Ecological Integrity on Wildlife Areas in Washington State

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Introduction

The Washington Department of Fish and Wildlife (WDFW) has a mission to serve Washington's citizens by protecting, restoring, and enhancing the ecological systems that support fish and wildlife populations. One approach the WDFW employs to achieve this mission is management of approximately one million acres of land distributed in wildlife areas across the state. To make informed and adaptive management decisions, credible data on how human activities affect the chemical, physical, and biological integrity of ecosystems needs to be collected, monitored, and evaluated. The purpose of this project is to provide the technical advice and support necessary to collect and interpret that data.

WDFW is undertaking a collaborative research effort to monitor or measure changes in biodiversity over time, beginning with a pilot project focusing on Ecological Integrity Monitoring on WDFW owned and managed lands. The Wildlife Program has developed a cross division/cross discipline project to advance effective management of fish, wildlife and their habitats by engaging Wildlife Outreach citizen science volunteers to report metrics designed by Wildlife Science for monitoring ecosystem integrity on wildlife areas. This citizen science project will focus on inventorying, monitoring, evaluating and disseminating information initially focusing on four key Wildlife Area locations in Eastern and Western Washington State. Registered and trained citizen science volunteers will use Wildlife Science protocols to provide photo point images and report data online to a WDFW corporate data base. Wildlife Science staff will analyze the data with Wildlife Lands staff and Wildlife Area Managers to inform management decisions on Wildlife Areas. This citizen science project operationalizes the principle of communication across WDFW divisions and programs required by the agency's Conservation Initiative. The project will work with a diverse public, implementing ecosystem-based volunteer opportunities and communicating natural resource priorities while striving for efficiency.

Ecological Integrity

An ecosystem is the biological environment consisting of all the living organisms, or biotic component, in a particular area, and the nonliving, or abiotic component, with which the organisms interact. All of Washington State is mapped at the ecosystem level as part of the 2006 National Land Cover database and the names of the ecosystems are defined by NatureServe. Standard names and definitions for ecosystems are advantageous as they: (1) characterize ecosystem patterns across the entire landscape or watershed, (2) provide information on relative rarity, (3) classify the relationships between different ecosystems, and (4) facilitate sharing of information.

The integrity of an ecosystem can be measured through a standardized and repeatable assessment of its current structure, composition, and ecological processes to give a general sense of

conservation value, management effects, and restoration success. A fundamental component of this assessment process is comparison of an ecosystem to a reference site, where characteristics of the ecosystem are operating within the bounds of natural range of variation. The Ecological Integrity Assessment (EIA) will be based on this work of WADNR Heritage program ecologists. The EIA method addresses a number of objectives including: (1) assessment of ecological integrity on a fixed, objective scale; (2) comparison of ecological integrity of various occurrences of the same ecological systems; (3) determination of, and support for, conservation priorities such as desired ecological integrity; (4) improved decisions on monitoring individual ecological attributes; and (5) provision of an aggregated index of integrity to interpret monitoring data.

To manage, protect, and restore an ecosystem, it is essential to know its current state and how it is responding or will respond to management. The EIA method provides this information at three different scales:

1) ***Remote***—Uses GIS and remote sensing data to identify priority sites, ecosystem condition, ecosystem trend, landscape configuration, and restoration and monitoring processes.
2) ***Rapid***—Incorporates qualitative and/or quantitative data to inform restoration and management projects, support landscape, watershed, conservation, and management planning, and provide an opportunity to evaluate remote assessments.
3) ***Intensive***—Incorporates detailed quantitative data to inform restoration and management projects, support landscape, watershed, conservation, and management planning, and provide an opportunity to evaluate other levels of assessment.

Regardless of the scale employed, a critical aspect of linking ecological integrity to reference sites is distinguishing the natural range of variation from variation caused by negative anthropogenic impacts or stressors. This is addressed with specific metrics that can be used to measure key ecological attributes, especially attributes that are responsive to anthropogenic stressors (Table 1). Metrics are identified using a variety of expert-opinion driven processes and through a series of data-driven calibration tests, ideally with consideration of the following criteria.

1) Useful at multiple spatial scales.
2) Inclusive across ecological attributes of composition, structure and function.
3) Grounded in natural history and ecologically relevant.
4) Practically relevant to managers, decision-makers, and the public, not just scientists.
5) Flexible to implement and measure.
6) Target or threshold settings should be relevant.
7) Responsive to changes, including changes due to stressors.

Table 1. Initial metrics used in ecological integrity assessments; additional metrics may be developed.

Metrics for landscape context	Metrics for vegetative condition
Buffer and edge length, width, and condition	Cover of native understory species
Connectivity	Cover of native bunchgrass
Landscape condition	Cover of invasive species
Relative patch size	Cover of native increasers
Absolute patch size	Species composition
Patch diversity	Fire-sensitive shrub cover
	Canopy cover and condition
	Regeneration of woody species
Physicochemical & hydrology metrics	Coarse woody debris
Soil surface condition	Organic matter accumulation
Water quality	Biological soil crust
Water source	
Channel and streambank stability	
Water table	
Hydrological alteration	**Natural disturbance regime metrics**
Hydroperiod	Forest pathogens
Hydrological connectivity	Fire condition class
Sand dynamics	On site land use

A standard ecological integrity ranking is used to score each metric. A report-card style assessment is used to rank metrics, key ecological attributes, or overall ecological integrity from "excellent" to "degraded." To make these rankings operational, the general ranking definitions are specifically described for each metric for each ecosystem (example in Table 2). Despite the differences in metrics, the rankings are designed to ensure that all metrics are represented on a comparable scale.

Rank A "Excellent"—The highest quality with respect to major ecological attributes, functioning within the bounds of natural disturbance regimes and few if any stressors.

Rank B "Good" —Favorable characteristics with respect to major ecological attributes, functioning within the bounds of natural disturbance regimes and few stressors.

Rank C "Fair"—Unfavorable characteristics with respect to major ecological attributes and natural disturbance regimes, affected by distinct stressors.

Rank D "Poor"—Severely unfavorable characteristics with respect to major ecological attributes and natural disturbance regimes, affected by several stressors.

Table 2. Sample ecological integrity scorecard for Intermountain Basins Big Sagebrush Steppe ecosystem. Similar types of scorecards are available for most ecosystems in Washington.

Metric	A Excellent	B Good	C Fair	D Poor
Edge length	≥75% bordered by natural communities	≥50–75% bordered by natural communities	≥25–50% bordered by natural communities	<25% bordered by natural communities
Edge width	Average width of edge ≥100 m	Average width of edge ≥75–100 m	Average width of edge ≥25–75 m	Average width of edge <25 m
Edge condition	>95% native vegetation cover; <5% non-native cover; intact soils	75–95% cover native vegetation; 5–25% cover of non-native plants; mostly intact soils	25–50% cover non-native plants; moderate or extensive soil disruption	>50% cover non-native plants; barren ground; disrupted soils
Connectivity	Intact: Embedded in 90–100% natural habitat; connectivity expected to be high	Variegated: Embedded in 60–90% natural habitat; connectivity generally high	Fragmented: Embedded in 20–60% natural habitat; connectivity generally low	Relictual: Embedded in <20% natural habitat; connectivity essentially absent
Relative patch size	Site at or minimally reduced from natural extent (≥95% remains)	Occurrence modestly reduced from original natural extent (≥80–95% remains)	Occurrence substantially reduced from original natural extent (≥50–80% remains)	Occurrence severely reduced from original natural extent (<50% remains)
Absolute patch size	>1000 ha	500–1000 ha	16–500 ha	<16 ha
Native species	Cover of native plants ≥95%	Cover of native plants ≥80–95%	Cover of native plants ≥50–80%	Cover of native plants <50%
Native bunchgrass	Relative cover >80%	Relative cover ≥50–80%	Relative cover ≥30–50%	Relative cover <30%
Invasive species	None present	Present, but sporadic (<3% cover)	Prevalent (3–10% cover)	Abundant (>10% cover)
Native increasers	Absent or incidental	<10% cover	10–20% cover	>20% cover
Species composition	Diversity/abundance at or near reference standards	Diversity/abundance close to reference standards	Diversity/abundance differs from reference standards, but largely native	Severely altered from reference standards; dominated by non-native species
Fire-sensitive shrubs	Shrubs mature and recovered from past fires; generally 3–10% cover	Shrubs not fully recovered from past fires, generally <20% cover	Shrubs generally >20% cover; affecting bunchgrasses	Shrubs clearly >20% cover; reducing bunchgrasses
Biological soil crust	Matches site capacity	Evident, but its continuity is broken	Present in protected areas and minor component elsewhere	Mostly absent
Soil surface condition	Bare soil areas limited to naturally caused disturbances	Bare soil due to human causes, but extent and impact minimal	Bare soil due to human causes are common	Bare soil areas substantial and they contribute to long-lasting impacts

General Methods

The WDFW plans to develop and implement a monitoring and assessment EIA strategy for all wildlife areas in Washington. This EIA strategy is designed to support the efforts of the WDFW to manage and restore ecosystems and to provide the monitoring and evaluation data needed to support the Habitat Conservation Plan and wildlife area management plans for the wildlife areas. Because a considerable amount of monitoring and evaluation already takes place on WDFW wildlife areas, we would like these efforts to standardize and simplify data collection, storage, and reporting within an EIA umbrella. It is expected that this EIA strategy will include the following:

1) A pilot EIA project will be implemented in 2012.
2) Periodic EIAs will be designed and conducted on all wildlife areas, possibly at 5-year intervals.
3) EIAs for specific management activities will be designed conducted at frequent intervals.
4) The EIAs (remote, rapid, intensive) will be designed to complement activities on wildlife areas. Wildlife area managers will have a major role in providing EIA design input.
5) Most of the EIA data collection will be done by specialists or citizen scientists, the wildlife area managers are primarily expected to provide guidance.

EIAs of WDFW Wildlife Areas Pilot Project

Four wildlife areas were chosen for an initial EIA effort including the Swanson Lakes, Sinlahekin, Scatter Creek, and Johns River wildlife areas. This list is tentative and the inclusion or exclusion of specific wildlife area units has not been finalized. The Swanson Lakes Wildlife Area was chosen because it is a shrub steppedominated area that is the focus of intensive wildlife and habitat research including detailed mapping efforts. We anticipate that these detailed efforts will supplement the development and implementation of EIAs. The Sinlahekin Wildlife Area was chosen because it has already been the focus of EIA research and it is a forest-dominated ecosystem. Portions of the Scatter Creek Wildlife Area have been evaluated intensively, thus making the implementation of an EIA easier. The Johns River Wildlife Area is an area dominated by wetlands and offers a unique set of challenges for EIAs, thus providing the opportunity to adapt what is learned to other projects.

Specific Tasks for 2012

The activities for 2012 are generally targeted to the four wildlife areas included in the pilot project. However, because much of this monitoring and evaluation effort will eventually be adapted for all wildlife areas, in some cases we plan to include other wildlife areas as needed.

Background Data Compilation and Management

The Science Division will assemble background information and data concerning the management and history of each wildlife area. This information will be essential for providing the “boundaries” for the assessment area as well as development and interpretation of desired ecological conditions. Much of this information is already available in wildlife area plans,

Habitat Conservation Plan documents and maps, and in various databases. This is an ongoing process, but the primary effort may last through May 2012. Existing and additional data will be managed by WDFW.

Map Development

GIS maps with land cover and use data will be improved for each wildlife area. The ecosystems that are incorrectly labeled will be corrected and the maps updated. This will be accomplished with NatureServe classifications (e.g., Field Guide to Washington's Ecological Systems) and technical support from the Washington Heritage Program and WDFW GIS staff. Status: This process is mostly complete for the Swanson Lakes and Sinlahekin wildlife areas. The Westside pilot areas may take a little longer but should also be completed shortly. The maps will also incorporate management information when available, such as that available for the Habitat Conservation Planning effort.

There may also be opportunities to improve existing maps with new technology and/or refined techniques. For example, there is a Bureau of land Management (BLM) effort to map the Swanson Lakes Wildlife Area with the National Agriculture Imagery Program (NAIP). This effort is almost complete and may provide an improved map for implementing EIAs. The goal is to have all EIAs designed with enough compatibility that they can be used with revised maps and/or new technology.

EIA Design

EIA information for each ecosystem has been simplified as a 'scorecard' that lists the ranking criteria (A, B, C, and D) for each metric. Although ecological integrity scorecards are available for most ecosystems, these need to be developed and integrated into actual procedures for all three levels of assessment (remote, rapid, and intensive). This is especially important for procedures which might involve use of citizen science. There are also statistical ramifications of these scorecards which should be considered. These scorecards will be developed first for the Swanson Lakes Wildlife Area and then for the Sinlahekin Wildlife Area.

A sampling strategy will be designed for each wildlife area with consideration of statistical power, number and extent of ecosystems, anthropogenic influences, management history and direction, and availability of other types of data (potentially usable for validation of different levels of assessment). Level 2 and 3 EIAs (rapid and intensive, respectively) will be integrated in this process to optimize the quality and quantity of the information gathered. The preliminary draft strategy will be produced to evaluate statistical power and validity. The monitoring strategies will include the following considerations:

1) Available staffing will determine how much area can be monitored and evaluated.
2) The number of wildlife areas, number of ecosystems, and size of area needing to be monitored can determine how much can be monitored in one field season.
3) Statistical and programmatic requirements play an essential role. In this situation, programmatic requirements refer to mandates and/or management objectives on a specific wildlife area.

4) The EIA needs can influence how often an area needs to be assessed. For example, a level 1 EIA might be possible every year, but it may be unlikely that an annual assessment would be sufficiently precise to document annual variation. In contrast, a rotational assessment every 5 years may prove to be sufficient.
5) The budget can influence all other considerations.

Responsibilities

The research, lands and citizen science staff will develop and implement the EIA (Steps, Roles and Tasks summarized in Appendix A). We expect that as the program becomes established the duties will increasingly be allocated to a seasonal team hired to monitor wildlife areas on a rotational basis each year and/or to volunteers that assist with the citizen science component. WDFW's Science division is responsible for design and oversight plus data management of the program. Outreach staff will focus on the involvement, training, and integration of volunteers in the citizen science portion of this effort in consultation with Lands staff (Appendix B). The primary expectation of wildlife area managers (with input from District Teams and Lands Division) is to provide the following: (1) information on historical and current land use; (2) help clarify desired ecological integrity; (3) specific management directions that need to be monitored and evaluated; (4) logistical support for conducting EIAs; and (5) Suggest volunteers for the citizen science with help from the Citizen Advisory Groups.

Conduct EIAs

We will visit each pilot wildlife area to conduct level 2 (rapid) data collection, to ground truth level 1 (remote) analysis, and to verify ecosystem definitions and plot placement. We expect that level 2 sampling EIAs will be relatively quick to conduct (mostly qualitative), often requiring a general "walk through" of the area. This is the stage where the observer can conduct a field assessment of stressors and on-site conditions of the assessment area. As with level 1 analysis, available data can be used to supplement this effort. Level 2 analysis will serve the purpose of providing detailed information on critical sites, sites that are difficult to monitor remotely, and validation (ground truthing) for level 1 analysis. This will be initiated in summer 2012. We will also conduct level 3 data collection as part of the EIA. The types of monitoring and evaluation situations likely requiring level 3 sampling may include the following:

1) Response to alteration by livestock grazing.
2) Long-term change in ecosystem ranking.
3) Effectiveness of habitat restoration practices.
4) Integration of statistical power into inferences.

Data Management and Evaluation

Data will be collected, managed, and analyzed by the Science Division, with support from the Lands Division. These data, and resulting products, will be provided to wildlife area managers and the Lands division to inform: (1) management decisions; (2) adaptive management; and (3) revised management plans. Wildlife area managers and the Lands Division will also provide

input into the monitoring and evaluation process to ensure that the overall effort is addressing their specific requirements.

Other Monitoring Efforts

Additional types of monitoring and evaluation (e.g., birds, mammals, etc.) can be integrated into the overall effort. The purpose of these additional strategies needs to be clearly stated in the plans, but will likely only be supplemental to the overall monitoring and evaluation strategy. This type of monitoring may be conducted, but is not being scheduled at this time.

Citizen Science

The WDFW's Wildlife Program is planning to engage citizen science volunteers to undertake Level 2 EIA tasks of the project at each pilot Wildlife Area. The citizen science component of the EIA project includes recruitment, training, data reporting and feedback to citizen science volunteers. In consultation with wildlife managers, WDFW outreach personnel will recruit volunteers to field test the EIA protocols. WDFW Outreach will work with science and lands personnel to develop and deliver training to registered citizen science volunteers preparing volunteers to provide quality data through the online data reporting site. The pilot project effort will be focused on:

1) Photo plots as a way to photographically monitor features of the landscape (Hall 2002). Photos will be available on WDFW's website by wildlife area and location within each wildlife area and citizen scientists will contribute to the effort remotely. Photo plots provide a technique for addressing ecosystems at the level 1 and 2 monitoring level.
2) Level 2 data collection will be conducted with ecological integrity scorecards specially designed for this purpose. These will be conducted at the same time as the photo plots.

For the purposes of this pilot, citizen science volunteers will be carefully recruited with input from Wildlife Area Managers. Outreach anticipates recruiting volunteer coordinators among those who express an interest in providing leadership. These volunteer coordinators will agree to implement a quality assurance plan to maximize the accuracy of citizen science data, and offer support to an identified volunteer group formed for each Wildlife Area in the pilot. Following the successful implementation of the pilot project, Wildlife Outreach will consult with Wildlife Lands' staff and Citizen Advisory Groups (CAGs) through the wildlife area managers to explore expanding the citizen science cadre.

The EIA Citizen Science Project outcomes will be achieved by implementing the components as identified in Table 3 and Appendix A. The projected outcomes include:

1. Volunteers are mobilized to collect data
2. The 4 designated Wildlife Areas are covered as planned
3. An initial assessment of the quality of citizen science data is provided to stakeholders
4. The project is consistent with the Conservation Initiative

Table 3. Components and responsibilities of the Citizen Science EIA project.

Components	Division Responsibility	Cross-Division Roles
Wildlife Cross Division Planning	Science, Lands, Outreach	Agreement on project plan, implementation & timeline
Science Question & Target Area	Wildlife Science	Choose & inform targeted Wildlife Areas
Protocols	Wildlife Science	Consult with Wildlife Area Managers. Develop citizen science website – Outreach & Public Affairs staff
Volunteer Recruitment	Wildlife Outreach	Recruitment managed by Outreach with the guidance of Wildlife Area Managers
Volunteer Training	Wildlife Outreach	Wildlife Outreach assisted by Wildlife Area Managers participate in training online and on-site with Wildlife Science
Data Collection & Reporting with QA/QC	Wildlife Science	Citizen Science volunteers report data to WDFW online – QA/QC filters in place
Data Analysis	Wildlife Science	Science with WLA Managers provide regular feedback on findings via website
Feedback	Wildlife Science	Assisted by Outreach & Website staff in consultation with WLA managers/Lands Division

Data management

A critical step in the process is what happens after the baseline data is collected. The baseline data and initial analysis is crucial information for the Wildlife Area Managers/District Teams/ etc to determine the EIA goal for that unit on the Wildlife Area. The baseline data plus the EIA target need to be documented in the formation of the new Wildlife Area Management Plans.

WDFW Wildlife Science will work with Information Technology Services (ITS) and web site administrators in Public Affairs to develop spatially enabled web-based data entry forms for collecting project data. Data forms will be available to staff and volunteers through the WDFW public internet site and will ensure data integrity through structured entry and validation (pick lists, input masks, and required fields). Existing spatial data management technologies (ESRI) will be used for digital photo management so that photos are directly uploaded, stored, and assigned to a spatial location during digital data entry. All data collection forms will interface with corporately managed data structures ensuring that data are highly secure and accessible at all times.

Implementation Plan

The implementation of EIA (summarized in figure 1) follows the Science Divisions guidelines for effective data collection, management and dissemination methodologies, in particular protocols, data reporting and repository and quality control. The Science Division and Lands Division will collaborate on determining criteria for success and data feedback mechanisms to stakeholders concerned. Wildlife Outreach will focus on recruiting, training, mobilizing adult volunteers in concert with the Wildlife Area Managers' recommendations. In addition Outreach staff will work with public affairs staff to develop a WDFW website, with multiple functions that include linking to the CERVIS site registering volunteers, and providing a means for reporting and archiving citizen science data. Wildlife Outreach, Science and Lands will jointly develop a feedback mechanism.

A tentative timeline for most activities has been developed (Fig. 2).

Fig. 1. The following diagram illustrates the design for implementing the EIA Citizen Science project.

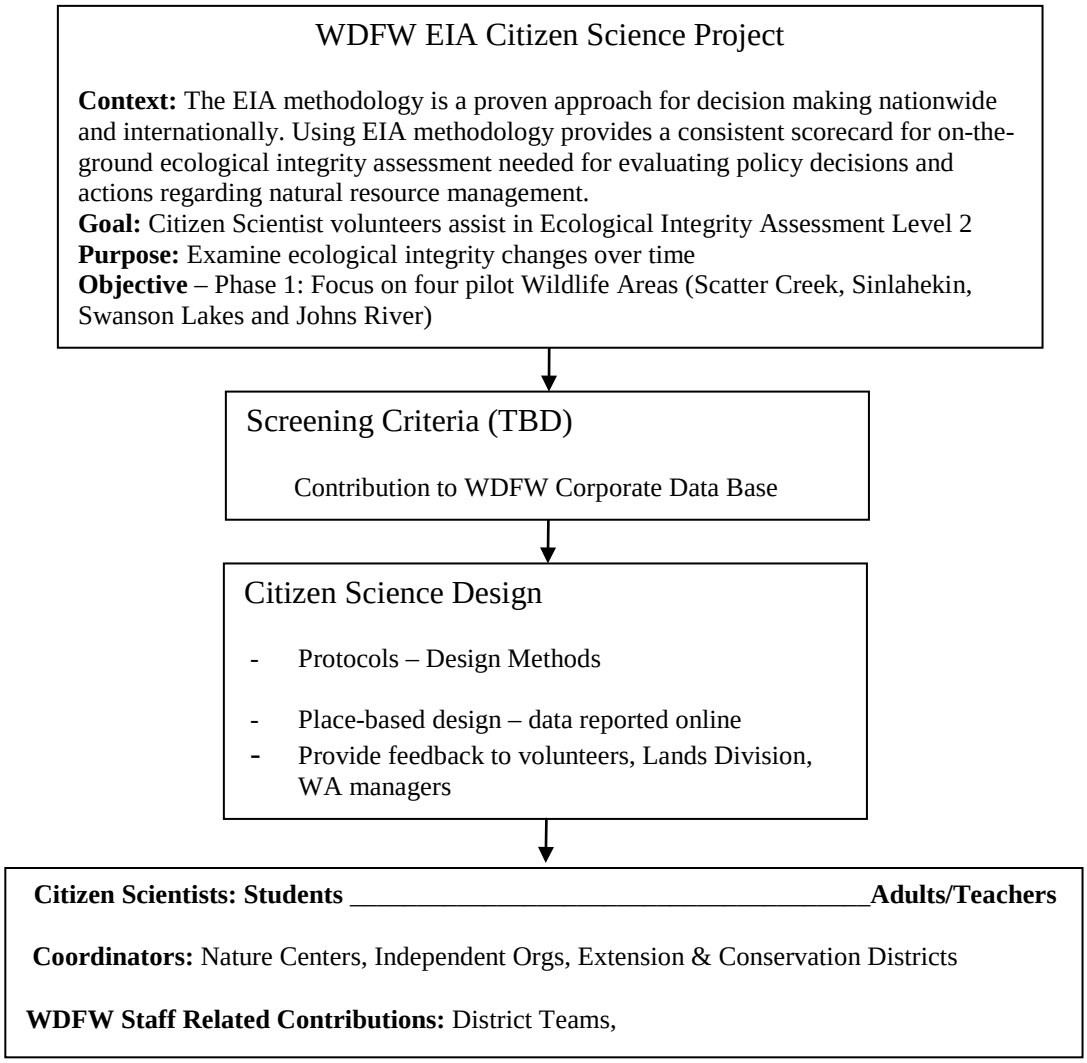
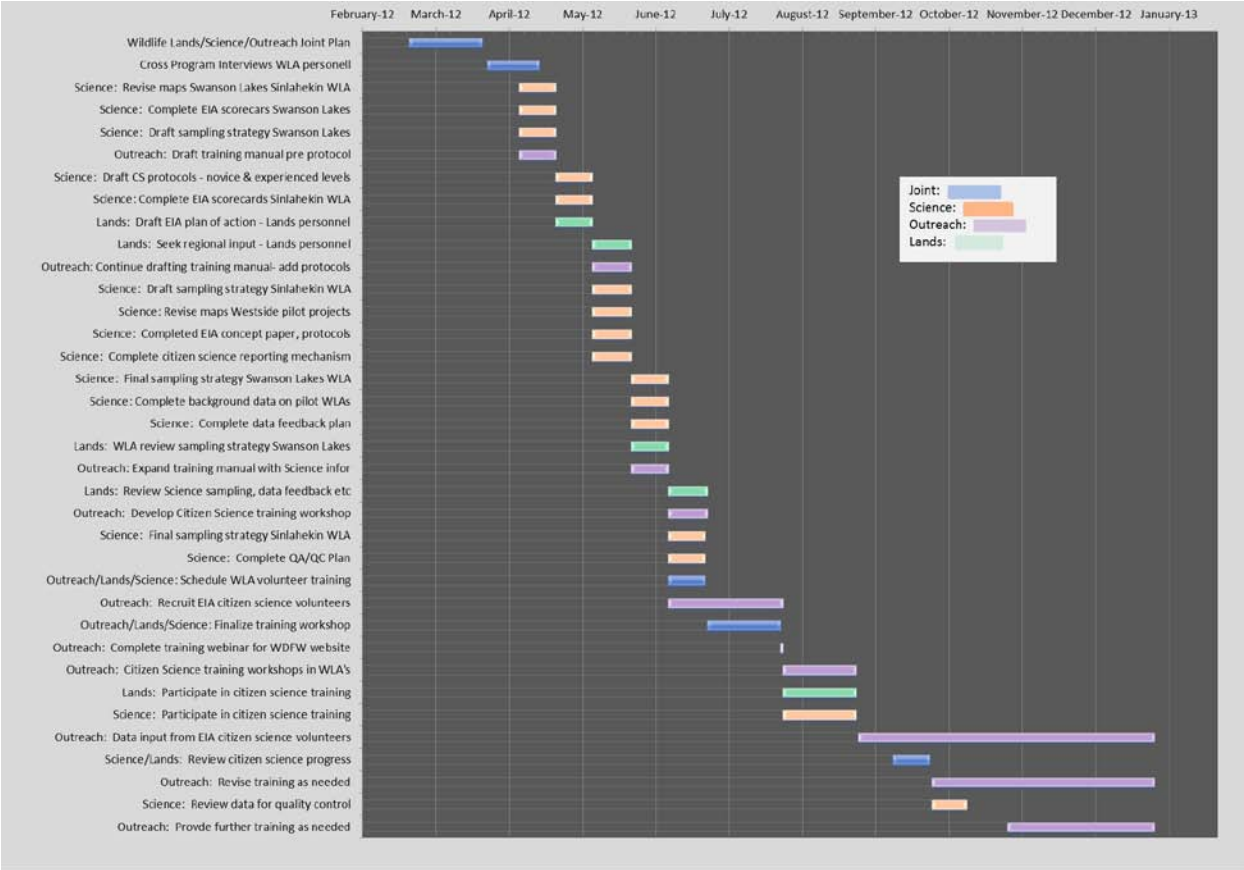


Fig. 2. The EIA project components and detailed execution are provided in a timeline.



Conclusion:

This concept plan describes the research rationale for implementation of the Ecological Integrity Monitoring Project (EIA) on pilot Wildlife Areas. The goal for the project on wildlife areas is to track the ecological integrity of lands managed by WDFW. The project design includes a citizen science component, where trained volunteers provide photo point and biological data, at locations set up for long-term monitoring. Volunteers will be able to upload their data to a WDFW webpage. Wildlife Science and Lands staff will examine the images and analyze the biological data to evaluate specified wildlife sites and trends in ecological integrity. The project findings will be evaluated for their contribution to policy decisions and actions regarding natural resource management of WDFW lands.

Appendix A**: <u>Implementation Plan for EIA Citizen Science Project</u>**

Detailed steps to implement the Ecological Integrity Assessment Citizen Science Project, addressing roles and tasks for each component.

Components	Steps	Roles and Tasks
1. WDFW Cross Division Planning	• Develop WLA EIA Citizen Science Plan • Interview and meet WLA managers to determine time commitment and volunteer supervisory responsibility • Energize the Citizen Advisory Groups to recruit volunteers	• Develop EIA Citizen Science plan with WLA, Science, Outreach Leads • Conduct Informational Interviews with WLA Managers to determine concerns and plan for success • Share citizen science plan with WLA managers • Establish WLA Manager Terms of Supervision of citizen science volunteers • Determine lead volunteer to become the point of contact for team of volunteers for each pilot wildlife area
2. Science Question & Target Area	• Leadership determines science questions that need to be addressed with EIA • Determine Target Areas • Determine timing – what time of year-how often	• Consult with WLA Managers re challenges • Determine possible volunteers
3. Protocols	• Create Science Protocol with data form • Outreach staff interprets Science Protocol for volunteers • Review citizen science protocol with WDFW and WADNR biologists • Provide protocol on website	• Clarify WLA staffing necessary for each aspect of the protocols; planting the stakes, locating volunteer planted stakes etc. • Clarify the role of WLA managers in QA/QC • Indicate what percentage of the land area is covered by EIA
4. Volunteer Recruitment	• Determine the type of access EIA volunteers have on WLA's • Create citizen science CERVIS project description	• WLA decision re Discover Pass etc for EIA volunteers • Coordination with WLA managers re volunteers

Components	Steps	Roles and Tasks
	• Find and assign WDFW volunteer lead for EIA volunteers in each area • Market opportunity to volunteers recommended by WLA Managers • Register Citizen Science volunteers for EIA through CERVIS	recruited and volunteer leads assigned. • James Chandler incorporates citizen science description in CERVIS program and names citizen science volunteer leads • Create Citizen Science website that requires volunteers to register through CERVIS.
5. Volunteer Training	• Develop WLA training with field staff – determine field staff role • Provide a workshop at each WLA with EIA volunteers • Create a webinar for EIA volunteers posted on WDFW website • Ensure volunteer record hours conducting EIA	• Outreach and science staff coordinate with WLA staff to launch EIA project • Determine Discover Pass requirements or access for citizen science volunteers
6. Data Collection & Reporting with QA/QC	• Data base design • Data form available online to download, and print, online data entry form developed for reporting information to WDFW • Format for uploading Photopoint images to WDFW and web based tools to assign images to spatially referenced point locations	• Wildlife Data systems will develop database structures to store project data • Wildlife Data Systems, ITS, and Public Affairs (Web administrators) will develop an online data reporting mechanisms for habitat and photopoint data
7. Data Analysis	• Science program data analysis • Outreach program interpretation and posting of analysis	• Share baseline data with WLA program and managers/District Team/Lands Division
8. Feedback **9. Usable Outcomes**	• Determine rate of feedback over a year period • Examine initial analyses for inferences	• Ensure feedback shared with WLA managers • Evaluate for incorporation into WL area plans