² http://www.ec.gc.ca/press/2001/011107_b_e.htm

³ <http://www.natureconservancy.ca/files/index.asp>

³ <http://www.goert.ca>

1.0 Background

1.1 About the Decision Support Tool

Garry oak ecosystems are among the most valuable and the most threatened ecosystems in British Columbia (BC). They are home to over 90 species designated as “at risk” in the province, and many of these are also at risk nationally and globally. Less than 5% of their original habitat in BC remains in a near-natural condition, and invasions of non-native species pose a serious threat to remaining ecosystems. A Decision support tool (DST) has recently been developed that will help make decisions regarding whether, and how, to manage invasive species in Garry oak and associated ecosystems (GOEs) in BC.

The Decision Support Tool for Invasive Species in Garry Oak and Associated Ecosystems is intended for agencies with management authority over GOEs (e.g. municipal or regional governments) led by ecosystem managers who have on-the-ground experience with GOEs, and local non-governmental groups (e.g. “Friends Of” groups) interested in GOEs under the leadership of someone knowledgeable about these ecosystems. The DST may also be used by private landowners interested in managing GOE sites on their property, if they have some knowledge of GOEs or will work in association with someone who has this knowledge.

The use of this tool will provide a tremendous opportunity to build on the current base of knowledge regarding how best to manage invasive species in these ecosystems. The challenge is to keep track of where it is applied, the management decisions and actions that result from its use, and the outcomes of these management actions. The purpose of this Adaptive Management Strategy is to provide guidance on how to improve the use of the DST, and improve management across GOEs, using an adaptive management approach.

1.2 About Adaptive Management

Adaptive management is a problem-solving approach to environmental management. It involves synthesising existing knowledge, exploring alternative actions, making explicit predictions of their outcomes, selecting one or more actions to implement, monitoring to see if the actual outcomes match those predicted, and then using these results to learn and adjust future management plans and policy. Many people involved in resource management mistakenly believe it is simply “adapting as you go” based on trial and error. Adaptive management is actually a rigorous approach for learning through deliberately designing and applying management actions as experiments. Dr. C.S. Holling and Dr. C.J. Walters and associates, at the University of British Columbia and the International Institute for Applied Systems Analysis in Vienna, first developed it in the 1970s⁴. It has since been applied to a wide range of resource and ecosystem management problems throughout North America and elsewhere.

Ecosystems are complex and dynamic. Our understanding of how they work and how they respond to natural and anthropogenic disturbances is limited, and unexpected events are inevitable. This makes ecosystem management and restoration particularly challenging. Adaptive management is a very useful approach for proceeding with restoration activities in the face of uncertainty regarding how best to achieve desired outcomes, and in the face of inevitable change and surprises.

⁴ Holling, C.S. (ed.) 1978. *Adaptive Environmental Assessment and Management*. John Wiley and Sons, New York.

2.0 The Strategy

The objectives of this strategy are to provide guidance on how to:

1. Improve the DST, and
2. Use the DST to coordinate and improve invasive species management across GOEs in BC.

Both of these objectives rely on the Garry Oak Ecosystems Recovery Team (GOERT) obtaining information from DST users, and feedback to GOERT is an important design feature that has been incorporated throughout the DST. In several places the DST prompts users to complete, and send to GOERT via fax or email, recording sheets with the following information:

- **Record of Decision:** Documentation of the decision whether to undertake invasive species control and management, and if so, for which species (Fig. 1). This sheet will also include factors that were considered in making this decision.

Record of Decision:

Name of GOE:

Location:

Name of DST user: Date:

Telephone #: Email:

Decision: Proceed with control and management for invasive plant species?

No. Reason:

Yes, for:

<input type="checkbox"/> Scotch broom
<input type="checkbox"/> English ivy
<input type="checkbox"/> blackberry

Figure 1. Record of Decision box from the DST.

- **Record of Management Plan:** Documentation of the Action Plan for the invasive species to be managed, the Disposal Plan for the removed biomass, and the Monitoring Plan for control or management of the target invasive species, as well as any uncertainties. The Action Plan will include the chosen control methods, the planned schedule, expected results, anticipated follow-up activities, the size and skill of workforce, and the tools that will be used.
- **Record of Learning:** Documentation of what has been learned through the implementation of the Action Plan, the Disposal Plan and the Monitoring Plan. This includes a description of what control methods worked, what methods did not work and why, what the user might do differently next time, and surprises that were encountered.

Collectively, the various components of these records will allow GOERT to track not only the use and users of the DST (who, when, and where), but also track the decisions made, the actions taken, the success of these actions, and remaining uncertainties. This information will allow GOERT to use an adaptive management approach to improve the DST, and to coordinate and improve invasive species management across GOEs.

2.1 Improving the DST

Figure 2 shows a simple adaptive management framework for improving the DST. A similar framework is currently used in Part C of the DST, where users are guided through the six steps as they assess, plan, implement, monitor, evaluate and adjust invasive species control and management actions within a GOE. The same framework can be used by GOERT at a *strategic* level to implement, monitor, evaluate and adjust the DST itself. As shown in the figure, the assessment and design steps have already been completed, and GOERT is about to proceed with implementation by making the DST available to users – perhaps on a pilot basis at first. The rest of this section describes how GOERT might monitor, evaluate and adjust the DST.

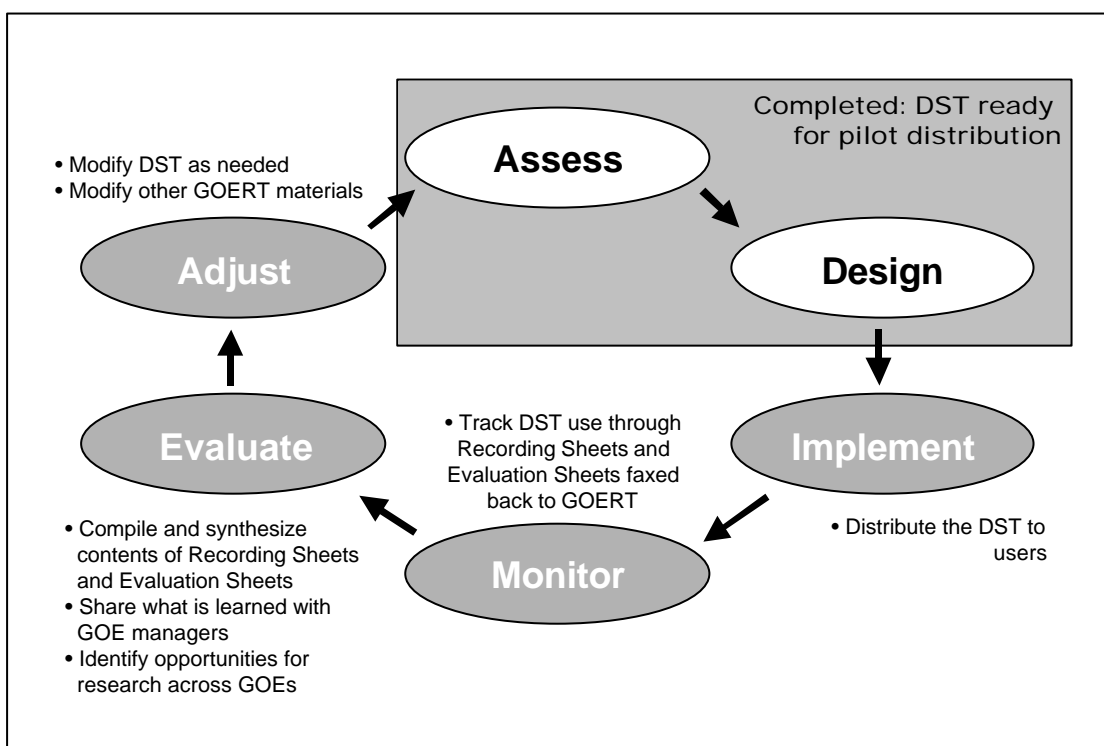


Figure 2. Adaptive management framework for GOERT management of the DST.

Task 1: Track use and users

In order to know how the DST might be improved, GOERT must first monitor who is using it, and for which GOEs. There are four mechanisms by which GOERT may obtain this information:

- From the Record of Decision box (Fig. 1) that DST users are prompted to fax or email to GOERT,
- From the Evaluation Sheet that DST users are asked to fill out and send to GOERT,
- Through less formal responses to the feedback request at the front of the DST, and
- Through word-of-mouth in the GOE management and restoration community.

It will be important for GOERT to keep track of this information, and how it is obtained, as the mechanism itself is useful knowledge. For example, if GOERT learns of users through mechanisms c) or d) but does not receive a Record of Decision from these users, it indicates that some users are not sending in their Recording Sheets as requested. This will hinder the ability of GOERT to meet either of the objectives of this strategy. In such cases, particularly early on in DST implementation, such users should be contacted to discuss their reasons for not sending the Record of Decision, to learn if changes to the DST might increase the response rate.

It may be useful for GOERT to build a simple relational database to help track DST use, as well as invasive species decisions, management and control actions, and the results of these actions. This would not only provide a convenient mechanism for storing this knowledge, but would provide powerful querying capabilities for identifying needs and opportunities for both research and management across GOEs, as discussed in Section 2.2.

Task 2: Determine if it is working

Once the DST is implemented, with evidence of use and users, the next logical step is to learn whether the DST is actually working. The DST was designed to *help users make decisions regarding whether, and how, to manage invasive species in GOEs in BC*. There are several ways of determining whether the DST is accomplishing this. The most direct and least difficult way is to compile and synthesise the information on the Evaluation Sheet that users fax or email to GOERT. This sheet asks users the following questions:

1. Was this Decision Support Tool easy to download and print?
2. Was this Decision Support Tool easy to understand?
3. Was this Decision Support Tool easy to use?
4. What improvements (if any) would you consider essential to making this tool effective?
5. Can you suggest any additional “nice to have” improvements?

More difficult, but more informative from the perspective of “ecological effectiveness”, is to compile and synthesize the information provided on the Record of Management Plan and Record of Learning sheets that users are prompted to fax or email to GOERT. These sheets should provide GOERT with the following information:

- Description of the methods that worked,
- Description of the methods that did not work, and why,
- Description of what the user would do differently next time, and
- Description of surprises.

The quality and quantity of information provided on these topics will provide GOERT with valuable insights into the success of the DST. For example, if “tried and true” methods do not appear to be working for some DST users, it may indicate that the DST is not providing sufficient guidance to the user. If few surprises are recorded, it may indicate a lack of understanding of the importance of this information, and its value in learning how best to manage and restore GOEs.

GOERT may also learn a great deal from telephoning selected users and encouraging them to discuss their experiences with the DST. Active discussions enable greater richness and depth of feedback than can be obtained through structured forms, and are recommended to the extent possible, given the availability of GOERT resources for this task.

Task 3: Improve the DST for broom, ivy and blackberry

Evaluate the information obtained from Tasks 1 and 2 to make any adjustments, if necessary, to the DST. It may be helpful to organize the feedback into categories according to the major sections of the DST:

- **Introduction:** Is the introductory material clear and sufficient to prepare for proper and successful use of the DST?
- **Instructions:** Do users understand the instructions? Are they easy to follow? Is more detail needed in certain sections? Have we learned more about broom, ivy or blackberry that we can further refine (or perhaps simplify) instructions in Part B: Risk Assessment (Questions 4, 5 & 6)? Have we learned more about managing broom, ivy or blackberry such that techniques can be added, modified or deleted for Step 7: Assess?
- **Recording Sheets:** Are they easy to use? Is there enough room to record the pertinent information? Are users sending the Record of Decision, Record of Management Plan and Record of Learning to GOERT? Should users be instructed to send other Recording Sheets to GOERT?
- **Reference:** Are the references useful? Do any terms need to be added to the glossary? Do the lists of species at risk, or invasive species, need to be updated?

It may also be helpful to establish criteria for improvements, to help determine, and prioritize, revisions. Suggested criteria might include:

- **Frequency of occurrence:** How many users have requested this revision? Is it something most users want or need?
- **Importance:** Is the revision necessary for correcting an error, or significantly improving accuracy?
- **Level of effort:** How much time and effort is needed to research and implement the revision?
- **Simplicity:** The DST is designed to be as simple as possible – if it is too large or complex, users may become overwhelmed and abandon it. Will the change increase the simplicity of the tool? Will it dramatically increase its size or complexity?

During every evaluation, clearly document the intended changes, and the rationale. Also document who participated in the evaluation and related discussions. Clear and systematic documentation is important for learning (it maintains “institutional memory”) and is a key element of adaptive management. This information should be kept on file at the GOERT office, and will be very useful during subsequent evaluations.

Plan on a regular schedule for evaluating feedback, adjusting the DST, and making the revised version available to users. For example, doing this on an annual basis might be reasonable, but the final schedule should match GOERT capacity. Be sure to inform users of this schedule, and to inform them when a new version is available. If the DST is posted on the GOERT website, a “what’s new” section of the site could let users know that the DST has recently been updated, and summarize the changes.

Task 4: Add invasive species

The regular evaluation discussed in Task 3 should include consideration of whether to expand the DST to include other invasive species. If GOERT decides to add invasive species, the production of the expanded version of the DST should coincide with the regular update schedule.

If the candidate species exceed the capacity of GOERT to expand the tool at any given time, selection criteria should be applied to help choose the species to add. Suggested criteria include those used in the design and development phases of the first version of the DST:

- Significance of impact in GOEs,
- Urgency of control or management,
- Difficulty of control or management,
- Current state of knowledge regarding control or management of the species, and
- Accessibility of this knowledge.

A prioritization of the top ten invasive plant species currently threatening GOEs in BC⁵ using the first three criteria suggests that orchardgrass (*Dactylis glomerata*), gorse (*Ulex europaeus*), velvet-grass (*Holcus lanatus*), laurel-leaved daphne (*Daphne laureola*), common hawthorne (*Crataegus monogyna*), sweet vernalgrass (*Anthoxanthum odoratum*) and hedgehog dogtail (*Cynosurus echinatus*) all be considered as candidates for expansion to additional invasive plant species, and weighed against the final two criteria. However, other taxa should also be considered.

Adding species to the DST may require changes to all sections, but at the very least will require changes to the following parts of the DST:

- Instructions:
 - Part A, Question 3: What invasive species are present? Diagrams for the new species should be added, as well as references to field guides and links to web sites that may help in identifying these additional species.
 - Part B, Question 4: What species pose the greatest threat? Factors in determining which species pose the greatest threat may need to be refined for additional plant species, and will almost certainly need to be modified for vertebrates or invertebrates.
 - Part B, Question 6: Proceed with management and control, and for which species? The factors considered in deciding whether to proceed may be sufficiently broad to apply to new species, but the factors in deciding which species to target may need to be modified. At the very least, the new species will need to be added to the example table provided in Question 6.
 - Part C, cover page. The new species will need to be added to those listed, and illustrated, on the Management Actions cover page.
 - Part C, Step 7: Assess. At present, the DST contains a set of instructions Step 7 for each invasive species. If a new species is added, another set of Step 7 instructions will also need to be developed.
- Recording Sheets:
 - For Question 4, according to the modifications of the instructions as described above.
 - For Question 5, as the answers are organized by species.
 - For Question 6, according to the modifications of the instructions as described above.

As in Task 3, any evaluation regarding expansion of the DST to other species should be clearly documented, along with the participants, the decisions and the rationale. This information should be kept on file at the GOERT office, and will be very useful during subsequent considerations to expand the tool.

2.2 Using the DST to coordinate and improve management across GOEs

GOERT has an excellent opportunity to observe the “big picture” across GOEs where the DST is applied. An ever-expanding GOERT database (suggest in under Task 1) documenting invasive species management activities

⁵ From the February 2002 report entitled “Towards a Decision Support Tool to Address Invasive Species in Garry Oak & Associated Ecosystems in B.C.” (<http://www.goert.ca/docs/GOEDSTreport.pdf>).

and outcomes from the Records of Decision, Records of Management Plan and Records of Learning could soon grow to become a valuable asset for creating a systematic, science- and experience-based collection of knowledge. Since the Record of Decision includes the name and contact information for the DST user, GOERT can follow up to request and store any additional information from the DST recording sheets (e.g. site characteristics including species at risk that occur at the site, risk assessment, and specific monitoring observations). This growing base of knowledge, through continued analysis of different combinations of data sets, and with the benefit of internet-based access, can greatly increase our individual and collective knowledge about how best to deal with invasive species management. Simply by sharing with GOE managers and landowners what is learned through the use of the DST will greatly improve collective knowledge of how best to manage GOEs for invasive species, and will cultivate an environment in which users feel encouraged to share their experiences, thereby becoming contributors to the growing domain knowledge base.

The data and knowledge base that emerges from DST results can provide tremendous value to the GOE management community, including:

- Users who are beginning to assess the state of an individual GOE in terms of its characteristics, assess existing treatments on the site that may have been undertaken, weigh management options and predict likely responses to treatment, given the particular site characteristics and experiences gained in similar GOE situations elsewhere in the region.
- GOERT members, including regional, municipal and related conservation staff, who are interested in assessing the overall state of invasive species control activities– and the state of recovery of GOEs from invasive species– across the entire region. Products might include comprehensive reports on the *State of GOE Invasive Species Management in BC*. This “big picture” would allow for more strategic assessments of GOE management needs across BC, and the allocation of precious management resources in the locations, and in the manner, they are most likely to be effective. It will also contribute valuable information in support of the *Alien Species Strategy* currently being developed by the Biodiversity Branch of the BC Ministry of Water, Land and Air Protection.
- GOE invasive species experts who wish to analyse management response (monitoring) data to refine and update the knowledge base of best practices
- Researchers or GOE managers who wish to direct research or management experiments towards reducing the key uncertainties identified through the use of the DST. For example, experts involved in the knowledge engineering process during DST development raised the following key uncertainties:
 - What is the nature (size, longevity) of the blackberry seed bank?
 - Is it possible to detect and remove young blackberry seedlings? They seem to produce a deep root very quickly.
 - Can blackberry stands useful to people for berry picking exist without being a continual threat of invasion to other areas? If so, what is the maximum stand size?
 - How can deep blackberry roots be destroyed during the first removal?
 - When controlling broom in early December, is it better to pull or cut?
 - If small broom volumes are spread out over an area to avoid suffocating the remaining indigenous flora, can it be safely left on site? Are there seasonal caveats?
 - Does composting destroy ivy or broom seeds? At what compost pile temperatures?
 - Does composted ivy have any ecological value?

Figure 3 shows one vision of a formal GOERT Data and Knowledge Base, following adaptive management approach, that provides a means to systematically capture and track management activities and monitoring findings, site-by-site and for the entire GOE region. These results, when analyzed in relation to a specific site and treatment situation, would provide essential feedback on the success or failure of different practices. It could also be expanded beyond DST data to include broader GOE management and restoration knowledge.

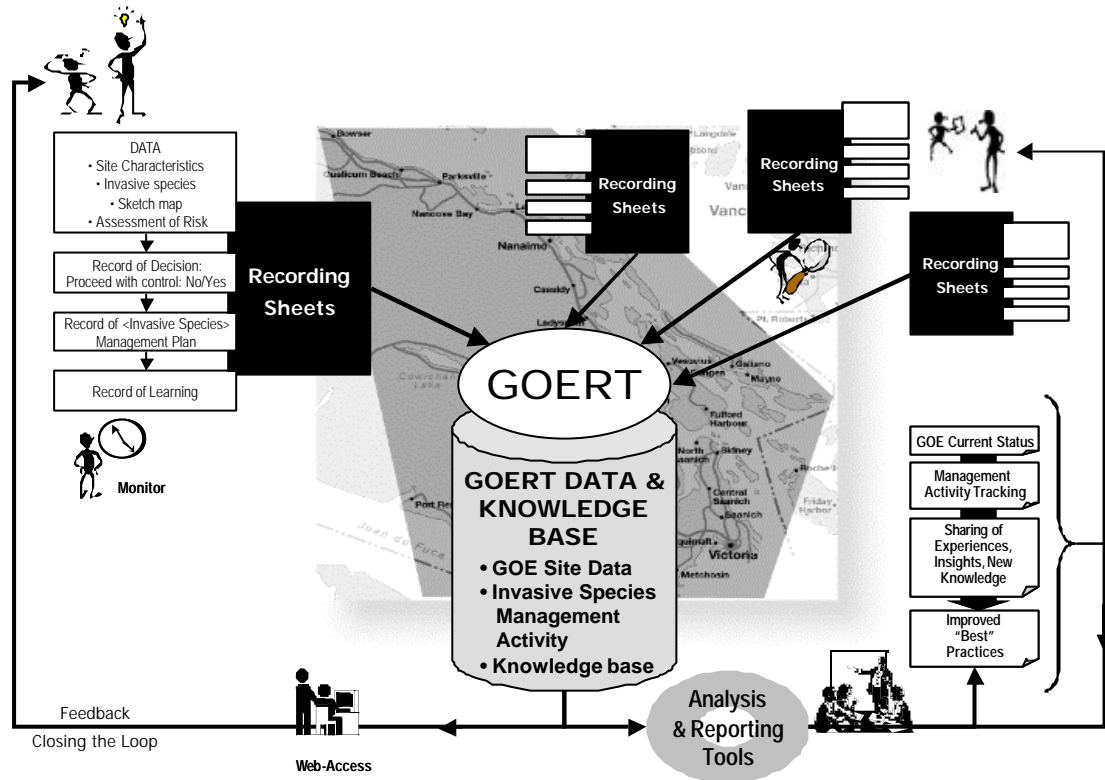


Figure 3. Framework for a potential information system to support and improve GOE management.

A GOERT Data and Knowledge Base would provide the ability to analyze much larger, multi-GOE site management situations. Collectively these different subsets of the database can be used to learn about the more broad-ranging success and failure of current best management practices. These data will offer several insights. First, we will know with greater certainty (via a large sample size) what best management practices are consistently achieving the objectives identified for the invasive species control or eradication. Second, we will know more confidently which ones are not providing consistent results, or under what kinds of repeated site and management situations they are not providing the desired results. Third, we will know better which treatment strategies we continue to be uncertain of, and can facilitate discussions among the research community of ways to reduce these uncertainties. Uncertainties provide an opportunity to use our knowledge to devise a new set of “management experiments”. These adaptive management experiments can be designed to include a number of similar GOE sites across the region – increasing the sample size will increase confidence in the conclusions drawn. Further details on designing adaptive management experiments can be obtained from a variety of sources (e.g. www.for.gov.bc.ca/hfp/amhome/amhome.htm, www.adaptivemanagement.net/). More structured, directed testing of management practices, over a larger number of GOE sites, all supported by a dynamic GOERT database will ultimately lead to increased knowledge about invasive species management, and to healthier Garry oak and associated ecosystems.