MANAGING LANDSCAPES – INITIAL THOUGHTS – NEEDS WORK/ORGANIZING

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The SHC Process

By design, the SHC framework can accommodate an emphasis on habitats or landscapes or species, depending on the needs of the FWS conservation program. If fully implemented, SHC is a rational, 21st Century approach to managing natural resources based on the principles of landscape ecology and population biology. In addition, SHC provides a functional mechanism for the incorporation of the effects of global warming into management and conservation actions.

The trichotomy of species management versus habitat management versus landscape management is a human-imposed artifact meant to simplify analysis and interpretation. Under this artifact, one level (populations, habitats, or landscape) is chosen as a focus for action, and the two remaining levels are generally not specifically evaluated and are assumed to be stable, static or deterministic, at least over the short term (temporally stable) or across a limited landscape (spatially uniform). Decoupling populations, habitats, and landscapes is a major detriment to achieving long term stability of native biodiversity. SHC is a significant step toward rectifying this problem. SHC is structured to frame management decisions on scientifically based information on populations in habitats across landscapes. Lindenmayer et al. (2008) emphasizes the need to manage the entire mosaic of patches and the intervening matrix that is critical for connectivity; to identifying disproportionately important species, processes or landscape elements that are critical to achieving clearly defined and quantifiable conservation objectives; and to mange at multiple scales for species and ecosystems. These management goals are also the intended goals of SHC.

<u>SHC should be generative</u> – SHC should provide a flexible structure for creative and effective application of the principles of conservation to the management of conservation targets.

- Taxon-level conservation targets: populations, species, communities, biodiversity (note that biodiversity is transitional between taxon-level and landscape-level)
- Landscape-level conservation targets: habitats, patches (=land cover units), ecoregions (*e.g.*, Bailey’s ecoregional classification), ecosystems, landscapes (= mosaic of patches plus corridors and the inter-mosaic matrix)

<u>SHC should not be sterile</u> – SHC should not constrain creative and effective management by limiting the analysis or application of the principles of conservation. (need to define: “principles of conservation; effective conservation; effective management)

<u>SHC should avoid being prescriptive</u> – SHC should avoid setting arbitrary limits on the effective management and conservation of trust resources. In a changing natural world such as that posed by climate change and invasive species, prescriptive approaches to conservation and management will eventually fail.

What SHC Does Not Do

SHC does not cover all actions that may be deemed critical for the effective management of conservation targets.

- SHC will not provide help to develop or implement policy changes needed to promote effective conservation. For example, policy changes needed to prevent or reduce the spread of non-native species may be critical for future success in conservation.
- SHC will not provide help in overcoming social or political challenges that may prevent actions needed to reduce or eliminate limiting factors. For example, social/political acceptance of the use of extensively reviewed and monitored management actions (biocontrol, herbicides, pesticides, etc.).
- Other?

Anticipated Outcomes for SHC

SHC should lead to a reduction in the **limiting factors** that affect each conservation target and should enhance the target's ecological integrity and ecological viability.

Outcome to evaluate: Status of the Limiting Factors -- Evaluate the trends of change and the magnitude of effect for each current and future process that limits the recovery and/or sustainability of the conservation target.

- Outputs used to evaluate this outcome could include the changes in the geographic range d the degree of severity of each limiting factor.
- "Limiting factors" are often characterized as Threat Status.

Outcome to evaluate: Ecological Integrity – The conservation target should have, or will have (via restoration) sufficient size, structure, composition and functioning ecological processes to allow it to persist over a long period of time (several hundred years).

Outcome to evaluate: Ecological Viability -- The dominant ecological characteristics (composition, structure, function and processes) of the conservation target should occur within their natural ranges of variation and should be able to recover from natural and human-caused perturbations.

- Short-term ecological viability is years to decades.
- Long-term ecological viability is decades to centuries. The conservation target must be able to persist within its natural range given the long-term effects of climate change or other long-term human-caused perturbations.

Managing Populations (see Figure 1) or Landscapes (see Figure 2)

Managing populations requires specific actions on specific parcels of land – habitat. As such, managing populations usually appealing to biologists for several reasons:

- Managing one or a few similar species allows biologists to become "local experts".
- Objectives for populations and habitats can be clearly defined and quantified using well established methods.
- Conservation actions are applied to known sites (= habitats) within a circumscribed area (a few acres to a several million acres).

All field population management actions have (or should have) some degree of habitat and landscape features built into them. However, managing habitats distributed across a large area is not landscape management in its most complete sense. Landscape management is at its best when managing a mosaic of patches, corridors and the inter-patch matrix. When focused at a specific type of habitat or patch, landscape management should work to achieve a network or system of interconnected patches and corridors (Forman 1995).

Potential landscape problems that may arise when managing populations:

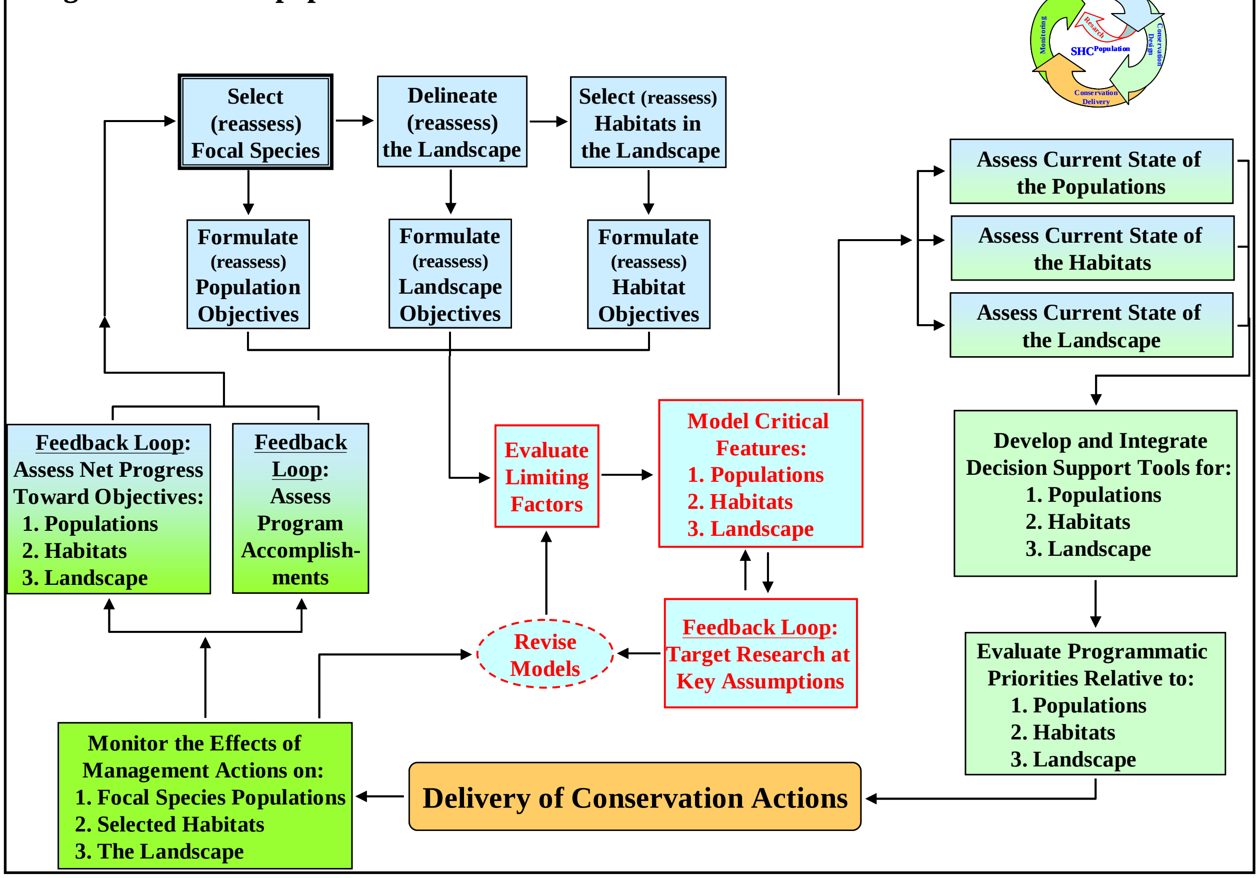
- Habitats or the landscape are not quantitatively assessed (only the organisms are measured) so landscape effects remain unknown.
- Factors that ultimately affect the fate of the population/species may occur in areas required by the species but that are outside of the managed or monitored areas.
- The managed landscape is too small or too degraded to adequately sustain a local population – the habitat is a population "sink" and not a population "source". This may include historically managed area, and no assessment is made with regard to the actual value of the area to overall species status.
- Cannot manage for all of the species within a landscape. Selecting "landscape-critical species" may present dilemmas with reference to social and political mandates (*e.g.*, T&E species may not have an adequate landscape component for management).

$\text{SHC}^{\textbf{Population}}$ (= $\text{SHC}^{\textbf{P}}$) is designed to help minimize these (and other) problems, if carried out in an effective and complete manner.

A landscape approach to managing populations can lead to a quantitative improvement in population status, and improve the likelihood of achieving the desired outcome. A critical first step to a landscape approach is to clearly define the landscape conservation objectives as distinct from objectives for each of the managed populations. Equally important are clearly defined quantitative measures that can serve as indicators of progress toward the landscape conservation vision. For SHC^{P}, these quantitative measures should include population and habitat objectives, but should also incorporate landscape measures of composition and spatial configuration (see below).

Measures of Landscape conservation can be used to achieve "landscape stability," and to evaluate the nature of the changes that are occurring on the landscape due to natural processes or human actions, including climate change.

Figure 1. SHC for populations: SHC^{Populations}



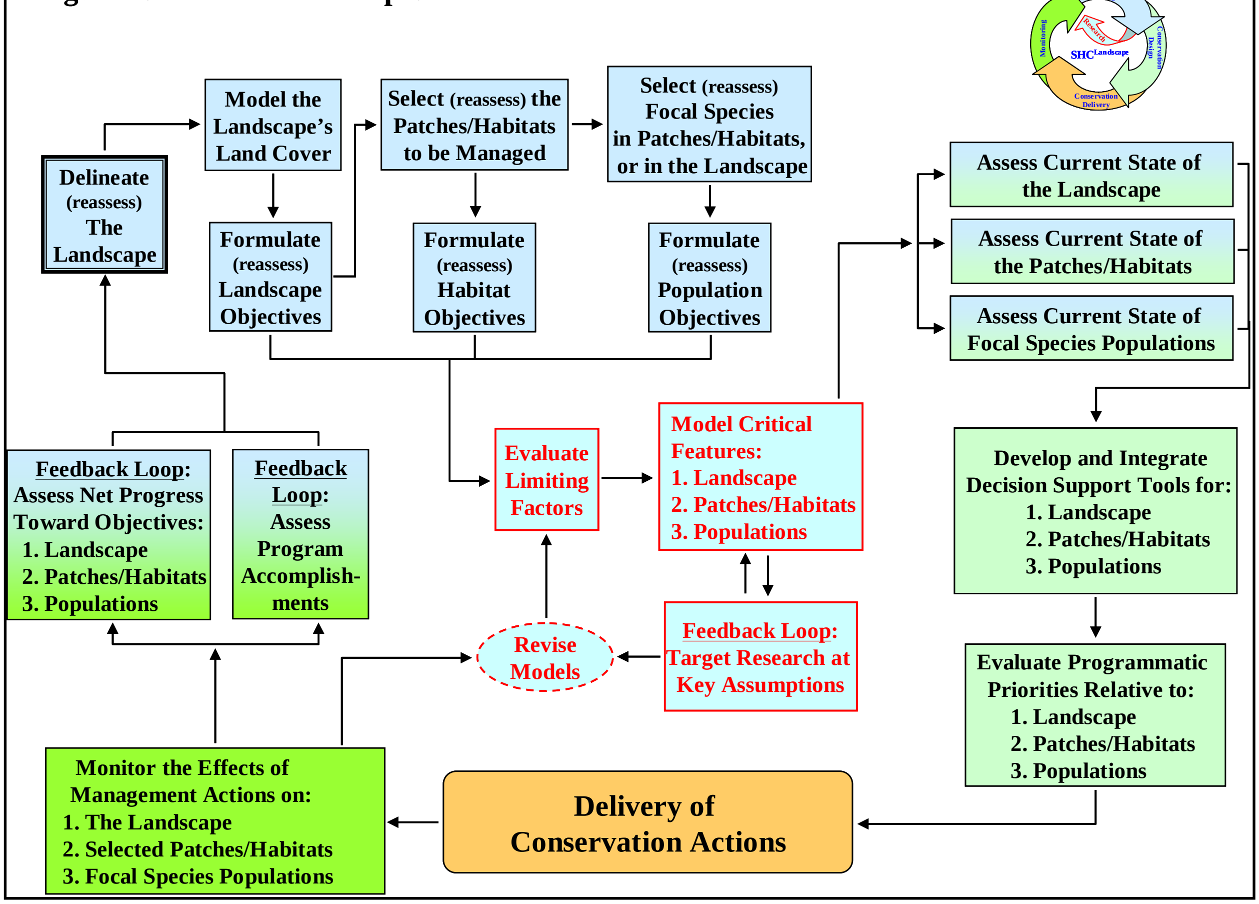
Implementing Landscape Conservation

Managing a set of habitats or patches scattered across a geographic area is not landscape management. Managing for connectivity among the selected mosaic of habitats/patches is the most basic form of landscape management – some level of management for the inter-patch matrix is needed to maintain connectivity. Managing for landscape (habitat/patch) resilience over time and space is the most complete form of landscape management and can only be achieved when the patch mosaic and the matrix are managed to allow for ecological change. This is because habitats and patches come and go; grow and shrink; shift between high and low quality; etc. These dynamic habitat/patch qualities can only be maintained within a matrix that can also change. Managing for stability is not managing for static conditions; it is managing for capacity to change over time – that is, managing for dynamic stability. This type of dynamic management is often difficult to achieve because natural rates of change often span several human generations, and it is often difficult to work multi-generational management and monitoring into the human administrative structure. Climate change (see below) will make dynamic landscape management absolute essential for conservation of natural areas. Unlike natural change, changes driven by global warming will occur well within a single human generation. Examples already exist for shifting species distributions due to climate change (Devictor *et al*. 2008, Kelly 2007, Parmesan 2006, Lenoir *et al*. 2008, Walther *et al*. 2002, Fitter and Fitter. 2002). This may be an opportunity to institutionalize landscape-scale monitoring.

- A complete evaluation of land cover should be the starting point for landscape conservation, include SHC$^{\text{Landscape}}$ (SHC$^{\text{L}}$) approaches. This will involve applying a landscape classification system. The quality of this classification will determine the accuracy and value of the land cover analysis – garbage in, garbage out. Detail and accuracy are critical to a successful land cover. The land cover analysis should include the target habitats or patches, <u>and</u> the inter-patch matrix should be composed of land cover classes that reflect the true composition of the matrix (*i.e.*, don't lump the matrix into a single class). This will allow for an evaluation of management actions in the context of the entire landscape.

- Land cover is usually portrayed as a map showing the spatial distribution of compositional elements or attributes of the landscape. This is an important but limited portrayal of the landscape, and it mainly fails to capture "landscape processes". This can be partly addressed seasonal flooding, sediment transport, soil types, tree stand age or other measures of succession, etc.

Figure 2. SHC for Landscape: SHC$^{\text{Landscapes}}$



- If possible, specific objectives of landscape management should also be presented as land cover layers. If, for instance, the land cover is to be used to manage one or several species, then a land cover overlay should be developed that reflects the specific needs of those species. This may "lump" the more detailed classification into more general categories or "patches", but it should not replace a more detailed classification – both need to be considered (along with process layers) in Biological Planning and Conservation Design.

- Measures (metrics) of important landscape-level factors (McGarigal *et al.*, 2002) can be derive from the land-cover layers:

    - landscape composition
        - proportional abundance of each class of the land cover classification system
        - number of different patch types (= richness) within the landscape – only if classes are views as patches or patch composition is defined (see habitat discussion, below)
        - relative abundance of the different patch types (= evenness) within the landscape patch diversity, as function of richness and evenness

    - spatial configuration of the landscape
        - patch sizes within the landscape – only if classes are views as patches or patch composition is defined (see habitat discussion, below)
        - patch shape or complexity
        - edge effects for each patch (can be made species-specific)
        - patch core area
        - patch aggregation/dispersion
        - patch-type subdivision (number of patches within a patch type)
        - connectivity among patches (ability of species or processes to move across a landscape; species/habitat/patch/process dependent; includes corridors)
        - patch contrast (how different is it from its adjacent neighbor patch types

- Next consider habitat. Within the context of landscape ecology, a patch is the habitat of interest for management.

    - Species-defined habitat: the patch is defined by the habitat needs of the species of interest within the landscape-to-be-managed. For SHC$^{\mathbf{P\ or\ L}}$, these are the focal species.
    - Land cover-defined habitat: the patch is defined by the type of land cover – riparian habitat; wetland habitat; late successional old growth forest habitat; etc.
        - This approach to defining habitat is heavily dependent on the land cover classification system and its ability to resolve important habitats or important components of habitats.
        - Using land cover to define management habitat may not adequately address the needs of all priority species, species of interest, or species of concern, since species may often use multiple land-cover types in the course of their daily or seasonal activities or throughout their life histories.
        - Land cover patches may be an excellent way to track specific elements of the landscape that are accurately identified by the land cover classification system. This would apply to major patch types such as forest versus grassland or to specific species, including invasive species, with clear signatures that can be used in classification.

- Next consider the role of focal species in a SHC^{L} approach. The landscape-based focal species are perhaps the best means of quantifying the value of landscape conservation actions. The selection of the landscape and the habitats or patches for management will determine which species should be considered as focal species.
    - Focal species may be associated with habitats or patches that have been selected for management actions. These species provide a direct management link among populations, habitats, and landscape.
    - There may be focal species that are selected because they can provide inform on patch dynamics for patches that are not actively be managed or monitored. Monitoring the annual status of these focal species may greatly enhance the breadth of the landscape analysis, while the more detailed habitat-species assessments provide depth of detail in the landscape analysis.

Literature

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